Spanish contribution to 34th IGC. Istanbul 2020
Spanish Committee of the International Geographical Union

Spain, bridge between continents

AGE Asociación de Geógrafos Españoles
CSIC Consejo Superior de Investigaciones Científicas
Gobierno de España
Ministerio de Transportes, Movilidad y Agenda Urbana
Instituto Geográfico Nacional

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Spanish Committee IGU

Spain,
bridge between continents

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Aportación Española al 34.º Congreso de la UGI. Estambul 2020

España,
puente entre continentes

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Presentation

Presentation

On the eve of the centenary celebration of the creation in 1922 of the International Geographical Union (IGU), the Spanish Committee will resume an old tradition consisting in the compilation of representative texts of the research activity of the Spanish geographical community between congresses. On this occasion, the **Spanish Committee of the IGU** will participate in the 34th International Geographical Congress under the title ***Spain, bridge between continents.*** This congress was planned to be held in August 2020 at the University of Istanbul. However, due to the Covid-19 pandemic it has been postponed until the summer of 2021. Despite the difficulties arising from this unforeseen complication, we can now offer the international geographical community **Spain's Contribution to the 34th International Geographical Congress**, following the format created after the remodelling of the Spanish Committee established in the Washington Congress (1922), coinciding with the celebration of the 5th Centenary of the discovery of America. Basically, since then, it has sought to present the advances made in our discipline, reflected in the variety and quality of the scientific production of Spanish geographers and also their commitment to the problems of today's society and to the search for solutions.

As on previous occasions, the Spanish Committee promoted a work methodology in which the organisational work of the Committee was coordinated by the Editorial Committee created for this purpose with the participation of the members of the geographer's group channelled through the organisations belonging to the Committee, and, particularly the consolidated work groups within them. In this process the Editorial Committee of the Contribution selected five thematic blocks or research lines and an open call for contributions related to them was made. Of the contributions presented, after a selection and assessment process, a total of 21 were selected. Simultaneously, the Editorial Committee commissioned five specialists of renowned prestige to write introductory texts for each of the above-mentioned thematic lines.

Essential complements to these blocks of the Contribution are the texts written by the representatives of the six organisations that currently make up the Spanish Committee of the IGU. Thanks to these texts, the reader of the Contribution can gain a broad perspective of the trajectory of these entities, of their contributions to the development of Geography in Spain and the applied research and dissemination of geographical knowledge in which they are currently involved.

In line with the above ideas, the book presented is structured into two large blocks; the first one which includes the texts of the geographical organisations that form part of the Spanish Committee of the IGU, written by their representatives in the Committee or by qualified people designated for this task. A second one, including the introductory texts and the contributions associated with them.

First block

A first block of contributions corresponding to the organisations which are members of the Spanish Committee of the IGU in this edition of the Spanish Contribution were also presented, although less extensively, at the Congresses of Washington (1992) and Glasgow (2004). This time there is a good reason for their presence due to the changes occurring in the Spanish Committee a century after the foundation of the IGU in 1922. Given the heterogeneity of origins, the resulting texts have a freer structure than those of the first block. The approaches vary in accordance with the functional and operative characteristics of each specific entity and its trajectory. Therefore, the papers also vary greatly in terms of length.

Royal Geographical Society (RSG)

That said, we will give a brief summary of the individual contributions beginning with the oldest in terms of its foundation (1876) and its presence in the Spanish Committee of the IGU, being the only representative of Spain between 1922 and 1988; The Royal Geographical Society (RSG). The contribution titled ***The Royal Geographic Society in the history of the spanish geography*** was written by the professor emeritus of the Autonomous University of Madrid and member of the Board of Directors of the RSG, Fernando Arroyo Ilera. In this highly detailed text replete with bibliographic references, he has combined the role and functions that the society undertakes today and its future plans and projects, without forgetting the origin and history of the corporation, one of Spain's oldest scientific societies, and the important heritage that it has accumulated throughout its history. Both variables are constantly intermingling and have to be seen and understood together.

Spanish Geographical Association (AGE)

One century later (1975) the Spanish Geographers Association was founded. It recently changed its name to the Spanish Geographical Association (AGE), and its presentation for this Contribution is titled ***The Spanish Geographical Association, looking to the future***, written by the professors Jorge, Olcina and Rubén Lois, current vice-presidents of the Spanish Committee and the IGU respectively, together with the professor Carmen Mínguez, from Complutense University of Madrid, former secretary of AGE and of the Committee in the previous period. After describing the origins of the AGE and explaining in great detail the activities developed by the Association over its forty years of existence, it goes on to give an in-depth description of the profile of its members from the many points of view that the register of associates allows; then the internationalisation process of Geography taking place in recent years is addressed. Finally, looking to the future, the text emphasises the commitments taken on by AGE with respect to the renewal of Spanish geographical thought and the resolving of major challenges posed by the current complex global context.

National Geographic Institute (IGN)

The National Geographic Institute (IGN) which has been present in the Spanish Committee of the IGU since the foundation of the IGU has made its contribution to the Istanbul Congress through its representative in the Committee, the geographer

Teresa Albert Fernández. In her text titled ***The National Geographic Institute. 150th anniversary: 1870-2020,*** she has constructed a brief summary of its 150 years of history with its successive changes in name, reflecting the modifications in its competencies throughout its long history in serving the needs of territorial knowledge and representation of a modern state. The paper focuses particularly on the current organisational structure of the Institute, renewed in 2020, and its functions within the framework of the Ministry of Transport, Mobility and Urban Agenda as a governing body attached to the Sub-Secretariat of the Department. The National Centre of Geographic Information (CNIG), is an autonomous body of the IGN. Its functions of creating and disseminating cartography and the associated information bring it closer to the undertakings of the geographers in their different activities (teaching, research and professional).

Army Geographic Centre (CEGET)

The Spanish Contribution to the Istanbul Congress also includes contributions from other organisations with a presence in the Spanish Committee of the IGU and which, as we shall see below, are highly heterogeneous. We will start with the Army Geographic Centre *(CEGET*), which is also an ex-officio member of the Management Board of the Royal Geographical Society. Its text titled ***Army Geographic Centre. 80 years of military cartography serving the army*** has some unique characteristics namely its length, with four sections, each with its own title and written by four authors and the technical-military background which they all refer to. Under these premises, the contribution is structured into an introduction, written by Colonel of the Corps of Signals and Military geodesist Emilio Cortés Narváez, which emphasises how the modern arms systems and information systems used by the Spanish army require geographical information in standardised digital formats which has generated changes in the processes carried out in the *Army Geographic Centre*. The second section, written by José Luis Sánchez Tello, Lieutenant Colonel of the Engineers Corps and military geodesist, highlights the role of the Geographic Information Headquarters (JIG) which is responsible for producing geospatial information for which it requires highly specialised personnel distributed across different departments. Obtaining reliable and updated geospatial information in any geographical area of the world for the development of military operations is the function assigned to the Army Geographic Unit (UGET) which is presented in the text by Artillery Commander and Military geodesist Francisco Javier Capellá Cuesta. Finally, the section presenting the *Carta Digital, the GIS supporting small units* by Infantry Commander and Military geodesist Carlos Borrallo Corisco analyses the past, present and future forecasts of this connecting instrument which is essential for the planning of army missions and their execution on the ground.

Institute of Economics, Geography and Demography (IEDG)

Also associated to the Committee since its expansion in the 1990s, The Institute of Economics, Geography and Demography (IEDG) of the CSIC is a leader in geographic research and the dissemination of its results through the veteran journal Estudios Geográficos. The current director of scientific research Gloria Fernández-Mayoralas has written the contribution to Spain's Contribution to Istanbul. After presenting a retrospective view of the geographic research in the institution and its most relevant contributions over time, she describes the broad inter-disciplinary programme which its members are

currently undertaking, reflected in the Action Plan 2018-2021. To this end, she describes the departmental restructuring carried out and the research groups in which the geographers of the institute are distributed: *The Research Group on Ageing,* led by Vicente Rodríguez Rodríguez, *the Research Group on Multi-scale Geographical Analysis of Global Change*, led by Javier Martínez Vega and the *Research Group on Cross-border Human Mobility between East and West, in the European Geopolitical Context*, led by Silvia Marcu. Furthermore, there are two laboratories in the Institute which are also directed by geographers: the *Ageing on the Web (EnR?*) laboratory directed by Antonio Abellán and the *Spectroradiometer and Environmental Teledetection Laboratory* led by M.ª Pilar Martín. In her contribution Dr. Fernández-Mayoralas makes a final reflection on why, despite the relevance that the geographic perspective has in the research proposals of the IEGD, its results are not applied in the disciplinary field of Geography.

Catalan Society of Geography (SCG)

This block of papers of the Spanish contribution closes with the Catalan Society of Geography (SCG)**,** currently a quasi-permanent member of the Spanish Committee of the IGU in the section assigned to regional geography associations. In this case, the text has been written collectively by the members of its Governing Body. After reviewing the major milestones and relevant figures of the Society since its foundation in 1935, within the framework of the Institut d'Estudis Catalans, information is provided about how the entity works, and, in more detail, the activities developed, taking as a sample those carried out throughout the academic year 2018-2019, from October to June. It briefly summarises the publications, research in progress, study excursions and trips, the means of communication with its associates and its collaborations with other national and foreign geographic institutions. In short, with its contribution, the SCG has sought to transmit to the international geographic community the trajectory of an institution dedicated to producing and disseminating geographic knowledge in general and, more specifically, everything related to Catalonia and its culture.

Second block

The second block including the introductory texts and the contributions associated with them based on the following thematic lines

Physical environment, extreme and environmental changes

Population and current mobility

Growth and decline. Application to different levels

Territory, landscape and culture

Cartographies and representations of the world

It is worth mentioning in detail the different contributions contained in the Spanish contribution to the Istanbul Congress. We will do this by following the afore-mentioned sections.

Physical environment, extreme and environmental changes

In the research line on Physical environment, extreme and environmental changes, the presentation has been written by **María Jesús Perlés Roselló,** professor at The University of Málaga, with the title ***Territorial pattern and risk generation. Contributions for a more efficient planning and management of high-risk territories,*** which, based on the critical review of previous literature, proposes conceptual and methodological contributions that Physical Geography can and should make on an applied level in order to resolve the gaps and challenges currently existing in the studies on risk. More specifically, the territorial nature of risk is vindicated and conceptualised as is the important role played by the spatial relationships as a vector of the relationship between the hazard-causing areas and the impact receivers.

This broad and documented paper is accompanied by five more contributions by research teams made up of physical geographers. Therefore the article titled *Biogeographical valuation of global plant landscapes using the lanbioeva (landscape biogeographical evaluation) methodology*, signed by a team of geographers from the University of Valencia, led by Pedro J. Lozano Valencia, compiles and compares the results of a biogeographical research study that began more than 25 years ago on a global scale, which affects almost 200 plant groups in America (Nicaragua, Chile, Brazil), Europe (Spain, the Netherlands, Croatia, Montenegro, Finland, Norway) and Africa (Morocco).

Other text, written by researchers from the universities of the Basque Country and Santiago de Compostela, led by Alfredo Olleros, under the title *Physical Geography in river hydromorphological characterization, evaluation and restoration* describes how fluvial hydromorphology has developed on a scientific and technical level in recent years, largely due to the European Water Framework Directive and that within this line of fluvial hydromorphology, the majority of the research undertaken in Spain has been from a Physical Geography perspective.

In the same line of research but with a distinct interest in natural risk, there are three papers by three teams. This section opens with the paper titled *Climate change´s evidences on the Spanish Mediterranean coast*, which highlights how in recent decades we are observing very clear climate changes in the Mediterranean region, which already extreme and irregular climate patterns. The episodes of torrential rain are becoming more frequent in seasons of the year in which, until now, they had only occurred occasionally.

Another topic along similar lines has been chosen by a team of four physical geographers from the University of Málaga led by Juan Francisco Sortino Barrionuevo, which, under the title *Integrated multiple hazard assessment associated with the road infrastructure environment. Application to roads in the province of Malaga (Spain)* addresses the infrastructure and its environment as a unique space of risk in which hazards of different causes interrelate and interact in space and time, such as mass movements or the removal of soil, among other factors.

The text by Antonio Jesús Gallegos Reina and another two researchers from the University of Málaga which analyses the district of Axarqui in the province of Malaga. The paper is titled *Accelerated change of land uses and repercussions on risks in the territory. The case of the extension of subtropical crops in the Axarquía of Malaga*. Specifically, it reports the results of a comprehensive analysis of the consequences that the accelerated expansion of these new uses is generating on risk processes.

Population and current mobility

In the second line of research, focused on Population and current mobility, professor **Dolores Sánchez Aguilera** from the University of Barcelona presents the paper titled ***From Academia to the Mass Media. Demographic challenges in Spain today.*** In her contribution, professor Sánchez Aguilera claims that it is frequent to find references to the existence of demographic challenges both in the scientific production and in the media and even among citizens. Therefore, this contribution places the spotlight on one of the topics that has received most media attention and which is perceived as being a major demographic challenge in Spain today: the depopulation of large rural areas.

Four papers complement the presentation. First, Francisco José Torres, Antonio García and Juan Francisco Ojeda, professors at the University 'Pablo de Olavide' of Seville have studied *Geography and cooperation on the Euro-African border. Intervention in a urban slum in Larache (Morocco)* referring to the renovation Project of the Jnane Aztout shanty town in Larache (Morocco) as best practice in International Cooperation in Public Housing Policy, awarded by UN-Habitat. The project was developed between 2006 and 2013 and the paper presents its geographical, environmental, territorial and population perspectives.

A different social and spatial context is contemplated by Remedios Larrubia, S.R. Navarro Rodríguez, S.R. and José Natera Riva from the University of Malaga in their paper *Mechanisms of recovery and maintenance of the rural population. About the province of Malaga,* in which they discuss the role that the transfer of income and social benefits of different origins are playing in the population decline and the weakness and productive change of many rural areas, specifically in the province of Málaga.

In the metropolitan context is the text by professor Isabel Pujadas and another three researchers from the University of Barcelona titled *Transformations in large Spanish metropolises in the 21st century: From suburbanization to demographic and social fragmentation?* It discusses how, after the profound crisis of 2008, the Spanish economy showed signs of recovery after 2014; this improvement has not benefited the whole population, although it has had a significant impact on the housing market, employment activity and is generating changes in residential mobility flows with significant socio-economic, demographic and residential implications.

With a perfectly complementary approach to the previous paper, this group of studies is signed by Ramón López Rodríguez and María José Piñeira and titled *Social and citizen implications in territorial governance: key elements in democratic governance.* The contribution forms part of an on-going research project addressing the new models of governance implemented in certain Spanish cities (Madrid, Barcelona, Valencia, Pontevedra and Santiago de Compostela), resulting in the cooperation and citizen inclusion models in the design of urban policies.

Growth and decline. Application to different levels

The third line of research proposed to Spanish geographers for presenting contributions for the Istanbul Congress is Growth and decline. Application at different levels. Following the pattern of the previous lines of research, the introductory text was designated to professor **Macià Blázquez** of the Universitat de les Illes Balears, who has titled the paper ***Escaping the Capitalocene: sustainable development, green capitalism and degrowth.***

The text is based on the study of globalisation from a critical perspective and the scientific conclusion is reached that the origin of the current socio-ecological crisis resides in those spaces favoured by globalised capitalism. This observation would be particularly applicable to anthropogenic climate change, the sixth extinction of living species or the exhaustion of hydrocarbons. All of these are symptoms of the socio-ecological crisis that are rooted in capitalism. Therefore, they are considered to be characteristic of a new geological age called the Capitalocene. The socio-institutional responses to this situation developed in recent decades have essentially consisted in proposals of sustainable development, green capitalism and degrowth, referred to by the author throughout the text.

In the Spanish Contribution volume and within the same line of research, there are four papers on very diverse themes. María José Viñals and Carlos Baños, from the Polytechnic University of Valencia and the University of Alicante, respectively, present *Overtourism in coastal destinations. Considerations about beach spaces and water demand management*. Its objective is to identify a system of indicators of tourism intensity specifically for coastal destinations. To do this; the recreational carrying capacity of the beaches and the global tourism carrying capacity are analysed, facilitating basic information about the level of saturation suffered by these territories.

The paper presented by Rafael Temes Cordovez from the Polytechnic University of Valencia conducts a similar diagnosis of the territory. This contribution, written with another five researchers is titled *Methodology for the identification of the degree of consolidation of urbanised land in the coastal strip of the Valencia Region. Hypothesis for a shrinking urbanism*. This research provides a way to identify and analyse, through remote sensing techniques and the use of cadastral bases, the level of occupation and real development of buildable land on the coastal strip of the Region of Valencia in order to predict the consequences that its reversal would have for the local governments affected.

Another paper from the University of Santiago by Ángel Miramontes Carballada titled *The forest industry in the circular economy. Analysis of the case of Galicia, the forest reserve of Spain.* The author indicates that there are certain sectors that have a series of characteristics that link them in a unique way to the circular economy, such as the forestry industry. In this case, wood, its principal raw material, is, by nature renewable, reusable and recyclable and, therefore, it should assume the principles of and be fully integrated into the circular economy.

This thematic block closes with the paper presented by professor Rubén C. Lois González titled *The economic and symbolic value of the territory in Spain: an analysis of cases.* Based on the fact that Spain has always been a country of contrasts and that the construction of the idea of nation has always been subject to debate, the paper concludes that there is a need for a geographical and symbolic reassessment of understanding in Spain, based on the construction of bridges and higher levels of understanding between territories, as promoted by the Istanbul Congress.

Territory, landscape and culture

In the fourth line of research based on the theme Territory, landscape and culture, the professor **Antonio Zárate Martín** of the UNED (Spanish open university) and member of the Spanish Committee of the IGU has written the introductory text titled ***Green and blue plots for sustainability and recovery of urban cultural landscapes.*** It reports

that the recent urbanisation processes, which are highly speculative, generate difficulties of sustainability for current cities and lead to the disappearance or deterioration of cultural landscapes. The research carried out for several Spanish examples (Madrid, Vitoria-Gasteiz and Toledo) reveals the importance of applying strategies to recover and construct green and blue areas in order to guarantee the sustainability of the current urban systems and to facilitate the conservation and recovery of cultural landscapes that are heritage of the whole society.

Following the format of the previous blocks, the introductory text is accompanied by a series of papers which, in this case, have covered a diverse range of themes and approaches, starting with the member's of the Spanish Committee of the IGU, professor Teodoro Martín Martín presents his study *Hispanic Visions of Istanbul* which seeks to obtain the geographical image of the Sublime Port through the texts elaborated by Spanish travellers who visited it. Thanks to them it is possible to perceive the geographical distribution of power in ancient Constantinople and the geographical conception that transcends the impressions in his different studies.

With another change of topic, in this case to the urban context, Cándida Gago García and Roberto Díez-Pisonero, geographers from the Complutense University of Madrid have contributed *Bohemian, hipster, alternative, ethnic, all trendy: neighbourhoods of Madrid and Barcelona and their contribution to recent urban dynamics*. The authors observe that Spanish cities, particularly the most significant in terms of demography and economy, have experienced overall production restructuring processes. This has placed certain urban activities (leisure, consumption, tourism, innovation and the production of cultural services) at the centre of the economy. To empirically test this, transformation indices are analysed in different neighbourhoods of the principal Spanish cities (Malasaña and Lavapiés in Madrid; Siete Calles- Bilbao La Vieja in Bilbao; Poblenou and Raval in Barcelona; Russafa in Valencia; Alameda in Seville).

The rural dimension in the line of research has been addressed by José León García Rodríguez, a geographer at the University of La Laguna in his paper *The regional heritage of the enarenado farming method in the Canary Islands.* From his observations of this unique case, the author concludes that agricultural space is a historical construction, fruit of the ever-complex relationship between humankind and nature. In the case of the Canary Islands this includes facing problems difficult to resolve such as the aridity, the steep gradient of the land, the fragmentation of the land rents and the scarcity of agricultural land giving rise to a particularly original creation.

The contribution made by Samuel Esteban Rodríguez and Eugenio Climent López, geographers of the University of Zaragoza titled *Territorial heritage and production models in wine designations of origin: the case of the Ebro Valley (Spain),* is a complete change of topic and context. The authors start with the hypothesis that significant relationships exist between forms of heritage management and the production models of the PDOs. To test this they have designed a methodology based on the elaboration of synthetic indices using multiple sources which has enabled them to identify the forms of production of each PDO and the forms of management of their territorial heritage.

The block of papers on this line of research closes with a contribution by a team of geographers from Granada and Extremadura who, led by Francisco Antonio Navarro Valverde, present a text with the title *Attempts and projects of neoendogenous development for rural areas in the South of Spain*. It contemplates the obstacles existing

in these types of areas that prevent the development policies from fully achieving their objectives. This is the case of the LEADER programmes, which have encountered realities and conditioning factors (financial, economic feasibility, training, business mentality, etc.), that have prevented most of the proposed projects from being carried out.

Cartographies and representations of the world

Finally the line of research on Cartographies and Representations of the World takes shape within the Contribution thanks to the introductory the written by professor **Juan Carlos García Palomares** of the Complutense University of Madrid and three interesting papers described below. First, we will refer to the keynote paper of the line of research under the title ***New data for a new representation of the city: some contributions.*** This contribution presents the opportunities offered by the data sources associated with Big Data and its cartographic representation for research in urban geography. Geolocalised data explosion and the improvements in geographical information technologies experienced in the last decade facilitate a new cartographic representation of the city and its dynamics. From this starting point, the text analyses some of the studies carried out within this line by the tGIS research group of the Complutense University of Madrid.

With respect to the accompanying papers, the themes chosen are well researched. First, the researcher from the University of Barcelona, Bárbara Polo Martín and a member of the Grupo d'Estudis d'Història de la Cartografia, presents a paper called *Historical cartography of the world during the middle Ages, so different the conception between Islamic and Christian view?* She undertakes the arduous task of demonstrating how, through a comparison between the maps of the two traditions, we can observe a similar stylistic development and a conception of the world under similar religious precepts. As a result, the differences between the two worlds that have been portrayed throughout history would be diluted by the power of cartography.

At the other end of the scale due to its current and applied nature is the contribution of professor María Luisa de Lázaro y Torres of the Spanish Open University and another three researchers titled *Teaching with GIS at the University, a proposal for employability: the Erasmus + MYGEO project.* It is based on a current assumption in the training system that Integrating Geographical Information Systems (GIS) in the teaching of geography and other territorial sciences at university level enables technology to be used naturally in the learning process, responding to the demand of companies, the labour market and the challenges posed by universities today.

In an intermediate point between historical analysis and the applicability of the results of the geographical research is the paper presented by Cristina Montiel Molina, a professor at the Complutense University of Madrid and a broad team of another six researchers titled *Cartographic reconstruction of land use and fire history through geohistorical sources*. The research shows that fire has been one of the tools historically used by human societies to manage territory. In this way, a complex historical fire-territory interaction has been generated on a local scale that is fundamental for understanding the current fire hazard conditions.

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Presentation of geographical entities

The Royal Geographical Society in the history of the Spanish Geography

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To talk nowadays about the *Royal Geographical Society*, founded 143 years ago under the name of the Geographical Society of Madrid, implies fitting two underlaying and supplementary approaches. On one side, we have to refer to the role and functions the *Society* currently plays and to its future plans and projects, and second, it is also essential to take into account the origin and the history of this institution, one of the oldest scientific societies in Spain, as well as the important patrimony it has accumulated throughout its active life. Both variables intermingle constantly and have to be explained one with the other.

A patrimony of the past and a reality nowadays

Nowadays the *Royal Geographical Society* is one of the Spanish scientific societies that, at a regional or state level, attempt to gather those people interested in the geographical study to, as their Statutes read: *promote the advancement and diffusion of geographical knowledge in all its branches and in all its applications to social, political and economic life*. It has around 300 members that, until the 1960's, were most of them Engineers, Military men, Seamen and some Industrialists, apart from Secondary and Higher Education Teachers and Professors. Nowadays, due to the increase in Geographic Degrees and to the increasing specialization of those studies, most of its members are qualified Geographers looking into territory, environment, political and patrimony problems, but there is also a large group of fans of the Geography of travels and trips, of landscaping, and of what we can call as the most friendly and leisure facet of our science.

To achieve its goals, the *Society* engages in all kind of activities: conferences, discussions, courses, trips, exhibitions, visits, round tables, either by itself or in collaboration with other institutions and societies. All these activities are accounted for in the *Society*'s communication means and, once they are completed, they appear in the Report of Activities that every year is made public in the journal, the *Boletín,* published by the *Society* and to which we will refer below.

But there are some current elements that can only be explained by their relation with the past and with the origin of the *Royal Geographical Society*, such as, first of all, the

composition and structure of its Board of Directors, a reflection of the conditions and circumstances of the foundational period and that the *Society* wants to keep as a tacit identity mark. In fact, the Board of Directors is made up by a President, four Vicepresidents, a Secretary-General, two Deputy Secretaries, a Librarian, a Treasurer and 31 Directors, of which six are institutional members called Born-Directors, which represent the main Spanish institutions and bodies competent in the knowledge and use of the territory. They are the *Instituto Geográfico Nacional*, the *Centro Geográfico del Ejército*, the *Instituto Español de Oceanografía*, the *Instituto Geológico y Geominero de España*, the *Biblioteca Nacional* and the *Instituto de Economía Geografía y Demografía del CSIC*[1]. This institutional representation in the Board of Directors of the *Royal Geographical Society* is the result of the role played by this Society throughout its life, which has needed the support or collaboration of those institutions to achieve its goals.

Another element are international relations, because the *Royal Geographical Society* is part of the main international geographical-oriented organisations, such as EUGEO, an international organisation of Geography societies and associations, EUROGEO, the European Association of Geography Professors that is part of the HERODOT network, for the promotion and teaching of Geography at an international level. Besides, since 1922, the *Society* was the Spanish representative in the International Geographical Union, of which it was one of the 7 founding societies. This representation is done, nowadays, by an Enlarged Committee of the Board of Directors, where representatives of other Spanish geographic institutions and associations are also present.

In short, and in words of the Honorary President of the *Society*, Mr. Rodolfo Núñez de las Cuevas: *our Society remains because it has adjusted to the different currents and trends in geographic evolution, because it has had the support of the Institutions represented in the Board of Directors and has known how to accept the new technologies and breakthroughs in modern Geography.*

These three features of the *Society*, which have enabled its continuity and development, have been present in its history since its foundation. In fact, the early *Geographical Society of Madrid* was born as a scientific association, private in the form but direct and undirectly promoted by the public powers, so it complied and promoted certain functions. It was a formula also used in other nations to mobilise the private sector and, in general, all the society in support of what the government thought of as "national policies", such as the colonial expansion in 1876, or the teaching of Geography and local nomenclature or scientific expeditions in the first decades of the 20th century.

Therefore, the history of the *Royal Geographical Society* is a relevant chapter in the History of Spain, almost its metaphore, and it is reflected in the *Society*'s archive of manuscripts, specifically valuable for the 1876-1926 period, as well as in the pages of its *Boletín*, the earliest of the Spanish geographical journals, published steadily since 1876, except for the years of the Civil War. It is therefore an essential source to know the history of the Spanish Geography of the last 150 years and it is an undeniable cultural patrimony of all Spanish Geography.

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1 Translator's Note: The Spanish Geographical Institute, the Army's Geographical Centre, The Spanish Oceanographic Institute, the Geological and Mining Institute, the Spanish Library and the Economy, Geography and Demography Institute in the Higher Centre for Scientific Research (CSIC).

Figure 1. Map of Spain by Carlos Martínez y Claudio de la Vega, (1735-1744). 1:445.800 scale. It covers the Spanish land except for Galicia, Asturias, León, Castilla la Vieja (less Ávila and Logroño), the Balearic Islands and the Canary Islands. The North of Africa appears as well. It is a hand-written copy, likely drawn from the original first draft existing in the Duque del Infantado's funds and issued by the workshop of Tomás López, which was to be reproduced nor printed. It was lost for many years until its then owner, a descendant of Tomás and Juan López, offered it to the Real Sociedad Geográfica in 1904. Because of its magnificent cartographic representation and beauty, this map is in the opinion of Rodolfo Núñez de las Cuevas, one of the most prominent pieces of Spanish mapmaking and the most valuable work in the Real Sociedad Geográfica *map collection.*

But the main material patrimony of the *Royal Geographical Society* is its bibliographic and cartographic funds, which the institution has accumulated throughout its life and can be described as follows:

- More than 5000 books
- Almost 8000 brochures
- A collection of Spanish and foreign journals, with more than 1120 titles.
- A collection of more than 8000 maps. Most of them are from the 19th century, but there are some relevant maps from the 16th to the 18th centuries.

This important geographical fund was created thanks not only to the *Society*'s acquisitions and to the contributions of its members, but also to the donations of official civil and military institutions (*Instituto Geográfico*, *Observatorio Astronómico*, *Instituto Geológico,*

Comisión de Estadística, Dirección General de Instrucción Pública, *Depósito de la Guerra*, *Depósito Hidrográfico*[2], etc.) that, due to the mixture of private characteristics and public functions present in the *Royal Geographical Society*, assisted it sending to the *Society* all kind of documentation from those bodies that could interest its objects.

At the beginning, this library was located in the *Real Academia de la Historia* (the Royal Academy of History), the then-seat of the *Geographical Society* itself, but as the funds kept growing it had to be moved to other places. Thus, from the 1920's and until 1971, the library was located in the third floor of the Perales Palace, where in 1950 a fire in the first two floors put it in great danger as it affected part of the funds, although not in an irreparable manner. Again the State had to help the *Royal Geographical Society* and, at the *Society*'s request, the then-Ministry of Education decided, in November 1971, to transfer the library to the *Biblioteca Nacional de España (National Library of Spain)*, where it is kept as a single deposit, maintaining its personality and the original unity of the funds.

Figure 2. The Marqués de Perales' Palace. It was built by Pedro de Ribera in the 17th century, and it is located at 10, Magdalena Street in Madrid. It was the seat of the Real Sociedad Geográfica's *Library until 1950 when a fire forced its transfer to the Biblioteca Nacional.*

The origin of the *Royal Geographical Society* and the political and scientific circumstances at the end of the 19th century

Our Society was created in a specific situation that, from both the Spanish and international points of view, is to affect its later development much. The last third of the 19th century is

2 Translator's Note: The Geographical Institute, Astronomical Observatory, Geological Institute, Statistics Commission, General Directorate of Public Education, War Deposit, Hydrographic Deposit

characterized in the international field by two essential facts of great geopolitical relevance, which are to affect the institutionalization of Geography as a strategical knowledge. First, the national unifications of Germany and Italy that added two important nations to the list of the then great European powers. Secondly, the colonial expansion that, since the opening of the Suez Canal in 1869 and since the economic crisis of 1873, specifically, is going to throw over Africa the expansionist appetits of those powers, until the continent was totally divided up in the Congress of Berlin in 1885. In this large expansive process, the geographical societies acted as agents of change, as scientific advance parties and, at the same time, as the moral excuse for such a division. Thus, when the *Geographical Society of Madrid* was founded in 1876, it was imitating the Societies of Paris, Berlin, London, St. Petersburg, Rome, among others and, in a way, it was to fulfil in Spain the same function that those societies had played in their respective countries.

As important as the international events was the Spanish situation, represented by the Borbon dynasty restoration in the person of Alfonso XII; we could say that the foundation of our geographical society was a typical product of the period that started at the uprising of the General Martínez Campos in Sagunto in late 1874 and is to peak with the return of the King and the Constitution of 1875. That's why, many of the politicians starring in that time will participate in the *Society* foundation and will be members of the board of directors. This is the case for Cánovas, the Conde de Toreno or for Marcelo de Azcárraga among the conservative politicians, and for Segismundo Moret among the liberals. In the foundation of the *Geographical Society of Madrid* other two intelectual movements are present: the Regenerationism, embodied in the presence and the role played by two significant figures: Joaquín Costa and Macías Picavea, in the first years of the *Geographical Society*, and the *Institución Libre de Enseñanza* (the Free Teaching Institute), founded in the same year than the *Geographical Society* and it instilled in the *Geographical* their common concern for education and geographical teaching, due to the presence of Eduardo Saavedra, Rafael Torres Campos and Ricardo Beltrán y Rózpide in both institutions. The *Geographical Society of Madrid* was born in an exceptional period of Spanish History, a period that also saw the foundation of most of the Spanish scientific societies, such as the *Real Sociedad de Historia Natural* (1871), *Real Sociedad de Física y Química* (1903), *Asociación Española para el Progreso de las Ciencias* (1908) and *Real Sociedad Matemática Española*[3] (1911).

The four periods of the *Society Geográfica* and its main attainments

As already stated, on March 27th, 1876, a year and three months after the uprising of the General Martínez Campos in Sagunto, the *Geographical Society of Madrid* was founded in the kingdom capital city. On February 18th, 1901, fifteen months before Alfonso XIII was of legal age, a Royal Decree of the Regent Queen M.ª Cristina, modified the name of the society and its approach, to *Royal Geographical Society.* When the 2nd Republic was proclaimed, the name was changed to *Sociedad Geográfica Nacional* (National Geographical Society), until 1939 when the *Royal Geographical Society* was again recovered up to today. This dance of names was not just a terminological one, it reflects the political changes taking place in the country, that specifically affected the society taking into account its close

3 Translator's Note: The Royal Natural History Society, the Royal Physics and Chemistry Society, the Spanish Association for the Scientific Progress, and the Spanish Royal Mathematical Society.

relations with the public powers. Thus, we can make use of these changes to separate its one hundred and forty-three years of life in different periods.

First period (1876-1901)
The foundation. Colonialism and geographical teaching.

It is well known that it was in the Geographical Sciences Congress of Paris in 1875, when Mr. Francisco Coello, attending on a personal basis as there were not any societies representing Spain, had the idea to promote the creation of a geographical society in our country. It seems that it was the Belgian King Leopoldo II, also attending the Congress, who suggested him such a purpose, when the talked about his African expansion proyect and invited him to the Brussels Conference the following year, but he needed a geographical society to represent Spain.

Back in Madrid and in less than six months, Coello put together the *Geographical Society of Madrid*, as a private association promoted for and from the power, as the idea was to create a geographical society *with a free carácter and separated from the guardianship of the Government* in the words spoken by the Conde of Toreno in the foundational meeting. However, the presence of many political figures, starting with the count itself, will show the private-public ambiguity we are talking about. With Coello other promoters were two of the then-celebrities: the Arabist, Geographer and Historian Eduardo Saavedra y Moragas, a much learned man and a convinced institutionist, and the Director General of Public Education, Joaquín Maldonado Macanaz, the representative of the high State Administration. The first president was, as already mentioned, Fermín Caballero, an ex-minister and ex-mayor of Madrid.

Figure 3. A Map of Oran, with no autor nor date on a transparent paper. 40 x 50 cm.
A significant evidence of the interest that the Sociedad Geográfica de Madrid *felt for Northern Africa.*

The colonial project was soon set in motion. In 1877 the *Asociación Española para la Exploración de* África (the Spanish Association for the Exploration of Africa) was created, as a branch of the International Association of Africanists and of the *Geographical Society of Madrid*, and seven years later, in 1883 the Spanish Congress of Colonial and Trading Geography was held in Madrid, with the intervention of Joaquín Costa and the creation of the *Sociedad Española de Africanistas y Colonialistas* (the Spanish Society of Africanists and Colonialists), which sponsored and acted in most of the expeditions leaving in later years. Among those expeditions we have to mention: Iradier's expedition to Fernando Poo in 1877, Bonelli's to the Sahara in 1884 and to Guinea with Enrique D'Almonte in 1888, the mythical expedition of Juan Victor Abargués de Sosten to Ethiopia from 1881 to 1883, and that of Joaquín Gatell et alia to Morocco in 1878, within the expedition of the "Blasco de Garay" ship led by Cesáreo Fernández Duro, who was to be a president of the *Geographical Society*.

In those late years of the 19th century, the *Geographical Society* had a large interest for the education in general and for the teaching of Geography in concrete. This interest was due,

not only to the shortcomings of the educative system and to the ignorance of geographical issues by the public in general, but also to the influence of institutionalists such as Rafael Torres Campos and Ricardo Beltrán y Rozpide, members of the Board of Directors of the *Royal Geographical Society* for several years. A consequence of their concern for the low geographic teaching was the report on the situation, problems and possible improvements, drawn by the members Luis García Martín, Manuel M.ª del Valle and Manuel Merelo, which was published in 1878, only two years after the Society's foundation.

From that time on, reports and pressure on the government were a constant, a significant one due to the political influence of most presidents in those years. A peak was reached in 1895, when the Directorate General of Public Education commissioned the *Geographical Society of Madrid* an Elementary Geography book as a basis for teaching Geograhy in all the schools of the country, commission that finally fell on the Secretary General of the Society, Martín Ferreiro y Peralta, who drew in around two years, an interesting text-book, with some beautiful illustrations, that however was not published due to Ferreiro's death and the negative consequences of the *Disaster*[4].

Second period (1901-1931)
The royal sponsorship. The Society at the service of the State

The resulting isolation due to the loss of Cuba and the Philippines in 1898 implied basically the end of the colonialist approach in the Society, because it was difficult to feel interest for the creation of a colonial empire in Africa when Spain was losing the remnants of the empire created so many centuries ago in America and Asia. But it was also a hard blow to the efforts the Society was making to promote and encourage the teaching of Geography, since some politicians credited the colonial disaster to the little interest and knowledge that the Spanish society had of the geography and importance of the overseas colonies. Thus, this event, apart from its undoubtable seriousness, left the Society without a purpose.

It was the State, once again, who acted to change the situation. The Regent Queen, M.ª Cristina, issued a Royal Decree, that was countersigned by the Minister of Public Education García Alix, in 1901, to re-direct the *Geographical Society* to three directions, something that is at least astounding as you cannot forget that it was a private society. These three new directions were: the change of name to make evident the royal sponsorship, the assignation of a subsidy to help maintaining the patrimony and fulfilling their objects, which resulted, thirdly, in the recognition of some objects that the Society was to meet at the service of the State, of which we have some very clear instances.

Thus, in 1914 & 1915, the *Royal Geographical Society* collaborated efficiently in two projects that were specially relevant for the nation, both of them due to the efforts of one of its most representative members, Odón de Buen y del Cos, a Professor of Marine Biology in the Universidad Central of Madrid and the Vice-President of the Society. These two projects were, first of all, the creation of the *Instituto Español de Oceanografía (the Spanish Oceanographic Institute)*, institute that became one of the Born-Directors of the *Society* Board of Directors and, secondly, the *Society*'s participation in the International Conference for Mediterranean Studies as a basis for Fishing Exploitation, which chaired by Marcelo de

4 Translator's Note: The Disaster in Annual (1921) was a serious Spanish military defeat in the Rif war in Morocco.

Azcárraga, the then-president of the *Royal Geographical Society* and of the Senate as well, ought to have taken place in 1915, but had to be postponed due to the First World War.

Figure 4. Four significant figures in the life of the Real Sociedad Geográfica *during its first half-century (from left to right):*

— *Francisco Coello de Portugal y Quesada (1822-1898): A Military Engineer, autor of the Athlas of Spain and the main promoter of the* Sociedad Geográfica de Madrid, *which he chaired twice, in 1876-1878 & in 1889-1898.*

— *Joaquín Costa Martínez (1846-1911): A Jurist, Notary and distinguished Regenerationist, he took an active part in the colonialist approach, and is one of the promoters of the Spanish Congress on Colonial and Merchantile Geography of 1883.*

— *Marcelo de Azcárraga y Palmero (1832-1915): A Field Marshall, Minister of War and Chairman of the Senate. He chaired the Sociedad from 1909 to 1915. In any of his different military and political offices, he always paid the* Sociedad *a special attention.*

— *Odón de Buen y del Cos (1863-1945): A Naturalist and a Marine Biologist, one of the main founders of Spanish oceanography. A Professor in the Universidad Central of Madrid and the main promoter of the* Instituto Español de Oceanografía *(1914)*

The following year, on July 2nd, 1916, the *Gaceta de Madrid* (Madrid's Gazette) published a Royal Decree that proceeded to modify the name of 570 municipalities to distinguish them from other homonyms, avoiding thus duplications and mistakes. According to the Royal Decree, the name changes were carried out following the reports and decisions taken in the *Royal Geographical Society* by one of its most relevant members, Manuel de Foronda y Aguilera, the Marqués de Foronda. This decree and its subsequent application is the origin of the competences that the Society has since then in relation to the change of names in the Spanish municipalities.

Some years before, a distinguished member of the *Geographical*, the Historian, Geographer and Librarian of the Society, Antonio Blázquez y Delgado de Aguilera made known its work on the Itinerary of Ferdinand Columbus, according to the original document kept in the *Biblioteca Colombina de Sevilla* (Colombina Library in Seville), later on published by the *Royal Society*, under the title of *Descripción y cosmografía de España* (Description and Cosmography of Spain), with a study by Blázquez himself. Besides, in those years, the *Royal Geographical Society* started several works that, if they have been completed, would have implied a clear progress for the Spanish geographical studies. First, the different attempts by the Society to draft a geographical dictionary, both of terms and of places, that derived to the updating and improvement of the Madoz[5]. One of the sponsors of the idea, Vicente Vera, reflected this work in the activities report of 1916: *Work will be long, exhaustive, but fruitful and profitable and it is likely that all the members of our Society will collaborate in it* […] *The final product will be one of those works that by their scientific and practical usefulness are to contribute the most to the national culture and to the name of the RSG*.

5 Translator's Note: Diccionario geográfico-estadístico-histórico de España y sus posesiones de Ultramar is a huge geographical-statistical-historic dictionary of Spain and its overseas territories published by Pascual Madoz from 1845 to 1850.

Years later, in 1926, another well-known member Valentín Fernández Ascarza promoted another important project, the Spanish Photo-Geographical Archive, that in his own words was to *gather, classify, sort and give to any Teaching Centers, Writers, etc., all the graphic documents that contribute to the knowledge of Spanish Geography; besides, it will encourage the production of true graphical elements in the regions where those documents are scarce.* Thus, the *Royal Geographical Society* intended to obtain an archive of geographical-theme photographs that would have meant a large advance for the concept of Geography and its teaching.

Figure 5. Emblems of the Real Sociedad Geográfica (left) and of the Sociedad Geográfica Nacional *(right)*

We could present some other instances of actions by the Society to the benefit of the state and the nation, but there is a very significant action that is a clear proof of this role. The part taken by the *Royal Geographical Society* in the commemorative activities of the Fourth Centenary of the First Sail Trip Around the World, due to the important role that the Society played then in the cultural and geographical field as that of the Magallanes-Elcano heroic deed. The committee of the Fourth Centenary wanted to erect a memorial in Guetaria, Elcano's home-village, to the seamen that had completed with Elcano the first sail trip around the world; so the commission, through the Government, asked the *Royal Geographical Society* a report on those seamen and their birth places. The report was presented to the commission on June 1st, 1925, fulfilling the Royal Order of March 12th of that year, issued by the President of the Government and the Military Board, governing then the country. The names of the seamen proposed by the *Geographical Society* are the names that still appear in the forementioned memorial in Guetaria.

But, undoubtly, the most significant event in this period was the participation of the *Royal Geographical Society*, representing Spain, in the creation of the International Geographical Union in 1922, and it made our country one of the seven founders of the Union with Belgium, France, Italy, Japan, Portugal and United Kingdom. This fact, significant for our Society and for Geography in our country, was reflected in the minutes of the Society's Board meetings, and then published in its *Boletín*, enabling readers to follow the development of the events: *The war broke up the scientific International Unions and to re-start them the allied countries held two Conferences* […] *they proceeded to create autonomous International Unions.* The *Geographical Society* took part, apart from the Geographical one, in several of those Unions always related to Geography, such as the International Union of Geodesy and Geophysics. In the Biological Sciences committee, the Oceonographic section was directed at the beginning by the outstanding members of the *Royal Geographical Society*: Odón de Buen, as the President, and his sons, Rafael de Buen, Vice-President, and Fernando de Buen, Secretary. Moreover, another member of the *Society*, the General Severo Gómez Núñez was appointed Vice-President of the International Committee of the Geographical Union.

A consequence of all these steps –it is explained in the minutes of the Board meeting– *was the Royal Order of the Ministry of Public Education, dated December 26th, 1922 that authorised the Society to create, in the manner most beneficial, the National Committee for the International Geographical Union on the basis of its Board of Directors.*

Besides, and also as a result of the role played by the *Royal Geographical Society* at an international level was the recognition, in the Congress held in Cairo in 1925, of the Spanish language as a language spoken in the IGU Congresses under the same terms than French and English.

Third period (1931-1939)
The Republic and the National Geographical Society

The proclamation of the Republic implied another change in the name of the *Geographical Society*, but not in its goals to the service of the State. In that short period of eight years, but of just five in truth, the *Society* only had two presidents: Gregorio Marañón and Luis Rodríguez de Viguri, and we can only mention an important event in which the *National Geographical Society* collaborated: the expedition to the Amazonia by the captain Francisco Iglesias Brage, a famous aviator in that time, who in March 24-26th, 1929 had completed the transatlantic flight from Seville to Bahia, in the "Jesús del Gran Poder" airplane.

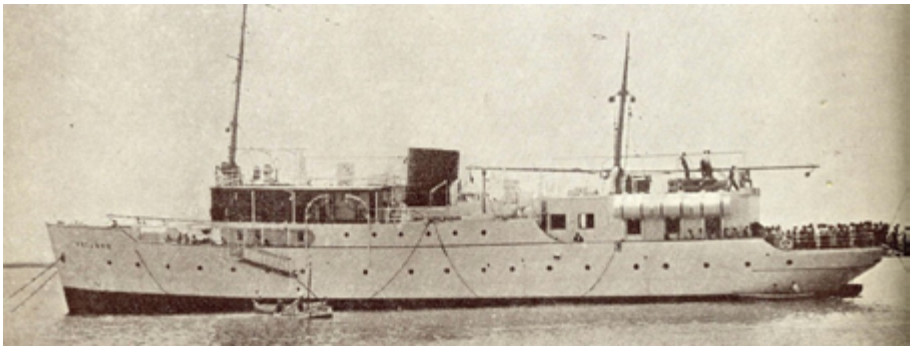

Figure 6. The Ártabro ship that ought to have been an essential tool in the Captain Iglesias's expedition to the Amazon.

The purpose of this enterprise was to return to the tradition of the Spanish scientific expeditions of the previous century, such as the Scientific Commission to the Pacific, but empowered with the new technological innovations and directed to the Amazonia, a then-not well known territory. It was Captain Iglesias himself, a member of the *Geographical Society*, who presented the project before the Society on April 13th, 1931, asking for their support. Later on, in May 1932 with the Republic already proclaimed, the expedition was approved by a decree, within the *Fundación Nacional para Investigaciones Científicas y Ensayos de Reformas* (National Foundation for Scientific Research and Trials of Reforms), created by the main cultural and scientific Spanish institutions such as the *Instituto Geográfico*, the *Servicio Hidrográfico de la Marina*, the *Museo Nacional de Ciencias Naturales*, the *Servicio de Meteorología Nacional*, the *Museo Nacional de Antropología*, the *Jardín Botánico de Madrid* and the *Escuela Nacional de Sanidad*[6], as well as the *National Geographic Society*.

6 Translator's Note: The Geographical Institute, the Navy Hydrographic Service, the National Museum of Natural Sciences, the National Meteorological Service, the National Anthropological Museum, the Botanic Garden in Madrid, and the National Health School.

The "Ártabro" ship, that was to be the seat of the expedition, was launched in Valencia on February 16th, 1935 and it was scheduled to cast off from Ferrol on October 12th, 1935, but after several deferments, the Government decided to cancel finally the expedition that was forgotten after the civil war.

Nowadays since 1940

After the end of the Civil War, the *Society* recovered the name of *Royal Geographical Society*, and General Antonio Aranda, a relevant soldier of the insurgents, was appointed its president. They tried to recover a large part of the activities suspended by the conflicto, such as the Dictionary and the Photogeographic Archive, but times were different and there were not economic means. Besides, in 1940, within the *Consejo Superior de Investigaciones Científicas*, the *Instituto de Geografía Juan Sebastián Elcano* (Juan Sebastián Elcano Geographic Institute) was created, where professors and researchers were educated to hold the new chairs in the Spanish universities. A new generation of geographers from the universities were taking positions in Secondary Schools and in the profesional field, and therefore the *Geographical Society* lost the monopoly that it had as the representative of the Spanish geographers. Thus, in 1975, the *Asociación de Geógrafos Españoles (AGE)* (the Spanish Geographers Association) was created with a more academic and university slant, and the IGU's Spanish National Committee, that up till then was only made up by Directors of the RSG, had to be changed to include other geographical institutions and associations.

However, even under these new coordinates, the *Royal Geographical Society* is still, more than ever, a patrimony of all the Spanish Geography. Beyond its members and current Directors, beyond its activities, reports and publications, the *Royal Geographical Society* nowadays is a patrimony of all the geographers and even of the Spanish culture in itself. This characteristic has been shown many times, specially in the activities organized for the Spanish society. It happened at the beginning of this century, when the *Royal Geographical Society* celebrated, at the same time, the first century of its creation and the 125th anniversary of the foundation of the *Geographical Society of Madrid*. Apart from the conferences and other similar activities, the centenary was celebrated with an exhibition of some of its most relevant works in the Marqués de Valdecillas Library held from November 25th, 2002 to January 3rd, 2003.

Figure 7. Two post stamps commemorating the foundation of the Real Sociedad Geográfica. *On the left, the 75th anniversary, in the series devoted to the Spanish Sahara (1953). On the right, the sheet of the first issue day on the centenary (2003).*

Moreover, the exhibition entitled *La Real Sociedad Geográfica en la Biblioteca Nacional de España. Geografía, Colonialismo y Enseñanza en la España de la Restauración* (The *Royal Geographical Society* in the Spanish National Library. Geography, Colonialism and Education in the Spain of the Restoration) took place eleven years later. It was located in the Las Musas Room of the BNE, from February 4th, to May 18th, 2014, and several conferences and workshops were held as well with the purpose to make the patrimony of our Society known to all the people interested in the Spanish 19th century Geography and History. Besides and always under this same concept that goes beyond any purely scientif limits, the past of the *Royal Geographical Society* has been celebrated twice with the issue of monographic series of Post-Office stamps, the first one in 1953 devoted to the then Spanish Sahara colony and to the 75th anniversary of the Society, and the second one to its Centenary issued in 2003.

Beyond the simple anecdote of these events, both the exhibitions and the stamps issue are the best proof of the integration of the *Royal Geographical Society* with a period and its turning into the best showcase of Geography towards the Spanish population. As already said, the *Society* gives advice to the local Administration, in relation to the mandatory report about changes of names of municipalities or of their status of capital populations, so newsworthy nowadays by current depopulation of the countryside. But apart from those reports and advices, the current value of the *Royal Geographical Society* is its existence in itself, as a true inmaterial patrimony forged throughout the last century and a half, but a patrimony alive and active nowadays, that implies a way to understand the relations between man and environment, of society and nature, which is the main challenge for the 21st century.

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The Spanish Geographical Association, looking to the future

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1. AGE, four decades of work for the discipline

The idea of creating a Geographical Association in Spain emerged in 1975 in Oviedo during the 4th Geography Colloquium within a complex political, social and economic context that was embarking on a transition towards democracy with no clear scenario. Spanish geography had a principal objective when it proposed the creation of the Association: the defence of the discipline from the academic world or as the statutes of its constitution indicated, the "promotion and development of Spanish geographical science". In other words, the acknowledgement of geography as a science in the same way as natural or social sciences. Two years later it was institutionally formalised. In private conversations, Professor García Fernández of the University of Valladolid and the first President of the AGE indicated that the principal achievement of the creation of the AGE was having united the different opinions existing in the university geography sector, rising above personal ideologies. Since then, the AGE has not stopped growing in terms of the number of associates and thematic orientations, in line with the changes experienced in society, the economy and the geographical environment as a whole.

The AGE was not the first geographical society in Spain. La Real Sociedad Geográfica (The Royal Geographical Society) (1876) and the Societat Catalana de Geografía (Catalan Geographical Society) (1935) had a long history of promoting the geography discipline. In 1977, the Sociedad Instituto Vasco de Geografía "Andrés de Urdaneta" (Basque Geographical Institute "Andrés de Urdaneta") was also formed. Therefore, at the beginning of the 1980s there was a series of prestigious academic and social organisations that went on to play a prominent role in defending geography on different levels. We should not forget the important role played by state and regional cartographic organisations and bodies, either long-established or newly-created (IGN, Army Geographical Services, regional cartographic services), that constitute a reference in their field and whose output has been, and continues to be, a major territorial management instrument. This panorama of organisations and associations for promoting geography became consolidated with the creation of the Colegio de Geógrafos (Professional Association of Geographers) (1999) and the Sociedad Geográfica Española (Spanish Geographical Society) (1997). The professional association particularly, which was created on the initiative of academics belonging to the AGE, has been the principal support for the consolidation of the geography discipline in Spain and not only on a professional level.

Within this context, the AGE should play a harmonising role, ensuring good relations and the coordination of initiatives between all of these institutions, maintaining the initial objective that led to its creation: "the promotion and development of Spanish geographical science": Therefore, we believe that, at the beginning of the third decade of the twenty-first century, it should be understood as a consolidated discipline. Although it is prone to circumstantial ups and downs due to the reduction in enrolments in university geography courses or the decrease in professional activity due to the economic crisis that has affected Spain in recent years.

Some features inherent in the structure and functioning of the AGE have been fundamental for its consolidation in its more than four decades of operation. It has a distinct democratic nature, where members control the direction of the Association at all times and are equals in the General Assembly. In fact, the board of directors has an expiry date and none of its members can be re-elected more than once. These founding principles were highly important when AGE was created, a few months before the death of the dictator Franco. It is a non-profit association which is financed with its own resources or by public or private entities for specific purposes (congresses or publications). This requires an absolute transparency of its economic management which is carried out through the preparation of the financial statements and annual expenditure forecasts. Its commitment to modernising and updating management objectives and methods is reflected in the updating, on different occasions, of its principal internal operation documents (Statutes, Regulations). The latest versions of them both were approved in 2018 and 2019 respectively, in order to adapt to the general regulatory changes and the new ways of understanding associationism as a transparent, participative and equal form of working. In this respect, in 2018, by statutory reform, its current name was approved as the Asociación Española de Geografía (Spanish Geographical Association) AGE, more in keeping with an organisation of the twenty-first century[1]. All of the documents approved in the governing bodies of the AGE and the reports that are regularly prepared by the different committees of the Board of Directors or work groups may be freely and transparently accessed on the AGE website, which has become an important consultation tool for the Spanish geographical community. In 2019, the web portals of the AGE were renewed (home page[2] and *BAGE*[3]) to adapt them to the new forms of social communication (social networks and consultation through mobile devices).

A basic principal of action in the Association has been the partial renewal of the Board of Directors, particularly the president every four years. This has enabled the Association to maintain a spirit of permanent change and a principle of operation based above all on: the promotion, defence and constant boosting of our discipline.

The very structure of the AGE as an association present in every territory of Spain, as a single entity, which seeks to respect the different territorial sensitivities is, moreover, an indisputable principle of action of the Association. This is also true of the promotion of Working Groups that address thematic issues (currently 15 groups) and develop activities with full autonomy. As indicated by Professor Mata Olmo (2013), of the Autonomous University of Madrid and president of the AGE between 2005 and 2009, a fruitful relationship

1 This change of name, replacing the former Spanish Geographers Association, was approved on 15th March 2019 by the Sub-directorate General of Associations, Archives and Documentation of Spain, belonging to the Ministry of the Interior

2 AGE-Asociación Española de Geografía: https://www.age-geografia.es/site/

3 *BAGE*: https://bage.age-geografia.es/ojs//index.php/bage/index

for the Association has been built between the dynamics fostered from the Board of Directors and the actions proposed by the Working Groups, as there is a shared desire to constantly promote the discipline.

In this respect, an important element of the identity of Spanish geography is the biennial celebration of the general congresses of the AGE which are organised in collaboration with the Geography Departments of the Spanish universities in which it is based. They constitute the most important meetings of the discipline in Spain, where, under a general identifying slogan, transversal themes across the whole of the discipline are addressed as well as contemporary and relevant socio-territorial issues in order to bring as many associates and non-associates together as possible. The publication of their results has become a reference of the dynamism and renewal of Spanish geographical research.

CONGRESSES OF THE SPANISH GEOGRAPHERS ASSOCIATION/SPANISH GEOGRAPHICAL ASSOCIATION		
Edition	**University**	**Year**
4	University of Oviedo	1975
5	University of Granada	1977
6	University of the Balearic Islands	1979
7	University of Navarra	1981
8	University of Barcelona	1983
9	University of Murcia	1985
10	University of Zaragoza	1987
11	Complutense University of Madrid	1989
12	University of Valencia	1991
13	University of Seville	1993
14	University of Salamanca	1995
15	University of Santiago de Compostela	1997
16	University of Malaga	1999
17	University of Oviedo	2001
18	University of Barcelona	2003
19	University of Cantabria	2005
20	University of Pablo de Olavide (Sevilla)	2007
21	University of Castilla-La Mancha	2009
22	University of Alicante	2011
24	University of the Balearic Islands (Palma)	2013
25	University of Zaragoza	2015
26	Autonomous University of Madrid	2017
27	University of Valencia	2019

Table 1

Source: AGE

The AGE has found a uniting element as part of its vocation to promote geographical science in the journal *Boletín de la AGE (BAGE)*, which has become a reference of good work and a source of pride for the associates. The incorporation into the most prestigious national and international publication quality indexes (JCR, WoS, Scopus, etc.) and the progressive improvement of its position in them, based on constant and rigorous editorial work, has enabled it to internationally promote the AGE and capture members from different countries around the world.

In this facet of promotion, scientific communication and diffusion of geographical research, the AGE acknowledges research excellence through its Awards which it announces with

the frequency established in the rules. They are the "Roser Majoral Moline" Award for the best article published in a foreign journal, the "Manuel de Terán Álvarez" Award for the best doctoral thesis and the "Jesús García Fernández" Award for young researchers. These are three names of reference who have given prestige to our discipline as have those of the award winners of each prize in every edition.

All of this activity has been possible thanks to a sense of continual renewal and internal criticism, which is what enables the AGE to advance as an association and promote a scientific discipline. Without this, we could not understand the many activities that are proposed annually by the Working Groups or promoted by the Board of Directors to develop at the AGE itself or in collaboration with other geographical bodies or territorial, environmental or socio-economic entities in Spain. It is most likely the state barometer that is closest to reality available for assessing its activity.

The AGE has known how to maintain a highly fruitful relationship of cooperation with geographical organisations and associations in Europe and Latin America. The collaboration with the Portuguese Geographical Association (APG) has been particularly special due to the close ties existing between the promoters, namely experts in the discipline, of the two institutions (Ribeiro, García Fernández, Terán, Cabo) in the 1970s. This has resulted in the biennial celebration of an Iberian colloquium, which has consolidated institutional work and research relations between teachers over the last four decades. Since 1979, sixteen Iberian Geographical Colloquiums have been held in different cities of the two countries and the next Colloquium is to be held in Salamanca in July 2020.

IBERIAN GEOGRAPHICAL CONGRESSES		
Edition	**University**	**Year**
1	University of Salamanca - Spain	1979
2	University of Lisbon - Portugal	1980
3	University of Barcelona - Spain	1984
4	University of Coimbra - Portugal	1986
5	University of León - Spain	1989
6	University of Oporto - Portugal	1995
7	University of Cáceres - Spain	1995
8	University of Lisbon - Portugal	1999
9	University of Huelva - Spain	2004
10	University of Evora - Portugal	2005
11	University of Alcalá de Henares – Spain	2008
12	University of Oporto - Portugal	2010
13	University of Santiago de Compostela – Spain	2012
14	University of Guimarães - Portugal	2014
15	University of Murcia - Spain	2016
16	University of Lisbon - Portugal	2018
17	University of Salamanca - Spain	provided 2022

Table 2

Source: AGE

In addition to these Iberian geographical meetings, the AGE has developed others with the Comité National Français de Géographie and has participated in the International Congresses of the International Geographical Union, sharing the management of the Spanish Committee of the IGU with the Real Sociedad Geográfica (Royal Geographical Society), within a context of fruitful collaboration.

SPANISH-FRENCH CONFERENCES		
Edition	University	Year
1	University of Granada	2016
2	University of Paris – 8	2017
3	University of Seville	2019
4	University of Lille	provided 2021

Table 3
Source: AGE

In addition to its work in the university sector, the AGE has prioritised the development of actions and activities aimed at secondary education in recent decades, including the organisation of the "Courses for teaching Geography in Secondary Education" which are held every year during the summer. This activity has become an academic meeting point for Secondary and Baccalaureate Geography teachers due to the teaching innovation topics addressed within the relationship between new technologies and geography teaching. Along these lines, the AGE has carried out projects for the design of teaching materials and resources in collaboration with the CNIG and the IGN. An example is the publication of the National Atlas of Spain "*España en mapas*" in which many specialists of Spanish geography participated under the coordination of Professor Sancho Comíns, of the University of Alcalá de Henares. This was an example of a collective effort and collaboration of Spanish geography with the principal cartographic institution of Spain, in the interest of the social promotion of the discipline. In this field of action we should highlight the yearly award "*Explica Geografía con tus fotos*" (Explain Geography with your photos), which has been running for the last few years. It is aimed at Secondary Education and Baccalaureate students with a wide response from all parts of the country. After the agreement with ESRI was signed in 2019, a geovisor was created to present its results.

Finally, we should point out the close working relationship of the AGE with the Professional Association of Geographers. The institutional representation of geography that is developed by the two institutions, individually or jointly, is one of the principal lines of action for promoting the discipline of geography in Spain. The objectives and purposes of this fundamental collaboration have been established in various agreements which the two institutions have signed (the last one in 2019) and which may be consulted by the public on their corresponding websites. The result of this joint work is the "Nueva Cultura del Territorio" Award (New Culture of the Territory) which began in 2009 and is held every two years. This award, which is not a monetary prize, seeks to promote a new culture of the territory through the recognition of people, organisations and institutions that have significantly contributed to the development of land management and territorial planning, based on the values of environmental sustainability, economic efficiency and social equity. In its first edition in 2009, the Award was given to Andres Rábago "El Roto"; in 2011, the prize went to the Cesar Manrique Foundation; in 2013 it was won by Dr. Ángel Cabo Alonso, in 2015 it went to Ecologistas en Acción, in 2017 to Dr. Josefina Gómez Mendoza. In 2019, the Award was given to the writer Julio Llamazares and to the Observatori del Paisatge de Catalunya, for the diffusion and management categories which, from this year, make up the prize.

In short, the Spanish Geographical Association, AGE, has initiated a process of renovation to adapt to the changes imposed by the global society. To do this it has adopted a slogan which it wants to convert into the image of the Spanish geography brand and which encompasses the fundamental points of reflection and action that are going to drive the geographical discourse over the next few years: "Geography, the science of global change, environmental sustainability and territorial information" (*Geografía, la ciencia del cambio global, la sostenibilidad ambiental y la información territorial),* There is still a lot to do, with commitment, collaboration and determination. Only in this way can the spirit that led to the creation of the AGE be kept alive: the promotion of geographical science in Spain.

2. The AGE today: structure and composition

From the moment of its official creation in 1977, the AGE has evolved considerably without losing its essence: not only with respect to the activities carried out and the regulations governing it, but also in relation to its associates. These have grown in number from 200 when the Association was founded to the 1,070 inscribed in October 2019 and during this time we can observe how their characteristics and spatial distribution have changed.

The positive evolution experienced reaffirms the idea of maturity that Professor Méndez Gutiérrez del Valle, of the Spanish National Research Centre and president of the AGE between 2001 and 2005, highlighted in 2004, while confirming the success of the AGE. Until 2004, the growth in the number of associates was high, with a remarkable acceleration during the first twenty years of its life from 600 members in 1986 to more than a thousand in 1995. This process was related to the creation of new universities and with the increase in the workforces of the existing ones (Méndez, 2004). In 1995 a period of irregular stabilisation began which still continues today and in which we can observe phases marked by slight annual increases, with a figure close to 1,100 associates being reached at the beginning of the century and others, such as the period at the end of the first decade of this century and between 2013 and 2015 which were conditioned by the loss of associates (fig. 1). This decrease was due to external causes, such as the economic crisis which led to a greater labour instability and precariousness but also to internal readjustments of the Association related to the review of the fees.

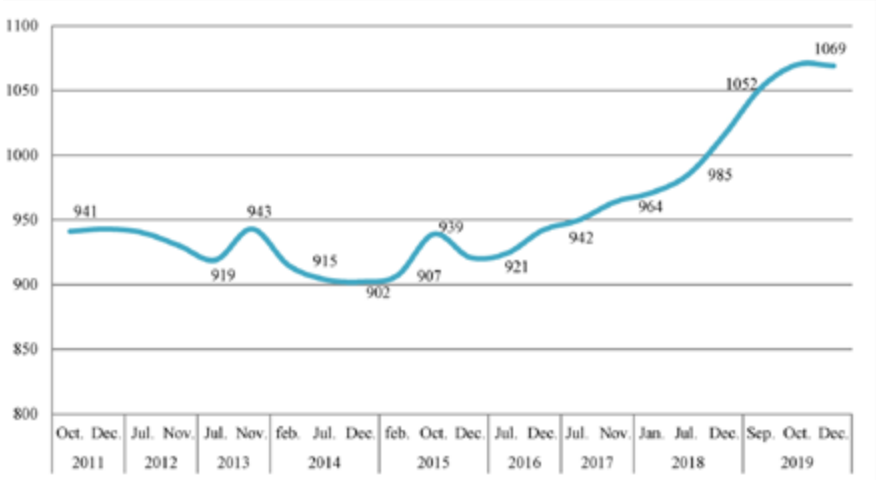

Figure 1. Evolution of the number of associates of the AGE (2011-2019)

From 2016 to the present, the number of members has grown constantly, a true reflection of the initiatives that are being implemented by a dynamic and highly active association in the defence of the interests of geography and its professionals. This increase also translates into the participation of the associates in the majority of the Working Groups, which reveal the interests and principal lines of research and work (fig. 2).

The AGE was created with very close ties with the university sector and the Spanish National Research Centre, to which the majority of its members still belong today.
In the last few decades, the membership of Secondary Education and Baccalaureate teachers has increased, all of whom are related to the Geography Teaching Working Group and of young pre and post doctoral researchers as a consequence of the different initiatives directed at them, such as awards, doctorate workshops and due to the interest that the

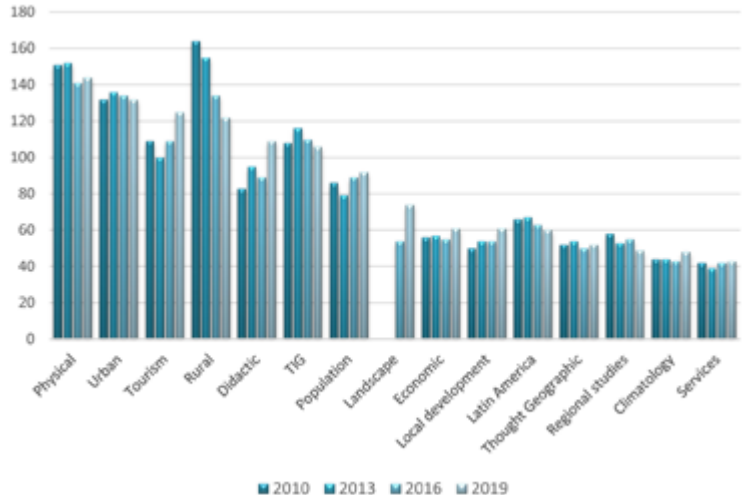

Figure 2: Evolution of the number of members of the Working Groups of the AGE

have in publishing in the *BAGE*. However, the presence of professionals who work in public administrations, institutions or companies is still weak (fig. 3). Of these, particularly noteworthy are the fields related to local and territorial development, urban planning and spatial data analysis as well as contracts either with the administration or with companies that are not related to the studies carried out.

DISTRIBUTION OF THE ASSOCIATES BY WORK CENTRE		
	Nº	%
Administration	25	2.34
Freelance	3	0.28
Research Centre - CSIC	15	1.40
Secondary Education Centre	49	4.58
Company	20	1.87
Other institutions (foundations...)	8	0.75
University	856	80.00
Unemployed	25	2.33
No information	94	6.44
TOTAL	**1,070**	**100.00**

Table 4
Source: AGE

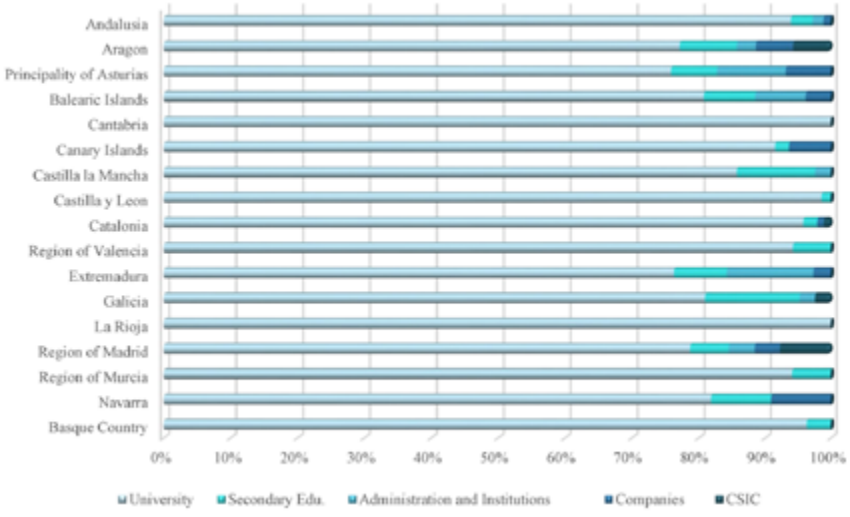

Figure 3: Distribution of associates of the AGE by work centre and autonomous region (2019)

Something that has characterised the AGE since its creation is a much higher participation of male geographers than female geographers. This difference has begun to narrow very slightly in recent years, although the proportion of men (65.05%) with respect to women (34.95%) is still very high and similar to that of other geographical institutions such as the Professional Association of Geographers[4]. The male dominance in the Association affects all of the Working Groups, except for Economic Geography in which the participation of men and women has been almost identical for several years.

The gender differences are also visible in the different work areas, with less of a gap among university teachers, although it is far from reducing and the trend remains the same (fig. 4). This can be seen in the new young members joining in recent years, who maintain a proportion of two-thirds to one.

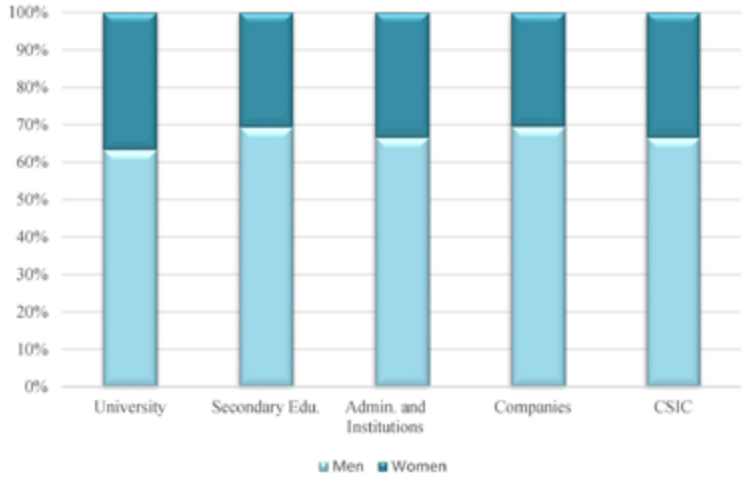

Figure 4: Percentage of male and female associates of the AGE by work centre (2019)

Despite the ever-more frequent incorporation of young researchers, the average age of the associates is high. Of a sample of 429 associates, we can observe that the average year of birth is 1965, the majority having been born before 1960 and there is also a very large group of retired associates. This has been understood as a new opportunity and from the research committee a plan for promoting "senior talent" is being developed. The objective of this project is to learn, from the associates themselves, their motivations, desires, interests, capacities and perspectives, and the activities that they wish to continue developing and those that they can carry out from the AGE to promote a transition from working life to retirement, foster the empowerment of those who wish to remain socially active, although they are no longer in the labour market and generate inter-generational contact to favour the transmission of knowledge.

In parallel, the AGE has to generate initiatives to attract young people who will be the future of geography. It is the Association's objective to offer new spaces for debate, joint reflection, the exchange of information and the creation of junior networks with innovative formats. Furthermore, opportunities will be provided for them to complete their academic training in aspects related to them starting and becoming leaders in their professional careers and, more specifically, in their research careers.

4 According to the 2018 report of professionals, 69.10% of members were men and 30.90% were women.

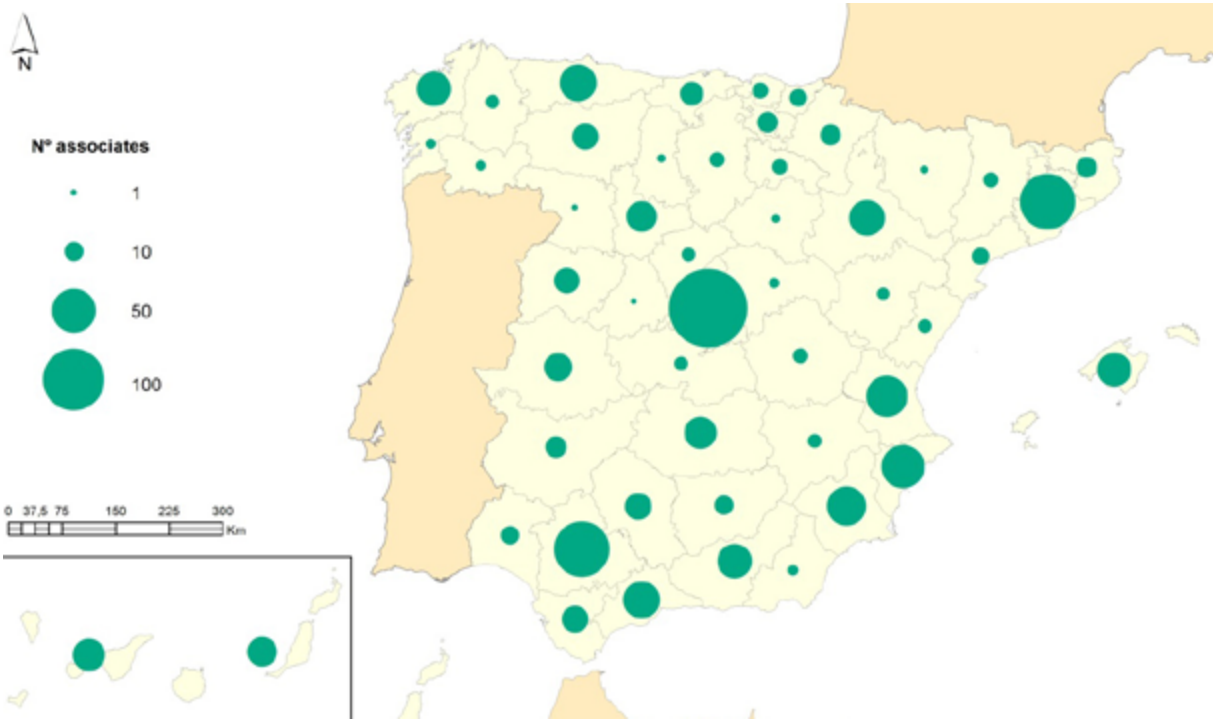

Figure 5: Provincial distribution of the associates of the AGE
Source and elaboration: AGE Data year 2019

Similarly to the certain professional diffusion has taken place in recent years, the same is occurring in spatial terms. It should be noted that there are associates in all of the Spanish provinces, although it is true that there is a higher presence in the cities where there are more than one university with degree courses in Geography or where there is greater activity in teaching and research.

Although still only symbolic, over the last decade there has been an increase in the presence of foreign associates from different countries, particularly Latin American countries. This is highly valued but, as their presence is unstable and irregular and due to the personal interests that lead them to join the Association, their involvement on an associative level and with Spanish geography is still very low.

Figure 6: Distribution of the associates of the AGE by country

The governing bodies of the AGE are aware that the increase in membership is circumstantial and could decrease in the coming years due to the situation being experienced by geography and its social recognition, the decrease in the number of students and, therefore, future professionals and the average age of its associates, which is close to retirement. Therefore, an important reflection must be made regarding the future, not only of geography but also of the Association itself. Strategies should be implemented that favour the integration of its members in the activities but also in the decision-making and the design of the future Association.

3. Internationalisation of the AGE: New phase

The early years of the AGE coincided with the isolation from the outside world that Franco's Spain had suffered in many different areas. One of the objectives of Spanish society was to become a democratic European country and its academia had to be at the forefront in this task. Except for the French influence, the fraternal relations with Portugal and the occasional entry of novelties from the Anglo-Saxon publishing world, Spanish geography had remained fairly isolated and inward-looking in the application of the classic regional-landscape method in the majority of its analyses. Few Spanish geographers had enjoyed training or a research placement abroad; and even less so in non-Spanish speaking countries. Since then, Spanish university geography and the AGE have taken a leap forward in the internationalisation of the discipline developed in Spain, an advance which follows an ordered scalar logic. First, the friendly relations with France and Portugal grew closer; furthermore, within Europe, Spain participated in the existing associations in the discipline and, finally great efforts have been made to become an active member of the IGU. And, through this participation, a Latin American and Iberian geography network has been created with its own personality and global vocation.

In fact, contact with the Asociaçâo Portuguesa de Geografos (APG) is not limited to the joint organisation of Iberian Colloquiums, but a joint repository[5] has been created of academic geography journals and the active presence of representatives of the APG has been regularised in the AGE congresses and vice-versa. With France, in addition to the organisation of the already mentioned bilateral conferences, it collaborates in the organisation of the Nuit de la Géographie and forms part of an action unit with the Comité National Français de Géographie both in EUGEO and in the IGU.

In Europe, there are two continental geographical societies (EUGEO and EUROGEO) with differentiated profiles and with which the AGE has decided to maintain a significant level of commitment. EUGEO is an organisation that includes around thirty associations representing the EU countries. The AGE regularly attends the meetings, collaborates in its congresses and with the initiatives that it decides to carry out. It also cooperates closely with EUROGEO, a network that groups together both geographical societies and individual members and which emerged from a European project to reinforce the teaching of geography. Its current President, Professor Rafael de Miguel of the University of Zaragoza, is also a member of the AGE and our association actively participates in its annual Congress which will be held in Madrid in 2020. Spanish

5 Repository of Iberian geography journals: https://revistas.age-geografia.es/

geographers frequently publish their articles in the European Journal of Geography, its scientific organ of expression.

If we return to the early years of the AGE and the democratic transition, it is understood that the desire to break the isolation of the Spanish geographical community was focused on the International Geographical Union (IGU), together with joining the European associations. Attending the IGU congresses, forming a delegation and becoming part of its management bodies or Working Commissions was an important objective for the most prominent Spanish professionals of the discipline. In fact, the decision of a group of geographers to participate in the IGC of Moscow in 1976 constituted a milestone. Although Spain's presence in Tokyo was lower in 1980, Professor Joan Vilà of Valentií of the University of Barcelona was elected Vice President of the IGU, a position which he held until 1988. Professor Vilà had come from the board of directors of the Comisión de Didáctica de la Geografía (Geography Teaching Commission) and during his years on the Executive Committee of the IGU he gave special attention to fostering contact with Latin America and countries whose official language was Spanish and Portuguese. Spain had an important presence in the Paris Congress in 1984 and in 1986 it organised an IGU Regional Conference in Barcelona, the only one held in Spain to date.

In the 1990s and the beginning of the twenty-first century, the activity of the geographers of the AGE as leaders or members of the Executive Committees of the Working Commissions of the IGU consolidated. The role played by three Catalan professors was particularly remarkable: Roser Majoral, Mª. Dolors Garcia Ramón and María Sala. The presence of geographers from Madrid such as Josefina Gómez Mendoza and Manuel Valenzuela was also highly important in boosting Spain's participation in the IGU congresses and activities. In this respect, we can highlight the relevance acquired by the Spanish Contribution to the Washington Congress in 1992 with a review of Spanish Geography 1970-1990, a joint edition of the Spanish Committee-, while for The Hague Congress in 1996 the Spanish contribution comprised the publication of a special edition of the *Boletín de la AGE*, in Spanish and English. For Seoul 2000, Glasgow 2004, Tunisia 2008 or Cologne, 2012 Spain resumed participating with the editions of the IGU Commission, in which the AGE plays a prominent role together with the RSG.

After a brief hiatus in the constant internationalisation dynamics of Spanish Geography through the IGU, in recent years we can observe a growing participation of Spanish colleagues in the Working Commissions of the Union. In this respect, we can highlight that first, Professor Jacobo García Álvarez of the University Carlos III and, to the present day, Professor Josefina Domínguez Mujica of the University of Las Palmas de Gran Canaria, have been presidents of the Commissions of Geographical History and Human Mobility respectively. Furthermore, the number of Spanish members in the Steering Committees of the Commissions has continued to increase, with up to ten in the Internationalisation Workshop of Spanish Geography held in Madrid in March 2019. In parallel with this presence, there has been an increase in the number of participants in the annual congresses organised by the Association of American Geographers (AAG) in different cities of the United States.

Undoubtedly, an important step forward in our internationalisation process has been the Vice-Presidency of the IGU of Professor Rubéof the University of Santiago de Compostela. This professor was selected in the spring of 2018 and became a member of the Executive Committee of the Union in August of the same year.

He was proposed by the National Committees of France, Portugal and Spain, reflecting the strong trilateral alliance that has been built recently. Since 2018, and after thirty years without a Spanish Vice-president, his work has focused on improving the projection of geography written in Spanish and Portuguese on an international level, fostering a greater presence of the IGU in Latin America based on the bridge role played by Spain and promoting Spain's participation in the ICG and all of the global forums that address territorial issues of major interest (climate change, migrations and human mobility, spatial data processing, ocean conservation, diffusion of scientific knowledge, etc.).

For the AGE, the reinforcement of the IGAU implies committing to the construction of a more democratic international geographical community where each country has a voice and a vote. In this community, English, while necessary, is not the exclusive language of academic expression and transfer of territorial knowledge to society. In short, a community which is not constructed from a large superpower or from the North in general and that listens to geographical, ecological and democratic voices generated in emerging countries and the South. In this context, the privileged position of Spain between Europe and Central and South America should play an important role in the international panorama.

Although geographical production that seeks prominence is increasingly expressed in English and strives to be published in Anglophone academic media with a global outreach, the current board of directors of the AGE defends the importance of constructing a solid geographical network expressed in Spanish (and Portuguese). Recovering the projection that it had for many decades over Latin America and its universities constitutes one of its major objectives at present. Fraternal collaboration projects with the countries with which we share a language and culture should be intensified; co-tutored theses on both sides of the Atlantic should be encouraged; and specific geographical research on Central and South America from Spanish universities and the construction of alliances with those of the New World should be fostered. According to the AGE, this complex task should play an important role in the construction of regional and general geographical knowledge in a context in which we can envisage significant transformations in the ways in which science on a global level are generated and disseminated.

In this project aiming to establish solid bridges with Latin American Geography, one of the Working Groups of the AGE, AGEAL (Spanish Geographical Association for Latin America) is making a considerable effort. Its board of directors has fostered regular congresses on the theme of Latin America held in different Spanish cities. The last two of these congresses, held in Madrid and Albacete in 2018 revived the AGEAL through well-attended meetings. These meetings were characterised by a high participation of colleagues from almost all Latin American countries and the presentation of joint research projects between geographers from both sides of the Atlantic. The work of AGEAL is one of the paths followed by the AGE to create an international geographical community that expresses itself in Spanish and Portuguese. Looking towards the future, a higher level of involvement is required of the Spanish departments and universities to lead and cooperate in research projects in Latin America. Furthermore, the construction of wider debate networks is needed, together with an intensification of the collaboration with media such as Geocrítica which is enormously prestigious among the Latin American scientific community.

Origin

Theme

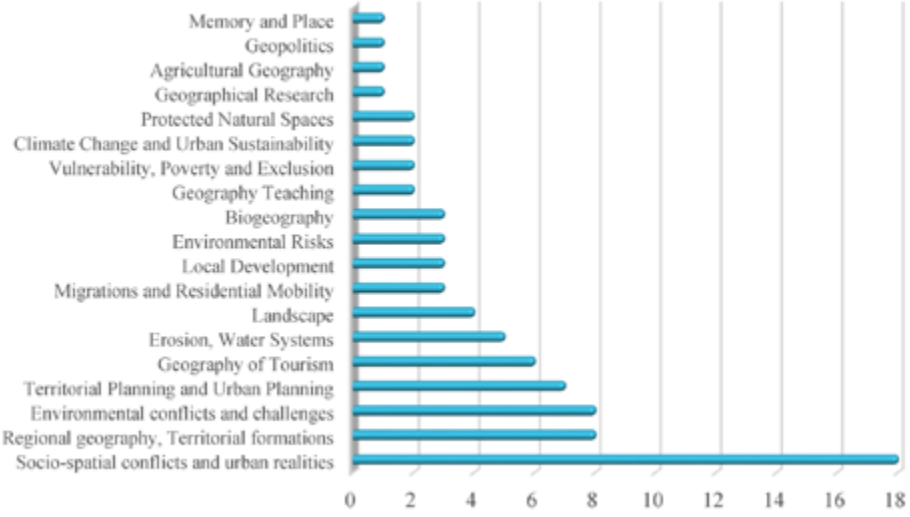

Figure 7: The contributions of Latin American, Spanish and European Geography in the book of minutes of the AGEAL Congress of 2018 (Asociación de Geógrafos Españoles para los estudios Latinoamericanos) titled "América Latina en las últimas décadas: Procesos y retos".

Source: Cebrián, F., Jover, F.J. and Lois, R. "América Latina en las últimas décadas: Procesos y retos". *Minutes of the AGEAL Congress of 2018* University of Castilla La Mancha, Albacete

4. Looking to the future

The AGE is the future of the geography discipline in Spain. At least it should be if we want this Association that has worked hard and well to promote geographical science for decades to stay alive. Now, AGE must continue to modernise and prepare itself for these new times where the geographical space will be a fundamental piece in social development and territorial sustainability on a global scale.

To do this, the AGE should design and lead the renewal of the geographical discourse that has been experiencing a lack of dynamism in recent years. The stage of the epistemological paradigms that marked the evolution of the discipline in the second half of the twentieth century came to a halt at the turn of the century. The accelerated environmental, social and economic processes occurring in today's society with overwhelming technological advances, the emergence of new forms of social communication and collective organisation, the new diverse ideologies and threats derived from changes in the way in which we interact with nature and in social relations have surpassed the way in which geography is regarded and practised as an effect of a principal current of thought. And we have had no time to reflect on what the new geographical discourse should be. But this does not mean that we should not begin to debate calmly but without pause. The AGE has to be involved in this process in the medium term, but fundamentally for its future. Its Working Groups have to play an essential role, as they are made up of specialists in the different geographical areas and themes who are highly knowledgeable not only in the current problems but also in the most recent research. Therefore, the Groups have to lead the debates and generate spaces for exchange. Furthermore, as a basic piece in the structure of the Association, they should commit to its recognition and social involvement. In this regard, in recent years, initiatives have been developed to launch "manifestos" with respect to topical issues, alone or in collaboration with the Professional Association of Geographers or other institutions related to the problems addressed.

The AGE should continue with its commitment to gender equality, an indisputable ethical principle in a discipline that has traditionally been male-dominated. This should begin with the pursuit of gender parity in its management bodies and all actions that require the formation of commissions, panels, etc. In the same way, the AGE will defend the representation and participation of members from all parts of Spain.

All of this reveals the close relationship between the geography discipline and the Sustainable Development Objectives (SDOs) of the United Nations that should guide the strategic actions and daily tasks of the AGE. Geography carries out activities in teaching, research and management, addressing several of the 17 objectives (for example, objectives 6, 11, 13 or 15 directly and several complementarily), established as the global agenda that must be fulfilled over the next few years. The AGE, either alone or jointly with the Professional Association of Geographers, has been sensitive to this issue: in fact, the "Manifestos" undertaken in recent years have been directed at complying with some of these SDOs (new culture of the territory, depopulation, housing, physical environment, the Amazon). These efforts will continue to be fostered in the coming years and will form a key part of the Association's management.

Finally, we should prepare for an important celebration for Spanish geography: the 50th Anniversary of the creation of the AGE in 2025. This event should constitute a meeting point for the discipline and for all of the geographical institutions and associations of other countries.

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The National Geographic Institute 150th anniversary 1870 - 2020

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National Geographic Institute

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1. Introduction

The Geographic Institute was created on 12 September 1870. It was administratively dependent on the Directorate of Statistics of the Ministry of Public Works, but with total freedom to exercise the technical skills attributed to it, consisting in "determining the form and dimensions of the Earth, geodetic triangulations of different types, precision levelling, topographic triangulation, map and cadastre topography and determining and conserving the international types of weights and measures".

The first director of the Geographic and Statistical Institute, the predecessor of the National Geographic Institute, was General Carlos Ibáñez e Ibáñez de Íbero.

General Carlos Ibáñez e Ibáñez de Íbero, first director of the Geographic Institute

The creation of the Geographic Institute marked an important step forward for a cartography based on a technical and civil concept that went beyond the traditional application of geographical knowledge only to the security and defence of the State. This brought Spain into line with the standards of other European countries which put it in a position to collaborate with them in determining the shape and measurement of the Earth.

The first headquarters of the Geographic Institute was in Calle Jorge Juan nº8 where there is a stone plaque, laid by the City Council of Madrid in 1921, to commemorate the fiftieth anniversary of the creation of the institution, with bronze letters reading: "*Al General Ibáñez de Ibero que en este edificio estableció por primera vez en España el Instituto Geográfico y Estadístico*" [To General Ibáñez de Ibero, who, in this building, established for the first time in Spain the Geographic and Statistical Institute].

Commemorative plaque

From 1873 the Institute no longer formed part of the General Directorate and became an independent body and maintains this status today, although the name of the Institute has changed over the years: Geographic and Cadastral Institute, Geographic, Cadastral and Statistical Institute and the current name, since 1977 as the National Geographic Institute (IGN), forming part of the Ministry of Development, today the Ministry of Transport, Mobility and Urban Agenda.

Furthermore, since its foundation, it has been responsible for geodesy and cartography; in 1878 it assumed the competences of calibration and metrological control, which it held until the Spanish Metrology Centre was created as an autonomous body in 1991.

Initial project for the construction of the IGN building (1928)

In 1904, the Astronomical and Meteorological Observatory was integrated into the Institute, and it is still responsible for astronomy today. The meteorology competences were transferred to the Central Meteorological Institute in 1906, although the Astronomical Observatory continued to publish the measurements corresponding to Madrid until 1919. In 1925, the rural land registry was incorporated and it undertook the corresponding cadastral functions until 1979. In this year the Services of the Geographic High Council were incorporated, dependent on the Ministry of the Army, and continue to form part of the IGN's commitments today.

In 1991, as an autonomous body, the Spanish Metrology Centre assumed the competences in calibration and metrological control which had been undertaken by the IGN until then.

In 1989, through the Law of General State Budgets, the National Centre of Geographic Information (CNIG, by its initials in Spanish) was created. It was an autonomous body attached to the IGN and responsible for the commercialisation of its products and for attending the ever-increasing demand. In 2008, the public dissemination policy regarding geographic information generated by the Directorate General of the National Geographic Institute was approved. This policy establishes the regulatory framework of the data policy.

2. Structure

The current structure of the Directorate General of the IGN is defined in Article 17 of the Spanish Royal Decree 645/2020 of 7 April, on the development of the basic organic structure of the Ministry of Transport, Mobility and Urban Agenda, being established as a governing body attached to the Sub-Secretariat of the Department and made up of the following bodies at the sub-directorate level:

- General Secretariat
- The General Sub-Directorate of Astronomy, Geophysics and Spatial Applications
- The General Sub-Directorate of Geodesy and Cartography
- The National Centre of Geographic Information (CNIG, by its initials in Spanish), an autonomous body attached to the General Directorate of the IGN.

In addition, there are a series of territorial units (organically dependent on the Ministry of the Presidency and for the Territorial Administrations) called Regional Services that are also dependent on the General Directorate of the IGN (through the CNIG). They are established in the different autonomous regions in the Government Delegations and their objective is to improve the knowledge of the territory and raise awareness among citizens about the functions of the IGN and CNIG.

Currently, there are Regional Services in Andalusia (Seville), Aragón (Zaragoza), Asturias (Oviedo), Cantabria-Basque Country (Santander), Castilla-La Mancha (Toledo), Castilla y León (Valladolid), Catalonia (Barcelona), the Region of Valencia (Valencia), Extremadura (Badajoz), Galicia (A Coruña), Murcia (Murcia), and La Rioja-Navarra (Logroño). The Geophysics Centre of the Canary Islands carries out the same functions as a Regional Service; and the Regional Service of Catalonia extends its scope to the Balearic Islands.

3. Organisational chart

The following functions correspond to the General Director of the National Geographic Institute:

- The presidency of the autonomous body The National Centre of Geographic Information (CNIG)
- The vice-presidency of the Geographic High Council and the presidency of its Permanent Commission and its Territorial Commission
- The vice-presidency of the Spanish Geodesy and Geophysics Commission
- The presidency (alternating with the president of the CSIC) of the National Commission of Astronomy
- The presidency of the Permanent Commission on Seismic Resistance Norms, under the terms established in their respective regulatory norms

4. Functions of the National Geographic Institute

The functions and competencies assigned to the General Directorate of the IGN, in accordance with the afore-mentioned Article 17, are as follows:

- **The planning and scientific exploitation of the astronomic instrumentation and infrastructures** and the conservation of the heritage of the National Astronomical Observatory (OAN)

Royal Observatory (Retiro Park)

- The technological development and operational management of its own instrumentation and infrastructures for **radioastronomy, spatial geodesy and geodynamics,** enabling it to operate as a unique technical scientific installation

- The planning and management of systems for detecting and communicating to the institutions **seismic movements** occurring in the territory and their possible effects on the coasts, and the elaboration of studies on seismicity and the coordination of seismic resistance norms, which is the responsibility of The National Seismic Network (RSN) distributed across the whole of Spain's territory

Control room of the National Seismic Network in Madrid

- The planning and management of systems for surveilling and communicating to the institutions **volcanic activity** in the Spanish territory and determining the associated risks, together with the management of observation systems of geodynamics, geophysics, volcanology, gravimetry and geomagnetism and the elaboration of studies related to the responsibility of the Central Geophysics Observatory

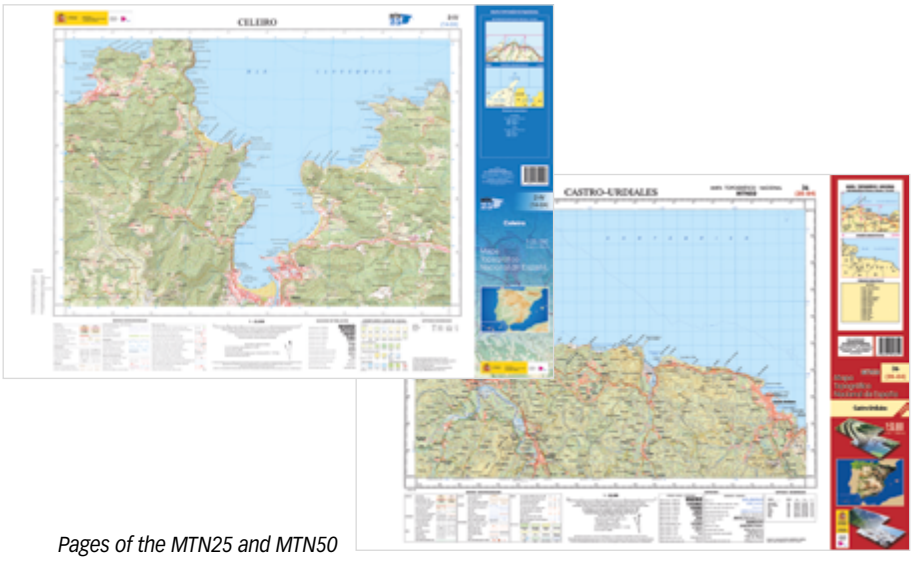
- The planning and management of the national active and passive geodetic networks, the high precision levelling network and the tide gauge network which make up the framework and the Geodetic Reference System, the exploitation and analysis of geodesic observations, the development of applications for navigation and positioning systems and the elaboration of geodynamic studies

- The direction and development of the national plans of territorial observation with cartographic application, and the use of photogrametry and remote sensing systems and the production, updating and exploitation of digital terrain models based on aerospatial images

25cm-resolution PNOA orthophotograph of the city of Logroño and surroundings

- The production, updating and use of the **databases** of the topographic aspects of the Geographic Reference Information considered in Annex I of Law 14/2010, of 5 July on infrastructures and Geographic Information Services in Spain on digital elevation models, transport networks and infrastructures, hydrographic elements, the geographic location and geometric shape of the population entities, the description of the surface of the terrain through georeferenced images obtained with satellites or aerotransported sensors and land cover

- The programming of the **National Cartographic Plan** and the production, updating and exploitation of the **Topographic and Cartographic databases** on a national level for their integration in geographic information systems and for the creation of the National Topographic Map and other basic and derived cartography



Pages of the MTN25 and MTN50

- The elaboration and updating **of the National Atlas of Spain (ANE)** which offers a synthetic and explanatory view of Spanish geography and of the organisation and dynamics of the national territory in all of its aspects

  The production and updating of the themed cartography that supports the specific action programmes of the State Administration

National Atlas of Spain

- Technical and operational support of the National Cartographic System, particularly the National Geographic Reference Equipment through the management of the **Central Mapping Register**, the formation and conservation of the National Geographic Nomenclature and the official toponymy and the expert's report on jurisdictional demarcation

- The preservation and updating of the bibliographic collections, historical cartographic and technical documentation and the archive of georeferenced legal information and the collection of instruments, facilitating its accessibility to the public

- The provision of **technical assistance** in cartography to other public bodies

- The management of the laboratories and cartographic workshops

5. Production and dissemination of geographical information

The IGN generates and maintains a large volume of geographic information, including data that are reflected in the national cartographic series and databases, in aerial orthophotographs and satellite orthoimages and in aerial photograms such as the initial documents of the orthophotographic and cartographic production and updating processes. These series, in digital format, constitute the majority of the continuous and complete geographical reference information for the whole of Spain.

The Geographic High Council is the governing body of the National Cartographic System. Its functions include consultancy and the planning of geographic information and the official cartography. It has the capacity to establish the requisites and suitable technical specifications or approval criteria which all of the official cartographic production should meet; the direction, control and reinforcement of the development of the infrastructure of geographic information; the authorisation of production other than that assigned in the National Cartographic System and the arbitration of possible conflicts between the members of the System, with significant participation of the Autonomous Regions.

The **General Secretariat** of the IGN encompasses all of the aspects involved in the organisational management: economic and budgetary management; recruitment; personnel administration; legal regime; provisions and standards; internal regime; maintenance of the facilities; IT systems; institutional relations; etc.

Furthermore, the General Secretariat of the IGN is responsible for the creation and preservation of the Central Mapping Register and of the National Geographic Nomenclature and the official toponymy.

Similarly, it also carries out the technical functions relating to jurisdictional demarcation and the establishment of boundaries between municipalities; and it is also responsible for the preservation and updating of the bibliographic collections, historical cartographic and technical documentation, facilitating its accessibility to the public.

6. Human, financial and material resources

Personnel

The personnel of the IGN-CNIG is organised into three large groups: the people working in Central Services, those in its Peripheral Services (Astronomic and Geophysical Observatories, dependent on Central Services) and those who work in Regional Services, forming part of the Government Delegations, which functionally depend on the IGN through the CNIG.

Internship programme

The National Geographic Institute (IGN) develops an internship programme for training in areas of knowledge related to the functions that are within its powers. This programme responds to the need to fulfil the specialisation requirements in Earth and Universe

Sciences which the IGN currently demands but cannot completely satisfy with the University Centres.

The intern positions are classified by scientific field and their objectives are defined depending on the area of knowledge to which they belong.

Material resources

The IGN has a solid infrastructure of technical equipment and facilities which efficiently fulfil their service to society. These facilities, in many cases, are state-of-the-art in terms of their technological development or have a high historical value.

Head office

The head office of the National Geographic Institute is located at Number 3, calle General Ibáñez de Ibero, in Madrid. It has seven buildings and covers a constructed area of 25,760.97 m^2. The activities of the units of the General Sub-directorates are carried out in these buildings as are those of the General Directorate and the National Centre of Geographic Information.

The building, designed by the architect Pedro Mathet, was created and inaugurated during the reign of Alfonso XIII and has a high historical value. It was declared an asset of cultural interest under the monument category by Royal Decree 68/1992 of 24 January.

Astronomical observatories

The IGN has several astronomical observatories. The most emblematic is the Royal Observatory of Madrid in the Retiro Park (calle Alfonso XII, 3) which houses the headquarters of the National Astronomical Observatory and that of the Central Geophysics Observatory and is made up of eleven buildings with a total area of 27,382.06 m^2.

13.2 m radiotelescope and the 40m radiotelescope behind it

The oldest of these buildings, designed by the architect Juan de Villanueva at the end of the eighteenth century, is one of the most interesting examples of Spanish neoclassical architecture and was declared an asset of cultural interest under the monument category by the Royal Decree 764/1995 of 5 May.

It has an observation centre in Calar Alto (Almería) and an IGN Centre of Technological Developments in the Observatory of Yebes (Guadalajara) which currently houses two radiotelescopes of 40m and 13.2m.

Network of Geophysical Observatories

The IGN has an extensive network of Geophysical Observatories, thanks to which it carries out the important tasks of observing the geomagnetic field, surveilling seismic and volcanic risks and conserving and digitising geophysical data.

It also has an extensive network of geomagneitc signals, GPS Stations, VSAT and analogical seismic stations and many accelerograph network stations and other facilities and technical equipment.

Regional Services

Although the Regional Services of the IGN are organisationally affiliated to the Government Delegations, the Ministry of the Presidency and Territorial Administrations, they are also functionally affiliated to the Ministry of Transport, Mobility and Urban Agenda.

Casas de Mapa and points of sale

The CNIG has a network of Casas de Mapa (Map houses) and points of sale in the provincial capitals in its own facilities, those of the Regional Services or Provincial Units of the IGN and in delegations and sub-delegations of the government or occasionally in the headquarters of other institutions by agreement.

National Geographic Institute and Casa del Mapa 2020

International activity

Relations with other institutions are fundamental and indispensable and have an increasing strategic value. They are carried out through courses, agreements or the participation in international or national organisations and projects.

The IGN-CNIG participates in the following international institutions, as a full member or as an observer or collaborator:

- European Environment Agency (EEA)
- The European Environment Information and Observation Network (EIONET)
- The Association of Geographic Information Laboratories for Europe (AGILE)
- Regional Centre for Seismology for South America (CERESIS)
- European Mediterranean Seismological Centre (EMSC)
- INSPIRE committee of the European Union
- The European Research Infrastructure Consortium "Joint Institute for VLBI" (JIV-ERIC)
- COPERNICUS European programme
- EUMETNET (European National Meteorological Services Network)
- EUREF-IGS (International Service GNSS)
- EuroGeographics
- EuroSDR
- The Atacama Large Millimeter/Submillimeter Array (ALMA)
- The Pan American Institute of Geography and History (PAIGH)
- Millimetric Radioastronomical Institute (IRAM)
- International Cartographic Association (ICA)
- International Geographical Unión (UGI)
- ISO and AENOR
- United Nations
- OGC (Open Geospatial Consortium)

Army Geographic Centre
80 Years of Military Cartography serving the army

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1. Presentation (Emilio Cortés Narváez)

The disciplines dedicated to the study and representation of the earth's surface have not been exempt from the revolution that has taken place in the field of information and telecommunication technologies. This has given rise to a meteoric development of satellite techniques for observing the earth and global positioning (GNSS). Therefore, the traditional terms used in this field, such as "cartography", "topography" or "geographic support" have given way to others such as "geospatial information" or "geomatics", in which these technological advances are implicit.

The modern weapons systems and information systems for command and control used by the Spanish Army require geographical information in standardised digital formats: this has given rise to changes in the processes carried out in the Geographic Centre, traditionally designed to obtain a final product on paper.

Another aspect that has influenced the evolution of the Centre has been the growing participation of our forces in international missions. In fact, since the Spanish Army began its trajectory in foreign operations, the need for quality and timely geographical information of these zones has gained weight with respect to the efforts dedicated to the cartography of the national territory. This has led to the gradual incorporation of Spain's Armed Forces into different co-produced multinational geospatial information projects (VMAP, MGCP, TREX programmes, etc,), as a fundamental procedure for obtaining this information.

The Cartographic Plan of the Armed Forces assigns the generation of geospatial information corresponding to areas of the world that are of interest for Spain's national defence to the Army Geographic Centre. The work relating to the Training Facilities and Manoeuvre and Firing Ranges is also highly important. In addition, the Centre also remains responsible for developing the mapping of the national territory, mainly related to the NATO series, although at large scales (1:50.000 and 1:100.000). It has been necessary to adapt the production to map sheets of special interest, namely areas subject to frequent movements or deployments of the units.

Current coat of arms of the Army Geographic Centre. On an azure field, a silver star, in the centre a polar ice cap tilting towards the right in gold with its geographical lines represented by swords, fringed with two laurel branches with berries, joined at their stems and tied with a golden ribbon. The azure field and the five-pointed star refer to the fact that the Centre used to form part of the Estado Mayor *(Defence Staff). The cap is a globe element that represents the primary function of the Centre.*

On the other hand, it should be pointed out that there is a deployable geographic unit that forms part of the Geographic Centre. Since its creation in 2002, on several occasions the Army Geographic Unit (UGET, by its initials in Spanish) has participated in operations abroad, usually supporting units that are undertaking exercises of a mostly multinational nature. It is made up of different shelters, equipped with modern means for capturing, analysing and printing data and based on a modular concept, which allows the support to be adapted to the real needs of the units.

Another important aspect is related to the Military Geographic Information System (SIGMIL in Spanish) and the *Carta Digital* (Digital Chart), two software developments for managing geospatial information which were created more than a decade ago by the Geographic Centre. SIGMIL currently constitutes the geographic manager of the principal information systems for the command and control of the Spanish Army. Meanwhile, *Carta Digital* is the geographic information system used extensively by our units in the national territory and in operation zones. The intention of the Centre is to carry out a comprehensive update of *Carta Digital*, so that it may continue to be the geographic information system of reference. All military personnel are able to freely download it from the intranet.

But the Geographic Centre has another wide range of tasks assigned to it, which constitute an important part of its activity: the editing, printing and binding of military publications; video filming and photography and its subsequent edition and reproduction; the demarcation of the border with France and Portugal, a mission in which the Geographic Centre reports to the Commission on the Limits of the Ministry of Foreign Affairs and Cooperation; the making the military identity cards; and we should not forget the work carried out by the Cartographic and Geographical Studies Archive, responsible for preserving and disseminating an abundant cartographic legacy and historical geographical documents.

Important steps have been taken recently with respect to the delicate issue of the personnel and their training, such as the creation of the course in Geospatial Information Production for non-commissioned officers. It should be noted that the course is given by the Department of Geospatial Information of the Army War College, whose prestige and the high quality of its teaching staff ensure excellent results.

Graphic arts positions

I will conclude this brief introduction by saying that those of us who make up the Centre firmly believe that continuing as an efficient and versatile tool in the hands of the command, together with the support of our Army and being integrated in the Army Information, Telecommunications and Technical Assistance Systems Headquarters, will ensure a promising future for the Army Geographic Centre, precisely in the year that we are celebrating 80 years[1] of serving in the ranks of the Spanish Army.

2. The geographic information headquarters (JIG) the soul of the CEGET (José Luis Sánchez Tello)

The CEGET carries out a wide range of tasks, but undoubtedly its raison d'être is the production of geospatial information (hereafter, *geoinfo*). The JIG is responsible for accomplishing this mission and therefore has highly specialised personnel distributed across the "Cartographic", "Digital Products, MGCP and Database" and the Army Geographic Unit "UGET" departments.

1 This presentation was written in 2019.

2.1. The need for timely and precise geospatial information

The development of the operations requires quality *geoinfo* in a timely manner, which means that the data must be the most up-to-date with the highest possible geographic accuracy and thematic precision, produced in the least time possible and even prepared in advance. Greater precision and exactness require longer production times while products created at a faster speed must sacrifice their quality to a certain degree.

Taking these characteristics into account, the products that the JIG produces can be classified into "standardised series" and "products on request".

2.1.1 Standardised series

This concept refers to cartographic series at different scales of the national territory or other areas of interest for National Defence, which are produced regularly and periodically and are reflected in the Armed Forces Cartographic Plan. They have a standardised format which is adapted to the STANAG that the Armed Forces have subscribed to and to the national cartographic tradition.

The cartography of the national territory includes the series of Manoeuvre and Firing Ranges (CMT, in Spanish), principally composed of topographic maps at a scale of 1:25.000 (hereafter, *25K*) - although there is also a 1:50.000 scale (hereafter, *50K*), two 1:10.000 (hereafter,*10K*) of the CENAD San Gregorio and two 10K of the CMT Alijares - and other maps in which the military layer is placed over a high resolution orthophoto at different scales depending on the area of the field.

Series M7815 (Spanish Peninsula and Balearic Islands), P736 (Ceuta and Melilla) and M713 (Canary Islands) at a *50K scale*, better known as the *L series*.

Series M682 (Spanish Peninsula and Balearic Islands) and P613 (Canary Islands) at a scale of 1:100.000 (hereafter,*100K*), better known as the *C series*.

Series 1501-G at a scale of 1:250.000 (hereafter *250K*).

Series 1404 at a scale of 1:500.000 (hereafter, *500K*).

Military Road Map at a scale of 1:400.000.

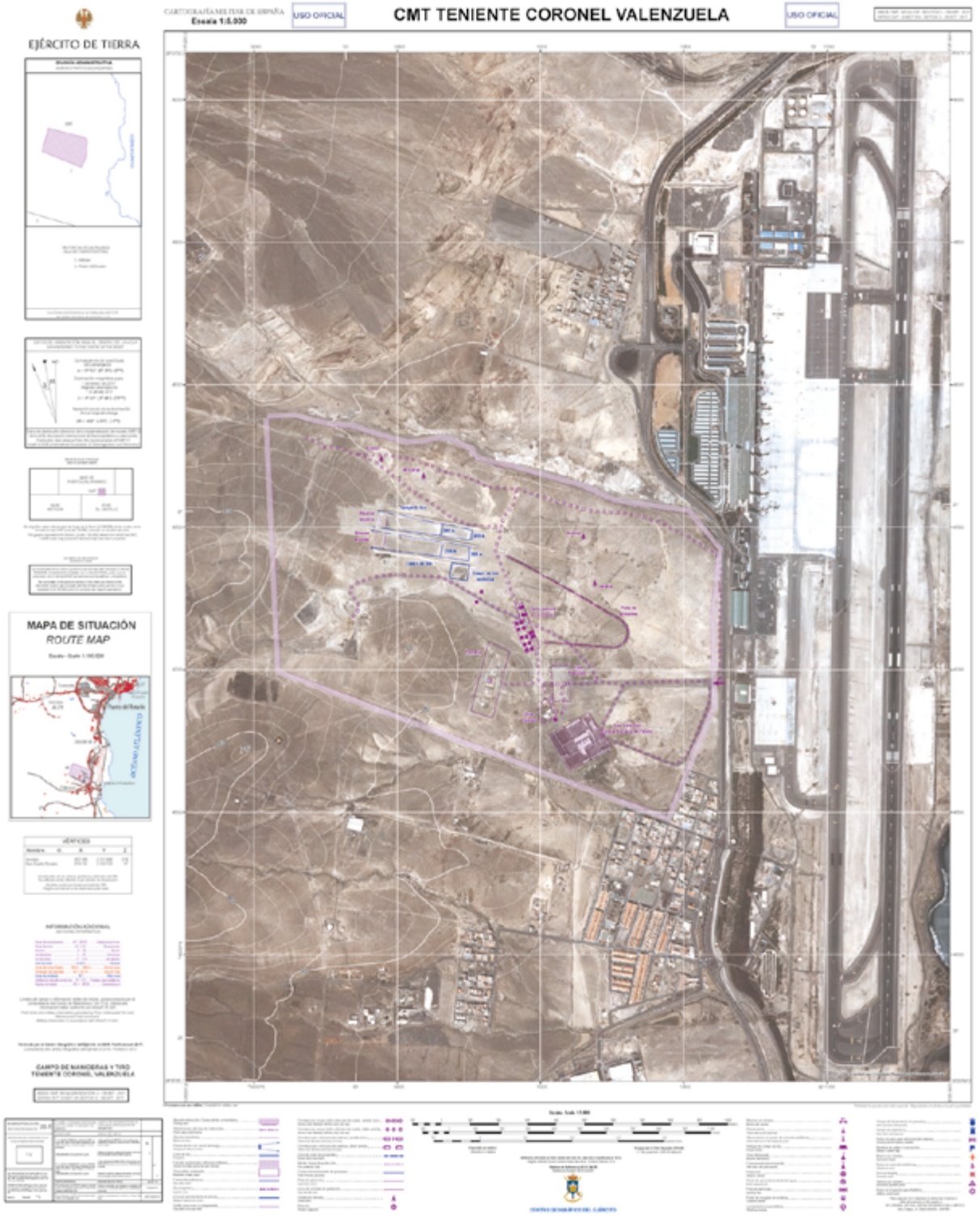
General Map of Spain at a scale of 1:1.000.000 (hereafter, *1M*) and 1:1.500.000.

There are some other cartographic products that do not belong to any of these series but are elaborated following the standards of some of them, these are classified as the "special series". They include, for example, 10K maps of Ceuta and Melilla or 25K maps of Tremp (General Basic Non-Commissioned Officers Academy), versions of the 10K of San Gregorio without planimetry or toponimetry or cartographic products at different scales of fictitious scenarios.

The mapping of operation zones and other areas of interest for National Defence is also carried out. The mapping of the series P737G, G727G (NAF) and G725G (Senegal) at a scale of 50K, and the series 1501-G (NAF) at a scale of 250K has also been elaborated.

Furthermore, a large number of "Image City Maps" (ICM) have been produced. These are maps of cities around the world based on a high resolution orthoimage (usually satellite) with a basic vector overlay superimposed.

This type of production of standardised series constitutes the basis of the JIG's production, involving the majority of the human and material resources.



Orthophomap of the CMT series

2.1.2. Products on request

When the standardised cartography is not sufficient to cover the needs due to the requirement of a more specific or updated type of product or one with a different format to paper, the JIG generates an *ad hoc* digital or printable product.

There is an endless number of possible products that constitute examples of the cartographic series for *Carta Digital* (including raster data at different scales and orthoimages, digital elevation model (hereafter, DEM) with different resolutions, vector data from different sources…); cartographic plots or orthoimages at different scales and sizes with or without superimposed additional information; digital, vector or DEM raster files in different formats, etc., all of both the national and international territories.

2.2. Co-production, anticipating needs

The multinational peacekeeping missions in which NATO and other organisations are involved mean that the exchange of *geoinfo* has become a fundamental tool for planning these missions. It was soon realised that the existing cartography and databases had grown obsolete, elaborated at small scales and even in other languages and alphabets (Arabic, Cyrillic…).

The need arose to create *geoinfo* databases with global coverage and a single data model (interoperable) and as up-to-date as possible. This task, which is too ambitious for just one nation, was undertaken as a co-production programme by a series of allied countries, with the development of the VMap project (vector map), with which global coverage was obtained on two levels: "VMap 0" for a scale equivalent to 1M and "VMap 1" for 250K. The Defence Geospatial Information Working Group (hereafter, *DGIWG*) provided outstanding technical support in this project. This is an international group operating in the field of defence, dedicated to establishing geographical standards, among other tasks, and in which the CEGNET represents Spain.

2.2.1. Multinational Geospatial Coproduction Program *(MGCP)*

Some years later, it was decided to initiate another even more ambitious project that would provide the *geoinfo* in vector format at a scale equivalent to 100K or 50K, based on high resolution satellite images, so as to produce an updated, large-scale cartography for the detailed planning of operations.

The project arose from the need detected by the USA to create a current geographical database (planimetry) of the hot spots around the world. Thirty-one countries are subscribed to the programme within a collaborative environment in which all of the members participate to establish the technical requirements, modifying them according to current needs and seeking to anticipate future needs. Spain joined the project in 2007 and since then it has been one of the "leader nations" of the programme with a production of 301 cells (each cell corresponds to 1º latitude by 1º longitude, approximately a 100 km-sided square). Being a leader nation enables it to access all the *geoinfo* produced by all of the members. The objective of the CEGET is to maintain an annual production of between 25 and 30 cells either digitalising new ones or updating the existing ones.

2.2.2. Multinational TanDEM-X High Resolution Elevation Data Exchange Program (*TREx*)

Complementing the MGCP, the objective of this programme is to obtain a global homogeneous digital elevation model with a resolution of 12 metres (altimetry) based on the acquisition of RADAR data from two satellites.

The task of the participating countries is to process the raw elevation data obtained from the radar images of the satellites in order to correct the deficiencies derived from the data gathering procedure, and finally to carry out a quality control for their validation.

A total of 32 countries participate in the project, which is led by Germany and the USA. It is currently in the initial phase, in which the member countries are obtaining the necessary certifications to initiate production. Spain is expected to produce 204 cells of 1º x 1º in five years.

Both projects, MGCP and TREx, must pass an international quality control before the cells produced can be validated. This means that another country other than the producer must grant the final validation. In the case of the MGCP, Spain not only produces cells but also validates those of other countries.

2.3. Interoperability with NATO and other multinational organisations

As a full member of NATO, Spain is obliged to fulfil the standards imposed with respect to the production of *geoinfo*. The information that the interchangeable national cartography should contain is defined within NATO and based on bilateral agreements between nations (Memorandum of Understanding - MoU).

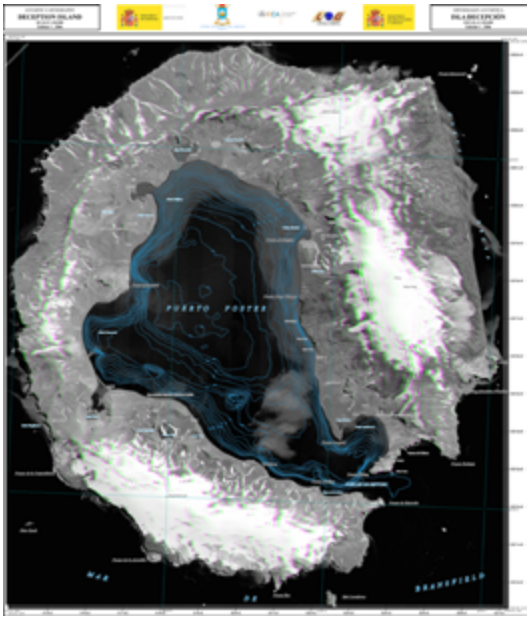
2.3.1. New data models

Recently, the allied nations agreed to take the MGCP data model as an exchange standard of *geoinfo* in vector format for scales of 50K and 100K. In order to continue the standardisation of exchange, the DGIWG has undertaken the task of defining the "NATO Geospatial Information Framework" (*NGIF*), a reference framework that provides the broadest possible common data model for all scales.

Currently, agreements are being reached to define single data models for the smallest scales such as 250K and 500K (the "VMap 1" and "VMap 0" libraries are out-of-date) based on the MGCP, so that there is a direct relationship between all of the scales. Furthermore, models for the cartographic maps of urbanised areas "Urban Map" will be elaborated (at larger scales) and for small scales such as 1M. All of these agreements are ratified on the NATO level in the "Geospatial Requirements Working Group" (GRWG).

2.3.2. New appearance of the cartography

For ISAF, the production of paper cartography was agreed at a scale of 50K based on the vector data of the MGCP. Given that each participating nation in this mission had its own regulations with respect to the system of symbols to use in military cartography in the distribution of the marginal information of the maps, etc., it was agreed to produce the



Satellite image of Deception Island, Antarctic

cartography according to the American army model (TLM). The CEGET elaborated and printed 56 sheets of the province of Badghis in Afghanistan. The whole of the product was conducted in collaboration with the Istituto Geografico Militare italiano.

After the use of the American TLM format, the MGCP Derived Graphic (MDG) was defined which has been used in recent years. Its definitive standardisation gave rise to the MGCP Topographic Map (hereafter, MTM), which is the format recently agreed in the meetings of the DGIWG for cartography at a scale of 50K, derived from the data of the MGCP, which will enable all of the armies to prepare with the same type of maps (Fighting off the same map). There is also work being done to define a single format for cartography at a scale of 250K which is expected to be completed in 2018 and will be called Joint Operation Graphic (JOG) and replace the format used until now with the same name. The next steps will be the publication formats of the scales 500K and smaller and the Urban Maps.

The three first 50K MTM sheets were produced in 2017 and the work flows were modified so that production after 2018 was based on this new format. Until 2017, the eight first 250K sheets outside of the national territory were elaborated with the above-mentioned JOG format. The change to the new JOG format is expected as soon as it is approved, both for the 1401-G series and the NAF.

2.3.3. National cartography, the dilemma

It should be noted that each change in the data model, map format, etc., involves extra work with respect to defining the production flows, training the JIG personnel and implementing these flows. Usually, it also involves changes in software, the evolution and development of the existing software, etc.

This has led to the decision to initiate an adaptation process of all the national and foreign standardised cartographic products to the new agreed formats. This change began with the CMT and L series of which the first digitalised sheets using the MGCP data model are in the field training phase. It will be published in MTM format which will enable the final users

to get used to using it and it will be an advantage in the case of having to use cartography derived from exchanges. The next step will be to change the data model and the publication format of the 1501-G series and smaller, something that will not be undertaken until the corresponding standards are perfectly defined and approved.

2.4. And furthermore

Collaborations are carried out with, among others, the National Geographical Institute, the Higher Technical School of Engineers in Topography, Geodesy and Cartography of the Polytechnic University of Madrid, the Geospatial Information Department of the Army War College and as many civil or military institutions as required.

2.4.1. Access to the data

The *geoinfo* produced in the GECET and that received from other organisations is stored in different digital formats. A database is used to do this, which is backed up through security copies that can be accessed from different servers. Geospatial data can be managed with the corresponding tools that enable spatial, thematic, etc. searches to be made. This requires a cataloguing which facilitates the searches, as the volume of data is very large.

Some of the cartographic data of the national territory can be downloaded through the Army intranet, but the majority of them are distributed on the request of the units. The Central Body is developing the Web Map Service (WMS) that will enable the access and downloading of all of this information through the intranet, with permission granted to the users in accordance with the criteria that are established.

2.4.2. Work on border demarcation

We must not forget the work on land border demarcation that the JIG carries out, supporting the "Commission on the Limits with France and Portugal" of the Ministry of Foreign Affairs and Cooperation. This includes both the annual field work comprising high precision topographic measurement and the desk research on Border Agreements and the resolution of any incidences that may arise and require the technical report of the CEGET.

2.5. Conclusions

The main responsibility of the JIG, which accounts for the largest workload and implies the highest number of staff, is the production of standardised cartography, although it performs many other tasks and elaborates many other products. In terms of the volume of tasks, those carried out on request are the most numerous despite only being briefly referred to in this article. All of the high-precision topographic support within the Spanish Army, and even some at the Central Body level, are carried out by the UGET.

Keeping ahead means the constant updating of the training of the personnel, their attendance at national and international meetings in working groups of organisations as different as NATO, Eurocorps, MGCP, TREx, the Infrastructure of Spatial Data or the Mixed Demarcation Commissions.

3. Army geographic unit (UGET) the deployable geographic force of the spanish army (Francisco Javier Capellá Cuesta)

3.1 Introduction:

The missions assigned to the Army in joint or specific and national or combined operations, in response to crises and emergency situations, involve the deployment of forces in a very short space of time in any part of the world.

Being able to access reliable, updated geospatial information provided in a timely manner and to any geographical location in the world for the development of military operations is a critical resource to which the Armed Forces must give priority.

The Army must have the capacities, organisation, structure and personnel and material resources necessary to respond efficiently to the geospatial information requirements of the Units, without depending on external bodies that condition their operational capacities.

The Spanish Army has the Army Geographic Centre (CEGET), whose structure enables it to efficiently materialise these requirements, focusing the resources to ensure the compliance with the principles of flexibility, simplicity and economy of resources.

The mission of the CEGET is to provide all of the military users with the geospatial information necessary for the planning and management of military operations and, therefore, it is the principal element of Geographic Support. On the other hand, the CEGET advises the current and future operations about the national responsibilities with respect to geospatial information.

3.2. Geographic support in the Army

The Geographic Support in the Army is organised on different levels, in accordance with the capacities and scope of action. It is structured into: General Geographic Support, Specialised Geographic Support and Organic Geographic Support.

The General Geographic Support is provided by CEGET to the different Army Units on an operational level. As the General Support Body of the CEGET it is responsible for the geographical support in the planning and directing of operations, providing the military users with the necessary and timely geospatial information. It is the primary centre for the acquisition, management and production of geospatial information in the interest of the land units. It includes the highest number of activities and the greatest potential given that the CEGET is the highest level unit of the Army and where the greatest GEO capacities are found. In addition to the production of geospatial information, this support also includes quality assurance, the instruction of the GEO personnel, geodetic and topographic studies, high-level GEO consultancy and studies aimed at research, development and innovation. This support is embodied, among other documents, in the Armed Forces Cartographic Plan.

The General Geographic Support is provided by CEGET to the different Army Units on a tactical level. It is materialised with GEO support directly provided by the CEGET to the units deployed in operations and exercises through its Army Geographic Unit and/or reinforcing the GEO Organic Elements of the Units.

The Organic Geographic Support is undertaken by the GEO Cells or Elements of the General Headquarters of the large units and of the Organisations for which it is determined this support is necessary.

Exercise in national territory

3.3. Organic composition of the UGET:

The UGET is made up of:

- Command. Chief of the UGET and principal advisor in geospatial material of the Command on which the Unit depends.

- PLMS. Responsible for the maintenance and logistics support of the UGET, including the supply of specific consumables of the Unit. There is a warehouse shelter for this type of material.

- Geographic Information Section. Responsible for obtaining, managing and analysing geospatial data and for generating digital products with this information.

- Production Section. Responsible for the small-scale printing of the cartographic products, both those generated by the analysis teams and those previously available. It is also responsible for the storage and distribution of the products printed in the section and for the cartography elaborated for the national territory. It has the capacity to assemble cartographic distribution depots either on a theatre of operations level (*TMD - Theatre Map Depot*) or on a forward mobile distribution level (*FMDP - Forward Map Distribution Point*).

3.4. Structure and capacities

The UGET, as a projectable element of the CEGET, is conceived in a modular way and therefore the way it is used can be adapted to the different needs of the Unit and to where support is required.

The structure of the UGET provides it with the following capacities: support to high availability operational structures, cooperation or action in multinational frameworks, deployment in operations, provision of additional GEO support and adaptation to the mission and at the correct level.

The Specialised Support that can be provided by the UGET is embodied in the development of the following functions: consultancy, instruction of personnel, obtaining high-precision coordinates (topographic surveys and stakeouts), establishment, maintenance and extension of geodetic and topographic networks, obtaining, producing and disseminating geospatial data in raster, vector or digital elevation model formats, terrain analysis, geographic data management (updating of the local geographic database on a tactical level), management and maintenance of its tactical GEO database, limited cartographic print run, dissemination of geospatial information in paper or digital formats, establishing two cartographic distribution depots on a theatre of operations level or through forward distribution, etc.

The cartographic drone during the launch phase

3.5. Participation in operations and exercises

Since the decision was made to create the UGET, even when it was still the embryo of what it would later become, the Unit has participated in all types of national and international exercises and peacekeeping operations, supporting the Army Units and even the Emergency Military Unit (UME, in Spanish).

It has participated in the Libre Hidalgo PKO (Lebanon) and the A/R Operation (Afghanistan).

Its officials participate in the meetings of the Expert Groups on a GEO level in different multinational organisations: NATO, Eurocorps and the European Union.

Of the multinational exercises in which it has participated we can highlight those supporting the NRDC SP, Eurocorps, *Battle Group* of the European Union, MN GSG (*MultiNational Geospatial Support Group*) among many more.

It has taken part in a large number of national exercises, among which it is worth mentioning the support given to the Artillery Academy, EMMOE, Engineering Training Schools (EPING), Field Artillery Schools, UME, among others.

3.6. Current situation

The UGET is principally made up of personnel from the Geodesy Department of the Geographic Information Headquarters of the CEGET, carrying out the activities of these Headquarters on a daily basis and supporting it when it participates in exercises and operations. In addition, it also participates with several multinational organisations as the Spanish Army lends its services to NATO, Eurocorps, the European Union and the recently created MN GSG (*MultiNational Geospatial Support Group*).

3.7. Looking to the future

The speed with which the scenarios and characteristics of the crisis situations change make it vitally important to have a flexible and agile structure and procedures in order to respond in a timely and adequate manner. It is essential that the UGET maintains its modular structure and that if is perfectly instructed in the most adequate tasks and procedures to respond to the geographic information needs that may arise in any of the agents requesting this information.

We should not forget that the digital world is evolving very quickly and for this reason everything related to it advances in the same way. Several examples of these advances are the cartographic RPAS that the Unit has at its disposal, the new laser scanning systems that are on the market (enabling the 3D mapping of a specific area and also 360º images), radar images (satellite or aerial), mobile devices for topographic studies and a long list of many others to which we have to add the most important factor which is what is yet to come in a maybe not so distant future. Being anchored in conformism or self-complacency can lead to losing touch with new IT programs, new sensors that act on everything that surrounds us (aerial, land, spatial, motorised, etc.) and, in general new capacities that will generate a more efficient support to the military units.

But these technological advances are only the tip of the iceberg. In recent years, the different international working groups have revealed that it is essential to work in a coordinated way with other countries and organisations. This also applies to other fields of Defence (intelligence, security, force generation, etc.), but is even more paramount in the production of Geographic Information.

An example of this is the creation and implementation of different geospatial support groups, as previously mentioned, in which members of the UGET participate actively and collaboratively. Participating in these groups involves a considerable work load as it entails preparing and attending many international meetings and the participation and involvement of material and human resources in many exercises and manoeuvres which have the objective of ensuring the cohesion and coordination of different capacities. But we should note the the result of this effort is highly positive as it enables Spain to participate with its allies in high-level decision-making and always with the objective of obtaining the best geographic information to support the Army units. We also receive, in return, a great amount of knowledge and procedures that lead to the improved productivity of the CEGET, and therefore, the quality of the products served to and requested by the Units.

All of these challenges oblige us to have a very strict instruction methodology and permanent commitment to improving the instruction in geodetic apparatus, software and new technologies. Having personnel trained in the new receptors and apparatus that are emerging and keeping up-to-date with the latest software version is a necessity and permanent concern. The incorporation of new personnel into the Unit means that this instruction is even more important, as the compendium of material that they must have a knowledge of is very large (topography, office automation, geodesy, Geographical Information Systems, operation of the apparatus) and it is rare for the personnel to have prior training in these aspects.

All new technology, latest generation apparatus and new IT programs are completely useless if the personnel are not well trained, motivated, with a vocation of service and with the only objective of ensuring that the Spanish army units are able to execute their mission in the most efficient way possible.

4. Carta ditigal, the GIS supporting small units

(Carlos Borrallo Corisco)

4.1. Origins

Carta Digital came into being in 1994. In that year, the military operations research office developed "*Carta Digital de España-SICOM v 3.0*" conceived as an advanced digital geographic information viewer. In 1997, the then Army Geographic Service (now the Army Geographic Centre) took over the development and even the dissemination with its own digital geographic information.

It was soon realised that the development of a geographic information system cannot be carried out independently or isolated from the other Armed Forces. Therefore the work carried out was used to create IT libraries initially called the "SIGET Project" which later became the SIGMIL Project in 1999. This gave it a modular capacity that could be used by

many other military systems requiring geographic functions, such as the location on a military map.

From then, new SIGMIL functions began to be developed, often according to the requirements of the users and sometimes in accordance with the pace of technological advancement at each moment, with the greatest boom being between 2005 and 2008. In this period, the principal beneficiaries were the military command and control systems and their subsystems associated to arms control, intelligence, fleet tracking, communications, etc. It goes without saying that all of these new SIGMIL functions are at the disposal of the military users and the systems that they use.

4.2. What is a GIS?

A Geographic Information System (GIS) is a series of integrated tools (users, hardware, software, data and processes) that enable us to capture, store, manipulate, analyse and deploy, in all its forms, the information gathered from the real world that is related to a spatial reference (georeferenced) in order to resolve complex planning and management problems, helping us to make decision efficiently.

Carta Digital is a software component forming part of these tools from where it professionally responds to the needs of the users.

What *Carta Digital* is, the capacities that it offers and the benefits that it offers in this decision-making process is what we seek to explain in this article.

4.3. SIGMIL and *Carta Digital*

The SIGMIL project was referred to at the beginning of the article. Now we will explain what it is in more detail. It is a series of geographic functions developed by the Army Geographic Centre and grouped into different components. These components can be used on different platforms run on the Windows operating system, facilitating and simplifying the communication between the different processes that a computer performs internally during its operation, and also the communication between different machines.

This gives it a modular nature so that it can be used by different computers and military systems. Let's take and example: the CEFAMET helicopter simulator has a series of mechanical elements and software. This software, among other things, requires certain geographic functions, such as being able to upload cartography in different formats, obtaining coordinates for flight calculations or visualising the terrain in three dimensions. This is where SIGMIL intervenes, which provides all of these geographic possibilities. We could also refer to the BMS-Lince (*Battlefield Management System*) which uses SIGMIL to obtain the above-mentioned geographic capacities.

We can currently define the *Carta Digital* as the software component of a geographic information system that has been developed using all of the functions implemented by SIGMIL. Therefore, it can be installed in computers with different versions of the Windows operating system. This system is equally able to adapt to a user who requires advanced geographic information management functions or to provide the more basic and useful

functions for a military unit's day-to-day activities. It has its own information formats which enable it to be used internally by the Armed Forces and, if necessary, make it independent from commercial formats.

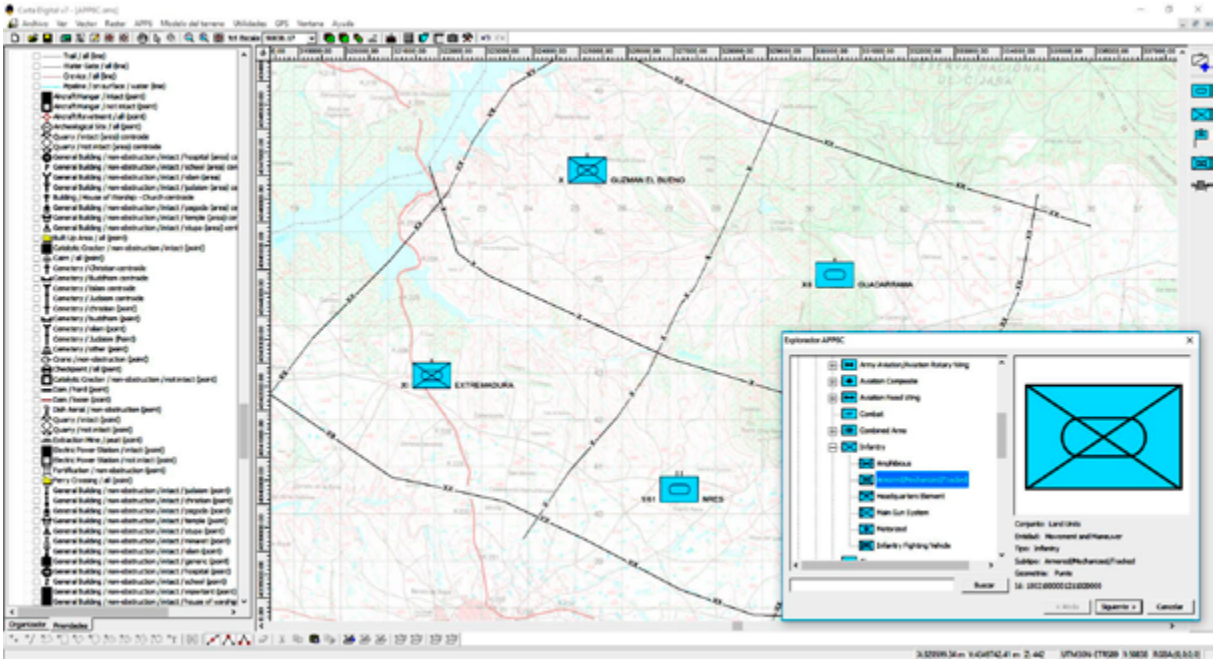
4.4. Desktop *Carta Digital* in the present

We live in a world in which it is very easy to access all types of digital geographic information (DGI) including that related to the Armed Forces, therefore there is an increasing number of users of *Carta Digital*. The efforts of the Army Geographic Centre have contributed to this by ensuring its free dissemination throughout the Armed Forces and by training personnel serving in its ranks throughout the whole of Spain.

A website has been made available to the military users on the Defence intranet with a wide range of geographic information, together with the *Carta Digital* software in desktop format and the mobile version for Android devices (this version of Android will be addressed later in the article). In addition to this content, an initiation course in the use of the *Carta Digital* has also been created, facilitated by the Geodesy Department of the Army War College.

In this intranet section, the latest available version of the desktop *Carta Digital*, currently 8.1, can be downloaded in a few seconds and installed on any computer. Together with this installation system the *Carta Digital* has also been launched via radio, so that those corporate groups registered in the group always have the latest version of the software available automatically.

All of these resources on the intranet enable any user to obtain the necessary tools to begin working with the geographic information. Now let us see what it can do.



APP-6C tool of the Carta Digital

4.5. Capacities of the *Carta Digital*

Every map, in the broad sense of the word, seeks to give a faithful representation of an area of the earth's surface at one scale or another. The information that we are used to seeing ranges from constructions to contour lines, including roads, bridges, electricity lines, water accumulations, etc. In order to manage all of these data in the *Carta Digital* it is necessary to store them in computerised form. There are different ways to store, generate and manage this information. We will look at the three that are of most interest for this article:

For storing maps or aerial images, a structure called **raster** is used. This stores the information in a similar way to a digital photograph. On the other hand, there is the **vector** information. In this case, an area is represented, displaying everything existing in the terrain in the form of simple geometric figures, that is, dots, lines and areas, and this is saved in a database. Finally, if we wish to store height data, we must use the **matrix** structure, which stores the height of a series of points of the terrain separated by the same distance between them.

Carta Digital enables this information to be shared with other users of the program and even other commercial applications as we shall see later.

The easiest and quickest way to distribute a map that we wish to visualise through *Carta Digital* is in raster format. This is similar to visualising a digital photograph or image on the screen of our computer. With this format, a map can be obtained without having a great knowledge of GIS. It is also possible to digitally cut or join several maps and if, for some reason, the computerised file does not contain the information about the coordinates, *Carta Digital* enables us to geographically reference it, that is, if we have a paper map, it can be scanned so that it can be used in *Carta Digital*. Although we are referring to a map, it is also possible to visualise and carry out the same above-mentioned operations with one or several images of the terrain that have been obtained through a satellite, plane or similar.

Carta Digital is able to connect to a type of web service through the WMS connection tool. This tool which can only be used with an Internet connection, enables us to visualise a wide range of raster information or even download it in order to subsequently use it if we are not going to have an Internet connection; the information referred to may not only be cartographic or satellite images; we can also visualise geological, land use, cadastre information, etc.

It is also possible to benefit from the functions of *Carta Digital* if the height of the terrain at each point is added. With this operation we can visualise the three dimensions, being able, in just one glance, to observe the most characteristic elements of the terrain that may be of military interest. This is achieved by moving through a 3D visualisation as if from a helicopter. The flight of a plane can also be reproduced, tracing the route in a graphic way on the viewer and choosing the flight height and speed, generating a video of this flight for its subsequent visualisation or dissemination by video.

The inclusion in our viewer of a digital model of the terrain (matrix) provides access to a series of relatively simple tools which are also highly useful from a military point of view, particularly for the elaboration of an INTE[2]; for example, a transparency of the viewed and occult areas from one or several observations.

2 Terrain-Enemy Integration

Use of Carta Digital in vehicles

In addition, an image of the slopes can be created that would provide information about the transitability of the terrain depending on the slopes that each type of vehicle is able to climb or simply to determine the harshness of the area if it is necessary to walk through it.

Carta Digital has tools to prepare routes. They prepared in the office and then exported to a format that a GPS is able to read and to other formats that mobile device applications can read with operating systems such as Android, iOS, etc.

This is a two-way function. In other words, if the "track" of a route that has previously been carried out with a GPS is known, it can be connected to the computer to import it to *Carta Digital* and make this information available on the computer.

If the device chosen to navigate is a small laptop with *Carta Digital* installed, we can receive the location through an integrated antenna in a PC or by connecting one through an USB port or by Bluetooth.

If, on the other hand, we want to browse with an Android device, the Geographic Centre has developed a browser for this platform. This browser interacts with desktop *Carta Digital* enabling the exchange of different data. The possibilities of this browser will be examined in a separate chapter.

When users begin to manage vector information, little by little, they discover the enormous analytical capacity that this GIS provides or the possibilities to create IGD.

This is the moment when a user can user *Carta Ditigal* to elaborate his or her own cartography. With these afore-mentioned points, lines and areas we can "draw" in two dimensions any object in the terrain, such as a wind generator, a swimming pool, a road, the floor of a building, etc. But as well as digitalising all of this information, we can also assign an infinite number of attributes, which are simply a series of properties of this element that is being registered.

With all of this information that is associated to these elements registered in *Carta Digital*, which we will call entities, it is possible to represent those that fulfil the criteria that are chosen on a map.

Another possibility is toponymy management with a search engine for cities, places or characteristic sites through their logical name. In other words, in the same way as in some GIS search engines the word "Madrid" is introduced and the viewer focuses on the capital; *Carta Digital* does the same.

From an exclusively military point of view, this application enables us to generate military deployments in order to visualise them in accordance with the geographic information that is uploaded in the viewer. These deployments are represented in accordance with the STANAG APP-6C. With this tool one or several deployments may be drawn and their properties modified. In each unit drawn, we can choose, among other things: the entity, specialisation, if it is a friend or enemy, etc., and *Carta Digital* will know which symbol to use to represent it.

Finally, we are aware of the large amount of IGD processing software on the market. This is why *Carta Digital* uses libraries called GDAL. These libraries give *Carta Digital* the capacity to read more than 150 different formats and to write in a large number of them. This means that today, *Carta Digital* is able to understand the IGD produced by any software on the market, bestowing it power of interaction with different commercial software and NATO software.

4.6. Capacities of *Carta Digital* for Android

Throughout the article we have referred to the capacity of *Carta Digital* to exchange information with mobile browsers and the existence of a browser developed by the Army Geographic Centre on the Android platform.

This new software has a similar browser to those that can be found on the market but with the advantage that its updating is performed in accordance with the needs of the military users.

Today, it is able to record our routes and interact with desktop *Carta Digital* enabling the transfer of the cartography elaborated in it to the mobile device as well as any route or point of interest elaborated in the office. This fills a gap that existed between the planning of missions and their execution in the terrain.

4.7. Future and conclusions

The Army Geographic Centre continues to look to the future. This future will include modernising *Carta Ditigal* which, although more than fulfils its functions, from a visual and structural point of view has become obsolete.

To do this, we are already working on the development of a new *Carta Digital* that contains all the current functions and the use of a new interface which has the potential of any current software.

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Spanish National Research Centre

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La Investigación Geográfica en el Consejo Superior de Investigaciones Científicas (Geographic Research at the Spanish National Research Centre) is the title of Dr. Mª Asunción Martín Lou's input to the contribution made by the Spanish Committee of the International Geographical Union (IGU) at the 27th IGU Congress which was held in Washington (Martín Lou, 1992). In her chapter, the author briefly summarises the historical evolution of the two institutes dedicated to Geography in the Spanish National Research Council (CSIC by its acronym in Spanish): the Juan Sebastián Elcano Institute, founded in 1940 at the same time as the creation of the CSIC itself and included in the Humanities Division; and the Institute of Applied Geography, created in 1967. This institute was a reconversion of a Department of the University of Zaragoza with the same name, and, after moving to Madrid it was incorporated into the Science Division. The two institutes merged in 1986, together with others from the economics and sociology fields and was given the name of the Institute of Economics and Applied Geography, which changed in 1990 to the Centre for Research on Economics, Society and the Environment. At that time, and in the words of its then director, Dr. Martín Lou, "Geography in the CSIC is experiencing its worst moment with respect to its acknowledgement within the Council's organisation chart, in which it has evolved from having two Geography Institutes to nominally disappearing in the current institutional organisation" (Martín Lou, 1992). Therefore, during the early days of the Institute, Geography was somewhat invisible. This was resolved by the researchers of the discipline who called themselves the Department of Geographical Studies. This is also the name of the oldest journal of Geography in Spain and in Spanish *(Estudios Geográficos*) which has been published since 1940 by the CSIC.

Twelve years later, Drs. Mª Isabel Bodega and Mª Asunción Martín Lou contributed with a reflection on *La Geografía en el Consejo Superior de Investigaciones Científicas* (*Geography in the Spanish National Research Council),* again adding to the contribution of the Spanish Committee of the IGU at the 30th Congress which was held in Glasgow (Bodega Fernández and Martín Lou, 2004). After recovering the name of the discipline in the then Institute of Economics and Geography, in this reflection, the authors highlight the difficult situation of Geography in the CSIC, imposed by a more rigid administrative structure after 1986. This new structure hindered the institutional collaboration with the university and the allocation of human resources for research, obliging the discipline to compete with others within the Humanities and Social Science fields. However, they also acknowledged that the identity of Geography as a discipline was being compromised, not only in the CSIC, but also in the university degree programmes.

Today, an update of this reflection is being presented as the Spanish contribution at the 34th Congress of the International Geographical Union which is to be held in Istanbul in 2020.

Currently, more than fifteen years later, the Institute of Economics, Geography and Demography (IEGD - http://iegd.csic.es/) is one of the 16 institutes that constitute the Global Area Society (formerly Area 1 – Humanities and Social Sciences) (https://www.csic.es/en/research/areas-y-produccion-cientifica/area-global-sociedad) of the CSIC, the largest public institution in Spain dedicated to scientific and technical research. The IEGD, together with the institutes in the field of Humanities located in Madrid and the Institute of Public Goods and Policies (IPP), merged in 2008 to form the Centre for Human and Social Sciences (CCHS - http://cchs.csic.es/) which is the Centre of General Services to the Global Area: Society on a national scale.

As mentioned above, the IEGD was the successor of the Juan Sebastián Elcano Geography Institute (1940) and the Institute of Applied Geography (1967). It was created in 1986 through the merger of these two geographical institutes with another two from the economics discipline (Institute of Agricultural Economics and Rural Development and the Institute of Applied Economics) and the Sociology Institute Jaime Balmes in order to unify and rationalise the different human and material resources in a single centre engaged in multidisciplinary research in Social Sciences. The Institute of Demography was annexed to the institutional project in 1996, with its name being incorporated into its current title.

At this point it should be remembered that the democratic transition, which had been in progress since the 1970s, brought with it the political interest to modernise at every level, including science and research. Consequently, in 1986, the Law for the Promotion and general Coordination of Scientific and Technological Research, the "Science Law", was enacted and was in force until 2011. In the 1980s, the objective of the CSIC was to become institutionally independent from the university and its disciplinary and teaching criteria. It sought to go beyond the isolated efforts of prominent individuals by introducing transversality in the objectives of its research groups, which would follow the priority lines of the ministerial research plans programmed by the recently created Inter-ministerial Commission of Science and Technology, to reorganise investments and resource allocation.

The IEGD created and developed the Geographical Information Systems and Statistical Analysis laboratories, both of which were at the cutting edge in technical, technological and methodological terms within the disciplinary and temporal context of that time. Currently, these laboratories constitute two units in the CCHS: the Unit of Geographical Information Systems and Digital Humanities - SIGyHD (http://unidadsig.cchs.csic.es/sig/index.html) and the Unit of Statistical Analysis (http://humanidades.cchs.csic.es/cchs/web_UAE/inicio.htm). In the same way, the extensive bibliographical, statistical and, particularly, cartographic resources today form part of the catalogue of the Tomás Navarro Tomás Library of the CCHS (http://biblioteca.cchs.csic.es/quienes.php), which houses the collections preserved and extended in the organisation since 1942, with more than 725,000 books (including manuscripts from the 17th century to the 21st century and various incunables), 11,000 maps and plans, 5,000 microforms and 1,000 electronic resources; all of which was recognised as an Asset of Cultural Interest in 2015.

Currently, the mission of the IEGD, formed by researchers from a wide range of disciplines, is to conduct theoretical-applied research specialised in the analysis of demographic changes and the living conditions of the population, sustainable territorial

development, the sectoral economy, geography and environmental economics and the management of natural resources. Conducted by its workforce of researchers, pre-doctorate and post-doctorate employees, specialised technical employees and other technical and administrative personnel, the research is financed through subsidies to R&D&i projects, obtained through public competitions arising from national, regional and European Union plans or those of other supranational institutions, but also through research contracts and agreements with public administrations and private institutions.

In accordance with its Action Plan 2018-2021, the IEGD is structured into two departments, which, in turn, are composed of five multidisciplinary research groups:

1. Department of Population

a) Research Group on Ageing

b) Research Group on Demographic Dynamics

2. Department of Applied Economics and Geography

a) Multi-scale Geographical Analysis of Global Change

b) Cross-border Human Mobility between East and West, in the European Geopolitical Context

c) Agro-Food Systems and Territorial Development

Despite the drastic fall in the number of research personnel since 2010, with a loss of almost 40% of the workforce (mainly due to the retirement of those workers who had joined the organisation from the 1970s, but also due to the scarce or absent allocation of human resources during the economic crisis), the presence of personnel in the Geography discipline is significant (more than half of the current staff), with three of the research groups of the IEGD being made up of geographers:

1.a) Research Group on Ageing (head: Dr. Vicente Rodríguez Rodríguez) (http://cchs.csic.es/en/research-group/research-group-aging-gie-csic), active since 1988 through the following lines of research:

- 'Ageing and residential strategies': This line seeks to analyse the process of ageing at home and other forms of residential mobility according to life course. Research on Age-Friendly cities and communities is included.

- The 'Active ageing and quality of life (QoL)' line aims to determine the Quality of Life as a result of ageing well, the QoL components, satisfaction achieved and determinants of the different domains.

- 'Ageing, health and dependence': A research line based on the growing number of older people and the implications (fragility and dependence, increased illness and health problems with age, use of and access to health services) and the changes in the family structure, in particular the role of women, its social and economic effects —care for the elderly—, pensions and health spending.

2.a) Multi-scale Geographical Analysis of Global Change (head: Dr. Javier Martínez Vega) (http://cchs.csic.es/en/research-group/multi-scale-geographical-analysis-global-change). Research lines focus on:

- Environmental Remote Sensing: Using a multiscalar approach, key biophysical vegetation variables are estimated in terrestrial ecosystems and agricultural land.

- Protected Areas: Indicators to assess and monitor the sustainability of terrestrial and marine protected areas and their surroundings are developed. An integrated perspective considers the four sustainability pillars: environment, society, economy and governance.

- Wildfires: Aiming to model multitemporal wildfire human risk and its explanatory factors through different techniques (logistic regression, generalised linear models and maximum entropy models). Land-use and land cover changes, along with climate factors and other human components registered in the Mediterranean regions in recent decades help explain wildfire occurrence.

2.b) Cross-border Human Mobility between East and West, in the European Geopolitical Context (head: Dr. Silvia Marcu) (http://iegd.csic.es/en/research-group/cross-border-human-mobility-between-east-west-european-geopolitical-context) whose research focuses on human mobility (with special emphasis on mobility from Eastern Europe to Spain, across borders), and geopolitical and social changes in Europe, Russia and Eurasia.

There are two further laboratories whose heads are also geographers:

- Envejecimiento en Red (Ageing on the web) (EnR?) http://envejecimientoenred.es/ (Head: Dr. Antonio Abellán). EnR?| Created as a result of the collaboration between the General Foundation of CSIC (http://www.fgcsic.es/) and the IEGD, with the objective of becoming a reference in terms of knowledge and verified, rigorous and quality information on research and innovation in ageing, of both individuals and the population as a whole, with an extensive documentary and multimedia base. It is a collaborative web platform, a science-society meeting point with respect to ageing and the elderly, a space for interaction between the different agents interested in this heterogeneous and multidisciplinary field.

- Spectroradiometer and Environmental Teledetection Laboratory http://www.investigacion.cchs.csic.es/espectroradiometria/ (Head: Dr. Mª Pilar Martín). Created in 2007, its objective is to develop basic and applied research in the field of teledetection and, more specifically, in that of spectroradiometrics. One of the fundamental activities of the laboratory is the obtaining of spectral measurements and the development of protocols and analysis techniques which enable biophysical parameters and relevant indicators in environmental management to be derived either alone or in combination with information obtained from airborne or spatial sensors.

In order to also understand the importance that Geography has in the IEGD, we can add that, of the eight directors since 1986, four of them have been geographers: Julia López Gómez (1988-1989), Mª Asunción Martín Lou (1991-2002), Ricardo Méndez Gutiérrez del Valle (2009-2011) and Gloria Fernández-Mayoralas Fernández (2011-2019).

Since 2011, the IEGD has more than tripled its income obtained through competitive projects based on research proposals related to: Longitudinal population studies, early

conditions and delayed adult effects on morbidity, disability and mortality, active ageing, quality of life and gender, changing families and sustainable societies, temporary versus permanent migration, human rights, Eastern European migrations, agro-food systems, family farmers, innovation and markets, innovative optical tools for proximal sensing of ecophysiological processes, remote sensing, etc. And, in line with these research proposals, the social transfer of knowledge has been developed through the participation in the Senate Committee on the Demographic Challenge and the Congress Committee for the Toledo Pact, in the Depopulation Commission of the Spanish Federation of Municipalities and Provinces and in the scientific branch of the IDEE (Infrastructure of Spatial Data of Spain), among other policy-making bodies and agencies.

The IEGD publishes and supports the journal *Estudios Geográficos* (http://estudiosgeograficos.revistas.csic.es/index.php/estudiosgeograficos) which has been published continuously since 1940 and is the oldest journal in the discipline of Geography in the CSIC and in Spain. Since 2018, the CSIC has been committed to reviving its journals, reformulating its editorial advice and promoting the open and electronic access to all of its publications. Currently, *Estudios Geográficos* is defined as a scientific journal with an international and inter-disciplinary vocation with the objective of publishing research aimed at resolving human problems that have a spatial dimension. The journal focuses on conceptual, methodological or empirical contributions and its object of study is territory, landscapes and geographical places. *Estudios Geográficos* has just renewed the FECYT Seal of Quality (recognition for its editorial and scientific quality) and is indexed in SCOPUS (https://www.scimagojr.com/journalsearch.php?q=28124&tip=sid&clean=0), CWTS Leiden Ranking (https://www.journalindicators.com/indicators/journal/28124), REDIB (https://www.redib.org/recursos/Serials/Record/oai_revista465-estudios-geograficos), Emerging Sources Citation Index (ESCI), ERIHPLUS (https://dbh.nsd.uib.no/publiseringskanaler/erihplus/periodical/info.action?id=488532) and DOAJ.

As a final reflection on the future of Geography within the research activity of the CSIC, it should be asked why, despite the relevance that the geographical perspective has in the research proposals of the IEGD, the new vocations seeking to apply these proposals do not come from the disciplinary field of Geography. Several reasons can explain this: maybe the training of the new geographers differs greatly from the research lines and groups of the IEGD; maybe other disciplines prefer to occupy these distinct social research niches; or maybe the instability of the research career in the CSIC in recent years has dimmed expectations which, on the contrary, have been kept alive in the teaching career. In any event, what seems clear, but still constitutes a debate to develop from within the field of Spanish Geography, is that there could be a certain divorce between the disciplinary identity and the necessary transversality of scientific research, where the geographers must also find our place. This is a global trend in the majority of universities.

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Catalan society of geography

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The Catalan Society of Geography is a subsidiary of the Institute for Catalan Studies (IEC), an institution founded in 1907 by the President of Barcelona Provincial Council, Enric Prat de la Riba, with the mission of incorporating new scientific know-how from the different branches of knowledge into the culture of the society of the time. The Institute is a scientific academy which forms part of various global academic organizations and, at the same time, one of its sections is responsible for establishing the grammatical rules of the Catalan language. The Institute has adopted associations as subsidiaries and integrated them, and they serve as a bridge between the merely academic and the dissemination activities. These societies have to meet a series of conditions, receive financial assistance to perform their scientific dissemination work and can also participate in research activities supervised by full members of the institution. The presidents of the societies also form part of the plenary of the Institute.

The Catalan Society of Geography was founded in 1935, at the request of a group of geographers and geologists, linked to the Geography and Geology section of the "Centre Excursionista de Catalunya" (Hiking Club of Catalonia), who were interested in increasing the scientific activities related to their studies. Some of them were lecturers from the university, from other higher education colleges, and technicians from various administrations. Another group of the founders was made up of people who had different jobs but with a marked interest in the knowledge that geography or geology provided. The founders included Eduard Fontseré, Professor of Physics and Meteorology of the University of Barcelona; Pau Vila, a geographer and lecturer in Teacher Training of the Generalitat; Lluís Solé Sabarís, a secondary school teacher and future Professor of Physical Geography, at the universities of Granada and Barcelona; Gonçal de Reparaz, a lecturer in the Nautical school; Josep Ramon Ballester, a geologist and lecturer in natural science, etc. Those who did not work in higher education included cartographers from official institutions, company executives and even an army general. There was only one woman among the initial members, Aurora Bertrana, who was a novelist, musician and who had travelled around Europe and Polynesia.

The organization's headquarters, at Calle del Carme, 47, is the same as that of the IEC and is located in the Nursing Home of the former "Santa Creu" hospital, a complex built between the 15th and 17th centuries, which has several rooms equipped with audiovisual media, made available to the subsidiaries for the development of their activities.

The end of the Spanish Civil War (1936-1939) meant that some of the founders had to go into exile, such as Pau Vila, Gonçal de Reparaz (the father of André de Reparaz) or Miquel Santaló, a lecturer in Methodology at the University of Barcelona and a former minister of the Republic. Those who stayed in Catalonia endured the closure of the Institute for Catalan Studies and a ban on continuing its activities. These were the so-called years of the catacombs, since the members who continued to be interested in geographic science had to meet clandestinely in the house of one of the most distinguished members. Nevertheless, they continued to hold scientific meetings, in which one of the members made a presentation. In those years (1950s, 1960s), the young members received the invaluable support of the geographer Pierre Deffontaines, director of the French Institute of Barcelona, who helped some of them to be able to continue to study in France, such as Joan Vilà Valentí in Bordeaux.

In the mid-1970s, the society experienced a considerable renewal. The activities of the Institute for Catalan Studies had already been allowed for some years, although without any official support. The beginning of the degrees in Geography at the University of Barcelona and the Universitat Autónoma de Barcelona made it possible to considerably increase the number of members. Key figures from this stage were Lluís Solé Sabarís, Enric Lluch and Lluís Casassas, especially the latter, a lecturer and professor in Regional Geography at the University of Barcelona who held various positions on the governing board of the society before becoming its president (1969-1991).

Under the impetus of Lluís Casassas, publication began of the journal *Treballs de la Societat Catalana de Geografia* (Chronicle of the Catalan Society of Geography), which has already published 88 issues since 1984. The journal defines itself as academic, covering all subjects of geographic interest. Its objective is to disseminate the scientific approach to Geography, to raise the awareness of society about the different territorial, social and environmental problems, and to enrich Catalan scientific expertise in the sphere of the different geographic disciplines. It is published twice a year, mainly in Catalan, with some articles in English and other Romance languages (Spanish, French, Occitan…). It has an editorial board and a scientific board and its editor is the lecturer Jesús Burgueño-Rivero, professor of Regional Geography at the University of Lleida. The journal has an anonymous external evaluation system and is published in paper and electronic format (http://revistes.iec.cat/index.php/TSCG). The texts that it publishes must be unpublished and the result of research undertaken by people interested in geography. It also publishes lecturers, papers at conferences and congresses, study visits and other events held by the society. It appears on the database of ISOC, REDIB, URBADOC and DIALNET. It is moreover subject to evaluation as a scientific journal in IN-RECS, DICE, Latindex, RESH, CIRC, CARHUS and MIAR.

The society currently has around 500 members, of whom 5% are Geography students, 93% full members and 2% honorary members. 65% are men and 35% women. The Governing Board of the society is renewed partially each year and the term of office is three years which can be extended up to a maximum of nine years. The current board consists of a president, vice-president, a secretary, a treasurer and eight members, representatives of the different sectors of the organization's members. The last presidents were Vicenç Biete (1992-2000), Maria Dolors Garcia-Ramon (2000-2006), Francesc Nadal-Piqué (2006-2012) and Josep Oliveras-Samitier, who is the current one. The society also has a delegate from the Institute for Catalan Studies who facilitates relations with the parent organization. This position is currently held by the lecturer Oriol Nel·lo-Colom and was previously occupied by the lecturer and former vice-president of the IGU, Joan Vilá-Valentí.

The organization's annual budget in recent years has varied between €30,000 and €35,000, which basically comes from the membership fees, a subsidy from the IEC itself and other subsidies which can come from collaboration agreements with public or private entities. The expenses arise from the publication of the journal and other publications, the organization of lectures, conferences and other events, expenses for sending publications, the administrative secretariat, representation, etc.

As an example of the activities carried out by the society, we can take as a sample those undertaken during the year 2018-2019, from October to June. Seven lectures were given, on subjects as diverse as "Cartographic anxieties and imaginations: the map as a critical instrument", "Macroregional dynamics in the Western Mediterranean: toward renewed territorial cooperation", "The recent transformation of urban river spaces as a subject for geographic studies", or "Citizenship and rights in a new era". There was also a session devoted to the city of Barcelona through film. The speakers tend to be members of the organization, although some foreign geographers are also invited, generally from other European countries or from America, and some representatives of geographic science from other Spanish autonomous communities.

For Geography students and other people interested in the current teaching of this science, an interesting debate was organized with representatives of students from the Geography degrees of the different Catalan universities, addressing the reasons for choosing to study Geography, the strong and weak points of the different curricula and the professional expectations which open up on graduating.

International Women's Day was also celebrated, with an interesting lecture by Marion Werner, from the University at Buffalo (SUNY), and also the GeoNight (Noche de la Geografía/Nuit de la Géographie) promoted by EUGEO and the French National Geographical Committee, with events in Barcelona, Lleida and Reus. Two commemorations were likewise held, one in collaboration with the Catalan Economic Society, to reflect on the contributions of Karl Marx to both sciences on the occasion of the 200th anniversary of his birth. The other commemoration was in memory of the lecturer and professor of the University of Barcelona Tomàs Vidal, who died recently. A course was also held in "Initiation to the QGIS open source geographic information system", intended for members and Geography students.

Two conferences were held, one in Sitges on "Urban tourism and rural development", sponsored by Barcelona Provincial Council, and another in Alcoi (Alicante) on Geography and development in the Alcoi region, in collaboration with the University and the IEC delegation in the city of Alicante.

Another aspect of the Society's activity is the organization of the study trips to a city, region, landscapes worthy of attention, agricultural and industrial facilities, elements of natural and historical heritage, etc. In the year 2018-2019, visits were carried out to the city of Reus, the Barceloneta neighbourhood of the city of Barcelona, the lower River Ter and the restoration work on the beaches, and Tinença de Benifassà natural park in the area of the boundary between Catalonia and the Valencian Community. At Easter each year, a study trip is moreover organized to a Mediterranean island or region. Cyprus was chosen, both the North, with its mainly Turkish population and organized as a republic which is not recognized, and the South, with mainly Greek culture and whose political regime is the Republic of Cyprus. On these trips, people from the country are contacted in order to have a more direct view of their situation, their main progress and problems. In previous

years, locations and regions have been visited in Morocco, Libya, Israel, Jordan, Syria, Turkey, Greece, Montenegro, Bosnia, Crete, Sicily, Sardinia, Puglia and Basilicata in Italy, the Romanian Carpathians and the mouth of the Danube, with Atlantic trips to the islands of the Azores and of Madeira.

In addition to the publication of the journal, the reference year saw the presentation of the book *Paisatges després de la batalla: Geografies de la crisi immobiliària*, by Antoni Domènech and Aaron Gutiérrez, which forms part of the book collection published directly by the Society and currently consisting of a total of 18. The collection includes republications of works ignored due to the passing of time, or completely out of print, as well as highly topical works such as the one mentioned, the essay *La invenció de la Terra*, by the Italian Franco Farinelli, the publication of all of the articles by Paul Vidal de La Blache which appeared in *Annales de Géographie* translated into Catalan, etc. Another publication that the members received was the republication and translation of the Ph.D. thesis by the lecturer Vicenç M. Rosselló i Verger, *Mallorca. El Sud i Sud-Est (Municipis de Llucmajor, Campos, Ses Salines, Santanyí, Felanitx i Manacor)*, copublished by the Institute for Balearics Studies and the Institute for Catalan Studies.

A research project was presented on "Abandoned spaces with added value", carried out by members with funds from the Institute for Catalan Studies. At present, and also with sponsorship from the IEC, one research project is being undertaken on mobility and air quality in relation to health problems, and another on the history of the Catalan Society of Geography in the light of the evolution of geographic science and of paradigm shifts.

The SCG awards two prizes each year to research projects. The Lluís Casassas i Simó prize, which has had 25 calls for entry, is intended for undergraduate or postgraduate projects. With a value of €1,000, it can be published completely or partially as an article for the journal. The Joan Palau Vera prize, intended for projects undertaken by baccalaureate students, has had 16 calls for entry. It is worth €800. There is widespread participation in the calls for entry, especially those for the Lluís Casassas prize.

In order to maintain smooth communication with the members and supporters, the SCG has three websites and accounts on Twitter, Facebook and Instagram. The official website is the *Obrador Obert* (www.scg.iec.cat), which contains a large quantity of biographical data, publications, studies, events, etc., related to Catalan and Spanish geography. Another website is *L'Àgora de la Geografia* (https://agora-geografia.espai.iec.cat/), which is devoted to the Society's activities, trips, excursions, photographs of nature, etc. Finally, the third website, *Eines i recursos per a l'ensenyament de la geografia* (https://ensenyament-geografia.espais.iec.cat), is intended for teachers of intermediate and advanced cycles, and for their students, and contains a large quantity of educational resources on geography, articles from geographic journals and news on courses and congresses. Members are responsible for the three websites, which have a large quantity of users, not only from Catalonia but also from other autonomous communities and from abroad, especially the first one.

More recently, the SCG commemorated the 250th anniversary of the birth of Alexander von Humboldt, with a lecture by the emeritus professor of the Universidad Autónoma de Madrid, Josefina Gómez Mendoza, and the book published by the Spanish Geographical Association *España: Geografías para un estado posmoderno*, was presented by Juan Manuel Trillo, Joan Vicente and Josefina Cruz. A session was likewise organized on the occasion of the 125th anniversary of the birth of the French geographer Pierre Deffontaines,

who played a major role in the development of geography in Catalonia and was a very good drawer of landscapes. In addition to two lectures, in the latter commemoration an exhibition was organized of some of his publications and of numerous drawings, grouped together in five main subject areas. A book is also currently being prepared on the introduction of the Vidalian paradigm into Catalonia through Raoul Blanchard and Pau Vila, in addition to the geographic study of mountains.

The Catalan Society of Geography is open to all kinds of collaboration with other organizations and associations, provided that their purpose is to support and extol geographic studies and science. In recent years, various collaboration activities have been developed with the Spanish Geographical Association (the AGE), with the delegation in Catalonia of the Official Association of Geographers, the Catalan Association of Regional Science, the Society of Onomastics, the Catalan Economic Society and the Catalan Society for Territorial Organization. The collaboration is especially intense with the Geography departments of Catalan universities, participating with them in the promotion and visibility of Geography and in some visits by lecturers from foreign universities.

The SCG is also a member of the European Association of Geographical Societies (EUGEO), forms part of the Spanish Committee of the International Geographical Union (IGU), and maintains direct relations with some of the geographical societies which exist in Europe, such as the "Societé de Géographie" of Paris. As the "Catalan Society of Geography", it appears alongside the Spanish organizations in the "Geographical Associations" section of the International Encyclopedia of Geography, of the American Association of Geography.

This brief summary of the history and activities undertaken by the Catalan Society of Geography is intended to present readers with the history of an organization devoted to producing and disseminating geographic knowledge in general and, in a more specific manner, everything related to Catalonia and its culture. Geographical features occur in the space of our planet and are analyzed on different scales, including the regional and local scales which are extremely important on being more immediate for the inhabitants who experience the proximity of their advantages and inconveniences, and the projects and transformations which take place in them. Doreen Massey, in her *Geography matters!* (1984) defended the need to study places and regions, "we are going to argue here that that aim should once again be far more prominent on our agenda", and this is one of the main missions of the Catalan Society of Geography, reviewing new facts and problems in order to try to contribute 21st-century ideas and solutions.

Titles and authors by subject lines

Territorial pattern and risk development. Contributions for a more efficient planning and management of high-risk territories

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Abstract

This article reviews the state of the question with respect to the Spanish contributions to the subject of risk in recent years, from a physical geography perspective and also from a human geography and regional geographical analysis point of view. Based on a critical review of these studies, conceptual or methodological contributions that Geography can and should offer in an applied sense are proposed in order to resolve the gaps and challenges that currently exist in the literature on risk. The article explains how these proposals can contribute to improving the planning and management of territories at risk, a particularly urgent matter within a context of rapidly changing environmental conditions.

The territorial nature of risk is vindicated and conceptualised as is the important role played by the spatial relationships as a vector of the relationship between the hazard source areas and the impact receivers. The notions of the risk territorial pattern and the risk territorial unit are proposed as clearly geographical constructs with a direct applied use within the context of the planning and management of at-risk territories.

1. Possibilities and challenges for the geographical approach of risk within a context of change

The capacity of the human being to generate risk in an area depends on the degree of adaptation of the occupancy pattern of the man-made space to the hazard pattern (natural or man-made). Depending on the degree of spatial compatibility of the two patterns, negative interference points between the systems will be generated to a greater or lesser extent. In those spaces where there are misalignments between the natural or anthropic functioning of the hazard and the human use of the land, friction points are generated with harmful results for the population and its assets (economic and heritage). This concept is based on the idea of Calvo García Tornell (1984), who states: "Risk (…) is a problem of interaction between humankind and nature, an interaction that appears to be governed by the respective adaptation between the human system of using nature and the state of nature in its own system" (Calvo García-Tornell, 1984).

The environmental conditions in the southern Mediterranean show an overall rexistatic trend, due to summer droughts, the rugged orography, the steep slopes and relatively uneven ground resulting from the proximity of the mountain ranges

to the coast and the torrential precipitations. All of these factors hinder pedogenesis and the maintenance of plant life, while they foster accelerated morphogenetic processes. In addition to this limitation we can add the intensive use of the mountain, plains and coasts, from the earliest civilisations to the current day, which has generated a multitude of diverse aetiological risk situations. The proximity to the tectonic plate boundaries around the strait of Gibraltar and the Cádiz-Alicante fault, as added structural factors, contributes to rendering the Spanish territory a high risk space. Furthermore, they are risks with a potential associated functioning, with the probability of creating very complex and catastrophic crisis situations due to their potential synergy effects (Perles and Cantarero, 2010).

The metrology of the hazard indicators of these risks in the Mediterranean context is currently revealing increases. With respect to the increase in the hazard associated to climate extremes, the 5th Report of the IPCC on Climate Change confirms the clear incidence of the changes foreseen in several associated behaviour risks, such as fires, droughts, erosion, flooding, mass movements and coastal processes of flooding and erosion associated to storms and the rise in sea level. Meanwhile, the pronounced peak acceleration parameters, according to the findings of recent research, and the updating of the Seismic Hazard Map of Spain (2012) carried out by the *Ministerio de Fomento* (National Centre of Geographical Information), has led to the adjustment of the anti-seismic construction regulation towards stricter requirements (Regulation NCSE-02).

In moments of global change and uncertainty regarding forthcoming events, the unstable balance between the pattern of land use in Spain and the hazard pattern is particularly fragile. In view of the forecast of an increase in extremes, the afore-mentioned documents indicate how the size of the growing impacts will depend on the characteristics of the natural and man-made systems and on their specific locations in order to withstand the impact. Damage to any system will depend on its exposure, sensitivity and adaptive capacity. The commitment to adapt and improve resilience is focused on specific mitigation measures, such as territorial planning, physical planning, reinforcements and constructive adaptation or informative and educational measures to improve risk prevention and the management of the crisis phase. These documents also indicate the need to further the knowledge on specific and realistic risk scenarios.

Within a context of global change, the field of risk management requires the integrated knowledge of the systematic relationships between the human environment and physical environment and the proposal of effective applied measures to mitigate the risk. Therefore, this is a great opportunity for Geography to position its comprehensive and spatial root approach to studying the problem. To do this, many work teams from the different areas of geography are making contributions, together with researchers from other associated disciplines. There are different aspects on which to focus and the success of the Spanish and international geographical contribution to the study of risk over the next few years will depend on the acknowledgement within the discipline itself of the gaps that need to be filled, the challenges to address and the potential that Geography and its unique approach can contribute to the analysis of risk as a territorial process.

The guiding thread of the article is based on the following questions: what contributions can Geography as a discipline make to improve the management of at-risk territories in a context of change? and; what is required from each area of Geography to improve, from an applied level, territorial risk management?

2. The study of risk from the physical geography approach. Recent contributions and challenges to address

Currently, from the physical geography point of view, and in particular that of climatology and geomorphology, an abundance of precise and specific thematic information is being generated on the functioning of the climatic and geomorphological processes that are giving rise to different hazards. The information is usually based on highly powerful and sophisticated technical developments and on the detailed study of occasional events and on case studies with a limited spatial scope.

With regards to the risk of erosion, some compilation texts, such as those of Arnáez (2014), on studies by García Ruíz, or those of Gómez, Schnabel and Lavado (2011), have contributed to consolidating a line of research with an extensive background. In this line of study, León, Badía and Echeverria (2015) compare different methods to evaluate erosion in the Ebro valley. With respect to the relationships of erosion and the changes in land use, Camarasa, Caballero and Iranzo (2018) make an interesting contribution carried out in a Mediterranean *rambla* (watercourse) (Valencia). Another geography topic,

namely the relationship between the abandonment of the crop lands and erosion, has recently been addressed by Martínez (2017) for the area of Murcia, following the previous studies in this line of research carried out by Lasanta *et al.* (2010) or García Ruiz and Lana-Renault (2011).

In relation to the risk of mass movements, interesting studies have been published on the analysis of specific catastrophic episodes, such as the studies carried out by García (2014 and 2018) on the region of Asturias. The majority of the research on this topic is essentially focused on the deduction of susceptibility factors that enable the development of predictive methodologies in line with previous studies such as those by Domínguez, Jiménez and Berrezueta (2007) on the Cantabrian mountain range or González- Jiménez *et al.* (2007), for the Central System. This is the case of the studies by Felicisimo *et al.* (2013) and Bornaetxea, Ormaetxea and Antigüedad (2016 and 2018) for Guipuzkoa, in which, based on multivariate statistics, the validity of different predictive models is tested.

The studies on fires based on a physical geography approach preferentially focus on the post-fire repercussions on vegetation, run-off and, essentially, on soil and water erosion. This is the case of the studies carried out by Martínez *et al.* (2016), or those compiled previously by Cerdà and Jordán (2010). An analysis and description of specific events has also been carried out (Martínez (2015), in addition to bibliographic reviews such as Bodi *et al.* (2012). Particularly interesting are the risk mapping proposals, such as Vallejo (2019).

With respect to the processes associated to river morphodynamics and flooding, we should refer to the analyses of morphological changes and river incision processes from a historical perspective (Segura and Sanchis, 2013; Conesa and Pérez, 2014) for the east coast. Particularly interesting are those studies that examine the incidence of human activity on the dynamics and natural morphology of the river such as those by Sanchis, on gravel mining, the analysis carried out by Segura and Almonacid (2017) and the study conducted by Navarro, Sanchis and Segura (2016), which observes changes in river dynamics after the construction of a reservoir. The hydrodynamics of river flooding are analysed by Sanchez-Fabre and Ollero (2017) and by Espejo *et al.* (2008) based on specific floods of the river Ebro.

With respect to coastal processes, different studies map and describe the changes on the coastline and their possible consequences for risk. The studies by Pérez-Alberti *et al.* (2012) focus on the Galician coast, while Dawahidi, Ibarra and Gomariz (2019) estimate the problem for the area of Valencia, as do Fraile *et al.* (2014) for the Canary Islands. Ojeda *et al.* (2009) have carried out studies in this line of research for the group of Andalusian coasts, as have Ibarra *et al.* (2015) for the region of Murcia and Sainz de Murieta (2018) for the Basque coast. Together with these more descriptive studies, the analyses of Fraile *et al.* (2012,2017) and Fraile, Álvarez and Ojeda (2018), conduct a more direct connection of the process with the forecast of the extent of the coastal floods, based on examples in different points of the Andalusian coasts. Ojeda *et al.* (2013) calculate coastal erosion rates and other studies, such as those by Rasilla and García (2014). Guisado, Camarillo and Ojeda (2017) focus on high energy coastal sections and sea storm risk processes and analyse their consequences.

2.1. The shift of the basic research on processes towards applied research on hazards

Based on these advances in physical geography, among others, the knowledge of the morphogenetic and climatic processes that generate hazards is becoming increasingly precise. However, in many cases, due to its exceptional nature, the information obtained is related, to a greater degree, to the basic research, and is therefore not useful on an applied level. In fact it is not being used as much as desired in the prediction, prevention and mitigation of hazards. For this to happen, a shift from the basic research on hazard-generating geomorpoholgical processes towards applied hazard studies and hazard mapping is necessary.

In order to make this shift, the individual empirical results must be oriented towards deriving transposable models, based on an overall picture in wider spaces. Studies in this line or research include those of Sinoga and Romero (2010) who attempt to extrapolate the results of erosion obtained in specific plots to a whole pluviometric gradient in Southeast Spain. With respect to the task of making the specific research on hazard-generating geomorphological and climatic processes applicable to risk management, we can refer to efforts of many researchers to extract from the basic information on processes a series of proposals of measures to restore and correct hazards. Conesa and García (2007), for example, evaluate the effectiveness of the river retention dykes in the effective mitigation of erosion. Gómez, Schnabel and Lavado (2011) propose strategies for recovering gullies. Lima, Blanco and Gómez (2017 and 2018) research the role of specific agricultural practices for conserving the soil in mountain olive groves. Hueso *et al.* (2014) analyse the effect

of soil recovery measures based on protective covers. The compilation by Cerdà and Robichaud (coord.) (2009) contributes criteria for the restoration and recovery of soil after fire. Pérez *et al.* (2011) have made concrete proposals for restoring burnt areas. García Hernández *et al.* (2017) propose and evaluate the effectiveness of reforestation measures for controlling avalanches. Díaz *et al.* (2014) and Prieto, Díaz and Ojeda (2014) apply data relating to coast erosion rates and the rise in sea level in Andalusia obtained in their research to the detailed description of the consequences on the tourism activity on the coast, identifying those beaches that will see their accommodation space affected. Prieto *et al.* (2017), based on the calculation of coastal erosion rates, analyse the effect of this process on longitudinal coastal infrastructures. Based on criteria established in the basic research, Segura (2014) takes a step further in the critical assessment of river restoration criteria in Mediterranean basins. Salazar (2013) makes an interesting contribution to the measures for mitigating floods through water retention measures in the territory. Ollero *et al*. (2019), using the knowledge on the morphodynamics of ephemeral water courses in different parts of Spain, take a step further and propose specific restoration measures for this context of flooding.

On the other hand, we should not forget that the study of hazard has an applied objective and that risk mapping is the tool that enables planning and regulation in territories at risk. This requires the results of the basic research to be translated into cartographic language and, above all, the unification of the elaboration and representation criteria of hazard and risk in order to be able to make comparisons between the different maps and spaces analysed. It is necessary to adapt the inferred models and predictive methodologies to make them applicable, which means systematising them. When creating a hazard or risk map, it is also necessary to analyse the variation of the results depending on the sources, the cartographic basis, the scale of data entry and exit and the criteria used to delimit the intensity intervals. Along these lines, a series of authors are working on strategies to increase the precision and rigour of the data mapping process and are analysing aspects such as the relationship between the form of entry of the information and the results obtained, the scale dependency between entry data and spatial results, the new cartographic languages in the era of NICTs, the generation of visors and other cartographic services and several aspects related to the rigour of the hazard, vulnerability or risk mapping document. On these aspects, we can find studies such as those by García, Camacho and Paegelow (2019), in relation to the changes in land uses, Ojeda *et al.* (2010), Prieto *et al.* (2010), Fraile and Ojeda (2013), Fraile and Fernández (2018), Fraile, Sánchez and Ojeda (2014) and Fraile and Leatherman (2016) in relation to mapping sea level changes and the associated flooding risk and those by Camarasa and Soriano (2015) that analyse rainfall extremes. The attempt to unify cartographic representation criteria has been more successful in the case of flood hazard (Diez, Laín and Llorente, 2009). A necessary step in the shift from research towards the direct application of knowledge is the generation of decision-support software applications that adapt the hazard assessment methods and enable hazard mapping to be carried out in an agile way. This is the case of the contribution of authors such as Perles *et al.* (2019), who complement the methodological development from the research with specific applications of hazard and risk mapping. In the same vein, other studies have been carried out by Ojeda and other authors from the University of Seville focused on the design of software tools for geographical data management.

2.2. Adapting the functioning of processes to the context of global change

Another important challenge that should be addressed by physical geography and its research on hazardous processes to be used in the context of risk studies is contextualising them within the framework of adapting to environmental change. In this regard, there are many studies that analyse and describe the foreseeable consequences of change in the behaviour of different risks. With respect to changes in thermal behaviour patterns, the studies by Miró, Estrela and Olcina (2016) analyse the evolution of the local pattern in the Region of Valencia, similarly to the study by Barros and Martín-Vide (2018) for the Fabra observatory. The changes in the behaviour and pattern of rainfall and, consequently, the changes in erosion are analysed by Ruiz *et al* (2015) for a pluviometric gradient in south-east Spain. The consequences of the increase in drought periods and their repercussions on the scarcity of water resources are analysed by Quereda *et al.* (2010) and Saurí *et al.* (2013), who observe the consequences on the tourism activity. From an applied point of view, particularly interesting are those contributions that go beyond offering a prognosis and indicate possible measures to implement for the predicted changes. This is the case of the doctoral thesis of Marzo ARTIGAS (2016) which, after modelling a scenario of change in the thermal extremes of Andalusia, makes a precise calculation of the climate control needs and resulting energy requirements in the coming years, which enables the seriousness of the situation to be gauged.

2.3. Integrated processing of associated functioning hazards

One of the unresolved subjects of physical geography related to the study of risk is the discussion and proposal of methodologies to analyse associated functioning and chain risks. From a physical geography perspective, in conjunction with the collaboration of researchers from other disciplines, risk analysis has traditionally been carried out from a sectoral perspective, separating and individually analysing the types of hazard according to their etiology and designing specific methodologies in order to evaluate each type of risk. This method has enabled highly productive progress to be made in the individual evaluation methodologies of each of the types of risks and threats. However, these academically-based sectoral approaches do not adapt to the reality of how risk is generated in the territory, and even less to the proposal of comprehensive solutions for planning in high-risk areas. Space acts as an integration vector between the different types of hazard processes, which are manifested with close space-time interconnections. Not considering the interconnections and chain effects between the different types of risks leads to an underestimation of the overall synergy of the processes which ultimately constitutes an underestimation of risk.

From our point of view, in order to address hazard in an applied way, it is therefore necessary to shift towards multi-hazard and chain hazard mapping. The UN World Conference in Kobe (2005) proposed the integrated management of natural and technological risks and of multi-hazard and multi-risk problems, concepts that are also addressed in the *Risk assessment and mapping guidelines for disaster management* published by the European Commission in 2010. Subsequently, many initiatives and programmes on an international level have been developed that seek to address this issue.[1]

We can differentiate between different levels of development and complexity in multi-hazard mapping: on a more basic level maps have been developed that we could call grouped hazards, that is, maps in which the different types of hazards that arise in a territory are mapped together and accumulate, with no assessment of the inter-relationship that may exist between them. Recent studies on this topic include, for example, those conducted by Ley (2019) for the city of Mexicali. In Spain, good examples of this line of research have been conducted on an institutional level, largely promoted by the new flood legislation which, based on the EU Floods Directive (2007) has evolved towards giving greater prominence to the geomorphological aspects in the origin of the flood. The Directive specifies the need to conduct an analysis related to different types of natural flood processes (mass movements, debris flows, sedimentation from transportation, shore undermining and marine transgression), and also technological hazards such as pollution. These guidelines have used the phase of the Preliminary Flood Risk Assessment (PFRA) and similar criteria have been taken into account in the elaboration of other normative documents and flood regulatory plans, such as the case of the INUNCAT, PATRICOVA and PRICAM, among others. On a methodological level, the contributions made by the IGME and the PRIGEO Plan are also interesting. Together with flooding, they include the risks associated to suffusion, landslides, erosion or silting, among others.

Chain hazard maps are more complex. They assess and sometimes quantify the interactions between the different hazard processes and their possible synergy effects. The chain hazard map is a complex document because it must reflect the topological seriation of the actions involved in the different hazards, the feedback processes and resulting synergy and the spatial and temporal transfer between the causes and consequences. The effective studies on chain hazards have focused on highly detailed monitoring experiences such as Pedraza (2004). Others analyse experimental basins or plots with highly sophisticated and demanding models with respect to data entry. Therefore, in practice, they have no practical application on a planning level. The studies on a basin level carried out by *Ibarra et al*. (2005) are very interesting. They relate the generation of fires with the change in the hydrological behaviour of the flood. Determining how the processes function as a chain is fundamental when planning an at-risk territory. Therefore, it is vitally important to systematise and agree on methods that connect the processes to a scale compatible with that of planning, not only of experimentation. In a rexistasic

1 Examples of projects and programmes aimed at multi-risk analysis:
ARMONIA: Applied multi Risk Mapping of Natural Hazards for Impact Assessment
DDRM Multi-Risk approach. Délégation aux Risques Majeurs
ESPON: European Spatial Observation Network. Natural and technological hazards and risk in European Regions
GHRIMS: Generalization of Hazard/Risk predictive Mapping Standard for disaster management
JRC Multi-risk Approach
MEDIGRID: Mediterranean Grid of Multi-Risk Data and Models.
ORCHESTRA: Open Architecture and Spatial Data Infrastructure for Risk Management
TEMRAP: The European Multi-Risk Assessment Project
TIGRA : Integrated Geological Risk Assessment

Mediterranean environment prone to flash floods, the principal chain of associated hazards to resolve is that related to water erosion, gravitational movements and the incorporation of solid material to the flood flow. It is noteworthy that this problem is not contemplated in the majority of the floodability maps that govern planning in Spain, when it is evident that the degree of forecast risk without solid material underestimates the real virulence of the floods and their real consequences, as shown by many empirical cases (Perles, Gallegos and Cantarero, 2006).

Ruiz *et al.*, (2012 and 2013) have conducted highly interesting and timely studies related to the incorporation of wood and plant debris into the flood flow. The contributions of Cantarero (2013) and Gallegos (2015) seek to evaluate the incidence of hazards associated to the swelling and flood process in the generation of solid material transported by the flow, to deduce the consequences on the increase of the hazard of the process and the extension of the floodable area. Along similar lines, Perles and Cantarero (2010) make a proposal for the mapping of spatially and time inter-related hazards on a similar scale to that of planning. The hazards are associated based on the consequence vector concept or the vector of the transference of the material and energy that unites them, in this case a vector that is governed by gravitational and fluid dynamics. Using this basis, the hazard area is formed around a spatial pattern structured by hazard source areas, flow transmitting lines or surfaces and receiving areas of the impacts of the process. For a hazard to affect a receiving area, there has to be a vector of transference of material and energy that unites them, as mentioned above, and also, the causing area has to be located in a topological position that enables this transference.

2.4. Human induction of natural hazard

Anthropic interventions are, by far, those phenomena that can generate the most drastic alterations in the morphodynamic systems that underpin hazards, as currently they are based on very robust technical interventions. Human activity is, therefore, an important input in the geomorpholocial and climatic system. From a physical geography perspective, significant efforts have been made to develop conceptual or empirical models to analyse the incidence of natural factors in the generation of hazards; however, despite our capability to analyse the human environment, efforts to do so have not matched those analysing the impact of human activities on hazard. This has been left in the hands of the study of environmental impact or has been considered to be related to the field of engineering. From a geographical point of view, a reflection on the why is required, despite the data that warn of the prominent role played by man-made actions in morphogenetic and particularly hazard systems, very little attention has been given to them in the hazard maps.

Some authors have analysed the generic incidence of the urban development process in floodability and condemn how the pattern of town planning is not governed by risk prevention criteria. Pérez, Romero and Caballero (2016), Pérez, Gil and Olcina (2015), Membrado (2013) or Gaja (2015) observe the consequences of the accelerated and chaotic urban growth during the property bubble on flooding, while Villar and Ojeda (2012) analyse this phenomenon specifically for the coastal strip. Segura (2009) explores the modifications that the anthropic alteration introduces in the flooding of highly intervened spaces. In a more specific way, the analyses of the role of human activity on fire risk has been developed more extensively as the relationship between the increase in combustion hazard and the human factor is direct. Also in this line of research we can refer to the studies by Lara, Martin and Martinez (2008) or Martinez (2017) that incorporate the probability of the human activation of fire in a preventive model. We can also mention the studies related to human-induced hazards related to climate, indirectly in the case of problems associated with the global change or more directly in the case of the rise in thermal extremes in man-made environments such as cities (Pozo and Martín Vide, 2018; Alomar (2018). In relation to human-induced flood processes, the studies of Segura (2009), Segura and Sanchis (2018) or Baena *et al.* (2016) focus on the alteration that the flooding of waterways and plains generate in the hydrodynamic behaviour of the river and its tributaries. Romeu and Segura (2016), Pascual and López (2016) or Gallego and Perles (2019) examine the repercussions of the changes in use on flood potential. More specifically, Caballero, Romero, Espinosa (2015) analyse the effects of intensive agriculture and Caballero (2018) studies the repercussions of soil sealing. In 2008, in the publication *Mapas de riesgos naturales en la ordenación territorial y urbanística,* edited by the Spanish Association of Geologists, Ortega (2008) included a systematisation of anthropic actions that affected flooding and its mapping, but the reality is that this procedure has not been extended to a planning level. Perles (2015) provides a classification of the principal actions on the territory that can induce flood hazard and other associated risks, with the objective of considering them as inputs in risk mapping and taking them into account when analysing the risk of an area in the planning documents.

INTERVENTION PROCESSES ON THE LAND	HUMAN ACTION	ACTIVITIES AND ELEMENTS OF THE TERRITORY ASSOCIATED TO THIS ACTION	PRINCIPAL REPERCUSSIONS ON RISK
Modifications in the **morphology** of the terrain	Excavation, clearing (negative contours)	Ploughing (agriculture)	Decomposition of solid material (erosion, flooding)
	Clearances	Berms for emptying platforms (urban, agricultural, infrastructure use)	Slope increase (mass movement) Diversion of water flow direction (dams and unexpected flooding, perimeter channels)
	Filling, accumulation (positive contours)	Filling platforms, (urban, agricultural, infrastructure use)	Subsidence (movement of terrain) Subsidence, collapse, liquefaction (seismic) Diversion of water flow direction (dams and unexpected flooding, perimeter channels)
	Compacting, surfacing	Roads, platforms Livestock farming	Waterproofing, increase in runoff (erosion, flooding)
Modifications in **vegetation cover**	Elimination of cover	Logging, fires	Instability of hillsides Erosion, carrying, flooding, obstruction, fire
	Accumulation of plant debris	Stubble, pruning debris in gardens	
Increase in artificial loads and or mobilisation **energy**	Increase in cutting effort (weight)	Construction of buildings	Instability (movement of terrain)
	Detonations	Quarries, mines, fracking	
	Incorporation of materials in the transport process	Dumps, spills Remains of temporary structures Cars Urban furniture	Obstructions, blockages Dams Diversions Increase in destructive power
Morphological modifications in the flow networks for **evacuating material** and energy	Reduction in the functional capacity of the flow line	Occupation of channels Occupation of margins Channelling Vaultings Artificial Drainage Filling of talwegs	Accelerations Dams Headwater flooding Diversions (floods)
	Incorporation of materials in the transport process		

Table 1. Territorial actions and processes that induce hazard (Perles, 2015)

Taking a step further in the study of human-induced hazard, which is as necessary as it is difficult, involves the quantitative estimation of the incidence of human activity on the risk of the phenomenon in question in order to be able to include it as another factor in the assessment and mapping models. Some authors focus on the quantification of anthropic intervention processes and their findings have revealed highly alarming figures with respect to its importance. Sinoga, Romero and Belmonte (2011) measure an erosion rate in terrain that has been dug up for urban development that doubles the values that the FAO considers as a catastrophic phenomenon (479 Tm/ha/year). Martin Moreno *et al.* (2016) calculate an erosion rate in mining terrain of 318 Mg/ha/year.

An interesting approach in this line of study can be found in Cantarero (2013), which assesses the potential of the intrinsic alteration of each anthropic activity of the urbanised territory in three aspects: as issuers of extraordinary run-off due to the alteration in the permeability of the substrate (compacting, paving, logging), as issuers of debris (soil, plant debris, urban furniture, cars) and as generators of water flow blockages (different situations of interference with the flow, narrowings, changes in the slopes, etc.). The study also calculates the potential damage caused by each activity in view of its topological position in the flood process. The studies of Gallegos (2015) follow a similar line, insisting on the utmost importance of anthropic induction in the Mediterranean flood model, particularly in basins located in peri-urban environments, and therefore offering a methodology for hazard mapping adapted to this scenario.

Natural hazard functioning in antrophized environments

Another necessary challenge for physical geography related to risk studies is to learn to assess the changes in the dynamics of the hazard processes when they occur in anthropized spaces or mixed natural and man-made territories. In these contexts, the functional conditions of transferring material and energy of the processes are changeable and complex and it is necessary to adapt the hazard analysis methodologies. This approach is proving to

be particularly essential to adjust the results of the flood maps to reality when the process occurs in mixed natural and urbanised environments or in wholly urban areas. In these environments, the functioning criteria of the water flow change substantially, in terms of both their origin and dynamics. The reorientation of the study of flood hazard in mixed or artificially modified environments and the calibration of predictive models to anthropized scenarios are other aspects in which physical geography can offer its approach in order to obtain realistic results coherent with the territorial reality to which they apply. This is an urgent need, taking into account that a large part of the Spanish Areas of Significant Potential Risk (ARPs) correspond to anthropologically altered land where exposure is concentrated.

Examples of studies that address the functioning of natural hazards in mixed areas are those of Corominas *et al.* (2013) for the case of landslides. Perles *et al.* (2019) study territory as a continuum made up of hazard determining natural and man-made factors to adapt the behaviour of different types of related risks (mass movement, erosion, floods) when they occur in road infrastructure environments. The studies of Conesa, García and Pérez (2017) and Conesa (2013 and 2014) specifically analyse the interference produced by man-made elements of the environment (roads, bridges,*culverts*), in the dynamics of erosion, sedimentation and flooding. Along the same lines, Segura (2009) explores the modifications that anthropic alteration introduces in the flooding of highly intervened spaces.

3. Contributions and aspects to develop in the study of risk from the human geography approach

The contributions to the study of risk from a human geography approach focus on the analysis of the population and its assets as risk recipients and, therefore, on studies on exposure and vulnerability to risk. Within a context of climatic change and the increasing repetition of extreme events, the research focus is shifting away from the study of vulnerability towards that of resilience to catastrophe, that is, the capacity of adaptation of a territory and its dynamics to the occurrence of catastrophes in order to gradually become less fragile. From the discipline of human geography, research is also being carried out on the different measures to mitigate risk and policies and management models for the problem.

The abundance of studies on exposure, vulnerability and resilience are related to flood risk, due both to the prevalence of this problem in Spain and its connection with Territorial Planning. As is well known, based on the Flood Directive (2007), the elaboration of vulnerability and risk maps has been fostered. In theory, the circumstances have led to the consolidation of methodologies for the assessment and mapping of vulnerability to floods, but in reality very little consideration is currently being given to vulnerability in the legislation and planning instruments or in the majority of the research studies. Perles, Sortino and Cantarero (2017 a and b) offer a conceptual review based on a geographical approach of the vulnerability to risk, the gaps and potential areas to develop.

Essentially, two types of vulnerability maps are currently being produced. The first are based on a sociological approach and are related to radical geography, which offers generic socio-economic vulnerability indicators of the population usually on a municipal scale. These maps enable a comparison to be made of situations of vulnerability on a regional level. Synthetic vulnerability indices are often offered, usually obtained through multivariate statistics. A prominent forerunner in this field is the SOVI, conducted by Cutter in 2003 for the whole of the USA. Aroca, Bodoque and Diez (2018) generate a social vulnerability index based on a large number of socio-economic indicators with which they characterise the vulnerability to flooding on a regional level in Castilla-La Mancha.

Another line of research in vulnerability mapping is rooted in ecological economics and is based on cost-profit models. This line advocates, for example, the INSPIRE initiative. These are maps in which vulnerability is calculated as the parts per unit of the expected loss, and are usually created with a detailed scale and based on depth-damage curves. They are, therefore, documents in which the elements of a territory that are most vulnerable to a risk are not the most fragile, but the most costly. Furthermore, the part per unit of the expected loss is often calculated according to the hazard to which the vulnerable asset is exposed. Therefore, the incidence of risk is doubly calculated when creating the final risk map. Using this approach Bodoque, Alvarenga and Diez (2016) propose a very precise assessment of economic risk to a case of flash floods.

From human geography and similar disciplines there are also many studies that analyse the different types of mitigation methods and their role in reducing vulnerability.

The studies of Perles, Mérida and Olcina (2016) on flood management policies and those of Pérez, Gil and García (2015) on the historical evolution of the waterway protection measures are both compilations and analytical. Palma *et al.* (2019) conduct an analysis of the AEMET warnings and their evolution. The summary and reflection of Paneque (2015) in relation to the strategies to fight against drought in Spain is interesting. Along the same lines, Torres, Ribas and Vilá (2019) assess the effectiveness of the water saving measures in the tourism industry, while March, Domenech and Saurí (2013) analyse the perception of these types of measures among the population in general. Other studies make specific proposals to reduce vulnerability and improve resilience to floods, such as those by Ollero (2014) in a good practice guide, conceived as a manual for managers, or the proposal by Barredo and Engelen (2010) for recreating scenarios of land use that give rise to erosion control.

Progress is also being made in furthering the knowledge of risk perception by the population and its incidence on its vulnerability to act in case of a catastrophe (Ley, 2019; Bodoque *et al.* 2019; Díez *et al.* (2018), and also with respect to informative measures regarding the functioning of floods to improve the resilience of particularly vulnerable groups, as is the case of the child population (Hernández *et al.*, 2018; Díez *et al.*, 2018). Other studies, such as those by Navarro-Cueto, Vallejo and Navarro Bernal (2017) have advanced in the concept of resilience by understanding the degree of development of communication networks as a useful indicator of social capital in times of crisis. Other studies focus on the comparative analysis of different types of mitigation methods. This is the case of the contribution of authors such as Garrote *et al.* (2019) who compare the effectiveness of measures against floods based on infrastructures with respect to self-protection measures. Bernal (2016), meanwhile, using a cost-benefit analysis, assesses the advantages of applying flood risk mitigation measures. Other studies criticise the risk management model and question its effectiveness. This is the case of the reflections of Ollero (2015) with respect to flood management. Díez (2018) analyses the technical and legal implications of flood mapping.

3.1. The spatial representation of vulnerability in mapping. Problems to be solved

There are several problems to resolve in terms of the regulatory demands and those related to the research on the subject in order for vulnerability mapping to be truly applicable and useful in risk management. These issues are essentially related to the spatial dimension of the phenomenon and to the need to define a clear and agreed objective in vulnerability mapping so that it constitutes a useful document for risk management. In this respect, the *Sendai Framework for Disaster Reduction* calls for a further step to be taken away from the traditional generic population vulnerability studies towards the configuration of specific scenarios of vulnerability, which enable the shift to be made from theoretical to applied research.

With respect to the spatial dimension of vulnerability analysis, a double problem arises: first, the majority of the variables that express characteristics of the population (for example, exposure data) are usually attached to artificial synthetic spatial units (municipality, census section), while the hazard processes are manifested and mapped through analytical limits (sheet flood). In many cases, this means that there is no real spatial correspondence between the exposed element that is being addressed and the hazard process that it theoretically affects, which falsifies and even invalidates the purpose of the map. On the other hand, the majority of the vulnerability maps are created with highly generic scales, which does not allow the discrimination of situations on an intra-municipal level, so they are not useful as documents for supporting urban planning or risk management on a local scale.

From a human geographic perspective, it would be highly useful to contribute to resolving this problem through the exploitation of the potential of the new sources of digital information that provide ever-increasing and precise geo-localised data on the population, their assets and behaviour. Along these lines, the studies by Vallejo and Ramírez (2016) are highly interesting. They exploit the residential data drawn from the property register and obtain rich and spatially precise information about the vulnerability of the population. Díaz, Vallejo and Ojeda (2012) also conduct a study on the mapping of detailed population data that can be highly useful in the applied study of vulnerability on a local level. Accessibility and network connectivity studies, increasingly enriched by the affluence of geo-localised data on mobility (Moya *et al.*, 2017), can be applied to improve vulnerability and crisis management studies. In the same way, Sortino and Perles (2016) address the accessibility of the distress and assistance systems with the sheet flood, while Mérida, Perles and Reyes (2016) apply these procedures to calculate the vulnerability of the population due to the isolation of road infrastructures in the event of blockages due to multiple risks.

3.2. Unification of fragility criteria of land uses facing a hazardous event

Another aspect in which the human geography approach can help to improve the applicability of vulnerability mapping is that related to the fragility of the different productive activities and land uses in the event of flooding and also that of other risks such as fire, sea storms, seismic risk, etc. There are no agreed criteria for assigning the degree of fragility to a flooding of, for example, agricultural land uses (there are those based on the cost of the crop, but not on its fragility); however, the degree of resistance of the crop to hazards, and its resulting level of damage, is defined by a series of physical and functional characteristics that are not necessarily determined by cost. Perles *et al.* (2017 a) provide indicators of vulnerability to flooding for a total of 14 variables, identified and graded in all of the floodable areas of Andalusia. Remond *et al.,* (2018) suggest criteria for estimating vulnerability in heritage elements of the territory. Pérez (2012), meanwhile, assesses residential vulnerability to seismic risk. Other examples of studies on this issue are being carried out from the field of engineering and offer fragility values for different buildings depending on their type (Custer and Nishijima, 2015, for residential uses). In Spain, Garrote *et al.* (2017) analyse the vulnerability of buildings with a ground floor. In this sense, the Insurance Compensation Consortium has published a guide for reducing the vulnerability of buildings (Manrique *et al.* 2017).

On a more precise level, it would be necessary to specify the fragility of the use exposed to specific processes. First, it is essential to differentiate mapping that indicates vulnerability of the population or the asset to the impact from that indicating vulnerability to loss. The impact generated by the risk preferentially depends on physical and material conditions of the exposed elements, often irrespective of the socio-economic level of the population, while the documents that inform of the vulnerability to loss are largely related to the socio-economic situation of the population in order to assume what has been lost (Perles, Sortino and Cantarero, 2017a). On a second level, it is advisable to specify to what type of hazard process the asset is exposed. For example, in the case of flooding, it is advisable to differentiate the vulnerability to rapid flows from that to deep floods, permanent flooding or intense downpours as the resistance of the asset is different depending on the hazard process with which it is faced.

Finally, to take a definitive step towards the real usefulness of risk mapping as a tool for territorial risk management, it is necessary to refocus the conception of the resulting documents, giving them an end-result approach. When undertaking vulnerability mapping, it is common to steer the maps towards the concepts of social, economic and environmental vulnerability, etc. These behaviours constitute a way to classify what is based on the etiology of the impact. They may have a descriptive purpose, but they are less applicable to the search for solutions. Perles, Sortino and Cantarero (2017), base their design of the map on the relationship between the problem of vulnerability detected in an area and the information necessary for its solution, in a line of study referred to as safety construction. They propose the identification of specific and defined vulnerability problems, that is, those that can be resolved within the framework of risk management, and preferably within the framework of the public management of risk. The proposed vulnerability mapping catalogue seeks to respond to the following objectives: What vulnerability problem exists in the area? What mitigation measures could be applied? Which map is useful for applying the corresponding mitigation measure? Once the problems to be resolved have been identified in the field of risk, different specific mapping documents are designed in order to observe the spatial distribution of the problem in question. They also group useful variables to apply the mitigation measures that help to solve it. Problems with different solutions are not addressed in the same map. In this way, a mapping instrument is created to support the decision of the risk manager.

3.3. The poor development of the mapping of technological hazards

The ancestral understanding of risk as a naturally occurring phenomenon has given rise to the association of hazard analysis with the natural environment and in the field of geography with the area of physical geography. This could be the reason why geography gives very little attention to the study of technological risks, many of which are related to territorial processes and production activities widely studied from the human geography discipline and regional geographical analysis, such as agriculture, livestock farming, mining and industry or infrastructures, among other examples. Since the pioneer studies carried out by the Bosque Sendra group (Rodríguez *et al.*, 1999) on hazard derived from waste management and the subsequent studies on all technological risks, there have been very few studies that have developed this type of hazard which has so much potential for geographical analysis. In relation to the risk of groundwater pollution, we can refer

to the studies by García, Causapé and Abraho (2012) on the danger of nitrate pollution associated to agricultural risks, and those by Andreo *et al.* (2006) which analyse technological hazards of diverse etiology. This section could include studies on groundwater pollution, such as that conducted by Vías *et al.* (2006), which proposes the COP method to estimate the vulnerability or susceptibility of the physical environment to pollution, or Perles, Vías and Andreo (2006), which addresses the vulnerability of the human environment to this problem.

4. Contributions to risk analysis from regional geographical analysis. Towards the concept of a risk territorial pattern

Regional geographical analysis has traditionally applied a perspective of an inter-relationship between the physical and human environment to the study of territorial processes and a spatial integration of hazard and vulnerability through the study of catastrophic events. When addressing risk analysis, however, there is a predominance of studies that merely describe extreme and catastrophic events and their consequences and those that present and describe their spatial distribution. In the same vein, we can find the studies on the risk of fires and their distribution by Molinero *et al*. (2008) for Castilla y León, Balsa, Hermosilla and Lois (2014) for the case of Galicia or those referring to seismic risk by Martínez (2011) for the catastrophic event of Lorca. On the other hand, from a more integrated perspective, the individual characteristics of risk in specific territorial units such as the city, the peri-urban area or the urban-forest interface are also analysed. This is the case of the studies by Alomar (2018) and Moreno (2017) on the influence of the urban heat island on thermal extremes, Tauría *et al.* (2019), who offer a study of the variations in sea level in the city of Valencia, or Rodríguez *et al.* (2017), who observe the characteristics that the surface and underground drainage of urban areas introduces in flood dynamics and how this fact should influence planning. Perles and Mérida (2008) and Gallegos (2015) make a conceptual and applied contribution to the systematisation of risks in the peri-urban environment and Badía, Tulla and Vera (2010) characterise the specific elements of fire when it occurs in urban-forest interface spaces. Other authors, such as Hernandez (2016), Morote and Hernandez (2016) or Mérida (2018), when describing the individual characteristics of the territorial pattern in the new dispersed neo-rural areas for residential use located along the foothills of the Mediterranean coast, also address the repercussions that this territorial model introduces in risk production.

The contributions that further the study on the incidence of territorial patterns and risk production are noteworthy. Burriel (2008), Valenzuela (2016), Hernández (2016) or Nel·lo (2012) describe the disorganisation of the pattern of occupation in the Spanish territory, particularly on the Mediterranean coast and in the cities and the consequences of this organisational chaos on the territorial processes, including risk. In this sense, in a study of the Region of Madrid, Gallardo (2018) observes the high level of fragmentation that the occupancy pattern of the territory introduces into its physical basis, with logical consequences for risk. Macías (2017) analyses in detail the incidence of coastal tourist urbanisation and particularly the space occupancy on risk production.

More specifically, Pérez and Valenzuela (2015) further the study of the relationships between the urban pattern and flood production, and other authors focus on how the specific characteristics of the territorial pattern of certain spaces, the confluence of natural and of individual use characteristics give then a specific casuistry in relation to risk. This is the case of the studies by Pérez and Valenzuela for deltas and/or plains, by Camarasa (2016), Camarasa and Soriano (2014) and Segura (2014) on ephemeral basins and watercourses, Gallegos (2015) for Mediterranean peri-urban basins or the contribution of Romero (2011) on the direct incidence of the diffuse urban planning territorial model on risk generation.

4.1. The concept of a risk territorial pattern

In addition to the studies that describe the pattern-risk relationship, also highly necessary are contributions that, after observing and describing the inter-relationships between the human use pattern of the territory and the natural hazard pattern, take a step further and propose specific strategies or methodologies for making decisions applied to resolving the problems observed; methodologies that facilitate the consideration of the risk pattern in an area when establishing the planning criteria of the towns that are affected. It is essential to continue advancing towards a conceptual model that systematises the spatial relations between the different components of the risk territorial pattern of an area, and which gives rise to common strategies for its territorial planning on different levels.

In the same vein, Perles (2010) proposes a spatial approach to overcome the dichotomy between the physical environment and natural hazard with respect to the human environment and the vulnerability of the exposed elements. When observing risk production from a spatial point of view we can see how risk generation in an area depends on:

- The hazard pattern: spatial distribution of the hazard determining factors (natural, induced or technological).
- The human use pattern: spatial distribution of the different human uses in the territory, whether these uses are risk causing or inducing or receptors of the impact of the risk.

The combination of the two patterns (hazard and use) in the space generate the *Risk territorial pattern*, defined as the spatial distribution of the risk conditioning factors in an area and of the energy, material and population flow networks that interlink them. The structure of the risk pattern is based on three types of components:

- Hazard source areas. Areas of the territory in which the hazard process is generated by natural hazard, human-induced natural hazard or technological hazard. The hazard may be of any type.
- Impact receiving areas. In these areas we can find the elements prone to being damaged, both the population and any type of assets (economic, ecological, heritage, etc.).
- Areas and/or flow lines of mobilisation and/or transport of material, energy and the population, which interlink the hazard source areas and the impact recipients.

The morphology of the risk territorial pattern governs the spatial relationships between the hazard source areas and the impact receiving areas. The form of the pattern is responsible for its dynamics. The consequences or impacts on a hazard prone area depend on whether the risk in the causing areas remains stable, increases or mitigates.

The risk pattern displays a systemic behaviour, articulated by risk territorial units. A risk territorial unit is one in which the morphology and dynamics of the area constitute a system in which the hazard source areas and impact recipients are connected. In this unit, the material and energy mobilisation processes and the transport flows constitute a closed and relatively independent circuit. The behaviour of each spatial unit will depend on the capacity of the territorial system, in terms of its morphology and dynamics, to remain stable during extraordinary events.

4.2. Challenges in the governance and planning of risk spaces

The idea of the systemic functioning of the spatial risk pattern in an area is a key concept for efficient and sustainable planning in a risk area. This idea requires the regulation of the hazard and of the actions that induce it in the hazard source areas, not only in the impact recipient spaces. However, the current legal framework relating to risks in Spain is directed at protecting the area prone to the hazard, that is, the areas in which there is a risk of the population or assets being affected but it does not oblige the control of the hazard source areas. Human actions in risk causing areas in a territory are regulated in Spain by the following regulations:

- the sectoral legislation of some specific activities

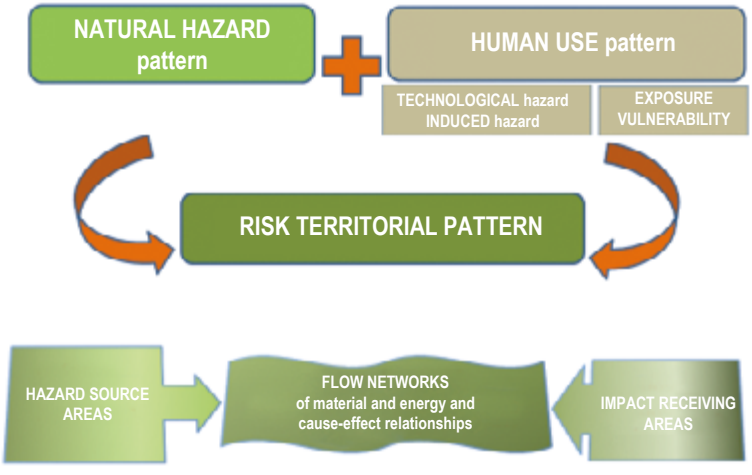

Figure 1. Conditioning factors and constituent elements of the risk territorial pattern

- the Environmental Impact legislation that regulates both private actions and the Plans and Programmes

- Territorial Planning on different levels, fundamentally Municipal Urban Planning

As we can see, the regulations focus on acting in the recipient areas, not the causing areas, therefore the objective sought is to limit the exposure to risk and not the hazard that produces it. In municipal planning, and in planning in general, the zoning criteria guided by urban zoning are used. In this way, uses and limitations are assigned based on homogeneous spatial units of the physical environment which have been generated by the vertical accumulation of factors that indicate the load capacity of the unit. They are units that do not necessarily have to consider the incidence of the processes that are generated in a neighbouring area. On the other hand, the land of a municipality and the Municipal Ordinance Plan that regulates it do not necessarily cover the causing area that affects the risk of the municipality. In short, neither the spatial model used in municipal planning nor the legislation regulating the activities in the territory facilitate the consideration of the horizontal transfers between the causing and recipient areas of the risk territory.

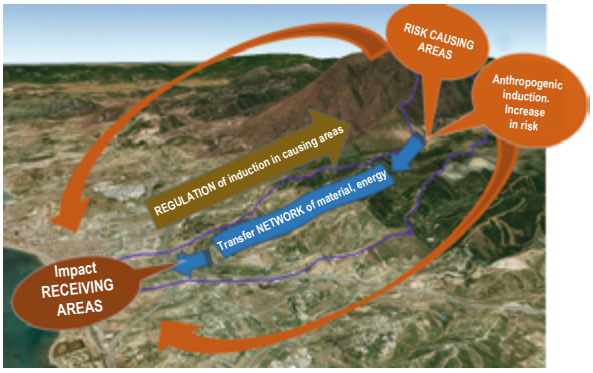

Figure 2. Spatial relationships between the causing areas and the recipient areas of the risk territorial pattern. Systemic nature and gaps in the regulatory development for its planning

The planning of high risk areas and its governance have been addressed by different authors, such as Valenzuela (2016) or Burriel (2008), among others. The latter warns about the need to go beyond planning on a local level when addressing risk issues. Garrido (2014) addresses the relationships between risk and planning regulations on different levels. Other authors study the need to contemplate the systemic nature of certain spaces when managing them. Barragán (2014) offers a specific methodological proposal for the planning and management of coastal spaces that contemplates the coast as a territorial unit, among other matters, due to the specific characteristics and interconnections between its risk processes. Gallegos (2018), meanwhile, proposes a series of criteria for the urban planning of spaces vulnerable to flooding and their governance on different levels. The results reveal inconsistencies and regulatory gaps that hinder effective risk management. The proposal for risk management by Paucar (2016) consists in territorial planning in the urban context. Perles, Mérida and Olcina (2018) assess the flood risk management policies in Spain and carry out a critical analysis of the limitations to the urban planning of spaces with risk. The legal aspects of risk and their relationship with planning have been addressed by Díez (2018) and Diez *et al.* (2018).

As previously mentioned, the contributions that propose specific changes in the legislation or risk planning strategies that go beyond the local level are scarce but highly necessary. Ayala's (2000 and 2002) direct, reasoned critique and proposal of a specific administrative procedure for risk management highlights that this continues to be one of the problems to be addressed in order to construct safety on an institutional level and one of the outstanding issues for geography.

In short, in our opinion, the analysis of the causing areas and the prognosis of their stability, their capacity to sustain anthropic interventions, should be a systematic exercise in hazard and risk mapping geared towards planning. The context of uncertainty and change requires a prudent and well-reasoned management of the role of the risk territorial pattern on a local and global scale as the only road towards the sustainability of human activities in risk territories. Resilience necessarily requires a "*Nueva Cultura del Territorio*" (A New Territorial Culture) (AGE, 2018)

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Accelerated change of land uses and repercussions on risks in the territory. The case of the extension of subtropical crops in the Axarquía of Malaga.

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Abstract

The work is based on the perspective that focuses the genesis of a good part of the processes of environmental risk in human action on the territory. The study area is a small basin located in the Axarquía (Málaga Spain), a region that experiences a very accelerated process of change of traditional agricultural uses towards the intensive cultivation of subtropical tree species. These crops require drastic changes in the hillside morphology in order to terrach them.

It is proposed an analysis of the consequences of the accelerated change of use on the risk processes, both of induction of those of natural origin (erosion, mass movements or flooding) and other technological (pollution of aquifers). Several parameters has been chosen to assess that impact on hazard in order to use them as indicators of the variation of it. The results show a general increase in hazard in this area.

Palabras clave: Natural hazards; Axarquía; subtropical crops; risk.

1. Introduction

Axarquía is a region located east of the province of Malaga (Spain) whose economy has historically revolved around activities in the primary sector, mainly in the farthest areas from its coast. Despite the above, there is still some agricultural activity in those areas of the seashore where tourism has not been able to impose itself. At the end of the 20th century, a large proportion of the local active population was attracted by the boom experienced by the construction sector. The heyday of the construction activity lasted until 2008, and with it the urgent need to change the activity of a good part of the local business. An alternative was the return to agricultural activity through the introduction of subtropical crops, mainly mango. Due to its good acceptance, crops begin to occupy inland areas, peripheral to the alluvial plains, which were traditionally occupied by rainfed crops such as vine, almond or olive groves, and even saltus areas occupied by carob trees and broom shrubs. to be put into production intensively this new crop requires special conditions of terracing or irrigation, therefore, it is necessary to adapt the terrain where it has been introduced. In many cases, this requires

Types of tampering in the terrain	Action	Consequences of hazard (probability of activation, acceleration, intensification, transferring of impacts)
Modifications of the terrain morphology (relative slopes and unevements)	Subsident neo-reliefs: excavations, scarps. Bulcked neo-reliefs: accumulation of mobilized terrains, rubble.	Modification of the natural network of flow evacuation and energy transfer. Production of loose solids Increasing hazard probability from accumulations of by-products (landfills, dumps, stubble)
Modifications of terrain compaction	Excavations, solids removal	Production of loose solids
Modifications of terrain compaction	Asphalting, compaction with machinery, livestock, greenhouses.	Increasing of runoff processes
Modifications of the natural evacuation network of flows of mass and energy	Channel invasion and blockage Building on slopes	Transfer of consequences to unforeseen areas. Dam generation
Approximation (superposition, vicinity) of human activating factors to physical determinants factors	Actions over hazard causing areas (overlapping) Actions near hazard causing areas (vecinity)	Increasing of triggering probability

earthworks for make terraces, which sometimes involves substantially altering the physical characteristics of the terrain with changes in the geometry of the slopes, alteration of soil consistency, elimination of natural vegetation, etc. The outcome involves an alteration of the balances achieved naturally on the slopes and the increasing, by human induction, of natural processes such as soil erosion, hillside movements or flooding. In addition, it is added the fact that production of new fruit trees requires intensive inputs; chemicals used for this purpose may also be dangerous from the point of view of groundwater contamination.

In territorial contexts such as that addressed in this paper, economic and population dynamics are interfering with natural processes in those areas of expansion of anthropic activity. In such circumstances the susceptibility to the activation of hazardous processes is very high, not only because of the special violence of local climatic or geomorphological processes but because of its activation from the human side of natural dynamics that cause risk situations (reconfiguration of sloping, modification of drainage networks, etc.). If, in addition, it is joined human factors which add human exposure to risk (building in prone areas to flooding, mass movements, etc.; constructing communication routes over unfit areas, etc.) territories such as this are reconfigured to the risk propensity. The repetition of similar interferences throughout a region is a clear indicator of the maladjustment of the pattern of human land uses to existing natural dynamics. This circumstance, outlined by Calvo Garcia-Tornel (1984) or Ayala (2002), is specifically raised by Cantarero Prados (2013), who considers that hazard in transformed spaces will be determined both by the natural threat itself and by environmental misfitings derived from actions of human nature that active the natural conditions of hazard. Perles Roselló and Mérida Rodríguez (2010), Cantarero Prados (2013) and Gallegos Reina (2015 and 2019), among others have taken this approaching to study specifically the processes of hazard induction on the coastal spaces of the province of Malaga.

The overlapping of purely natural phenomena with others of anthropic origin necessitates a risk analysis with no longer sectoral approaches but phenomenological, which address the globality of factors involved in risk generation.

Cantarero (2013) summarizes the main reasons for interference of the artificial pattern on the distribution of flood hazard and its associated hazards (soil erosion and mass movements):

The pattern of human uses interferes, therefore, with natural dynamics of this area of study. The putting into cultivation of a quite part of the basin with subtropical fruit trees has required terrain conditioning works that could influence the mechanisms for generating the danger of some natural hazards in the area. For this reason, this work aims to estimate the evolution of the natural danger factor in the area derived from the changes introduced by the intensification of human activity. To do this, the variation in the intensity of natural hazard processes is compared

through the evolution of some parameters that have a direct impact on the generation of the threat. Thus, as partial objectives, it is evaluated the variation of the "slope" and "land use" factors of RUSLE (Renard *et al*. 1997) soil erosion assessing method, the variations in the drainage network and the variation in the propensity to the danger of contamination of aquifers. For this comparison, two reference dates have been taken: one prior to the large start-up of part of the basin, 2011, and another, 2018, after the modifications of the land that have been carried out.

2. Area of study and regional context

The basin studied in this work is placed in Axarquía, a region inside Malaga province. It is specifically located in the northern edge of the Velez-Málaga city peri-urban area. Its size is relatively small (1.65 km^2) and its main channel is the Salinas stream (tributary of the Vélez river on its left bank) that runs from north to south along approximately 3 km. Its exact location can be seen in figure 1. These are its extreme coordinates:

- Northernmost point: 36º 49'16.23'N - 4º05'55.36' W.
- Southernmost point: 36º47'49.60"N - 4º06'42.39" W.
- Westernmost point: 36º47'56.32"N - 4º06'49.38' W.
- Easternmost point 36º48'56.02"N - 4º05'51089' W.

The region where it is located stands out for its mountain landscape, of a certain uniqueness, in which flat spaces, which are scarce, are very well valued due to the implementation of diverse land uses. It highlights its natural landscape, that of a Mediterranean *solana* in southern latitude, which allows a great climatic benignity, and offers, in its descent from the mountains to the sea, a shared and rugged relief, that enhances its mountainous character. It is also remarkable in this region its human organization. It stands out its mountain of farmers, densely occupied and cultivated in the past. Its heritage is understood in the culture and landscape. This way it is found an abundantly humanized mountain space, with endless small settlements and a profuse disseminated habitat, within a heterogeneous and diffuse agrarian landscape, in which the ager and the saltus are frequently confused, that is the reason for a history of vicissitudes of advances and retreats of one over the other.

Its coastline has gradually been opened to tourism, although much less with the intensity of the coast sector located west of the city of Malaga. The mountainous areas that trace the coast are offered as zones of expansion of the new uses of the coastal strip. Such proximity constitutes a potential expectation of tourism activity development,

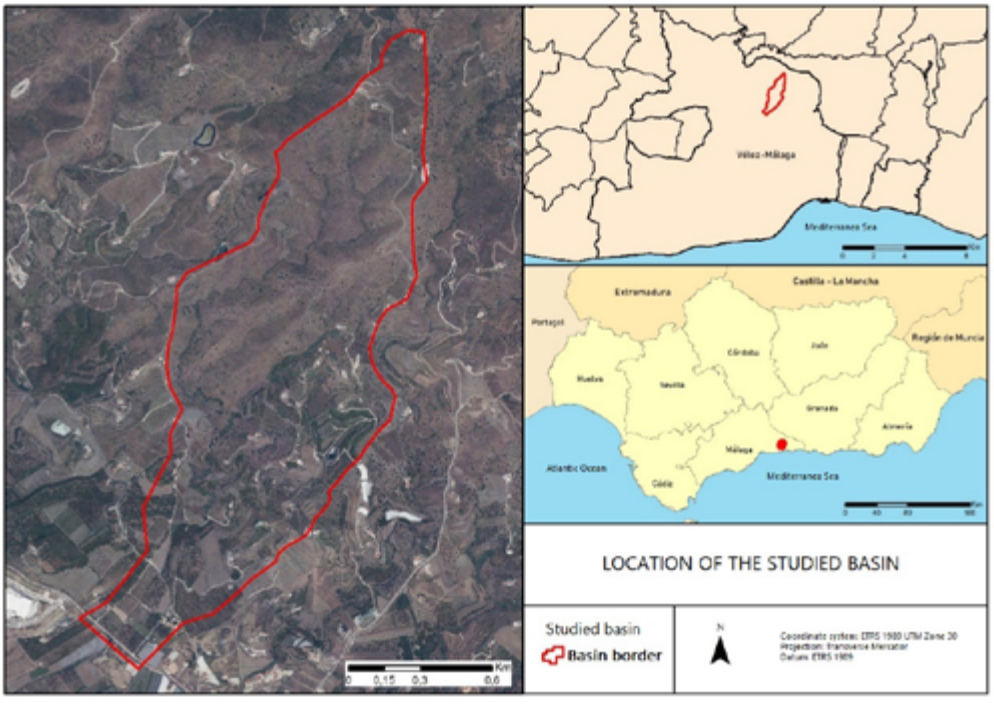

Figure 1. Location of the study area. Salinas stream basin (Velez-Málaga, Spain)

Source: Elaborated by authors using the "administrative reference limits of Andalusia at 10000 scale, 2009" (Datos Espaciales de Referencia de Andalucía, 2019) and orthophoto of sheet num. 1054 (PNOA, 2016)

much more real than in other rural regions, although this entails a greater risk in terms of the processes that triggers the large-scale tourism activity (denaturation, landscape transformation and loss of cultural values).

3. Materials and methods

The methodology applied in this paper is designed to carry out a comparative exercise of the natural hazard degree induced by the configuration of the terrain at two different time points: 2005 and 2018. Specifically, aspects such as erosion, flooding, terrain movements and pollution of aquifers. Several factors related to intensity are chosen to address every hazard in order to get conclusions regarding hazardousness and the influence on it of the accelerated transformation of the terrain in this study area.

3.1. Diacronic cartography of soil uses

This section summarizes in a synthetic and concise way the sources, tools and methods used to create the land use databases for the years 1977, 2005 and 2018, used to carry out the comparative analysis of the land uses and specifically subtropical cultivation in the study basin located in the municipality of Vélez-Málaga. We also must say that ArcMap 10.6.1 software has been used for the elaboration of said database.

The first step was to conduct an exploration of the data sources that already collected geospatial and land use information from the study area, in this case we use the data provided by the autonomous community of Andalusia, but also from the state of Spain.

In the specific case of the present investigation, the sources consulted have been:

- SIOSE Information System on Land Occupation in Spain. Database at scale 1: 25,000 for the years 2005, 2009, 2011 and 2014.
- MUCVA.. Map of Vegetable Uses and Coverages of Andalusia. Database at scale 1:25,000 for the years 1956, 1977, 1999, 2003 and 2007.
- PNOA ORTOPHOT. Orthophoto mosaic of the 2005 and 2018 PNOA in ECW format, ETRS89 reference geodetic system and UTM projection in its corresponding spindle.

For the comparative analysis the years 1977, 2005 and 2018 have been chosen. In the specific case of this research, the sources consulted for the creation of the geospatial database have been SIOSE for the most current dates (2005 and 201 8), while for 1977 the source consulted has been the basis of MUCVA data.

Once the data was downloaded, the land uses for the study basin were split in order to simplify the data as much as possible, then the attribute tables were modified in order to adjust them to the needs of the present investigation. In the same way, the cleaning of the attribute tables was carried out removing everything that did not provide added value.

Finally, once the databases were cleaned for each of the years, three additional fields were created that defined more clearly the land uses of both the MUCVA and the SIOSE, with the aim of creating a definitive oriented database to the study of irrigated crops. Each of these fields was created using satellite images as support for the year of study, the uses that did not match to reality was corrected by photointerpretation.

Finally, each field would collect all data from less to more detailed, the categories of each of the land uses until defining the type of specific crop, said information being used for the realization of the cartography present in this study. Additionally, a field was created in the area for each of the land uses of the study basin to be collected in order to quantitatively analyze the different uses found.

Once the previous procedures were carried out, we obtained three databases of different years with similar crop typologies, obtained and based on different sources (SIOSE and MUCVA).

It is possible to clarify that to obtain the land uses of the year 2018 the method used has been somewhat different, this is because the comparison and photointerpretation has been using the land uses 2014 on an orthophoto updated to the year 2018, existing, by therefore, greater needs to rectify land uses through photointerpretation and editing of the use layer with the ArcMap software.

Finally, so that the figures on the spatial databases of the crops of the years 2005 and 201 8 are closer to reality, those territorial elements that do not correspond to crops, that is, roads, were removed from agricultural plots, paths, tracks, etc. For this purpose, the cadastre and BTN25 information has been used.

3.1.1. Assessment of the incidence of land use change in the risk generation

The impact that changes in land uses have on both the hydrological response of a basin and other hazards such as soil erosion or slope slide, has been abundantly documented in the scientific literature, also being approached from different perspectives. Among these, those that refer to runoff modifications in response to changes in land uses, or the study of the spatial variability of urban areas and their effect on runoff generation (Camarasa *et al*., Stand out) 2018; Gallegos and Perles, 2019; Hammani, 2016; Battle, 2013; Gallegos and Perles, 2015; Conesa *et al*., 2011; Linares *et al*., 2009; Liquete *et al*., 2008; Bari *et al*., 2005; Landphair and Klat, 1998; Brown, 1988). Especially interesting works in this area are those provided by Bodoque (Bodoque, 2006, 2007), in which it evaluates different scenarios of the relationship between geomorphology and hydrology, including different methodological analyzes of water erosion, slope stability or edaphic quality.

Land uses have been obtained by digitalization, using a 1/500 work scale, on orthophotos at 1/10,000 scale in 2005 and 2018 (REDIAM, Junta de Andalucía). The software used has been ArcGIS 10.7.

In relation to land uses, a particular case of hazard in the study area is water erosion due to the frequency of deposits, excavations, fillings and discharges of inert deposits. These are easily mobilized, without waiting for a stormy event. In addition, the fact that the basins are made up of metamorphic materials is added. These are formed in thermodynamic conditions very different from atmospheric conditions, resulting in a mineralogy highly sensitive to weathering processes. In their alteration, they produce an earthy substrate of sandy-silty nature, with great ease of disaggregation, which also helps with poor plant cover. This favors the processes of superficial erosion in laminar regime, and in certain points in linear regime, producing furrows, ravines and gullies (Yus Ramos *et al*., 2004).

To quantify this fact, we work with the C factor, of plant cover or land uses, of the Revised Universal Equation of Soil Loss (RUSLE). This factor measures the influence of vegetation cover on the ground, which is especially relevant as it is the most effective means for erosion to decrease. Factor C is based on the concept of standard deviation, the standard being an area under fallow conditions with a clean crop in which case its value is 1. Initially with this factor the crop management was considered, but by extension, for non-soil agricultural, has been assimilated to the value of protection exerted by the vegetation cover, whose percentage of land cover is inversely related to the erosion rate. Its value varies between 0 and 1 and decreases as plant cover increases. This factor is decisive in the soil retention flow, and its value appears in the model as constant, entered manually from a table proposed by ICONA. This led to the fact that in the approach of the LUCDEME project studies (ICONA, 1982), whose results were published by ICONA in 1982, factor C was also analyzed in a simplified manner. In this way, the different types of vegetation mapped on the Map of Crops and Harvesting, carried out by the Ministry of Agriculture, were grouped and assessed in a series of types of roofs that have been used in this work. These values reflect how the areas of natural vegetation, in which there is a certain power in the development of it, the soils are quite protected because they usually have dense vegetation in the aerial part (tree top) and in the underground part (roots) , thereby decreasing the kinetic energy of the rain and avoiding soil destructuring.

3.2. Evolution of the drainage network

The drainage network has also been drawn up for the periods of 2005 and 2018. In both cases photointerpretation has been the procedure for its delineation. High resolution orthophotographs have been used with the aim of detecting any change even if it is slight. Specifically, the images used have been available in Google Earth © for the dates April 11, 2005 (Maxar Technologies, 2019) and June 17, 2018.

In addition, homogeneous relief units have also been delineated. Rules applied for its mapping were based on hydrological and morphological criteria. Segments of the water network has been the basic principle for its definition and, if uniform units are not achieved using that rule, then the procedure has used orientation and slope criteria to, finally, profiling hillslopes that contains terrain whose topographic characteristics are similar.

3.3. Comparative of the incidence of changes in the quality of underground waters

To study the hazards of pollution from human activities, which potentially affect the quality of groundwater, there are several approaches. The POSH (Pollutant Origin and Hydraulic Sucharge) method of Foster *et al*., (2001) analyzes about thirty potentially polluting activities, the DCI method (Danger Contamination Index) of Civita and De Maio (1997)

analyzes 41 activities, the DRA (Detailed Risk Assessment) method of Darmendrail (2001) analyzes 67 types of danger and incorporates the amount of substances that can be emitted to the medium and, finally, the method HI (Hazard Index) De Keteleare *et al*., (2004) that, in addition to analyzing more than 90 human activities and taking into account the amount of contaminant that can be discharged, includes the probability of spillage.

In this work the methodology developed by De Keteleare *et al*., (2004), which was developed by a group of researchers within the framework of the European COST Action 620 program, in the early 2000s, and whose main objective was to study the risk and vulnerability of aquifers to pollution from groundwater (Zwahlen, 2004).

The HI method is based on a numerical index that takes into account three factors. The first factor, which largely determines the final result of the index, is related to the toxicity of substances that can be emitted from the natural environment through various human activities. In total there are 96 human activities (with a variable score between 10 and 100) that during their operation can emit potentially polluting substances. The other two factors are corrective factors for this initial toxicity and are related to the quantity (whose values can vary between 0.8 and 1.2) and the probability (whose values can vary between 0 and 1) that these substances potentially contaminants can be emitted to the natural environment.

The product of the values of these three factors gives rise to the HI index that can vary between 0 and 120 and measures the degree of danger of human activities for the potential contamination of groundwater, 0 being the minimum value and 120 the maximum value of danger. The various values that the index can take are classified into five intervals that indicate the degree of danger of human activities on the environment in a relative way, as indicated in figure 2.

HI score	Hazard Class
(0 - 24)	Very Low
(24 - 48)	Low
(48 - 72)	Moderate
(72 - 96)	High
(96 - 120)	Very High

Figure 2. Classification of the Hazard Index according to De Keteleare, et al., (2004)

From the Land Use Information System of Spain, field work and photointerpretation, tasks mentioned in previous epigraphs, the potential danger of human activities for the contamination of groundwater in the study area has been evaluated in two historic moments: 2005 and 2018.

4. Results

Once the procedures detailed in the methodological section have been applied, the main results obtained are presented below.

4.1. Incidence of the use of soil in the water erosion evolution and risk of mass movement

Based on the results of factor C, vegetation cover or land use, the land movements made for the implantation of subtropical crops have doubled the risk of potential soil erosion.

Cartographic results are represented in figure 3. For 2005, the average value of this factor was 0.223 and for 2018 it amounts to 0.443. It should be taken into consideration, however, that this is a transitory situation, since once the subtropicals reach a certain maturity, the potential erosion decreases with respect to the potential erosion of the previous rainfed woody crops.

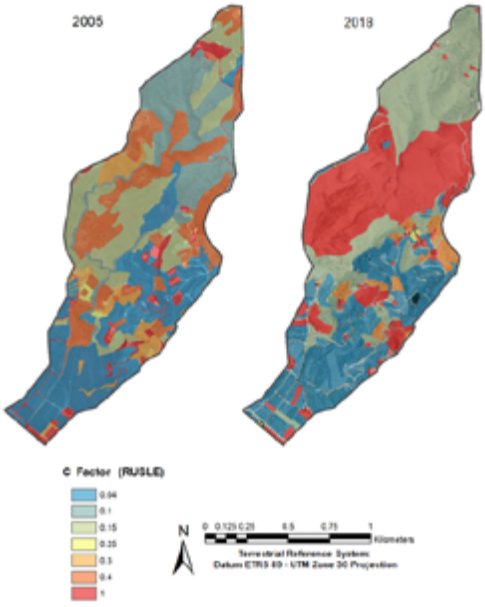

Figure 3. Distribution in the study area of C factor of Land Uses (RUSLE) for the dates 2005 and 2018. Higher values indicate a greater predisposition to soil loss

Source: Elaborated by the authors based on images provided by Google Earth for the dates April 11, 2005 (Maxar Technologies, 2019) and June 17, 2018 (Landsat / Copernicus)

On the other hand, in relation to the susceptibility to hillside movements (figure 4), we find a similar scenario, manifesting a considerably greater hazard on the most recent date, both in response to the susceptibility of land use, as well as the existence of new reliefs and easily mobilizable aggregate deposits in case of runoff.

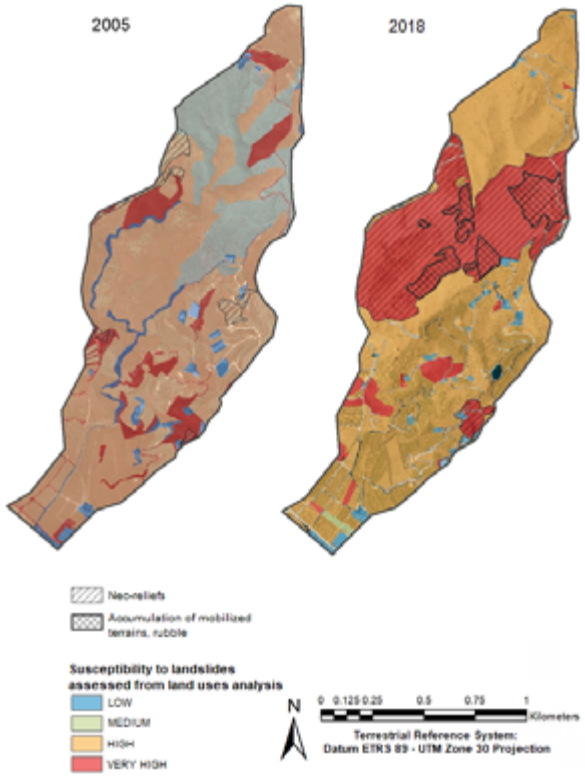

Figure 4. Diachronic analysis of the susceptibility to hillside movement based on land uses changes that have taken place in the study area. Beyond the own susceptibility of land uses, the existence of new refliefs means a medium susceptibility, and the existence of aggregate deposits a high susceptibility

Source: Elaborated by the authors based on images provided by Google Earth for the dates April 11, 2005 (Maxar Technologies, 2019) and June 17, 2018 (Landsat / Copernicus)

4.2. Hydrological features involved in the variation of natural hazards

The traced network in this basin, whose main stream is called Salinas, has a dendritic pattern tending to parallel. Being elongated and small, the stretches of channel that dissect it are not excessively long. Precisely the largest of all in 2005, with 650 meters in length, has been eliminated after the work that has modified the terrain in 2018. This modification is not the only one artificially practiced in the area. The cultivation of part of the basin has led to modifications. Some, even before 2005, can be observed in the southeast area of the basin, where artificial terraces have fragmented and isolated sections of riverbed that in the 70s ran straight to the main channel of the Salinas stream.

Specifically in the comparison period that concerns this work (2005 and 2018) the greatest change that is noticed is the disappearance of the aforementioned channel located in the central area (indicated in figure 5). In 2005, its receiving area had an area of 0.324 hectares. The rainwater that now precipitates in its former sub-basin has been diverted to the surrounding basins, and a small fraction will be directly received in an irrigation pond located in its upper area. In addition, another change that deserves to be mentioned is the appearance of two new small carved channels on the material removed from one of the areas located in the upper part of the transformed terrain. These are the product of the high erosion observed in that area, whose effects are detected in the aerial photograph (map "d" in figure 5) where a large portion of the heavily excavated terrain is observed.

Consequences in the generation of hazard are of differenced sign and varied. On the one hand, the new channel is longer and all kinds of vegetal elements that provide roughness have been removed on it. Being longer it can help to laminate possible avenues, while its low roughness together with the new, more rectilinear artificial layout, will print more evacuation speed to the flow. The land modification works have drifted approximately half of the water that the nearby channel suppressed in 2018 (figure 5) into this section. This circumstance forces to increase the section of the channel, because in addition the elimination of vegetation implies an increase of runoff because of the decreasing of the runoff threshold. Indeed, it can be observed that the works have widened it, however, despite this, it should be taken into account that the susceptibility to the obstruction of this new, artificially elongated channel, is perhaps higher than in its old natural state. This is happening because the works have placed on the same river branch several bridges of small section that did not exist before and that are now necessary for the passage of machinery or vehicles that require access to the brand-new agricultural plot. The probability of blocking of those structures is high because it is still observed that the terrain in this area has been removed and vegetation has been eliminated. In relation to these processes of hydric erosion, it is observed that they mainly affect the upper part of the transformed area. Its activity joined to runoff processes could involve an increase of flood hazard intensity caused by the contributions of solids that can be generated after the implementation of the works, something that did not happen before the works,

at least as intensely, because the natural vegetation was protecting the substrate before been removed. In addition, not only the lack of protection provides solid contributions; even greater could be those caused by the lands removed and deposited in some parts of the basin, as indicated in section 4.1 dedicated specifically to these processes.

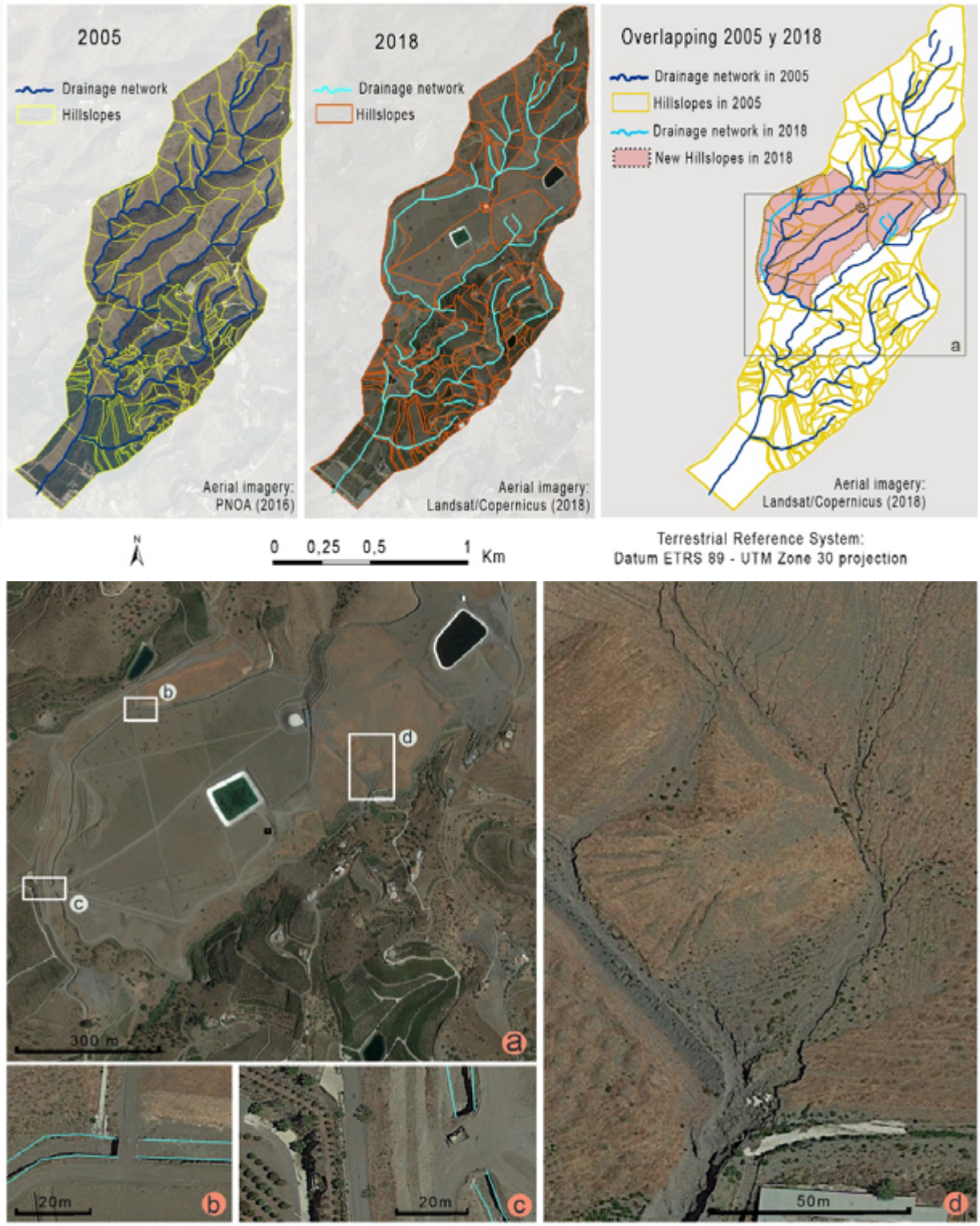

Figure 5. Drainage network comparison (years 2005 and 2018) and details related to hydrological functioning in the area recently modified to be put into cultivation

Source: Elaborated by the authors based on the images provided by Google Earth for the dates April 11, 2005 (Maxar Technologies, 2019) and June 17, 2018 (Landsat / Copernicus)

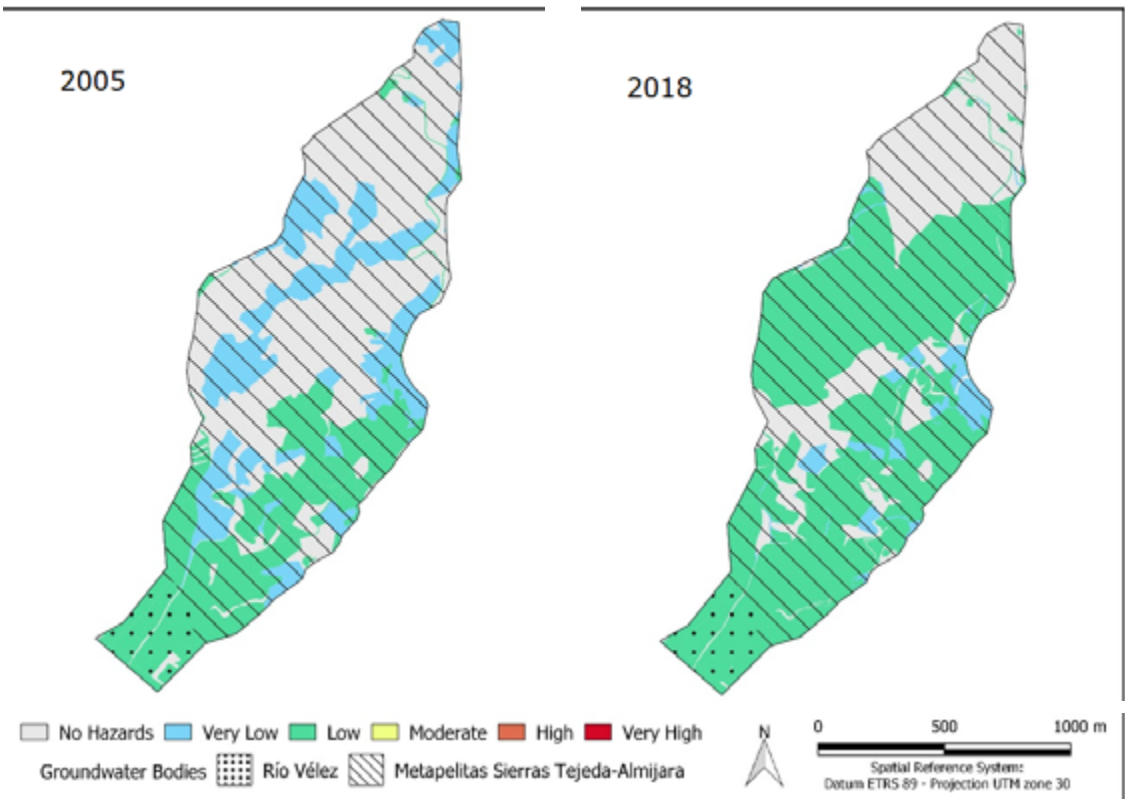

Figure 6. Distribution of groundwater bodies and hazards index mapping to groundwater contamination in the study area
Source: Elaborated by the authors

4.3. Evolution of hazard of pollution groundwater

The results obtained (figure 6) show, in general, a low class of HI to the groundwater contamination, as a result of the predominance of activities that generate a low impact on the quality of groundwater. In the study area, agricultural activities and, to a lesser extent, activities linked to human infrastructure predominate, in the case of the presence of rural houses and access roads to houses and farmland.

However, there is clearly an increase in the hazards between 2005 and 2018, especially in the central part of the study area, due to the production of land that had abandoned crops or was simply natural vegetation spaces. The cultivation of subtropical products has led to an increase in the danger on the ground by the introduction of a type of intensive agriculture in the use of fertilizers and pesticides, regardless of whether agricultural practices are optimized to improve the economic performance of the production of subtropical products, such as avocado. The new irrigation systems of the farms entail an environmental benefit by reducing the use of water and by optimizing the use of fertilizers, thanks to drip irrigation implanted in all the new farms put into operation in the study area.

In the study area, the predominant human activity is agriculture. According to the factor H of the HI method, the rating of intensive farming areas is 30. Taking into account the corrective factor Qn, relative to the amount of pollutant, varies between 0.8 and 1.2, the value of HI for agricultural areas can increase up to 36. That means that, at most, agricultural activity can reach a low class hazard, since the Rf factor, which varies between 0 and 1, can reduce the danger, but never increase it.

On the other hand, the HI method assesses the danger of each human activity in isolation and does not take into account the synergistic effects that are produced by the concentration and accumulation, in a given area, of potentially polluting substances. This fact is especially significant and relevant in agricultural areas on detritic aquifers in alluvial plains. In this type of natural environment, groundwater flows tend to be concentrated in certain areas of the aquifers, so that pollutants that are carried by groundwater are also concentrated in those areas, with the consequent increase in negative effects in the quality of groundwater. This fact has been present in the history of the alluvial aquifer of the lower course of the Vélez River, bordering the study area, which has been contaminated by nitrates for several decades,

being declared by the public administration as an aquifer vulnerable to nitrates.

The test site is located on two groundwater bodies (figure 6). The groundwater body 060.065, called Metapelitas of Sierra Tejeda-Almijara, has a low permeability of the materials and occupies 95% of the subsoil of the study area. The 060.027 groundwater body, called Río Vélez, is formed by lands with medium permeability and occupies only 5% of the subsoil in the southern part of the study area.

The río Vélez groundwater body is made up of two types of materials: alluvial sediments, such as sands, gravels and Rolling Stone holocene from the Vélez river and sediments such as silts, and marls. In the southern part of the study area, the groundwater body occupies loamy and silty lands of pliocene age and less permeability than alluvial materials of holocene age, which are not present in the test site. The rest of the study area, the remaining 95% of the northern part, is located on materials of the type mica schist and phyllites of Paleozoic age and low permeability, which provide natural protection to groundwater.

These characteristics of the study área, largely determine the vulnerability of the land to store groundwater bodies. In fact, according to the vulnerability map of the REDIAM (Environmental Information of the Andalusia Goverment), the test site is located in areas of Low or Very Low vulnerability, which gives the groundwater a high natural protection.

The overlap of the aquifer vulnerability with the hazards from human activities, allows a preliminary estimation of how the risk of contamination of groundwater in the study area would be, even in the absence of data on exposure and vulnerability of the elements exposed to risk of contamination. A priori, that estimation provides a low and, preferably, very low degree of risk of contamination of groundwater, regardless of the increase that has occurred, in the last years, of the hazards from human activities on groundwater bodies. This is because they are located on areas that does not show a high volume of groundwater and that has a very high natural protection capacity. The results obtained by Vías (2005) in the Vélez river aquifer, in which the vulnerability was high and even Very high and the contamination risk values were low, take that estimate for good. The test site is located on a groundwater body of low permeability and low volume of water resources, that is, low vulnerability and low exposure, which together with the low hazard makes it logical to assume a very low risk class.

Regardless of the results obtained by the hazard mapping and the estimation of the risk performed, the result of the hazard is highly conditioned by the evaluation method of the Hazard Index. HI method does not take into account the synergistic effect of very close activities in space that may increase the concentration of pollutants in the environment and, therefore, the hazard of these activities for the quality of groundwater. A recent study by Romero (2019) shows how the concentration of human activities in the natural environment increases the pressure on natural resources, in particular, on the quality of groundwater, with the consequent increase of the hazard.

Furthermore, the HI method does not take into account the flow of pollutants through surface and groundwater, which are especially relevant in valley areas. The proximity of the study area to the detritic aquifer of Río Vélez, and the hillsides adjacent to the entire aquifer, are a clear example of how activities carried out in the vicinity of the alluvial aquifer of the Vélez river endanger the quality of groundwater will eventually reach the unsaturated and saturated area of the aquifer and, therefore, could contaminate the aquifer. The HI method only takes into account the hazard of the activity carried out in situ, and not the consequences that could be derived from the entrainment of polluting substances by surface and subsurface runoff. This lack is a clear example of two events that occurred in times of heavy rainfall. On the one hand, in 2010 strong increases in the concentration of nitrates in groundwater (in areas of low danger) were detected as a result of the leachate that occurred during the intense rains of the spring of that year, which dragged a large amount of Nitrogen accumulated in the soil for years by agricultural activity, but which, given the lack of rainfall, common in Mediterranean climate environments, were not mobilized until the arrival of an extraordinary rainfall event. On the other hand, this same process of leachate of the soil and drag of the nitrate of the soil to lower levels, had as a consequence that the production of an avocado farm did not reach the required quality levels and were withdrawn from the market, with the consequent economic losses for the owner of the farm.

In summary, the hazards of the human activities in the test site to negatively influence the quality of groundwater is low. There is a high anthropic pressure in the surroundings of the alluvial aquifer of the Vélez River, which is declared vulnerable to nitrates, and the exploitation of new land for intensive agriculture of subtropical crops adds another threat to those in recharge areas of the aquifer.

5. Final reflections

The analysis of the results points to a general increase in the hazard in the area, something that agrees with what has been expressed in other similar works (Gallegos, 2015 and 2019; Cantarero Prados, 2013; Perles, 2010) in the region object of this study. It is also worth mentioning that those observed hazards have a synergistic and concatenated character, so it would be worthwhile to deepen the study or simulation of these through multi-hazard modelling strategies in a manner similar to that practiced by Perles and Cantarero (2010). It would also be worth considering different scenarios depending on the phase or moment of action on the hillslopes. In this sense, it is worth highlighting that the most critical moment is the one in which the movements of the terrain are carried out. Subsequently, once the transformation of the land in the area is consolidated, with the fruit trees already in production, it is logically expected that the runoff coefficients and the contribution of solids to the flood stream will decrease, however, it would also be worthwhile to track monitoring. For this purpose, variables similar to those used in this work could be chosen. In this sense, for example, to measure erosion, high-resolution topographic survey techniques could be used with drone support or simply using three-dimensional photo-reconstruction techniques in selected plots. In this sense, the works of Gómez Gutiérrez *et al*., (2014), Errea *et al*., (2014) or Gómez *et al.,* (2018), among others, can be taken as an example.

6. Conclusions

The studied area has undergone an accelerated change of land use that has also implied the modification of a large part of the relief of the Salado stream basin. In a short period of time: from mid-2015 to summer 2017, earth movements can be observed in the aerial photographs consulted, being especially notable on February 2017. Luckily, despite the earth movements, the probabilistic component to which the natural risk processes are subject "has respected" this whatershed with not very extreme rains during the hydrological years extended throughout the area covered by this study for the duration of the land adaptation works.

From the perspective of the natural hazards addressed in this paper, it can be concluded that all of them, in some measure, could experience an increase in their intensity in case of being triggered by extreme rain event. Erosion is the process that most obviously experiences this increase; This is shown by the estimates of slope values and land uses (RUSLE) and can also be checked by observing the gullies of figure 5 (map "d"). It can be expected a possible attenuation of the severity of the natural hazard indicator factors studied in this work (erosion, hillside movements and flooding) after the earthworks stage (2015-2017). Susceptibility to aquifers contamination is the exception to what it has been said as the entry into production of the subtropicals will may require chemical inputs to the fruit trees.

Terrain transformation responds to a favourable economic moment (demand for subtropical fruits by the European market). This intervention on slope stability control parameters of the requires, at a later stage than that of the adaptation work itself, maintenance and control of natural processes, such as erosion. This dependence on commercial factors may cause that the maintenance of the operations of conservation of the intervened slopes would be at the expense of the economic situation. In view of the above, a possible abandonment due to economic causes would entail a probable degradation of those operations and the consequent increase in the soil erosion, with an aggravation, in addition, of some other phenomena such as flooding or gravitational movements.

Spanish environmental legislation effectively provides control measures in earthmoving operations such as those that have transformed part of this basin, however the specific factors that determine the danger in basins suggest incorporating concrete recommendations focused on controlling flood risk (and its associated: erosion, gravitational movements, etc.) based on the worsening of its consequences by virtue of temporal or spatial aspects (specifically locational or of specific location on the basin). In this sense, it should be checked that the work of movements of the terrain can only be carried out during the dry season, in the same way that any type of fire in summer is prohibited in forest areas. On the other hand, in addition to the precautions derived from the aforementioned circumstances, it would also be necessary to contemplate the human exposure (people and property) existing specifically downstream of the area where the movements of the land are made. In this sense, it is necessary the maximum control of interventions such as these, so altering the substrate, in order to avoid disasters lived in the same region (for example, in Rincon de la Victoria in 2002) with similar conditions where the factor of greater danger was the solid load transported by the flood. In view of the results, it seems necessary to take

into account the mediterranean geo-systems, of rexistatic characteristics, are especially sensitive to the change of any of its components, but especially to the alterations of the relief and land uses. To these circumstances must be added the current context of climate change and the predictable increase in episodes of DANAs on the shore of an overheated Mediterranean (Gallegos and Perles, 2019). These storms likely act as triggers of the hazardousness studied in this work. It would be convenient for this reason, before authorizing changes in the land uses of the relevance of those considered, to include detailed studies of natural risks that previously analyze the environmental changes and their main hazards.

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Integrated multiple hazard assessment associated with the road infrastructure environment. Application to roads in the province of Malaga (Spain)

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Abstract

The study of risks near roads has been mainly addressed in the literature from a sectorial perspective, analysing independent processes linked to danger generation. In this work, infrastructure and its environment are considered an unique space of risk, proposing an integrated method which contemplates the simultaneous interaction in space of several kinds of threats which generally appear together in case of torrential rains: mass movements, dislocations of the road by substrate subsidence, artificial blocking of drainage systems due to solids moved by water erosion, flooding over the infrastructure in case of heavy rains, and flooding by overflowing of adjacent riverbeds. The proposed methods have been developed using a statistical approach, and the have been applied to several study areas in Southern Spain. We have implemented a semi-automatic GIS application, and the results show promising efficacy of the developed algorithm in order to predict critical points in roads.

Key words: multiple danger; road infrastructure; mass movements; floods; risk management.

1. State of the art

The study of risks related to linear road infrastructure (such as roads, railways and the like), requires a particular analysis of susceptibility factors, since these are environments that are highly altered by anthropic intervention. In them, the mixture between natural and artificial characteristics modifies the conditions of the transportation activities, as Luce and Wemple (2001); Perles and Cantarero (2010), and Corominas *et al*., (2013) have pointed out.

However, given these complex contexts, there has been a general tendency to address sectoral analisys by different specialists in each subject, studying the different types of risk as separate processes, while the integral perspectives have been approached more theoretically than in an applied way (Cutter, 1994), or at work scales closer to the informative than to the direct application (Greiving, *et al*., 2004).

As regards the susceptibility maps of the territory to mass movements, there are abundant study examples

of natural environments in the literature. In general, geomorphological methods have been used first, and they have subsequently been refined incorporating multivariate statistics and GIS techniques (Chacón *et al*., 2003, Guzzetti *et al*., 1999; Ardizzone *et al*., 2002; Carrasco *et al*., 2003, Gonzalez-Jimenez *et al*., 2007, Fell *et al*., 2008, Felicisimo *et al*., 2013, Razavizadeh *et al*., 2017, among others). Despite its direct interest in assessing risks in road infrastructure, susceptibility to mass movements in roads environments has been treated less frequently; in that sense, the works of Chau *et al*., (2004), Remondo *et al*., (2005), Ayalew and Yamagishi (2005), Ataollah *et al*., (2012), San Millán *et al*., (2016), and Sortino *et al*., (2016).

Faced with these strategies of sectoral approach, multi-hazard and integrated perspectives should be implemented in study methods, in order to carry out a homogeneous analysis considering the various cases existing in these natural-artificial interface spaces, considering equally natural and artificial factors, and contemplating the synergistic effects that may occur. Therefore, authors such as Casale and Margotinni (1999), Perles and Cantarero (2010), or Perles and Mérida (2010), propose a broad approach based on the general equation of risk and the concept of integrated risks. This type of integrative perspective, which effectively considers the interactions between the different risk processes, has been developed in works such as those of Montz (1994), Delmonaco *et al*., (2006), or Lexer *et al*., (2008).

Several authors have recently pointed out the context of opportunity for the development of predictive methodologies that serve as a support for disaster prevention in critical infrastructure (Zhao, *et al*., 2018), especially in a scenario of foreseeable increase in risks due to change climate (Razavizadeh *et al*., 2018; Petrucci & Pasqua, 2012; Cutter *et al*., 2018). Risk prevention in this type of infrastructure is leading to the enactment of specific laws for the protection of critical infrastructure, such as the European directive 2008/114 / EC. In the case of Spain, this trend is manifested in Law 8/2011, and the creation of the National Center for Critical Infrastructure Protection. Similarly, the recent modification of the Spanish Environmental Impact Law, (9/2018), from Directive 2014/52 / EU, brings as a novelty the obligation to include in the environmental impact study an analysis on vulnerability of projects in the event of serious accidents or catastrophes, about the risk of such accidents or catastrophes, and about the probable significant adverse effects on the environment, in the event of their occurrence. The aforementioned law refers specifically to critical infrastructures, by excluding repair or improvement works from the environmental impact assessment if they have been damaged by catastrophic events.

2. Objectives

The main objective of this work is to present a methodological proposal that integrates various hazard processes that occur in the infrastructure itself and its environment, activated by episodes of torrential rains (problems related to water and gravitational processes). Different types of danger can interact and cause complex risk situations. The method makes it possible to assess these hazards, first individually and subsequently as a whole, and establishes the interaction of each with the road infrastructure.

Therefore, the main objective of the methods section is to identify conflict points due to multiple danger, by establishing a mapping that gives priority to the neediest points of mitigation, in order to improve the management of road infrastructure risk.

The specific objectives pursued in the development of this work are the following:

- Analysis, evaluation and mapping of the susceptibility of the infrastructure environment to hazards that can be activated by torrential precipitation events, such as the following:
  - Movement in mass, both landslides and landslides on the slopes adjacent to road infrastructure.
  - Land collapse on the slopes underlying the road infrastructure.
  - Road flood.
  - River overflows caused by obstruction of transverse drainage works (culverts), product of sediment and vegetation drag.
- Identification and mapping of sections of roads that may constitute conflict points due to the confluence of different types of hazards.

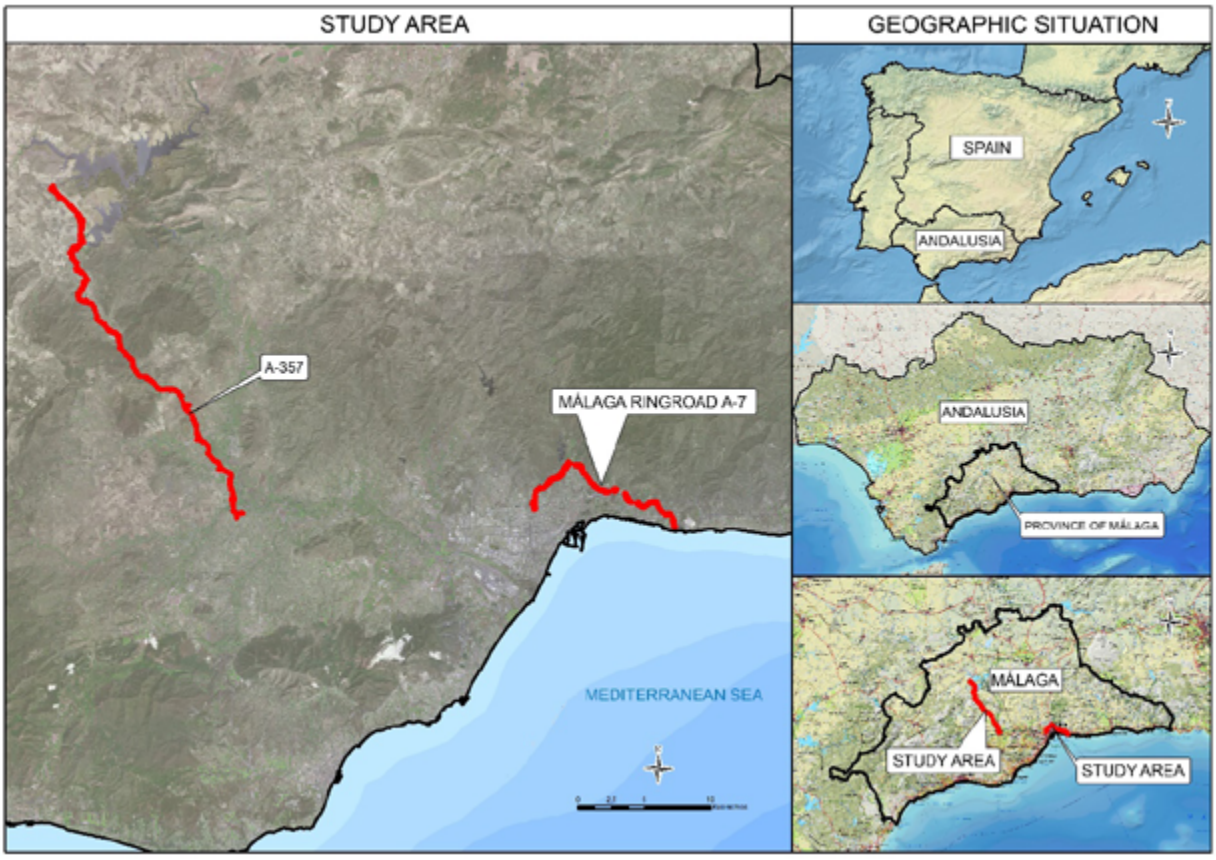

Figure 1. Sections of rad infrastructure selected as a study area
Source: own elaboration

3. Study area

The study area of this work corresponds to the province of Malaga (Andalusia, Spain), in which several sections of the road network have been analysed. We have selected two spaces with past experiences of flooding of roads due to obstruction of the culvers existing in the road, as well as experiences of rockslides and landslides of the slopes modified by artificial transformations in direct contact with the road infrastructure. The sections selected are the ring roads of the city of Málaga (MA-20, A-7 and MA-24, in that sequence, both ways and roads) and the regional road A-357, which articulates one of the greatest interior axes of the province: the lower course of the Guadalhorce River, the main area of influence of the city of Malaga towards the interior of said province (figure 1). The selected sections run through areas where a very active morpho dynamics has been detected, and a high potential danger due to the existence of high slopes on the surrounding slopes, highly mobilizable lithologies, high runoff coefficients, etc. In addition, these areas are characterized by their remarkable traffic volume, and a high exposure of the population and economic activities, given the importance of these roads in the accessibility to the regional centre of Malaga and, from it, to the Guadalhorce Valley; it is a definitely fundamental axis for the proper functioning of the local economy.

4. Methods

The methods proposed in this work focuses on the integrated assessment of the different hazards that can be activated after torrential precipitation in the environment of a road infrastructure. In detail, we perform an evaluation of the danger associated with mass movements, collapse of the firm, flooding of the roadway, or scope of the road due to overflows of surrounding channels. All of them can affect the road and generate conflictive points due to traffic cuts, and, ultimately, important territorial dysfunctionality.
This method aims to unify the consequences of all the danger points through the spatial vector, in order

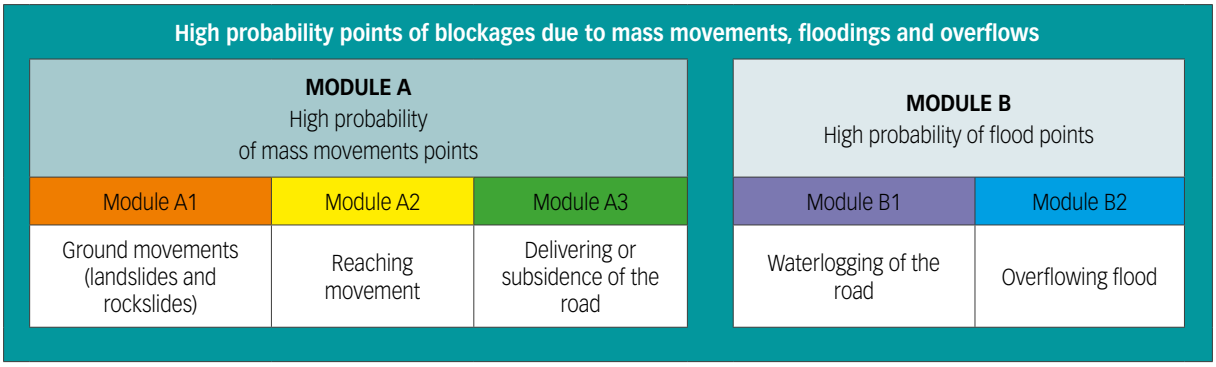

Figure 2. Modules that integrate the methodology of evolution of multiple hazards in road infrastructure environment

Source: own elaboration

to solve in an integrated way the generation of problem points after an exceptional event (Perles *et al*., 2019).

The methodology addresses the different types of danger through two modules: A, which brings together the hazards related to the movements of the terrain, and B, which considers dangerous processes related to water. The module related to the movements of the land develops three aspects of analysis: the probability of mobilization of land, the scope of the material mobilized and the possibility of collapse of the firm. Module B, meanwhile, is subdivided into two modules related to water. The first one analyses the problem of flood that can occur on the road after an extreme event of precipitation. A second sub-module focuses on the problems of overflow of riverbeds that may affect different sections of the road (figure 2).

4.1. Module A1: Ground movements

This module is dedicated to assess the susceptibility to mass movements on the slopes adjacent to the road infrastructure. Module A1 develops an evaluation procedure based on a deterministic model, in which the susceptibility to the mobilization of the land is calculated considering the concurrence of factors predisposing to instability on each slope. Similar techniques and works have been applied by authors such as Barredo *et al*., (2000), Razavizadeh *et al*., (2016), Wei Chen and Zhou (2016), or Yilmaz (2009), among many others.

It is based in the hypothesis that on the slopes with signs of mobilization already verified (previous events), the variables that determine the probability of mobilization of the land are playing an important role. Therefore, if these factors are identified of susceptibility to mobilization, a high probability of future occurrence of ground movement in other study areas can be predicted. For this purpose a predictive mapping model of susceptibility has been developed. The creation of the predictive algorithm of the susceptibility to mobilization is based on a statistical cause-effect analysis, a model of the relationship of spatial coincidence between the predisposing factors, which act as predictive variables, and the presence of indicative signs of mobilization in the same area In this same line there are other works that have obtained susceptibility results and differentiated algorithms for susceptibility to slippage and detachment (according to Varnes classification, 1978). Simultaneously and in order to verify the validity of the results, we have worked on the application of two different methodological procedures for the creation of the predictive model, on the one hand, a frequency-based analysis, and on the other hand a logistic regression binomial Once the results have been obtained, both predictive models have been subjected to a comparative process and have undergone a test in order to know the degree of success and their effectiveness, in order to validate the model.

The hillside has been used as the spatial unit of analysis in the elaboration of the indexing model (Carrasco *et al*., 2003). The statistical universe has a total of 564 hillsides, which have been analysed in order to create the susceptibility model. The development of the method consist in a series of analytical phases, which are described below:

a) Delimitation of adjacent hillsides to road infrastructure

The slopes surrounding the road infrastructure are considered the basic physiographic units of study, and all of them have been identified and delineated. The first condition that has been defined on each slope is its position with respect to road infrastructure. For this

reason, we have defined two types of slopes: 1) those overlying the road (position above the infrastructure), and 2) those others underlying (which provide physical support to the infrastructure). To define them, a Digital Elevation Model (DEM) of 5x5m resolution (National Geographic Institute) and orthophotos of the area (National Aerial Orthophotography Plan) have been used. For the definition of slopes there has been a semi-automatic tool for calculating slopes to the road, which has been very helpful. However, to obtain the required precision, the final delineation relies on photointerpretation through orthophotography and on different types of topographic, slope, orientation and shading of false relief. Through this procedure, a total of 564 slopes have been delimited in the study areas.

b) Inventory of historical land mobilization points on the slopes of the study areas (binomial dependent variable: falls / does not fall)

In this section, the empirical evidence of land movements that occurred previously on the different slopes has been inventoried and mapped, information that constitutes the dependent variable for the deduction of the predictive model. The data inventory has been supported by the following works and procedures:

- Cabinet work (photointerpretation and Street View application) oriented to the observation of morphologies indicative of mobilization of the land (erosion or deposit) on the slopes and subsequent route and verification by field work.

- Consultation of the reports of incidents related to the mobilization of slopes adjacent to the infrastructure, coming from the General Directorate of Roads, and inventory and mapping of the same.

- Identification of the presence of artificial works to control slopes indicative of previous movements.

c) Identification of predisposing factors (predictive variables of the model) and delimitation of intravariable intervals

For the initial selection of factors predisposing to the mobilization of the slopes, criteria based on the literature on the subject have been used, together with direct observations of potential susceptibility factors deduced from the field work, as has been the case with land clearing that are characteristic of the transformed infrastructure environment.

Although there are variables that cause or trigger mass movement related to the intensity of precipitation or seismicity, these have not been included in the model, since, as observed by Bornaetxea *et al*., (2016), they are not spatially discriminatory to the scale of detail that has been used, in which they exhibit a constant and non-variable behaviour.

The variables finally selected as predictors of the danger of mobilization have been:

- Lithology according to its slope stability
- Internal homogeneity of the lithological series
- Presence and type of lithological contacts
- Presence and type of tectonic discontinuity
- Orientation of the potential level of mobilization
- Hillside slope
- Presence of active geological forms on the slopes
- Presence of water in the hillside
- Presence and type of vegetation
- Signs of natural or artificial hillside removal
- Presence of artificial slope

There are some variables that generate instability on the hillside such as the presence of water on the hillside, vegetation, active geomorphology or the structural orientation of the strata favourable to mobilization; however, when correlated with the dependent variable (signs effective mobilization), they did not yield significant relationship values. The reason is linked with the lack of variability in the distribution of the variable, but not with the absence of the relationship if it were analysed at another work scale. For this reason, these variables have been included in the final evaluation model as a direct condition of instability, which in any case increases the susceptibility value to the greater predicted interval.

d) Deduction of the predictive model

To deduce the algorithm that predicts the probability of mobilization, it has used a procedure that seeks to identify

the pattern of causative factors present on the slopes that have already been shown to be unstable, to determine the genesis of the fallen slopes and see what frequencies are see more represented in each variable, and order their level of participation in the probability of falling by assigning weights proportional to their role. The repetition value of the maximum instability interval for each variable has been standardized and used as its weighting coefficient, that is, as an indicator of its contribution to instability. From this data, the final algorithm to obtain the probability of detachment or slippage of each slope is configured as a weighted sum, in which the interpretation of each coefficient is direct, since it indicates the distribution of the probability of linearly associated fall to each predictor variable. In the case of landslides, the linear model results:

$$S(desp) = l \cdot 0.27 + p \cdot 0.22 + h \cdot 0.17 + t \cdot 0.14 + c \cdot 0.11 + d \cdot 0.09$$

Being S(desp) = Rockslide susceptibility; l = Lithology; p = Slopes; h = Internal homogeneity of the lithological series; t = Artificial slopes; c = Presence and type of lithological contacts; d= Presence and type of tectonic discontinuity

Regarding landslides, the generated algorithm has the following structure:

$$S(desp) = l \cdot 0.32 + p \cdot 0.25 + h \cdot 0.20 + t \cdot 0.1 + c \cdot 0.08 + d \cdot 0.05$$

Being S(desl) = Landslide susceptibility; l = Lithology; p = Slopes; h = Internal homogeneity of the lithological series; t = Artificial slopes; c = Presence and type of lithological contacts; d= Presence and type of tectonic discontinuity.

The obtained algorithms have finally been used to generate predictive maps of susceptibility to mass movements.

e) Tests, checks and comparative analysis of the degree of success of the prediction results

The results of the predictive models have been subjected to a comparative analysis between the predicted results and the dependent variables of fallen slopes. In addition to assessing the level of coincidence through percentages of success in the different severity intervals, a confusion matrix has been developed, which faces the real and predicted values. A ROC (Receiver Characteristics Curve) curve has also been drawn, which represents the percentage of correct positives that a model predicts when the probability cut is progressively lowered from 1 to 0. The model obtains AUC (Area Under Curve) values around 0.8. Successful values in the estimation of fallen slopes can be described as very positive (Bormaetxea *et al*., 2016) and allow validating the predictive capacity of the model.

4.2. Module A2: reaching movement

The development of module A2 is aimed at establishing the potential reach of the material mobilized on the road. The methodological steps and calculations that have been used are developed below:

- Potential distance of movement of the material mobilized from each overlying slope.
- Distance between the base of the overlying slope and the road at each point.
- Probability of involvement of the material mobilized on the road sections, both in one and both roads, based on the relationship of the previous parameters.

After a literature review, we proposed a formula based on Nilsen (2008), who calculates the range of distance from easily obtained variables. The function below derives from a correlation observed between the slope angle (Ψ), and the angle formed by the line drawn between the top of the slope and the point reached by the detached material (β) ($R^2 = 0.80$).

$$\beta = 3.926 + 0.768\ \Psi$$

In the data used it has been assimilated that the angle Ψ is the one formed by the slope with a hypothetical horizontal plane at the foot of it, said calculation is obtained automatically from the slope map and by trigonometric relationships, the horizontal projection of the distance that the mobilized materials would travel. When the potential range distance data is calculated, it is compared on each slope, with the distance that exists from the edge of the slope to the outer line of the road (roadside) and the centre axis of the same. Depending on the relationship between them and the possibility of blocking one or two roads / lanes, the different kinds of range probability are assigned.

4.3. Module A3: delivering or subsidence of the road

The aim of this module is to select all the underlying slopes that support the road with a high probability of mass

movements and, therefore, to produce collapse on the road. To this end, the results of module A1 (slopes with probability of mobilization) have been used, to which extra conditions have been added that favour collapsing, as is the case of pooling the base of said underlying slopes, which translates into probability of humidification and instability, or also the presence of signs of erosion (removal and emptying of material) in it, both of natural and artificial origin.

4.4. Module A: joint evaluation

The objective of this module is the evaluation of the multiple hazards that may occur in the different sections of roads, in this case in particular summarizing in a cartography the confluence of the three proposed modules A1, A2 and A3 (mass movements, scope and collapse of the firm) in a single multi-hazard module, all potential problems related to mass movements and their likelihood of reach or collapse. For the cartographic representation of the danger, a spatial transfer strategy is applied through the analysis made possible with the GIS from the slopes causing the condition on the road, to the road itself, in order to define sectors of the road with greater probability of affection.

4.5. Module B1: high probability of flood points

The generation of water ponds in road infrastructure is one of the most common and repeated conflicts after episodes of extreme rainfall events. The objective of this module is to detect the potential areas of the roads where there is a high probability of occurrence of this danger. Among the main causes of waterlogging phenomena is mainly the accumulation of water and / or drainage deficit, which sometimes derives from the intensity of the precipitation (accumulation in situ), or from a blocked artificial drainage system of the infrastructure, due to accumulation of solid contributions in the culverts. In addition, in order for an flooding to occur, there must be topographic conditions, related to the layout where the longitudinal profile of the road draws sub-areas that favour water retention.

Based on these assumptions, the following methodological steps have been used to obtain the potential areas with high likelihood of flooding on the road:

- Longitudinal profile of the layout with topographic subsidence conditions, which leads to the detection of endorheic micro-basins.
- Volume of confluent surface runoff towards the endorheic point or basin.
- High probability of cross drainage jam due to the contribution of solid and plant debris. This will take into account the natural conditions of the upstream watershed upstream of said conflictive drainage point.

For the detection of endorheic sinks or basins, Geographic Information Systems (GIS) have been used, applying a sink detection algorithm based on a Digital Elevation (DEM) model of the road. In this case, the 5 m DEM of the National Geographic Institute has been used, which includes the movements of the land associated with the infrastructures and reflects the road surface. Once detected, those that are in the environment of the road infrastructure and that coincide with a concave profile in its longitudinal layout have been identified.

With respect to the contribution of surface runoff, we have decided to determine the discharge flow to all the concave points detected in the previous step, both from the slopes overlying the road, as well as the basins that pour into the lateral drainage system of the same one. The runoff per unit area generated by each slope or basin is the difference between the precipitation value and the average of that runoff coefficient calculated for the area of each spatial unit.

In the flooding module B1, the contribution of sediments and plant residues that will reach the transverse and longitudinal drainage systems of the road is also calculated for each basin and overlying slope, which makes it possible to approximate the possibility of system jams of artificial drainage of the infrastructure. For this calculation, we start with data on erosion (Tm / ha and year of mobilized material), plant residues and biomass produced on average for each crop and plant species, obtained from REDIAM (Environmental Information Network of Andalusia) and SIOSE (Information System on Land Occupation of Spain)

4.6. Module B2: overflowing flood

This module aims to estimate the likelihood of flooding of the surrounding channels and / or that cross the route of the road infrastructure, which can reach and flood it, affecting its functionality.

For this purpose, the estimation of flow rates has been used, which allows, by means of a one-dimensional

hydrological-hydraulic model, to deduce the height of the water sheet provided in a torrential type episode. With the obtaining of the height of the water sheet of said flood, these data are put in relation to the existing difference between the crossing point of the road and the height of the channel in question, in order to assess the probability of water reach to the road.

The estimates of avenues and flows have been adjusted to the reality of the channels of the Mediterranean environment, where floods occur, largely composed of solid trawlers incorporated into the flow. This translates into changes in the volume of the flow, and increases the likelihood of traffic jams and retentions that dramatically increase the probability of overflow and reach of the road through the water. Therefore, the hydrological-hydraulic study has incorporated the volume of solid waste that drags the flow. Once the solid sediments are evaluated, they are transformed to a volume value (m^3), their ratio is calculated with respect to the total flow drained during the rain (m^3), and the flow rate with which the hydraulic study is carried out is increased in that same proportion (%). From this modified volume flow data, the pond of the flood is calculated, and the height at which the flood plate will reach. This value is set in relation to the height of the road at two points: the base of the supporting slope and on the road itself. From these data, the infrastructure points with the highest probability of being flooded are identified by overflow of transverse or parallel rivers.

The methodological steps involved in the calculation of this section are the following:

- Estimation of the type flooding flow for the surrounding and / or transverse channels to the road infrastructure
- Incorporation of possible solid contributions from the basin to the volume of liquid flow
- Calculation of the maximum height of the flow of flood with incorporation of the solid carries
- Relationship of the height of the water sheet with that of the point of intersection between the channel and the road

4.7. Module B (synthesis): high probability of flood points

This module summarizes and brings together the different danger factors in the environment of the road infrastructure related to the topic of flooding, identifying those with a high probability of presenting as many concurrent problems in space as the time of flooding, aquaplaning or overflow on the road.

4.8. Conflicting points due to multiple danger

Once all the issues discussed separately have been analysed, the ultimate objective of the work, and the final module, is the whole assessment and spatial concurrence of hazards in different sections of the road infrastructure. The intention is to simulate and map a scenario of conflicting points on the road as close as possible to what happens in reality when extreme rainfall events occur that activate all these hazard processes simultaneously.

In summary, a chart is offered that exemplifies how different hazards can affect different sections of roads, considering that there may be a confluence of one or more hazards at the same time depending on the conditions of the roadway being analysed and the environment that affects said road section (figure 3).

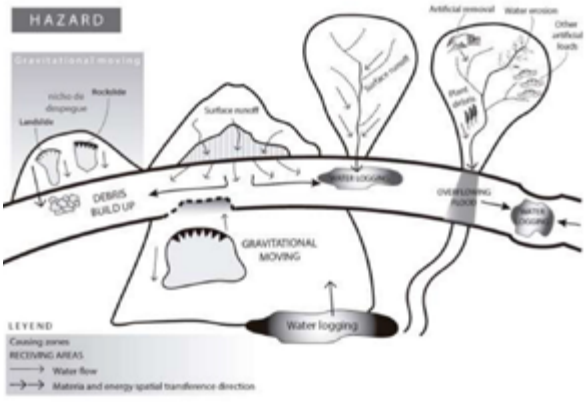

Figure 3. Danger process that occurs in the environment of the road infrastructure

Source: Reyes *et al*, 2016

5. Results

In relation to the danger linked to mass movements on the slopes adjacent to the infrastructure, after applying different predictive models of susceptibility, it is observed that the nature of the lithology and the slope are the most determining variables of susceptibility. It also highlights the incidence of the variable "presence of artificial slope" among the causes of instability. Below are some cartographic results of the A1 modules and resulting modules A and B designed in the methodology and that have been applied in the study area.

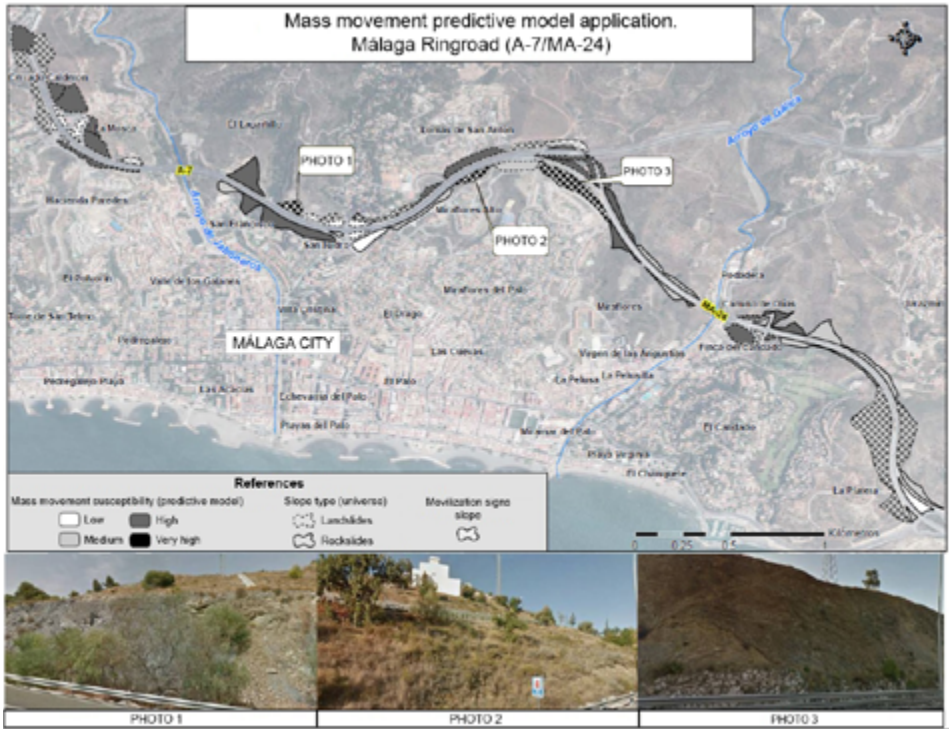

Figure 4. Results of susceptibility to mass movement in roads. Comparison of selected cases with reality

Source: Own elaboration

Figure 4 shows the results of applying the predictive model of mass movements, and establishing a degree of susceptibility (low, medium, high or very high) for each hillside that has been analysed. The map offers a fraction of the study area in which the methods have been applied and where diverse results can be seen in terms of the degree of danger. It also offers, through specific photographs, a sample of the real appearance of three slopes with high susceptibility to mass movement; as it can be seen, this slope has visible signs of mobilization, or they have retention ripraps that are indicative of previous movements.

Figure 5 shows the results estimated by the predictive method developed and applied to the study area, and offers the proportion of slopes collected for each interval of susceptibility of predicted mass movements.

ROCKSLIDES (SIMULATED SLOPES)					
	LOW	MEDIUM	HIGH	VERY HIGH	
INTERVALS	< 0,35	0,35 a <0,55	0,55 a <0,80	> =0,8	TOTAL
SIMULATED	67	71	86	17	241
(%) SIMULATED	27,80	29,46	35,68	7,05	100,00

LANDSLIDES (SIMULATED SLOPES)					
	LOW	MEDIUM	HIGH	VERY HIGH	
INTERVALS	< 0,4	0,4 a <0,6	0,6 a <0,8	> =0,8	TOTAL
SIMULATED	57	96	147	22	322
(%) SIMULATED	17,70	29,81	45,65	6,83	100,00

Figure 5. Estimation of susceptibility to mass movements

Source: own elaboration

Results corresponding to the Resulting Module A

The joint results of the different modules (A1, A2 and A3) represented in module A, establish an integration of the different hazards in the environment of the road infrastructure, all related to mass movements. As it can be seen in figure 6, on the one hand, all the slopes that have high or very high susceptibility to mass movements (landslides and rockslides) are represented with colours, and on the other hand we identify those underlying slopes with high probability of produce collapse. The overlying slopes that have a high probability of mass movements reaching the roadway are also represented. Finally, the road infrastructure sections have been specified on the map as they may be affected by collapse or mass movement partially (in one direction of the road) or total (in both directions) (figure 6).

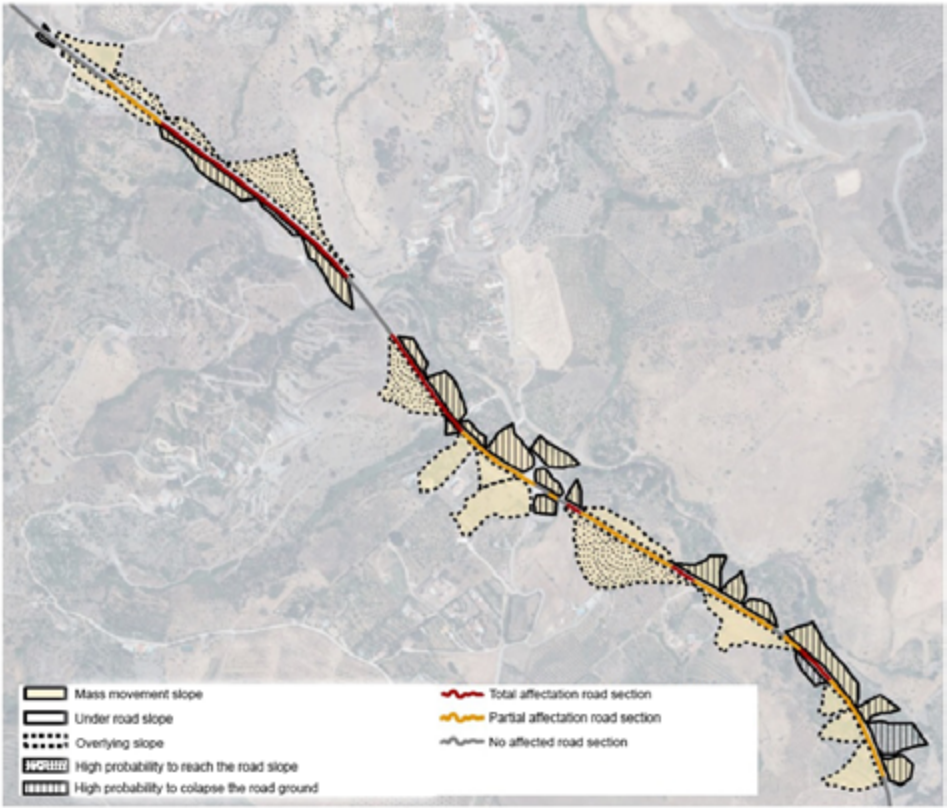

Figure 6. Results of danger associated with mass movements of Module A
Source: Own elaboration

Results corresponding to water-related danger points (Module B)

Module B focuses the analysis related to the danger of flooding the road by different mechanisms. figure 8 shows the results obtained in relation to the problems related to water on the road, while providing information about the processes that are at the origin of the problem, which can be located in the environment of the problem. The map provides information on the flow of runoff from slopes and watersheds to the road that can accumulate and flow longitudinally through the infrastructure itself, and the direction in which this stream of water circulates until it converges at concave points of the path. It also represents which are the hillsides and surrounding basins that incorporate a greater amount of solid load to the water flow, which allows to indicate which points of the transverse drainage of the infrastructure (culverts), will be more likely to experience water flow retention.

On the other hand, the concave points of the longitudinal profile of the road are represented as potential areas of waterlogging and aquaplaning. Those points that have a potential for important water storage have been selected as points of greatest danger and, in turn, have drainage works very prone to clogging or insufficient for the evacuation of the flow that is estimated to occur after an extreme event.

Also shown on the map are the points that cross the road with channels that, after having submitted the flow study

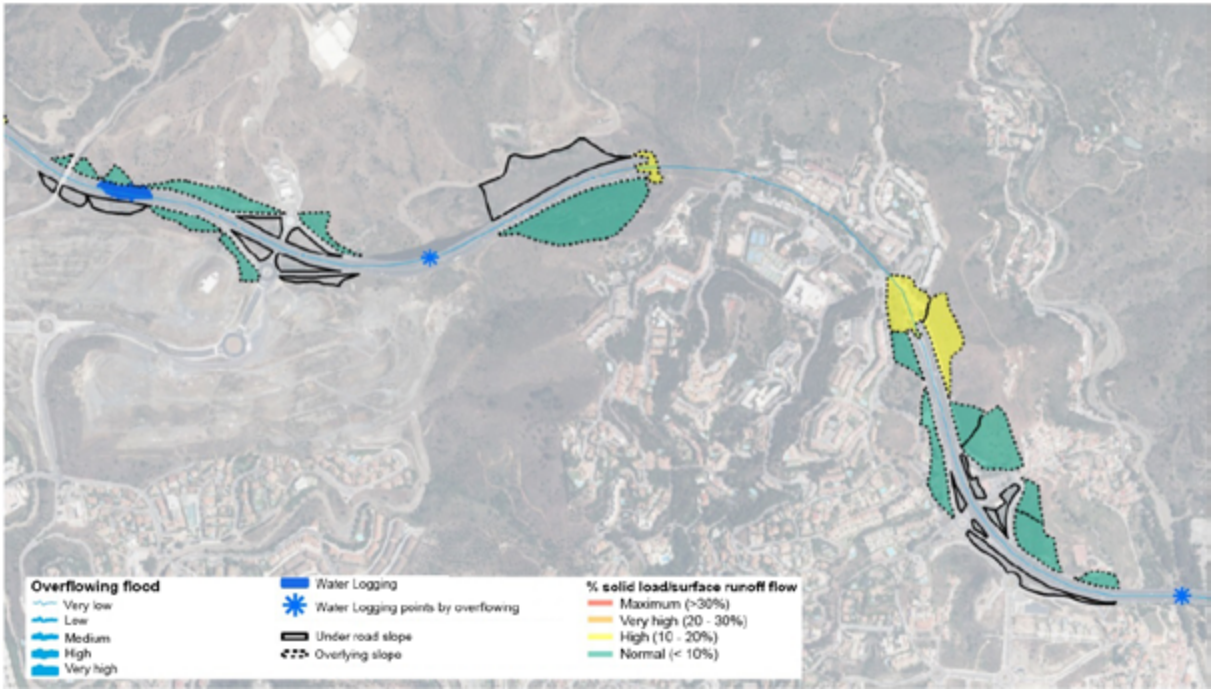

Figure 7. Danger results associated with mass movements (model A)
Source: Own elaboration

and calibrated the hydrological-hydraulic model, have not fulfilled the evacuation capacity due to the drainage work planned for such purpose. These points constitute dangerous points due to river overflows, and have been represented with a blue asterisk throughout the entire study area studied (figure 7).

In short, the resulting map of module B provides in this document the necessary information to address the improvement of the most needed drainage infrastructures: those that are more prone to blockage, being close to solid-emitting slopes in transport; information is also provided to reinforce the transversal drainage of road sections with greater frequency of concave points. Finally, the map is useful for alerting about the need for intervention at points with a probability of overflowing near the road.

Conflict points due to danger

The final results are represented in a multi-hazard mapping (see figure 8), in which different cases are represented that converge in certain sections of the road infrastructure. The probabilities of reach by mass movements, both simple and double, single and double mismatches, or the confluence at the same point of the road have been represented as the probability of danger of reaching mass movements and mismatches. Likewise, the points that have a high probability of flooding and those of a high probability of overflow are indicated.

Verification of the effectiveness of the methodology through real events in the study area

After the research, an extreme rainfall event occurred in the capital of the province of Malaga on November 28th, 2014. This extreme rainfall event that collected 180 litres per square meter in 24 hours, took place in the area of study analysed in this work and allowed to verify the functioning of the elaborated predictive cartography, especially in what refers to the accumulation of water in the road, probability of generation of ponds and risk of aquaplaning. This event resulted in a water pond at the El Limonar exit on the A-7 motorway, at kilometre 240. The pond generated a traffic jam and collapse during several hours (11.40 hours to 14.20 hours, reaching more than two kilometres of retentions). The most prominent factors for the pond to occur were the confluence of transverse drainage flows and accumulation of flow in a concave area of the path, added to the clogging of a transverse work producing the dragging of solids from the surrounding slopes underlying the roads, which led to the blockage of this work and produced the blockage of the culvert of transverse drainage.

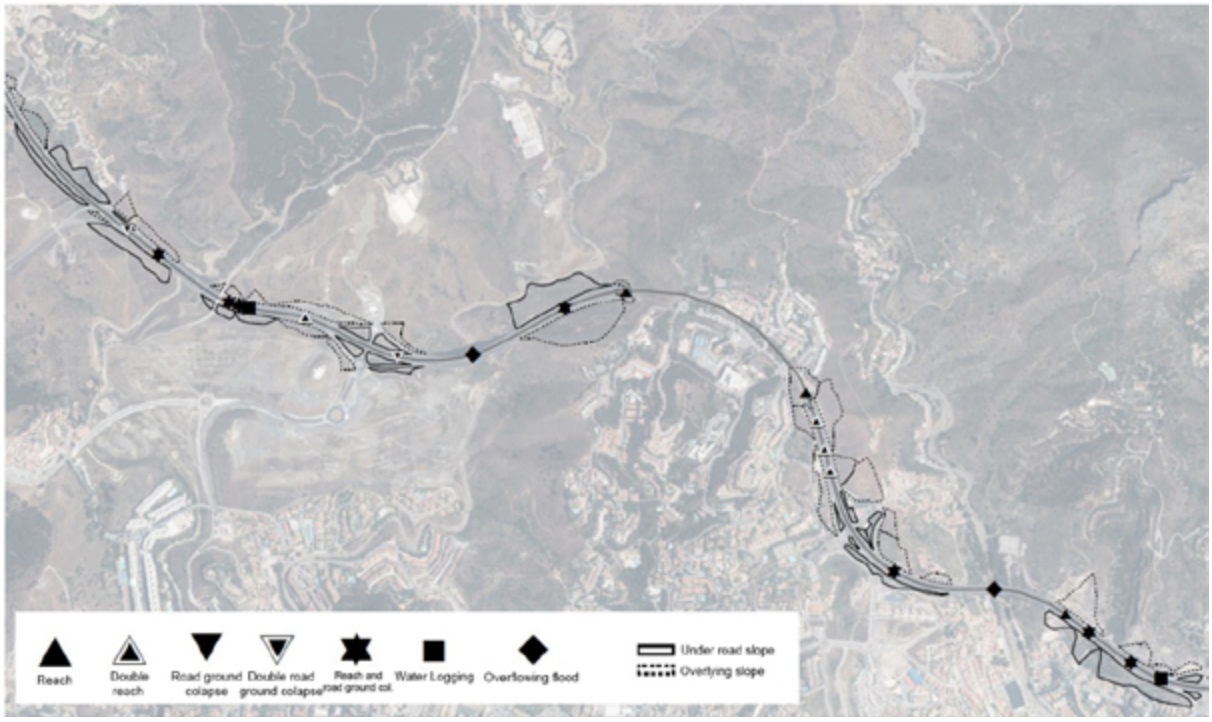

Figure 8. Final results of multi-hazard mapping
Source: Own elaboration

In the generation of the case, the totality of the danger factors that had been contemplated and foreseen in the predictive methodology converged and, as can be seen in figure 9, the elaborated cartography foresaw in detail and effectiveness the location of the pond, and even its magnitude, which covered only one of the highway branches. In short, the extreme event was very useful to validate the designed methodology, given that the event faithfully reproduced what had been estimated with our method (figure 9).

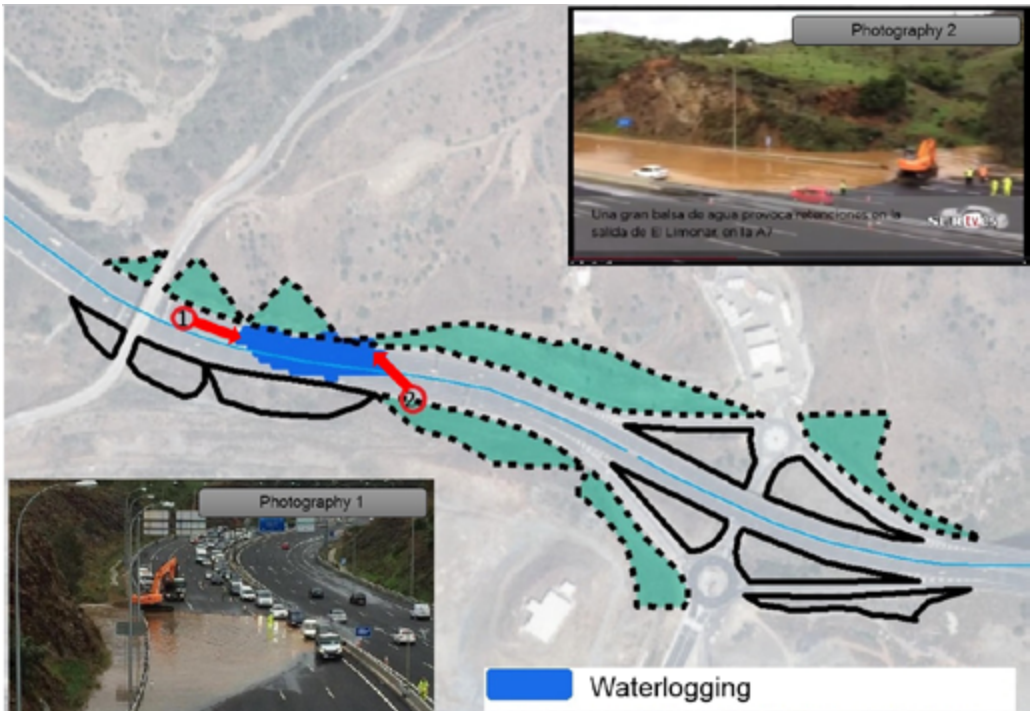

Figure 9. Detail of the resulting multi-hazard mapping and comparison of the flooding forecast made with a real event
Source: photo 1, La Razón (Málaga); photo 2, SurTV.es; infographic, own elaboration

6. Conclusions

The method used to comprehensively analyse the multi-origin hazard that may affect a road infrastructure after torrential precipitation brings a series of novel and interesting proposals for studying associated and / or synergistic hazard processes, and the simulation of real risk scenarios that are required in a context of increasing climatic extremes.

With regard to the proposed integration in the module and mapping corresponding to mass movements, the procedure used to effectively assess the danger on the road itself, and not on the slopes adjacent to the infrastructure, is noteworthy. The integration of the susceptibility of mobilization of the slopes with the real probability of reaching the road, and the collapse of the firm finish forming a model that not only focuses on the susceptibility of the hillside, but on how this phenomenon can interact in the entire environment of road infrastructure and how it can affect it, becoming a very useful tool for road infrastructure risk management.

The work strategy developed in the analysis of water-related hazard has been especially effective (module B). The perspective used is novel, and stands out for studying the drainage that affects the roads, not only through the calculation of the flow, but incorporating the morphology of the route through various variables, such as the topographic and longitudinal layout of the road. On the other hand, the incorporation to the final volume of the flow of solids and vegetal residues dragged after an episode of intense rainfall, is presented as a step forward to bring the results of the hydraulic models closer to what really happens in reality, especially taking into account the increase in global torrentiality derived from climate change, even more in the Mediterranean areas where these models have been designed.

The general application of the multi-hazard evaluation methodology improves the obtained results and allows better comprehensive risk management in the different sections of the road infrastructure. The multiple hazards that occur in space and time, after an extreme episode of rainfall, are rarely treated as a whole and do not usually cover all possible casuistic hazards that can interact with the road infrastructure environment. The multi-hazard approach is therefore consolidated as a step forward in the integrated management of road infrastructure risk, since it provides specific solutions for the different sections of roads, according to the multiple hazard cases to which they can be see submitted each of these sections. With the development of this type of multi-hazard approach work, the administrations responsible for risk management, have a battery of hazard estimation data in the environment of road infrastructure, in a detailed way and very localized in space, what will allow to generate a better prevention and mitigation of the dangers that threaten the sections of roads and contribute to an improvement in the management of road infrastructure.

With regard to the advantages of using methods with a multi-hazard approach, the strength of these approaches consists in obtaining a closer approximation of what happens in reality and avoiding the bias of studying each hazard separately, without taking into account the synergy that exists between the different dangers that occur in the environment of a road infrastructure. As regards the limitations of these methods, it should be noted that such approaches require great effort and high data processing, which may limit the applicability. Its precision on a detailed scale, on the other hand, is smaller than that obtained by specific sectoral methods, since they are designed for a scale of planning and problem management, not for that of basic process research, or that of action and technical intervention. However, by focusing on the infrastructure itself the problem to be solved, and not on the etiology and methods specific to each of the types of danger, the proposed workflow and the cartography obtained provide a precise framework for action directly aimed at applied risk management in road infrastructure.

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Climate change´s evidences on the Spanish Mediterranean coast

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Abstract

Obvious changes can be observed in recent decades in the climate of the Mediterranean region – which was already extreme and irregular. Torrential rainfalls are becoming more frequent and occurring in seasons of the year in which they had rarely previously occurred. This process is not uniform throughout the Spanish Mediterranean coast, and identifying areas where this trend is more evident has not yet revealed a clear trend. Temperatures, especially at night, have increased – and the Mediterranean waters are warming, which is causing a loss of climatic comfort. Evidence indicates that global warming and changes in atmospheric circulation are behind increases in meteorological extremes along the Spanish Mediterranean coast.

Key words: Spanish Mediterranean coast; heavy rains; Mediterranean Sea; tropical nights; weather extremes; jet stream; climate change.

1. Introduction: a more extreme climate in the Mediterranean

There is no longer doubt about the effects of the current climate change process as thermal heating is being accelerated by the man-made greenhouse effect. This change is revealed in climate data and in changes in the mechanisms of atmospheric circulation at various scales. The current climate is no longer that which we enjoyed three decades ago, and the Spanish Mediterranean coast is no exception. In recent years, trends have differed from those registered in previous decades. In the 1980s, when the hypothesis of global warming caused by the emission of man-made greenhouse gases first appeared, it was possible to doubt the hypothesis and outcome. At that time, data did not show evidence of clear trends – and some data was even contradictory. But today, as the second decade of the 21st century ends, the climatic evidence for such warming is increasing. In addition to trends in temperature and rainfall, climatic events have been observed that were previously very infrequent. The climatic and atmospheric manifestations of the process of climate change due to the man-made greenhouse effect are clearly visible, as the data and projections indicate, and we will have to live with more frequent extreme meteorological events.

On the Mediterranean coast there are three processes that are closely related to the planetary global warming mechanism: 1) seasonal variations in rainfall (figure 1) and the intensification of heavy showers; 2) an increase in average temperatures and, especially, night time temperatures, as revealed during the so-called 'tropical nights' (>20 ºC); and 3) a worrying warming of waters in the western Mediterranean Sea. All three processes are already corroborated by data and are clear manifestations of climate change in this region of the eastern Spain.

However, climate models still reflect uncertainty in the short and medium term regarding the evolution of several climatic elements in the Mediterranean region – and contradictory predictions can be found. We must not forget that the Mediterranean coast is a territory with a complex climate due to its geographical configuration (mountain ranges and narrow coastal strip). One of the aspects that most influences the climate of this area is its location to the leeward side of the westerly winds, a feature that is accentuated in the semi-arid region of the peninsular southeast. The mountain ranges and valleys behind the coast are oriented towards the rain-bearing winds (mostly easterlies) and this means that some areas receive high levels of rainfall with annual averages of around 1000 mm (for example, in the area to the north of Alicante and to the south of Valencia city). To these factors we must add a warm and enclosed Mediterranean and nearness to the African continent (the source of the warm air masses that visit the Mediterranean region with increasingly frequency). It should not be forgotten that the east coast of the Iberian Peninsula is also a climatic crossroads: a meeting point for different air masses (tropical, polar, and arctic) that change as they advance through the Iberian Peninsula and surrounding waters.

Why is the climate of the Mediterranean coast becoming more extreme? An increasing number of studies indicate that a slower jet stream (in this case, the polar jet stream of the northern hemisphere) is causing a significant increase in adverse events (hot and cold waves, intense droughts, and torrential rains) in the middle latitudes where the Mediterranean is located. This would be caused by a lower latitudinal thermal gradient as a result of global warming, which implies a slower jet stream. A study has shown that the average speed of the polar jet stream has fallen by 14 % since 1980.[1] This implies a greater undulation of the jet steam – meaning more frequent peaks and troughs with faster movements of warm air masses towards northern latitudes and polar or arctic air southwards. Projections indicate that this situation will become normal in the years ahead.

1 One of the most recent studies is by Jennifer A. Francis of Rutgers University and Stephen J. Vavrus of the University of Wisconsin–Madison. Available at: https://pdfs.semanticscholar.org/be1b/795c504d2fd9f3ad3a52a758381ccc76350b.pdf. Visited: August 2019. See also Francisco Martín León (2019) 'Los inviernos serán más cálidos, pero también con irrupciones más frías', en Revista del aficionado a la meteorología. February. Available at: https://www.tiempo.com/ram/507091/los-inviernos-seran-mas-calidos-pero-tambien-con-irrupciones-mas-frias/. Visited: August 2019.

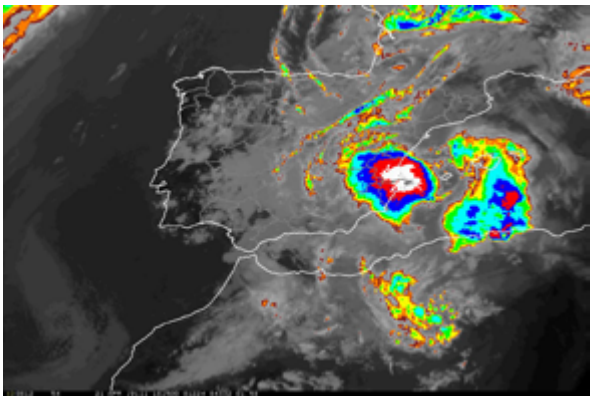

Figure 1. Mesoscale convective system responsible for the heavy rains of 21 April 2019 in the south of the Gulf of Valencia
Source AEMET

Mediterranean coastal areas with extreme meteorological events will, according to climatic models, experience a tendency towards increasingly extreme events. Recent episodes since 2000 seem to support these forecasts.

2. Changes in the rain: rainfall WITH great hourly intensity throughout the year

Variations in rainfall are causing uncertainty in the medium and long term, but it should not be forgotten that irregularity is one of the distinctive features of the Mediterranean coastal climates. In the major series of climates found along the Mediterranean coast, there is generally no clear trend showing an overall decline in rainfall, although there is a change in the intensity and distribution of rainfall, especially in coastal areas. Therefore, there is no significant decline in rainfall, and many Mediterranean observatories are recording rises in rainfall. However, it is raining differently. Since the beginning of the 21st century, it has been observed that convective rainfalls (especially those associated with the presence of upper-level isolated depressions[2] in the upper-middle layers of the troposphere) are becoming increasingly important.

In contrast, rainfall of Atlantic origin (linked to circulation from the west) seems to be losing share of the annual total and this is most evident in the interior. This is one of the

2 The Spanish national weather agency (Agencia Estatal de Meteorología) has proposed the name 'upper-level isolated depressions' (*depresión aislada en niveles altos* in Spanish) as a substitute for the popularly used term '*gota fría*' (cold raindrops).

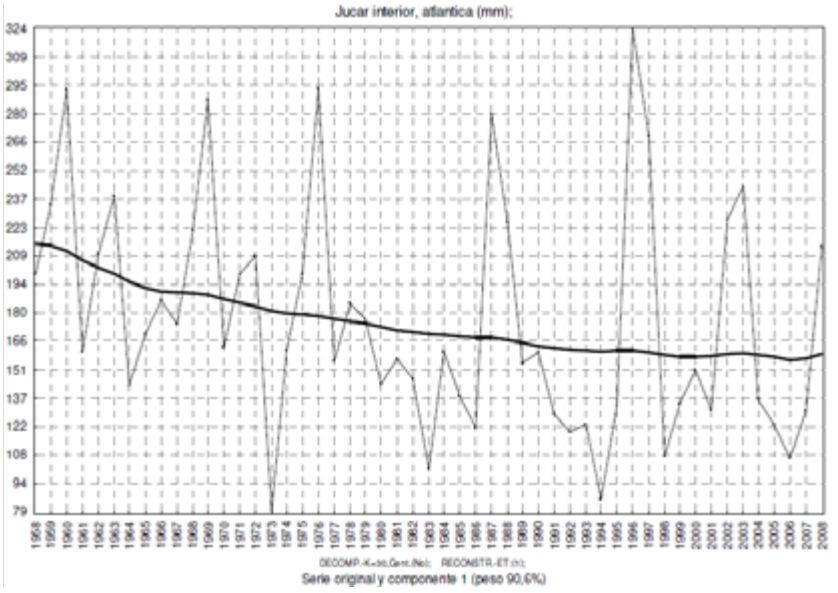

Figure 2. Rainfall in the Júcar basin (1958-2008). A downward trend can be seen

Source: Javier Miró Pérez (2014)

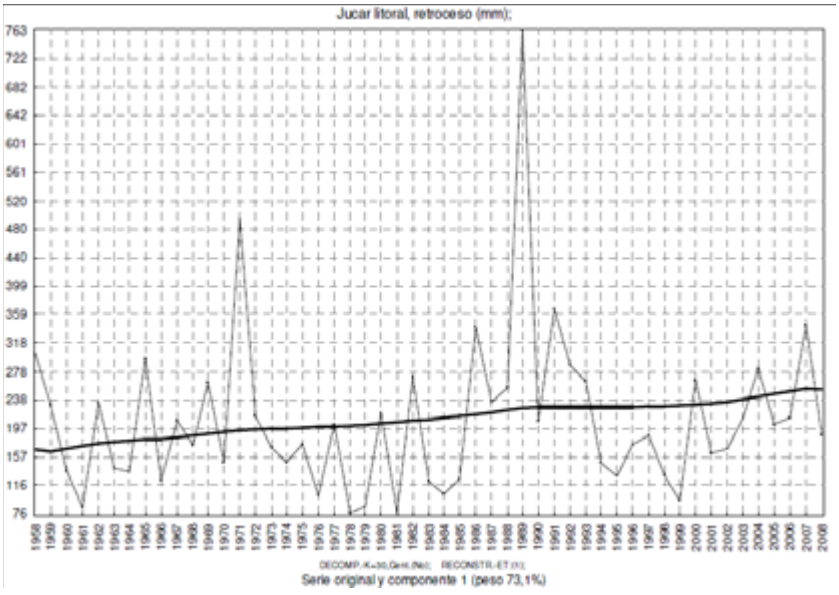

Figure 3. Rainfall on the coast of the Júcar basin (1958-2008). An upward trend is noticeable

Source: Javier Miró Pérez (2014)

points that reinforces the hypothesis that the increase in weather extremes in the middle latitudes and the Iberian Peninsula is linked to a more undulating polar jet stream. It should also be noted that in recent years there has been a decrease in the number of storms in the eastern half of the peninsula. This may be due to a loss of wind speed because of the warming of the Mediterranean, which causes the winds to penetrate less inland – and so the usual convergence between terrestrial winds driven by thermal lows in the peninsula and winds coming from the Mediterranean does not occur (figures 2 and 3).

Despite this probable decrease in number of storms, higher surface temperatures mean a greater potential for more severe storms with greater hourly intensity, especially along the coastal strip (figures 4 and 5).

Another aspect of the changes observed in rainfall on the Mediterranean coast is the temporal distribution of rainstorms. Traditionally, the period of greatest risk in eastern Spain was the period between the end of summer and the end of autumn (with some isolated events in winter and spring). However, autumnal type storms have become increasingly frequent in winter and spring in recent years. This can be seen in the province of Alicante, one of the Spanish territories most affected by flooding. It is noteworthy that the majority of the most intense rainstorms in recent years have occurred in winter and spring: March 2012 when more

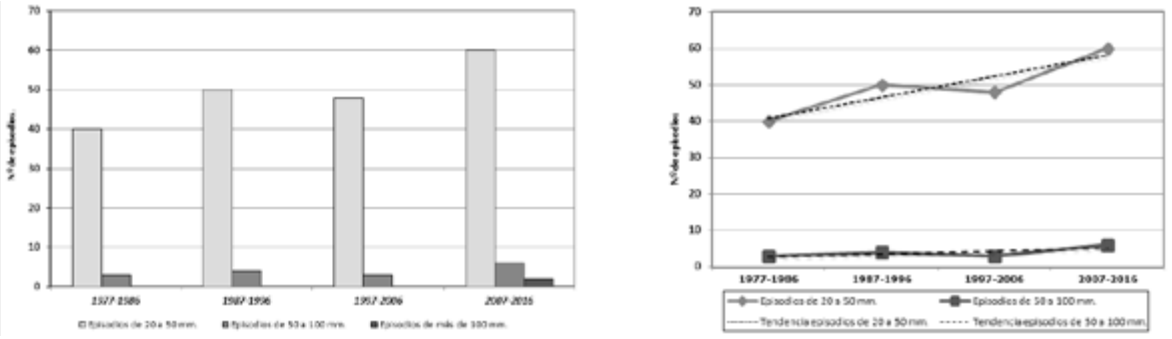

Figure 4. Trends for rainfall of high hourly intensity at the Palma de Majorca observatory

Source: Authors, based on AEMET data

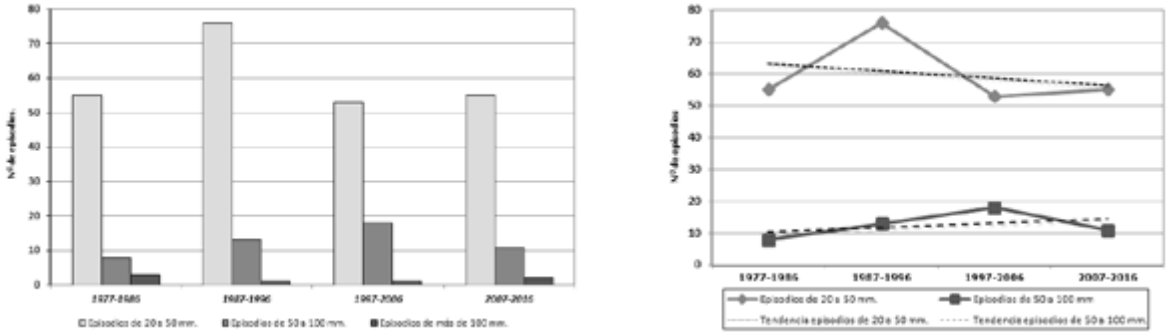

Figure 5. Trends for rainfall of high hourly intensity at Malaga

Source: Authors, based on data from AEMET and other organisations

than 100 mm fell in Torrevieja; extraordinary easterly wind storms in the winter 2016-2017; March 2017 when 200 mm fell at the University of Alicante; the upper-level isolated depression of Easter 2019 when more than 300 mm of rain fell in the Maigmó Sierra mountains and 250 mm in Javea and Denia in less than eight hours; or 21 August 2019 when more than 100 mm fell in just two hours in some parts of the city of Alicante.

The period of the year when highly intense rainstorms occur has changed, and the conditions for rainstorms are now favourable for more months in the year due to the warmer Mediterranean and a more meandering jet stream (see above). On the Spanish Mediterranean coast, the period for intense rainstorms is lengthening towards winter and spring. This is when the largest cold air fronts arrive, so if the sea remains relatively warm, conditions are favourable for episodes of high intensity rainfalls that are caused by high-energy storms.

In some Mediterranean coastal observatories, a significant percentage of the largest daily rainfall events have occurred in recent years. This is not an isolated fact: droughts tend to be shorter but more severe, while episodes of high hourly rainfalls are increasingly frequent. The rainfall extremes have become more extreme, and this affects economic activities such as agriculture and tourism. There are no large volumes of day-long rainfall, as was the case in the 1980s or 1990s (figure 6).

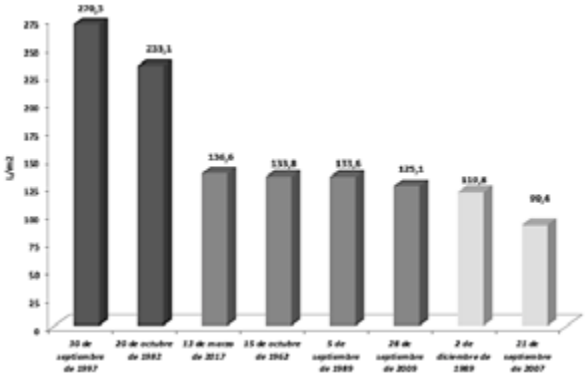

Figure 6. Torrential rainfalls in the city of Alicante (1950-2017). Three of the largest episodes of daily rainfall have occurred since 2007. The event on 13 March 2017 is noteworthy as it is one of the months that is 'theoretically' less favourable for heavy rainfalls

Source: Authors based on data from AEMET

At present, the intense rainfalls are less intense (100-150 litres in one or two hours) than in the 1980s and 90s, but more frequent. And in just one or two rainfalls lasting a few hours each, the average annual rainfall of a locality can arrive (figures 7 and 8).

Figure 7. In the town of Javea (Marina Alta, Alicante), more than 200 mm fell in six hours during the evening of 21 April 2019

Source: AEMET-Valencia Region

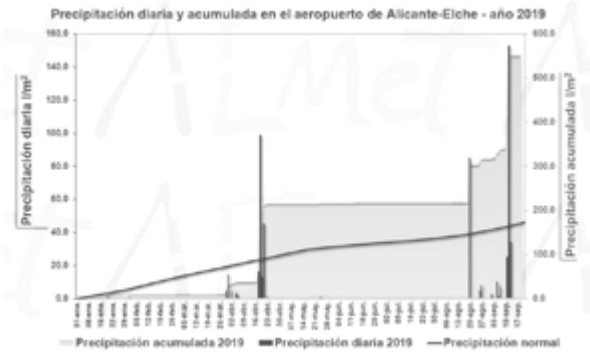

Figure 8. Intensity pluviograph and total accumulation (El Altet Airport, Elche) between 1 January and 17 September. The year 2019 has been the rainiest year since records began at the observatory, but with rainfall concentrated in just a few days

Source: AEMET-Valencia Region

A striking fact in relation to the changing pattern of rainfall is that in some mountainous sectors of the Mediterranean coast (in the Prebaetic System) there has been an increase in snowfall in recent decades, compared to a decrease in the number of snowy days in most of Spain. This is surprising in the context of an undeniable rise in average temperatures. This is again related to the development of unstable events (troughs and upper-level isolated depressions) due to the increased meandering of the polar jet stream, coinciding with circulations of sea winds that carry moisture from a more temperate Mediterranean in the late autumn and early winter (figure 9). This aspect has been studied in the area known as the Mountains of Alicante, where the analysis of a long series of observation shows an increase in snowfalls and increased severity. In this area of the province of Alicante there have been extraordinary snowfalls in the last two decades (December 2009 and January 2017). Snowfalls of more than 300-400 mm were recorded in 48-72 hours – with depths reaching two metres in some places. In addition, these snowfalls are sometimes accompanied by lightning. Such extreme snowstorms on the Spanish Mediterranean coast are a novelty.

Figure 9. Days with ground snow in the Sierra de Penáguila (1978-2017). It is not one of the snowiest areas in the province of Alicante

Source: Prepared by the author, based on data collected by Pablo Mirete and the observer Ángel Vañó

3. Increasing temperatures. More effects on lows than highs

An increase in global annual average temperature is undeniable, and the Mediterranean region is no exception. The increase in temperature has been 0.8 °C over the last century – with a pronounced rise since 1980. However, the most obvious example of the loss of thermal comfort along the Spanish Mediterranean coast has been the notable increase in 'tropical nights' when the temperature remains above 20 °C throughout the night. Since 1970, the number of tropical nights in many Mediterranean cities has tripled, increasing from 20 to about 60 or 70 a year (and in some cases more) (figures 10 and 11). In addition, since 2000 there has been an increase in 'torrid nights' (when night temperatures do not fall below 25 °C), and even in recent years there have been several occasions when minimum temperatures have not dropped below 29-30 °C.[3] In these

3 On 1 August 2017 the minimum temperature in the Alicante city suburb of La Florida was 30 ºC as recorded by a station in the official network for monitoring air pollution (*Red Valenciana de Vigilancia y Control de la Contaminación Atmosférica).* Similar values were recorded in July and early August 2019 at the national weather agency (AEMET) monitoring station in Pego

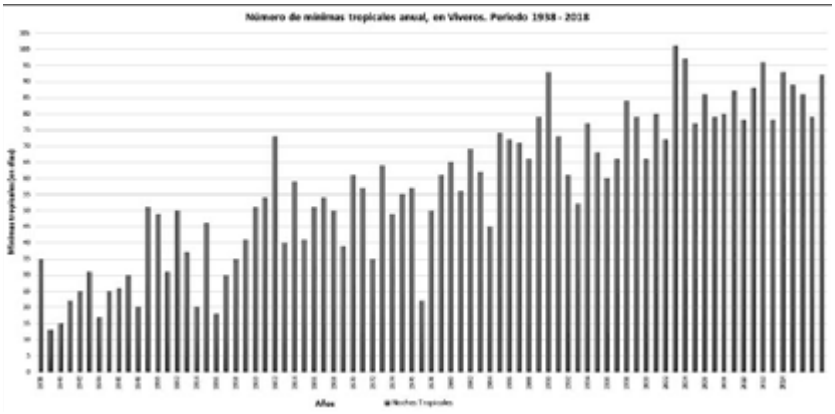

Figure 10. Tropical nights in Valencia - Viveros (1938-2018)
Source: Rafa Tena, based on data from AEMET

situations, some researchers[4] have proposed the term 'torrid night' as discussed above, rather than the incorrect term of 'equatorial night'. Coastal towns have suffered high night-time temperatures with high relative humidity. This last indicator is very important, since with relative humidity values of 70 % or more, the temperature felt by the human body (thermal sensation) is about 4-7 °C higher than the temperature marked by the thermometer. This is the aspect that produces the greatest loss of climate comfort as a result of global warming in the Mediterranean area.

There are several factors explaining this increase in minimum values on the Spanish Mediterranean coast. Firstly, the rise in temperatures as a result of the global warming process. In recent years, it has been observed that summer on the Mediterranean coast has tended to lengthen between the end of spring and the beginning of autumn. Another factor is the increase in the temperature of the Mediterranean Sea and this is discussed below. This last factor is decisive in the increase in temperatures (especially at night) in coastal cities. Nor should we forget the effect of urbanisation on the climate, and especially on the temperatures that modify the local climate (including temperatures, precipitation, and air pollution). Asphalt and concrete retain heat accumulated during the day while gradually transmitting this heat to the air at night, a situation that diminishes as we move away from the centre of the city. Sometimes, the differences between the suburbs and the centre of a city can be 4-5 °C or even greater.

The combination of the effect of urbanisation in the main cities, the warming of the Mediterranean, and the planetary global warming process implies a significant loss of climate comfort. For example, it has been observed in recent summers that the temperature rarely falls below 20 °C throughout the summer in the centre of large cities. In addition, such islands of heat also have an impact on convective processes even in snowy conditions. Thus, in mountainous regions snow does not settle on the ground in urban areas, as in decades past, because of the heat island effect, while the snow settles in nearby smaller towns at a similar altitude.

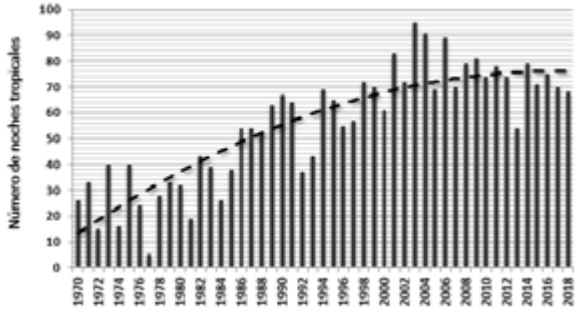

Figure 11. Trend in of the tropical nights in Alicante - Ciudad Jardín (1970-2017)
Source: Authors based on AEMET data

The trend for maximum temperatures is not so clear. Maximum values in some observatories have shown a clear rise, while no significant trends have been seen in others, and some observatories (especially near the coast) show a slight downward trend (figure 12). However, the main problem for researching maximums is the absence of sufficiently long series (except those of the main observatories) that help us understand changes in maximum daytime values in the Mediterranean region – in contrast to the minimum temperatures, where a rise has been very significant since the 1980s. One of the main causes for this stagnation or slight decrease in maximum values may be the lower frequency of intense episodes of westerly winds, due to the slower jet stream, and therefore of the westerly winds. When a wavier jet stream

4 The Spanish media has popularised the term 'equatorial night' when night temperatures remain at or above 25 ºC. However, the national weather agency (AEMET) recommends using the term 'torrid night'.

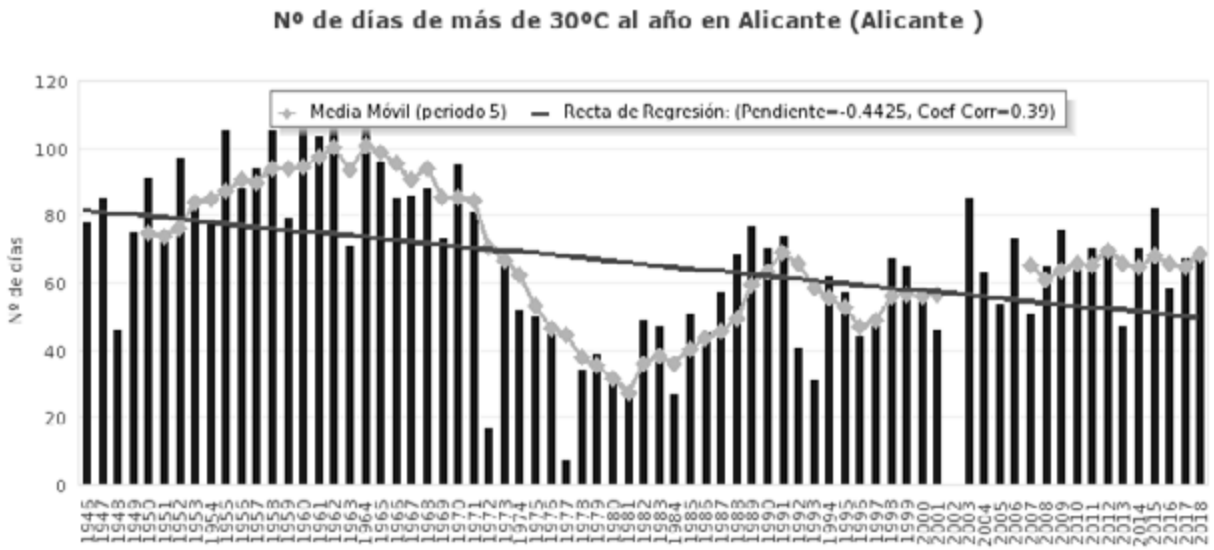

Figure 12. Number of days reaching 30 °C or more in the city of Alicante
Source: Javier Sevillano, from AEMET data

predominates, the westerlies reach the Mediterranean coast with less power, so that the easterly or southerly winds are increasingly dominant. However, these winds are also are weaker due to the smaller difference between an increasingly warm Mediterranean and a peninsula warmed by radiation.

We must not forget that a small difference in temperature (the motor of coastal breezes on the Mediterranean coast) explains why very high maximum temperatures are occurring in the coastal ranges or in the interior. In this case, the breezes cannot penetrate far inland, and so the daytime cooling effect of this wind circuit is reduced (figure 13).

4. The Mediterranean is warmer than three decades ago

A rise in sea surface temperature in the western basin of the Mediterranean, especially in the sector comprising the Balearic Sea and Sea of Algiers, reveals an obvious change in climatic conditions. This increase has been of the order of 1.0 ºC since 1985 (CEAM, 2018).[5] A process

5 This is further discussed in this interesting article: http://www.ceam.es/GVAceam/paginas/actualidad/PDFs/2018/Meteo2018cast.pdf. Visited: August 2019

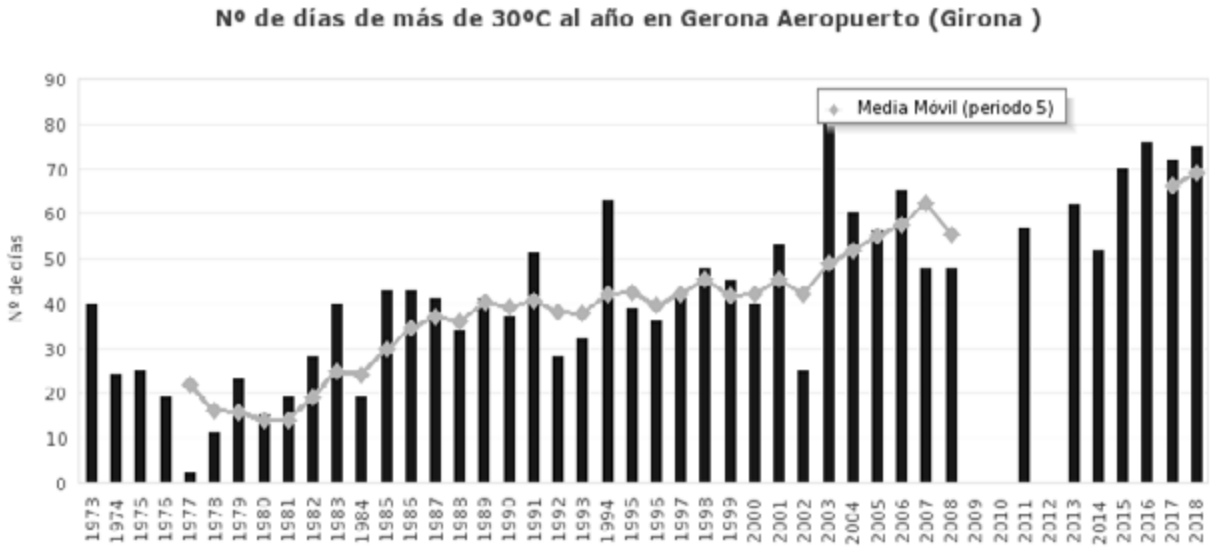

Figure 13. Number of days reaching 30 °C or more at Girona airport
Source: Javier Sevillano, from AEMET

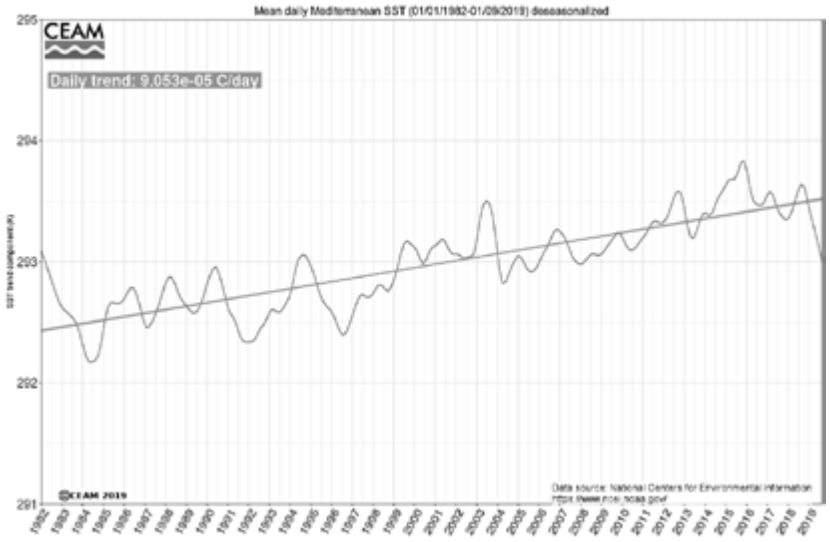

Figure 14. Increase in the temperature of the Western Mediterranean since 1982
Fuente: CEAM

of heat accumulation means that the Mediterranean is warmer than three or four decades ago, especially from late spring (May-June) and extending through the summer and well into autumn (October and early November). It is remarkable that recent annual peaks of up to 30 °C have been observed during the summer in the waters near Valencia, the Balearic Islands, and Algeria. Such values are more commonly found in tropical seas.

This phenomenon has a series of consequences that affect the climates of the Mediterranean coast. As previously mentioned, a warmer sea favours an increase in tropical nights in coastal cities, while daytime breezes can contribute to increasing the sensation of heat, especially on days when the Mediterranean temperature reaches or exceeds 28 °C off the coast (something that usually occurs from mid-July to early September in recent years). A warm sea better transmits heat and humidity to the air above. These additional degrees of sea temperature are a risk factor for possible instabilities associated with upper-level isolated depressions or troughs of retrograde circulation (circulations from east to west). This is because as the vertical gradient increases, so more evaporation occurs, which together with other factors, favours intense rainfalls in other times of the year. It had already been assimilated that high intensity rainfalls may occasionally occur in seasons other than autumn in the Mediterranean region. In recent years, we have witnessed a significant number of high intensity rainfalls in spring, winter, and even summer.

The possible increase in the "tropicalisation" of the Mediterranean may increase the number of warm rainfalls in the Gulf of Valencia. These types of events are exceptional since they can deposit more than 200 or 300 litres / m^2 in less than seven or eight hours in some areas. These rainfalls are typical of the late summer period and very difficult to predict using meteorological models (even those with the highest resolutions). Their formation is the result of contrasting temperatures between the sea surface and the mass of air in the lower layers – and with a slight convergence at surface level. These conditions support the growth of large clouds with unfrozen tops (known as warm clouds) and are typical of the tropics. One of the most characteristic features is the absence of lightning. Inside these clouds, air rises more slowly and more continuously than in typical cumulonimbus – and this enables raindrops to merge and grow. The resulting clouds are very efficient in terms of their ability to generate rain. They are static nuclei, and in those areas where mountain ranges are close to the sea, new rises of air can be produced that reactivate the nucleus over the same point. The strip of coastal land between Lake Albufera (south of Valencia city) and the north of the Marina Alta region concentrates most of the largest rainfalls due to its orographic peculiarities (coastal mountains, orientation, and exposure). The increasing numbers of these types of rainfall events is very clearly related to the warming of the Mediterranean near the Spanish coast (figure 15).

5. Conclusions

The results of the continuing manmade process of climate change caused by the greenhouse effect are evident on the Spanish Mediterranean coast. Extreme rainfall events are becoming increasingly frequent and intense. This climatic situation requires measures of adaptation and

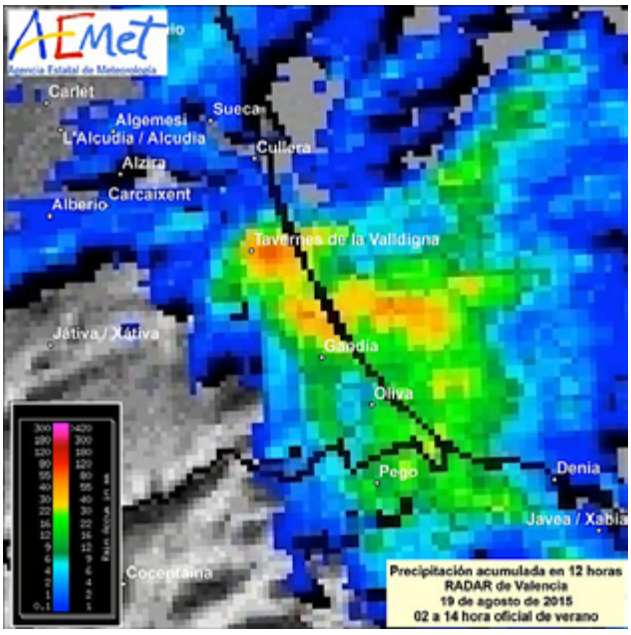

Figure 15. Radar image of warm rain scenario. Up to 300 mm in four to five hours recorded in Tavernes de la Valldigna (Valencia) on 19 August 2015

Source: AEMET

cities must urgently rethink the design of water supply and rainwater collection systems. Some vital economic activities such as agriculture and tourism will be affected by these changes. Data shows that in the Mediterranean the reduction of rainfall varies between regions. It now rains less often but with greater intensity. In addition, highly intense rainfalls are becoming more frequent at all times of the year. A significant increase in night-time temperatures is worrying, as this implies a loss of climate comfort with effects on human health. Maximum temperatures are scattered and show a significant increase in areas not immediately on the coast. These increases are not as noticeable nor uniform in coastal areas. In addition, in recent years there have been significant heat waves in June and October, which suggests that summers are becoming longer – while spring and autumn become shorter.

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Physical Geography in river hydromorphological characterization, evaluation and restoration

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Abstract

Spanish fluvial hydromorphology works have been developed in the present century and have been approached for the most part from Physical Geography. This science provides an integral perspective of all of its factors, elements and fluvial dynamics processes, being very useful for river diagnoses and the proposal of protection and restoration actions. The contributions of Physical Geography to an applied fluvial hydromorphology are synthesized in characterization, analysis, cartography and interpretation of processes, changes, impacts and trends, assessment indexes, training, geo-heritage, management and conservation in planification, risk mitigation, restoration, monitoring. All of it will be a relevant employment opportunity and source of research projects for Spanish Physical Geography.

Key words: hydrology; fluvial geomorphology; channel change; river assessment; river management

1. Introduction: the fluvial hydromorphological problem

Rivers are dynamic and complex natural systems whose main functionality on the planet is the transport of water and sediments. Therefore, the basis of their function is hydrogeomorphological, and only on this basis can they develop other ecological functions (Ollero, 2017). It is important to highlight and value this hydromorphological component in river function, since it is the key and the foundation, although it is generally less known and less valued than the physical-chemical and biological components in scientific, technical and social contexts.

Fluvial hydromorphology has developed as a field of scientific and technical work in the last two decades, largely following the Water Framework Directive, approved by the European Union in October 2000. This standard established hydromorphological indicators, although at a lower level than the biological ones, to determine the ecological state of a river. This involved the introduction of new concepts and methods that the hydrological managers, environmental consultants and biology and engineering professionals were unaware of. It also meant focusing on the serious and widespread hydromorphological problems of rivers.

From a functional and systemic perspective, the environmental state of the river network is fundamentally based on hydromorphology. The main and most serious evils or "diseases" of rivers are hydromorphological. The hydromorphological diagnostic methods to detect them are the most useful, and the improvement or restoration

treatments must also affect the hydromorphological, because the biological, the ecological, in good measure will only recover from there (Horacio, 2015a). Research on river problems derived from anthropic actions is very recent in all countries, but has clearly confirmed that the main problems are recorded in the hydromorphological field (Gregory, 2019).

But what are the hydromorphological problems of rivers? Basically, those derived from human actions that disrupt or alter the hydrogeomorphological processes of water and sediment transportation (Ollero, coord., 2007). The actions that cause these problems are the longitudinal and transversal obstacles in the channels: flow derivations, flood reduction, dams, fords, channeling, lateral disconnections and dredging, among others. The effects, serious and widespread in space and time, are associated with the effects of global change. They lead, mainly, to the simplification of channels (e.g. narrowing, plant colonization, reduction of channels, disappearance of morphologies) and incision. Both processes derive, in turn, from other problems of greater severity, such as water deficit, water table decline, riverbank scrubbing or increased danger and risk (figure 1).

This fluvial hydromorphological problem has called for the participation of applied Physical Geography, especially from its geomorphological and hydrological aspects, in river research and management.

Figure 1. Synthesis image of the current hydromorphological problem

2. Context and status of the issue

Spanish fluvial hydromorphology works have been developed mainly from Physical Geography. This science provides an integrated vision of all the factors, elements and processes involved in river dynamics, so it is extremely useful in the characterization of functioning, in the diagnosis of the state of rivers and in the proposal of conservation actions and restoration.

In the last two decades of the 20th century, fluvial geomorphology was considerably developed in different Spanish universities, highlighting those of Valencia, Murcia, Zaragoza, Barcelona, Lleida or Sevilla, and in research centers such as the Pyrenean Institute of Ecology. Work was carried out on different types of river courses, generating many PhD theses and research projects. In this context, two pioneering publications can be highlighted, in La Rioja (García Ruiz *et al*., 1987) and in Murcia (López Bermúdez *et al*., 1988), which laid the basis for the future fluvial hydromorphology.

The fluvial topic in the framework of Physical Geography was approached more from geomorphology than from hydrology, although there are also numerous contributions from the latter. However, it was not approached from the biogeography aspect, a fact that remains as such even today. These aspects are largely related to academic and professional issues. Therefore, the biotic and ecological component of river systems has been completely taken over by Biology and, on a second level, by Forestry Engineering. Hydrology has primarily been worked from Engineering, with secondary contributions from Physical Geography and Geology. Finally, Spanish fluvial geomorphology, in theory shared by Geology and Physical Geography, has a broad control of the latter in projects and publications.

This context of the late 20th century is consolidated with the aforementioned approval of the Water Framework Directive. The emergence of hydromorphological indicators generates two key effects. In the first place, fluvial geomorphology is necessary, although it is a great unknown for professional engineers and biologists, who cover, almost exclusively the administrations as well as hydrological and environmental consultancies. Second, there is a split of fluvial geomorphology in two aspects, one dominated by basic research and another more clearly applied, encouraged by the rise of hydromorphology, which will try to fill the knowledge gap exposed in the first key effect.

Both aspects of the geographical Spanish fluvial geomorphology coexist, collaborate and have been developed and consolidated in the first two decades of the 21st century, both achieving that there be a solid scientific

and technical level comparable to that of the leading countries in the international scientific landscape. On the one hand, basic fluvial geomorphology has reached a great technical and methodological level, and a remarkable excellence due to the number and quality of publications, highlighting the centers of Lleida, Valencia and Murcia, to which we must add work teams at other universities. On the other hand, river geomorphology applied to hydromorphological characterization and evaluation has its main center in Zaragoza and Vitoria-Gasteiz, developing different actions that will be exposed in the following sections.

In short, Physical Geography has contributed over other sciences to consolidate fluvial hydrogeomorphological research. Nonetheless, there are also some work groups that, from a Geology standpoint combine basic research with applied hydromorphology (e.g. Oviedo and Madrid).

Overall, the scientific production is so abundant that it is impossible to select and highlight works, projects and publications. Hence, this general vision without references has been chosen as a synthesis of the general state of the matter. As a final comment, and as of 2020, it can be affirmed that: (1) the contribution of Physical Geography to river science is exclusively geomorphological and hydrological, that is, hydromorphological or hydrogeomorphological (both terms are used as synonyms); (2) it is a consolidated, growing contribution of quality, and is very likely to continue growing in the coming decades; and (3) it is very well-focused towards a future and predictable integrated river science.

3. Contributions of Physical Geography to applied fluvial hydromorphology

In this section, we focus and specify the content of the article toward the aspect applied to hydromorphology, which is developed by the signing authors of this work specialists in Physical Geography. The applicability and the main conceptual contributions from Physical Geography are summarized in a general way in figure 2. The development of this line in the last 20 years has focused on the ten work topics presented below in a logical and thought-out order, although there are several interactions between all topics.

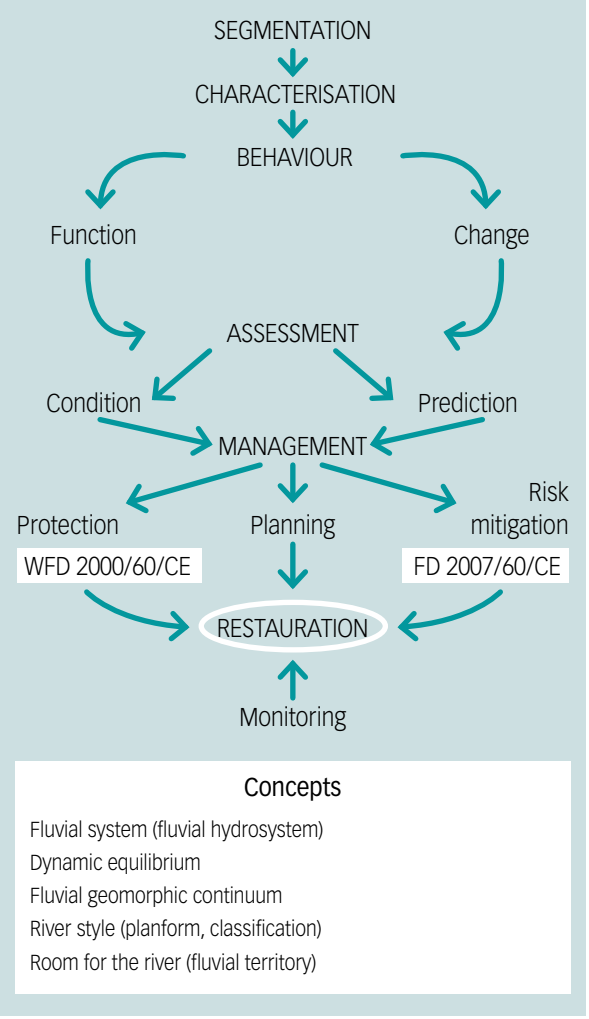

Figure 2. Application line and key concepts contributed by Physical Geography

3.1. River characterization on different scales

Characterization is a purely geographical task that is carried out on different spatial scales, from the basin to the reach, and from here to the sampling point (Ibisate *et al*., 2011). It involves four interrelated tasks: (1) processing of the river network, a basic and essential task which, in order to be effective, must be carried out from a hydrological and geomorphological criterion, identifying and defining internally homogeneous reaches that are different from each other; (2) hydrogeomorphological classification or categorization of each reach, assigning a specific river type or style (figure 3) (different classifications are used and adapted to each case study); (3) compilation of hydrological and geomorphological information for each reach, forming the characterization itself by filling in detailed databases; and (4) comparison among reaches and among fluvial styles based on the information obtained and on the aims of the work.

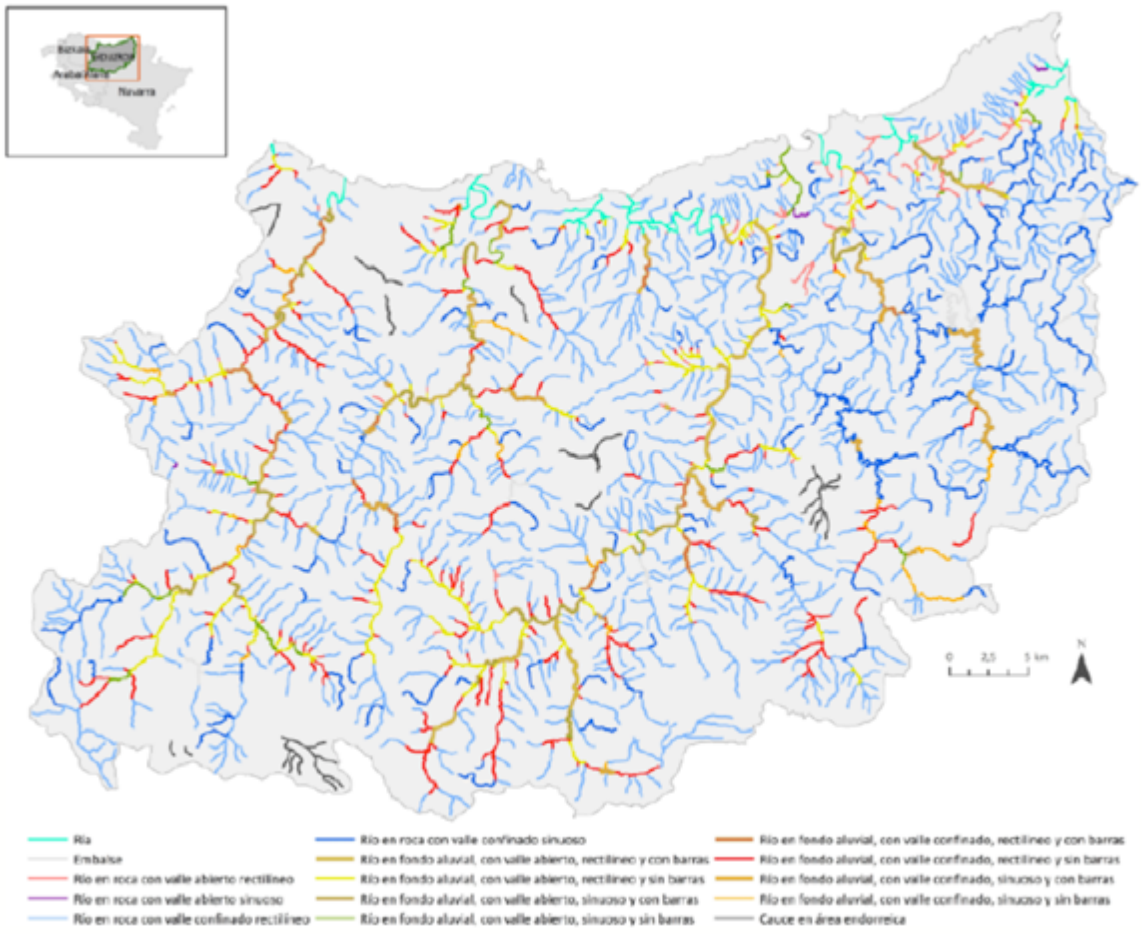

Figure 3. Example of processing and classification by river types or styles in the Gipuzkoa river network
Source: Ibisate *et al.* (2016b)

3.2. Measurement, analysis, mapping and interpretation of processes, changes and trends

A second step, based on basic characterization, leads to the understanding, quantification and qualification of the dynamic function of the fluvial system, similarly, at different scales (basin, reach, cross-section). The processes that are measured and analyzed are hydrological (channel runoff, flows) and geomorphological (erosion, transportation and sedimentation). It is not enough to compile data sheets and databases as in the previous section, but it is necessary to identify, measure and analyze them in detail in the field. The information cannot be collected only once, making it necessary to use and obtain data over time during different work campaigns (this prolongs notably the research time). Only in this way can the dimensions and efficiency of the processes be verified, changes be identified over time and, therefore, evolutionary patterns and trends be established (figure 4), both retrospectively and prospectively.

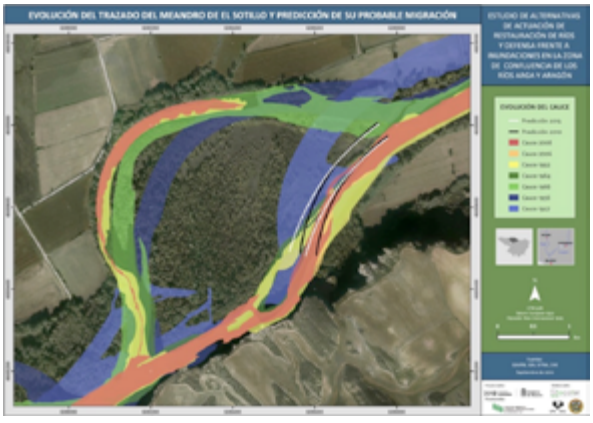

Figure 4. Example of evolutionary analysis of a channel (Aragón River) with estimation of trends
Source: Ibisate (coord., 2010)

The methodology is complex because different techniques can be applied, and because interpretation is a difficult task that requires a lot of experience. In this section, geomorphological cartography is essential

(figure 5), being necessary developed at different spatial scales for processes and forms, as well as with an evolutionary character, by means of diachronic maps that visually represent changes over time. In total, this section is the most laborious of any hydrogeomorphological project and is made up of specific Physical Geography tasks, which requires experts in this science. All of this work is essential for verifying compliance with the hydrogeomorphological and ecological functions of the river system, identifying all the factors and the weight of each of them.

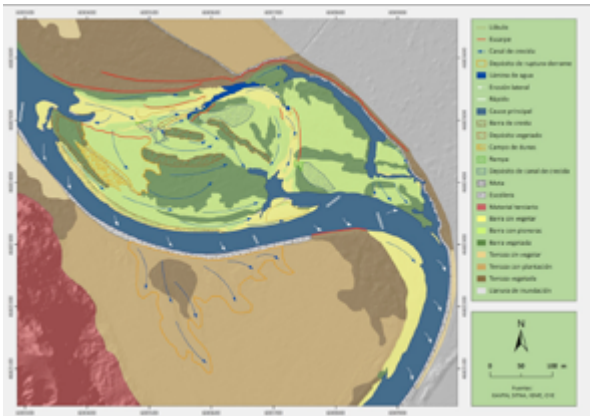

Figure 5. Example of geomorphological mapping in the Aragón river

Source: Ibisate et al., (2012)

3.3. Pressure identification and impact check

A part or all of the fluvial functioning analyzed in the two previous points may be disturbed or influenced by human action. Therefore, it is necessary to address the task of identifying all the anthropic pressures that exist in the fluvial system at the basin, reach and local point levels. Then, it is necessary to verify what hydrogeomorphological impacts these pressures produce in the system. Or what effects they have on the processes and forms, and how they affect these alterations at each point and as a whole, aside from what trends can be foreseen in the future river function and what adjustments the river will foreseeably make as resilience mechanisms and adaptation to these impacts. These tasks therefore entail systematic identification and location tasks, as well as more complex actions of interpretation, establishment of impact thresholds, evaluation and forecasting. The possible effects of pressures and impacts not yet executed can also be worked on, anticipating the expected situations from a knowledge standpoint, of the river system. The possible action of global change on the river would also be included in this section, which requires a deep knowledge of the territory and its evolution as well. Without a doubt, the most difficult task in river hydromorphology is to identify, to what extent a process, a form or an alteration is attributable to a natural phenomenon, to a local impact or to global change.

3.4. Assessment protocols and indexes

The three previous sections require different work actions and a wide collection of information that must be procedurally organized. For this, protocols are established. Each work team in applied hydrogeomorphology has its own protocols that are developed and adapted to each study according to the objectives, the dimensions of the fluvial system and the budgetary conditions. The protocols therefore entail a process of simplification, of information selection, as has happened in Spain with the protocol supervised by the Ministry of Ecological Transition (MITECO, 2019). It is necessary to know very well what to measure or observe, how to do it and for what purpose. To sum up, what is done is to define and use indicators, elements from which we can obtain, with the least possible effort, the maximum amount of information. And the use of indicators leads directly to the generation and application of indexes that are capable of qualitatively and/or quantitatively show the degree of hydromorphological naturalness (e.g. continuity, connectivity, complexity, processes, forms, dynamics) in fluvial function, the effects on the channels by human action, that is, ultimately, the hydromorphological state of the river, a key condition of the ecological state. This task is the river assessment or evaluation, the diagnosis of its state. It can be carried out for the present (how is the river?), but also for the past (How was it? Has it improved or worsened?), and for the future (How will it be if the impacts continue or if we apply actions for improvement?).

Hydromorphological evaluation can and should go much further than the simple considerations established by the simple and unstructured hydromorphological indicators of the Water Framework Directive. Hence, the effort to generate hydromorphological evaluation indexes in all countries. An example in Spain, also applied in South American countries, is the HydroGeomorphological Index (IHG, by its Spanish acronym) (Ollero *et al*., 2007), which allows us to diagnose the condition from the anthropogenic impacts that move it away from naturalness (in its functionality, in the channel and in the riverside corridor), also being very useful for follow-up of restoration actions and projects (figure 6).

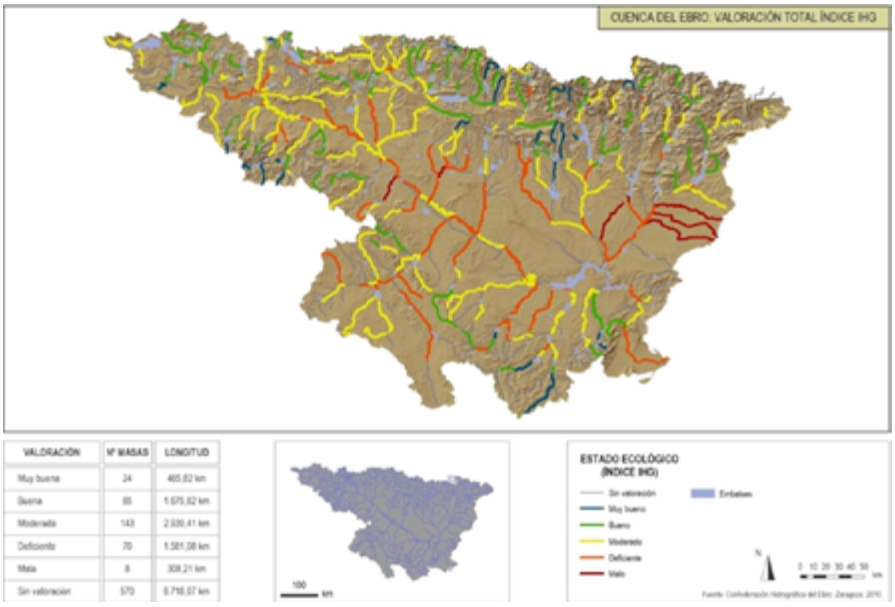

Figure 6. Result of the application of the IHG index to the Ebro basin
Source: Durán *et al.* (2010)

3.5. Technical and social training and impact reporting

Everything presented up to now in the four previous sections involves a complex technical application, intrinsic in the projects, studies and reports of river hydromorphology. But it is also necessary to set aside the strictly scientific, academic and technical aspect and promote hydrogeomorphology, the knowledge of this science, as a natural value and its problems as well, to those responsible for managing the territory and to society as a whole. This action is necessary and urgent and constitutes a responsibility for the people who work in this applied line, even more so, taking into account that from the purest or basic river research, it is barely considered. This permanent task is difficult and must be necessarily prolonged over time, because it starts from scratch and because there are different social inertias against it. It is necessary to develop it in three main lines.

Firstly, it is necessary to train technical personnel of the administration, and those responsible for river management and its territory, in fluvial hydromorphology. This was an obvious need since hydromorphological work began, and in recent years there has also been a growing demand from people receiving this training. As an example, the annual courses of applied fluvial geomorphology begun in 2019 and taught by the authors of this article.

In the second place, it is necessary to train society to overcome misconceptions and negative opinions about river hydrogeomorphology. It is important, efficient and extremely urgent to use the geomorphological perspective in raising people's awareness of river problems. Until now, progress has been very scarce because there is no space for this subject in school curricula nor has it been possible to reach the media consistently. Only slight progress has been made based on the efforts of some people in the presentation of lectures and courses and from the preparation of teaching materials, such as those of the Iberian Centre for River Restoration (CIREF, by its Spanish acronym).

A third way, as necessary and urgent as the previous ones, and equally important, is the denunciation of negative practices and actions on river channels, accompanied by explanations about their impacts on fluvial functioning. It is done on personal blogs and the websites of some associations, and sometimes even in the form of allegations and legal proceedings. It is a pedagogical and sensitizing task, not without conflicts for those who carry out these greatly extended negative actions. But it is key for the valuation of river geomorphology, for social awareness and so that management is gradually more appropriate, environmental, rational and sustainable. This is aligned with the environmental expertise of actions in the territory, which is one of the professional applied tracks of Physical Geography.

3.6. Valuation of fluvial geomorphological heritage

As we explained in the previous section, the deficiencies in the understanding and evaluation of fluvial geomorphology

by the population and administration are very notable. Fluvial geomorphology should be an object of protection, conservation and restoration itself. Part of the scientific efforts must be geared toward the valuation and enhancement of geomorphology as a key element, along with its processes, as a relevant indicator of river health and as an objective of restoration. Why is there not a single geomorphological paradigm to value rivers? No other arguments are needed. However, the situation is still not very favorable, because conservationism is fundamentally biological and management is basically engineering. Consequently, the assertion of fluvial geomorphology collides with the low value that is given to it at the social and administrative level, remaining subdued under the other two strongest tracks. A biocentric perspective dominates, both in the human perception of nature and in the objectives of conservation initiatives. Biodiversity has exclusively dominated the concept of nature, geomorphological values have been relegated to the background and geodiversity protections have been reduced to points in very specific places and geoparks based on Geology. Looking to a necessary change in mentality, within the passivity that must be overcome, the most relevant is the dominant belief in society, which is still very marked today, that fluvial dynamics is a problem that must be overcome with engineering actions. In most cases, these in turn, lead to bad environmental practices. The consequences are usually very negative for the river, putting the spotlight the strong degradation processes recorded in recent decades.

Geomorphological processes and fluvial dynamics should be considered a natural heritage to be protected, because they make up a complex functioning that is basic and transcendental to the planet's balance. Along these same lines, the river forms built by geomorphic processes are a unique asset due to their diversity and in alluvial courses for their ephemeral, dynamic nature, for their continuous processes of construction and destruction. This is why it is so important that these morphologies be frequently destroyed through extractions, dredging, clean-ups and maintenance tasks carried out by heavy machinery along thousands of kilometers of channels. The potential of this perspective is very high, but many indicated and important points of inertia must be overcome. Therefore, here is another huge task that can be perfectly focused on and approached by Physical Geography.

The key values for promoting fluvial geomorphology as a natural heritage are those of geomorphology, that is to say, the dynamics, diversity, processes, forms, sediments, singularities, the state, functionality and naturalness. Relevant examples of very damaged fluvial heritage in dire need of valuation and protection are the gravel channels and the ephemeral streams, which have and unmatched diversity due to very active dynamics. Currently, various projects in Spain are working along this line.

3.7. Management and conservation in the planning framework

Fluvial hydrogeomorphology should be an object of management and conservation in the administration's programs (e.g. into basin hydrological plans). This line of thought is much more consolidated in the Anglo-Saxon field (Brookes, 1995; Brierley and Fryirs, 2008). In Spain is notable the introduction of geomorphology in Royal Decree 9/2008 by which the Regulation of the Public Hydraulic Domain is modified. Specifically, it is necessary to pay attention to geomorphological characteristics in order to determine what is the channel, preferred flow zone and flood zone. This has opened up new needs for geomorphological application, not yet fully developed.

So far, the treatment of fluvial geomorphology in hydrological planning, and also in urban planning, has been scarce and disappointing, and not only in Spain. It is disappointing because of the lack of analysis and also the disdain for processes and forms, which are often considered river diseases. In urban settings, skewed perceptions and social tastes have led to implementing unnatural and very domesticated river landscapes. A consequence of all this is the defenseless situation of channels from a protection and conservation aspect, especially gravel channels and the temporary and ephemeral streams. Even a specific figure such as the Natural Fluvial Reserves does not consider geomorphological values but instead relies on biological ones. This fact conditions the lack of generalized sensitivity and the maintenance and impunity of the serious geomorphological impacts suffered by the vast majority of our channels (Ollero, 2019).

Therefore, we are faced with a great challenge for Physical Geography and geomorphology, a challenge imbricated in its implementation along with proposed in the other sections. In this case, the perspectives are less positive and will certainly take more time than is desirable, but it is necessary to make an effort from a geographical standpoint to address this challenge.

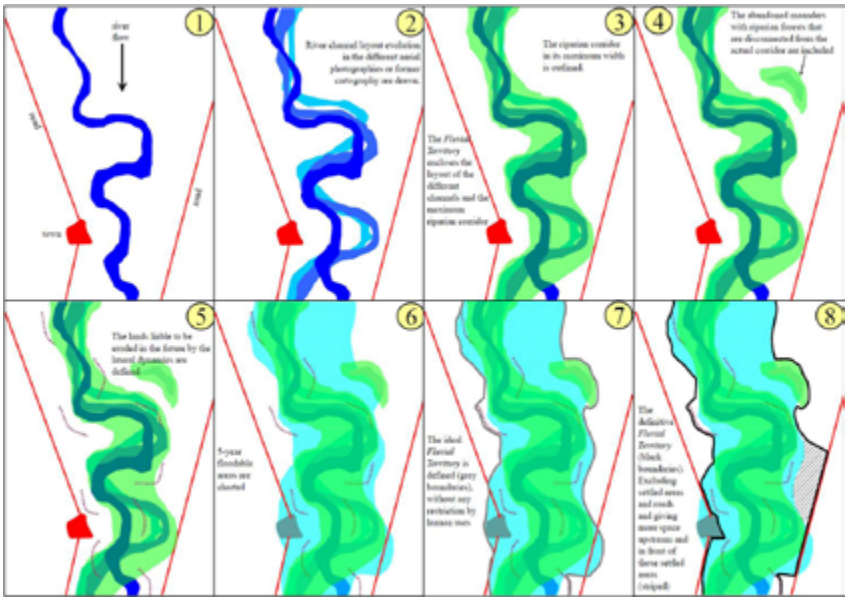

Figure 7. Methodology of delimitation of the fluvial territory

Sources: Malavoi *et al.,* 1998; Piégay *et al.,* 2005; Ollero *et al.,* 2009, 2015a

3.8. Mitigation of risks

One of the most important aspects of territorial management is aimed at mitigating natural risks. In the river area the risks are related to two main and associated processes that can and very frequently, in all waterways without exception, do, generate damage in the socioeconomic environment: flooding and bank erosion.

In the case of margin erosion and the study and effects of avulsions and changes of layout, its verification, quantification and cartography has been worked on from Physical Geography and fluvial geomorphology, but there has not been a search for solutions, for two reasons. In the first place, because engineering has traditionally covered these in their entirety, since it has dominated the primary fight against fluvial dynamics. Secondly, because from a geomorphological perspective, dynamics, erosion and processes are positive in themselves and must be respected as heritage (Bravard, 2000), as described in sections 3.5 and 3.6.

As for the delimitation of flood zones, overcoming an exclusively hydraulic tradition and based only on hydrological models, the use of geomorphological and historical characters has been introduced into the National System of Cartography of Flood Zones, but in this case, it has been from Geology (Sánchez and Lastra, coords., 2011). But the potential of Physical Geography in this work is enormous and should be consolidated in the future.

A fundamental solution provided by Physical Geography for risk management in different countries is the space for the river or fluvial territory (Ollero and Ibisate, 2012), a natural band that is sufficiently wide and continuous in which the watercourse can erode, overflow and reduce energy, safeguarding itself from harmful human uses, which are prudently removed (figure 7). It is a contribution to land management that is progressively being implemented under different denominations and conditions, but in a continuous and unstoppable line. Its progressive implementation by hydrological administrations is not recognizing the origin of the idea in research studies by Physical Geography, a silenced origin, so in this article we want to draw particular attention to this fact.

All of the above implies that the activity that develops from Physical Geography in relation to floods events is very relevant, covering all the phases of the process, from its hydrometeorological origin to its socio-economic consequences through all its hydromorphological complexity (Mateu, 1990; Camarasa, 1995; García Ruiz *et al*., 1996; Ibisate, 2004). The aspects of perception and communication are also worked on and there is participation in judicial processes, as well as in citizen participation debates regarding procedures about general and specific measures and actions.

3.9. River restoration or rehabilitation

A great challenge of the twenty-first century, even a moral obligation (Soar and Thorne, 2001), is the environmental restoration of everything that has been deteriorated by anthropic actions in the natural systems (Wohl, 2019).

In the fluvial environment this restoration consists of a process in which rivers recover their structure, naturalness and resilience, mainly from hydrogeomorphological actions. When a river must do the work, its own hydromorphological work, so that human action can be reduced to the elimination of impacts and monitoring, it can be considered an autonomous restoration. In many cases the recovery can only be partial, so that the term "rehabilitation" already dominates, instead of the more demanding and complete "restoration" (CIREF, 2010; Horacio, 2015a, Horacio 2015b).

In these actions Physical Geography has taken on a notable role, achieving an employment niche that implies, at the same time, that training in our discipline by other professional in the environmental field is demanded more and more. Therefore, the participation from Physical Geography, in a fluvial restoration in Spain can be described as outstanding at an organizational level (participation of about twenty geographers in the CIREF and in the organization of the Iberian congresses), a theoretical level (support in the National River Restoration Strategy, counseling to different administrations), applied (participation in river restoration projects) and fundamentally, always in hydrogeomorphological aspects (Ollero *et al*., 2015b). The work being done to unmask and denounce false restorations and to explain to what extent many of the actions that are carried out do not respond to the principles of restoration, nor imply improvements in the functioning of the river, are also important. This task is key for the future of river restoration in the social, political and cultural contexts.

But we believe that Physical Geography can contribute much more to river restoration. The holistic and integrative vision of the processes at the basin level that are contributed by Geography and that help with diagnosis and restoration proposals is very remarkable. And this restoration must be focused and integrated on many occasions towards territorial planning and risk management, as already stated, issues of a clear geographical component both at a theoretical level and in professional practice.

This trajectory must still be consolidated in the professional environment and in concrete projects. This is where the following steps have to be taken to ensure that river restoration can truly become an important employment niche of a professional nature for Physical Geography.

3.10. Scientific monitoring of changes and adjustments and the application of measures

As a culmination of all the applicability presented, it is necessary to emphatically state that people trained in Physical Geography have an excellent background for developing hydrogeomorphological monitoring projects

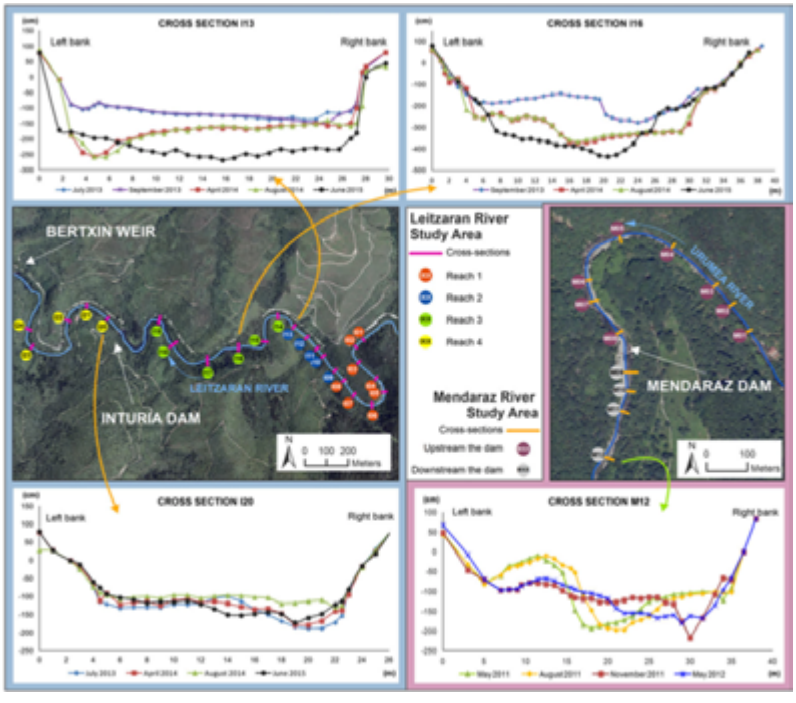

Figure 8. Example of monitoring work to demolish dams on the Leitzaran River
Source: Ibisate *et al.* (2016a)

in fluvial systems. Field measurements, monitoring via different techniques, permanent reflection on the effects of actions and cause and effect relationships, the possibilities of adaptive management in rehabilitation processes, all this is a constant in research projects and contracts for the administration. An example in which the authors of this work participate, is the monitoring of the demolition of dams, an activity that is developing more and more in channels and for which the monitoring procedures and the selection of indicators are being improved (Ibisate *et al*., 2016a) (figure 8).

The follow-up consists of a continuity in time that provides useful data for both the hydrogeomorphological problem that is the objective as well as for the learning and methodological improvement of the work groups. It is also very useful for education, for generational renovation and for social recognition, allowing, in addition, the participation of students and volunteers. Monitoring also approximates the understanding of long processes over time, such as global change and climate change. There is no doubt that it is a key aspect in the continuity and development of our scientific discipline.

4. Perspectives, challenges and conclusions

Physical Geography holds a prime spot as a scientific discipline in all countries. One of its fields of work is fluvial hydrogeomorphology, which is clearly expanding in the scientific field, both in basic and applied research. The topics covered augur a progressive development in technical and management spaces, in the future.

Increasingly, hydromorphological effects of global change have been observed in recent decades, and with greater intensity at the present time, in most of the planet's watercourses. In the near future of our rivers, incision, stabilization and streamlining will dominate, all of which will have relevant negative environmental and economic consequences. The hydromorphological monitoring of these processes will be key for diagnosis and management in each case, and Physical Geography is the most appropriate scientific framework for this monitoring. It is a transversal knowledge with great potential for application in broader present and future areas such as territorial planning, risk management, conservation and environmental restoration. This implies that many geographers will be able to work along these lines, lines that must also be consolidated academically, in order to properly train these professionals. And all this will undoubtedly be framed in a transversal and multidisciplinary applied river science, in which Physical Geography will have much to contribute in the hydromorphological aspect as well as in other subjects.

Therefore, it is urgent and necessary to open and consolidate specific academic and curricular tracks to train specialists in river hydrogeomorphology from a Physical Geography perspective. The first step should be to introduce more Geography in secondary and high-school education, and not only human and regional, but a Physical Geography that secures and values scientific and technical lines of the discipline and makes them known, on an academic and social level. Physical Geography has to stop being the great discovery for students of Geography degrees, and must be known and recognized before, because that will mean the application of more young people in said degrees.

Another necessary and urgent proposal is to train people who have specialized in Physical Geography, in fluvial hydrogeomorphology, and who in turn can visualize this as one of the most active and best professional possibilities in the future. In this future river science, hydromorphology will undoubtedly have a great weight, above and beyond that of the Water Directive requirements, at the level of scientific and technical advances and the needs of territorial management, risks and global change. In that river science, hydrogeomorphology must be led by Physical Geography. More work must also be done so that biogeography can be integrated in collaboration with other environmental sciences in the ecological lines of river science.

In short, the outlook is positive, but the challenges will be complex. We must work from a strong Physical Geography in science to consolidate a Physical Geography with more academic weight, a greater understanding and social recognition.

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Biogeographical valuation of global plant landscapes using the "lanbioeva" (landscape biogeographical evaluation) methodology

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Abstract

The paper presents and compares the results of biogeographic research work carried out for more than 25 years at a global scale, affecting about 200 vegetal groups from American (Nicaragua, Chile, Brazil), European (Spain, Netherlands, Croatia, Montenegro, Finland, Norway) and African environments (Morocco). The used methodology -LANBIOEVA (Landscape Biogeographical Evaluation) - is a tool for the analysis, diagnosis and management of biotic units and landscapes, both protected and unprotected. This methodology includes an inventory from which a multifactorial valuation is carried out at the level of Conservation Interest (INCON) and Conservation Priority (PRICON). From the results we can see INCON patterns as striking as the strong weight of territorial criteria in the units of the southern cone of South America, the important mesological values of the European ones, the modest overall scores of those located at high latitudes or the important weight that, in some cases, retain the criteria of cultural roots. As far as PRICON is concerned, the remarkable scores obtained by the formations subjected to strong anthropic threats are noteworthy.

Key words: Biogeography; Vegetal landscape; LANBIOEVA; INCON; PRICON.

1. Introduction

This article is part of a 25 year-long research study to design, test and improve a global vegetation landscape inventory and evaluation method. To date, the methodology used has been described in many works (books, book chapters, monographs, papers, conference presentations and scientific articles) and has been applied to different territories in Europe, Central America and the American Southern Cone. The results of the evaluations have been particularly useful in land-use planning processes (Cadiñanos and Meaza, 1998a; Cadiñanos and Meaza, 1998b; Cadiñanos and Meaza, 2000; Cadiñanos, Meaza and Lozano, 2002; Cadiñanos *et al*., 2002; Meaza, Cadiñanos and Lozano, 2006; Lozano *et al*., 2007; Lozano and Cadiñanos, 2009; Cadiñanos, Lozano and Quintanilla, 2011; Lozano *et al*., 2013; Sagastibeltza, Lozano and Herrero, 2014; Lozano *et al*., 2015; Lozano *et al*., 2016; Lozano *et al*., 2017 and Lozano *et al*., 2019).

One of the main objectives of Applied Biogeography is to develop methodological tools that generate data and provide society with information and methods of application for the implementation of land-use policies and management. In the past centuries, there has been a drastic reduction in various ecosystems and in diversity

on a global scale. In addition, the extinction of species has occurred at an ever-increasing rate compared to that of the past (Wittaker, 1979). In the face of such dangers, there is a need for protocols that focus on the true capacity of ecosystems to generate resources and create a more balanced approach in order to force a paradigm shift in land-use, economic, social and environmental policies (Mc Neill, 2000).

This is the reason why, for more than 25 years, studies have been conducted to create the LANBIOEVA method (Acronym for Landscape Biogeographical Evaluation), a powerful and scientifically robust tool to inventory, analyze, diagnose, evaluate and develop the proposals that are necessary for the correct management of different landscapes, environmental units and ecosystems on a global scale. LANBIOEVA is a long-established geographical methodological approach which is complementary to other proposals emerging from different research studies with a very diverse focus. The work by Constanza *et al.,* (1997) comes to mind, which discusses the environmental services evaluation offered in separate ecosystems from the perspective of different professionals. In turn, the evaluation of ecosystems and landscapes in quantitative studies exclusively focused on biodiversity (Wittaker, 1972; Benton, 2001) omit cultural criteria which are often equally, if not more important than naturally occurring values in ecosystems and landscapes deeply modified by human activity.

Often, these studies are based on relatively complex scientific exercises which are difficult to interpret and implement by decision-makers who are responsible for executing mandatory plans for land-use management, primarily in landscapes of predominantly natural vegetation. For this reason, a working tool with a methodological approach to assist in responsible decision-making has a high interest for managers (Strijker, Sijtsma and Wiersma, 2000; Debinski, Ray and Saveraid, 2001) and, above all, offers a transversal approach that combines questions intrinsically related to natural values in landscape units and other values tied to ecological processes, cultural criteria and land management.

The LANBIOEVA method offers a coherent, rigorous, versatile and practical methodology, based on simple, flexible and clear rules which are easy to interpret and which provide standardized results for the correct and hierarchical management of the biotic communities and landscapes in question. From this perspective, it is an important instrument for land-use and planning.

A fundamental tool used to gather information and help in the decision-making process concerning vegetation landscapes which are part of our cultural and natural heritage.

2. Objectives

The general objective is to globally gather and compare the partial results from all the different formations studied over a period of 25 years of research. In this way we assess the behavior, robustness and versatility of a method (LANBIOEVA) which has been applied and tested already in different ecosystems on a global scale. Furthermore, the contents and practical functionality encompass the following associated working objectives:

- Integration of an approach which takes into consideration multiple environmental attributes in the areas to be inventoried and assessed.
- Creation of biogeographic valuation protocols covering areas such as geology, geomorphology, soils, vegetation, fauna, land-use, anthropic hazards, didactic perception and value, sustainable and secular management practices, etc.
- Creation of partial assessments for sectors focusing on relevant attributes or questions (natural, cultural, mesological, hazard values, etc.) concerning planning and space management.

3. Methodology

Vegetation valuation analysis becomes an area of common ground for knowledge experts from different specialties – botanists, ecologists, geographers, engineers and other technical and professional experts (Cadiñanos and Meaza, 1998a and 1998b), so developing processes which are widely accepted and agreed upon, is a truly desirable outcome.

3.1. Inventory

Once the units and locations are predefined, a minimum number of disseminated inventories is calculated based on stratified characteristics picked at random by SIG

(ARCGIS.10). The number of inventories to generate for each unit, in order to obtain a non-inventoried type, depends on the following criteria:

a) The global area that each type of landscape covers within the general site. The larger the area the larger the number of inventories to take.

b) Considerations regarding the different landscapes that the unit in question may have. The larger the variance, the larger the number of inventories.

c) The number of inventories also determines the quantity of new species that appear in related inventories. Hence, if after one inventory the next two show less than 5 % in new plants the number of inventories is considered sufficient.

For each of the inventories the first step is to obtain data regarding location and identification (UTM coordinates, toponyms, etc.), geographic and environmental facets and patterns (topographical, lithological, geomorphological, soil and aquatic characteristics), photograph of the site, etc. Subsequently, data is gathered on vascular flora taxons, fungal and lichenic flora coverage (fungae and lichens) and some bryophite species (muscinal stata). While the latter are in general analyzed by groups, vascular plans are registered with an indication of the coverage for each species using a 6 grade scale (5: maximum, +: minimum), for each of the four layers in which we conventionally divide the communities (layers of >5 m, layers between 4.9 and 1 m, layers between 0.9 and 0.5 m and lower layers <0.5 m) and global coverage. A + indicates coverage of less than 1 %, 1 indicates coverage between 1 % and 10 %, 2 coverage between 10 % and 25 %, 3 between 25 % and 50 %, 4 between 50 % and 75 % and 5 between 75 % and 100 %.

Additionally, a series of indispensable data is taken for the complementary evaluation of forest communities. We refer to global coverage and richness by layers (COBEST and RIQUEST), diversity of indivisible habitats (FORHAB), area of homogenous mark (FORESP), typographical dasonomic variety (FORFIS), and cultural and ethnographic added values (FORCUL).

3.2. Biogreographic valuation

The methodology rests on two fundamental evaluation concepts: Conservation Interest (INCON), which is the sum of Natural Interest and Cultural Interest, and Conservation Priority (PRICON), which multiplies the value of INCON by the Hazard Factor.

Figure 1 shows the organigram of the LANBIOEVA method.

3.2.1. Natural Interest (INNAT):

Comprised of four criteria groups: phytocenological, territorial, mesological and structural.

3.2.1.1. Phytocenological Interest (INFIT): Phytocenological criteria consist of intrinsic characteristics of vegetation and landscape such as diversity, naturalness, maturity and spontaneous regenerability. Maturity, being of the highest importance, carries double the weight in the score. Consequently, the unit analyzed can obtain an INFIT score ranging between 5 and 50 points according to the following formula:

$$INFIT = DIV\ (1\ a\ 10) + NAT\ (0\ a\ 10) + MAD\ (2\ a\ 20) + REG\ (1\ a\ 10)$$

3.2.1.2. Territorial Interest (INTER): Territorial criteria are bifactorial - applied at the species and group level - and encompass attributes such as rarity, endemicity, relictic and finicola facets, both in existing taxons and in the formation or landscape unit itself. Rarity being the most important, carries double the weight in the score. Consequently, the unit analyzed can obtain an INTER score ranging between 0 and 50 points according to the following formula:

$$INTER = RAR\ (0\ a\ 20) + END\ (0\ a\ 10) + REL\ (0\ a\ 10) + FIN\ (0\ a\ 10)$$

3.2.1.3. Mesological Interest (INMES): Mesological criteria evaluate the contribution of vegetation to the protection, equilibrium and stability of biocenosis, habitat and geo-biotype. There are 5 parameters corresponding to geomorphic, climatic, hydrologic, edaphologic and faunistic functions (Cadiñanos and Meaza, 1998a). Geomorphic function, being of highest importance, carries double the weight in the score. Consequently, the unit analyzed can obtain an INMES score ranging between 6 and 60 points according to the following formula:

$$INMES = GEO\ (2\ a\ 20) + CLIM\ (1\ a\ 10) + HIDR\ (1\ a\ 10) + EDAF\ (1\ a\ 10) + FAU\ (1\ a\ 10)$$

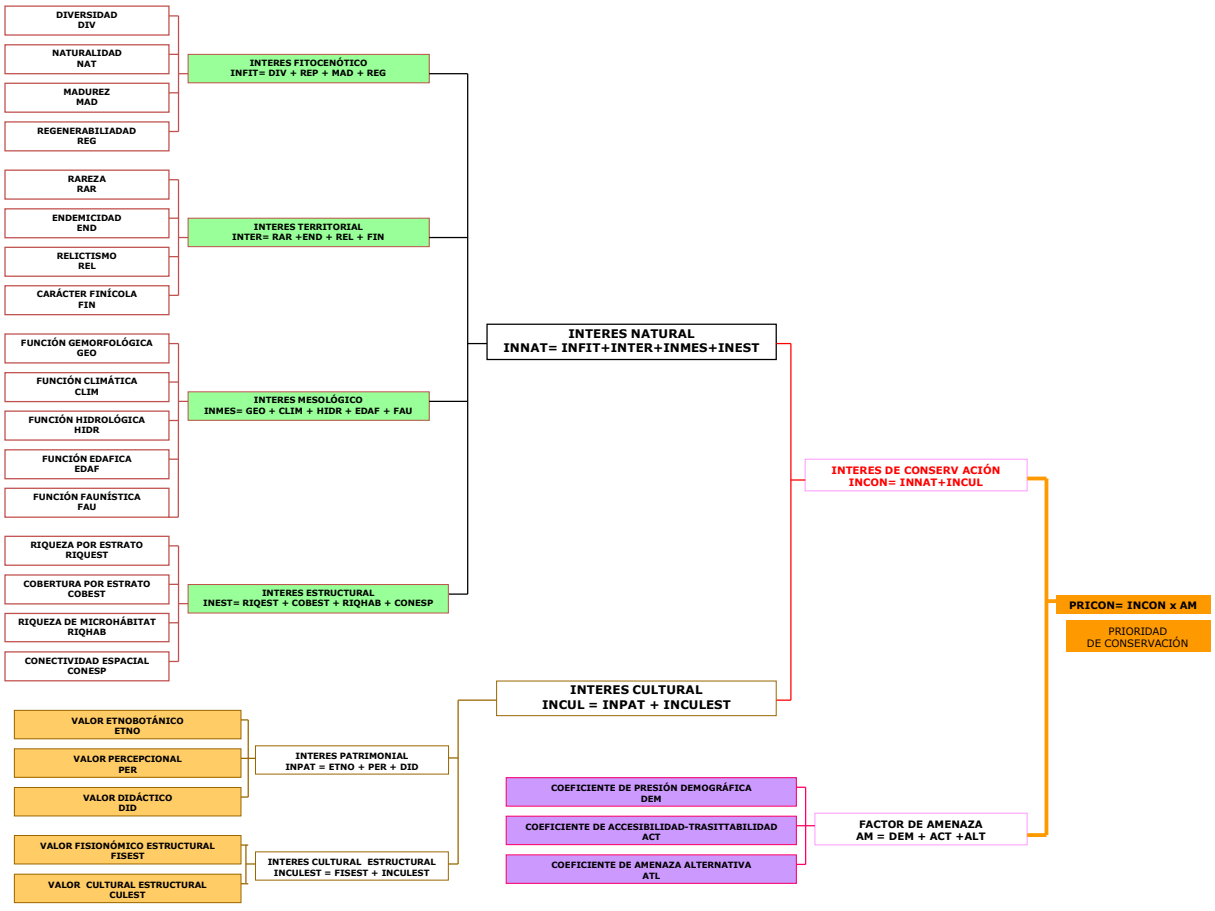

Figure 1. Organizational chart of the LANBIOEVA method
Source: own elaboration

3.2.1.4. Structural Interest (INEST): Structural criteria evaluate the richness and complexity of the different soil layers in addition to the number of microhabitats and the continuity and connectivity of each formation in relation to other masses or similar formations. There are 4 criteria or parameters under consideration: richness by soil layer, coverage by soil layer, richness of microhabitats and connectivity and area of the site. The first two parameter have half the relevance compared to the other criteria. The structural interest value of an individual vegetation group is therefore between 1 and 107 points.

$$INEST = RIQEST\ (0{,}5 \text{ a } 12{,}5) + COBEST\ (0{,}5 \text{ a } 12{,}5) + + RIQHAB\ (0 \text{ a } 20) + CONESP\ (0 \text{ a } 62)$$

The sum of these four criteria results in what is called Natural Interest (INNAT), which ranges between 11 and 267 points. The formula would be:

$$INNAT = INFIT\ (4 \text{ a } 40) + INTER\ (0 \text{ a } 50) + INMES\ (6 \text{ a } 60) + INEST\ (1 \text{ a } 107)$$

3.2.2. Cultural Interest evaluation (INCUL):

Cultural criteria have been omitted or under-utilized in most valuation proposals, basically due to naturalistic reductionism. However, they have drawn increasingly greater attention and awareness in conservationist policies. This score is calculated based on two value groups.

3.2.2.1. Patrimonial Interest (INPAT): Patrimonial criteria assess aspects which are almost always omitted because they are hard to measure and parameterize. However, the same weight should be attributed to these criteria as those of natural origin because they condition each of the formations studied and add intangible values which are often just as important as the tangible data. Three sub-criteria are contemplated: ethnobotanical value, perceptional value and didactic value. The first value establishes the sustainable utilization of the population in relation to formations and their taxons. Ethnocultural aspects of plants, vegetation and the landscape are evaluated (historical, archeological, religious, mythological, symbolic, recreative, medicinal…) which in each case

could contribute to an assessment making them worthy of conservation. The ETNO is multiplied by a correction factor of 2 because it has more importance than the other two values, and it may fluctuate between 0 and 20. The second value is based on local surveys which evaluate the perception and worth that the population associates with the formations. The third value measures the pedagogical capacity displayed by the different formations. Each value, with the exception of the first, uses a score from 1 to 10 depending on the interest and may vary between 4 and 10 points according to the following formula:

INCUL = ETNO (2 a 20) + PER (1 a 10) + DID (1 a 10)

3.2.2.2. Structural Cultural Insterest (INCULEST): Cultural values also concern the structure of certain formations and, therefore, their analysis, diagnostic and evaluation. It concerns traditional uses such as those found in tree and shrub boles, or those more directly ethnographical in type or tied to ancestral "ways of life": symbolic elements – individual trees or forests associated with traditional culture -, vestiges, structures and relictual micro-topographies of forest practices (trunk and foliage morphology; walls, dikes, bushes, site barriers or retaining levees and gullies; coal kilns…), farming or preindustrial (ironworks, water and fulling mills…) configuring peculiar vegetation landscapes, which add value to different units or formations.

Two sub-criteria values are defined within this group of criteria: structural physionomic value (FISEST) and structural cultural value (CULEST). The first group comprises only three types of boles depending on their use, lower mountain or ground level boles, pollards, tops, etc. trees which have been pollarded to two or three meters and are exploited because of the height of their stalks and, finally, lower mountain boles without any type of pruning or use left to grow to their natural state.

The second group fluctuates between 0 and 10 and highlights cultural elements such as vestiges, relictual structures and micro-topographies of agrarian and forestry practices: walls, barriers, dikes, shrubs, ridges and retaining gullies or site barriers, enclosures and traditional wooden palisades, hedges, cabins and other rustic constructions, pre-industrial elements (peat kilns, ironworks, water and fulling mills), archeological (menhirs, cromlech, dolmens, burial mounds, ruins…), symbolic elements, mystic or religious (trees or exceptional forests for subjective reasons, magic-religious traditions, hermitages, sanctuaries, etc.) distinctive vegetation landscape molders. For each element considered of high cultural value 1 point is allocated, following, as always, the scale from 1 to 10 points.

INCULEST = FISEST (1 a 3) + CULEST (1 a 10)

The INCULEST unifies two criteria which reinforce the importance of the general cultural value of the formation, therefore it is multiplied by a correction factor of 2, so the score fluctuates between 4 and 26. Global cultural interest would then vary between 8 and 66 points.

3.2.3. Conservation interest (INCON):

The conservation interest of a vegetation group studied results from the sum of the INNAT score (11 to 267) and the points obtained for INCUL (8 to 66), and therefore the INCON scoring range fluctuates between 19 and 333 points.

3.2.4. Conservation Priority (PRICON).

This concept is closely related to conservation interest but is in fact substantially different. The resulting score needs to be analyzed independently and should not be mistaken with the previous value. Conservation priority is expressly conceived for supporting the relevant administration and land-use managers, who need a clear and working diagnosis of the sites in order to prioritize decisions regarding their conservation.

The degree of endangerment to the vegetation units or landscapes analyzed in the evaluation process is calculated based on three parameters: demographic pressure, accessibility-transitability and alternative hazards.

3.2.4.1. Demographic Pressure or Rate (DEM), which prioritizes or penalizes high or low population density situations, with greater or lesser danger respectively, in vegetation changes. The range applied is obtained from the real density in inhabitants/km^2 of the study area. The researcher must consider topics such as the demography in the area, proximity to major population centers and conurbations and seasonal fluctuations, as well as availability and detail of the statistical sources. The proposed range varies between 1 for those areas with less than 50 inhabitants per km^2 and 10 in areas where the population is over 450 inhabitants per km^2.

3.2.4.2. Accessibility-Transitability Rate (ACT) is a mandatory parameter in order to understand the danger level to which the landscape unit is exposed, because human presence is conditioned by the terrain's density, size, conservation state and the degree of penetration of the road network into the more or less open structure of the assessed unit; when applicable, also by the limitations imposed by property owners or land administrators or as a result of governmental regulations. The proposed range shows a double entry matrix (6 accessibility values and another 6 transitability values ranging from very low to absolute for both). The combination of both variables provides scores which vary from 1 to 10 when accessibility and transitability are absolute.

3.2.4.3. Alternative Hazard Rate (ALT), measures alternative factors which could occasionally have an impact on the analyzed vegetation unit or landscape in a very real, coetaneous and serious way for the evaluation exercise – or in the very short term –: natural or human-induced disasters (floods, fires), noticeable damages from acid rain, toxic or polluting waste, eutrophication, plagues or other causes of excessive deaths, invasions or displacement of the original vegetation by aggressive foreign plants, short term disappearance of the vegetation from excessive felling, outfitting infrastructures, construction, electric lines, reservoirs, dredging, drilling activities, etc. The proposed range varies from 1 for a low alternative hazard to 10 for very high.

Thus, once the results of the three coefficients are obtained the Global Danger Factor (AM) is calculated by adding the values of demographic coefficients (DEM=1-10), accessibility-transitability (ACT=1-10) and alternative hazard (ALT=1-10), providing a ranging AM result between 3 and 30 points.

Conservation priority (PRICON) of a vegetation group of landscape is calculated multiplying its INCON value (19 to 333) by the corresponding AM coefficient (3 to 30), resulting in a PRICON score range between 57 and 9,990 points.

4. Results and observations

In the course of these 25 years very different areas have been studied, from the Scandinavian Northern area to the Chilean Mediterranean zone, and under various bioclimatic conditions such as the hyperhumid template of Artikutza, the semidesert Brazilian Caatinga or the humid Mediterranean of Croatia. From protected areas such as the Natural Park of Larra to unprotected territories which are seriously endangered such as the sclerophyllous forest with palms (*Jubaea chilensis*) of Valparaiso, Chile. Passing through completely cultural, anthropic or artificial formations such as the mesophyll meadows of Collsacabra in Girona, Garate-Santa Barbara and Mutriku in Gipuzkoa, to forestry landscapes with a higher degree of naturalness: the jungles of Nicaragua or the ample spaces of lenga (*Nothofagus antarctica*) in the Chilean Patagonia. From higher altitude areas such as the black pine forests (*Pinus uncinata*) of the Pyrenees or the cypress groves of the Andes (*Austrocedrus chilensis*), to periodically submerged units such as the biosphere reserve of Urdaibai (salicornias and meadows of *Zostera noltii*).

Research studies with very different goals have been taken into account also, for example studies in the Chilean Mediterranean area where the goal was to report the government for the lack of protection in certain formations, also work done in the area of Huidobro, in Burgos, within the context of management of different forestry landscapes inside the Natural Park of Hoces del Alto Ebro and Rudron, or a more recent study dealing with the planning and management of the various formations inside the rustic areas of Mutriku and Astigarraga for their inclusion, as a recommendation, in the General Urban Land-use Plan. In the case of Garate-Santa Barbara, a research study was conducted also to evaluate the varying landscapes and the economic compensation to be offered to the land owners of those areas with the best remnants of Atlantic cork oak forests (*Quercus suber*).

Additionally, there are investigation or I+D+i projects which have focused solely on one single unit, as is the case with the black pine forests of Larra or those evaluating the palm groves of Valparaiso and many other broad studies addressing all the existing formations in a particular space, for example the Balkans, the biosphere reserve of Urdaibai or those dealing with different rivers in the Basque Country.

Even so, until today, 20 different areas with over 800 inventories have been studied, some of which are unpublished or in the process of being published. Overall, up to 203 formations or vegetation landscapes have been evaluated. Table 1 shows some of the areas as well as some of the formations studied and assessed.

N.º	Formation	Area
1	Fir Forest of *Abies alba*	Northern Scandinavian Region. Lappavaara, Finland
6	Tundra	Northern Scandinavian Region. Kuaenangen. Norway
10	Ribera forest	Iberian Atlantic Region. Artikutza, Navarre
11	Oak grove of *Quercus robur*	Iberian Atlantic Region. Artikutza, Navarre
18	Southern peatland	Chilean Patagonia. Parrillar Reserve, Chile
23	Lenga of *Nothofagus antarctica*	Chilean Patagonia. Punta Arenas, Chile
30	Mediterranean sclerophyllous forest with palm *(Jubaea chilensis)*	Chilean Mediterranean Region. El Quiteño, Valparaiso
32	Mediterranean sclerophyllous shrubland	Chilean Mediterranean Region. Río Clarillo, Santiago de Ch.
34	Mountain Cypress *(Austrocedrus chilensis)*	Chilean Andes Region. Alto Huemul, San Fernándo
35	Beech grove with boxwood *(Fagus sylvacica-Buxus senpervirens)*	Iberian Mediterranean Coastal Region. Collsacabra, Girona
37	Mesophyll pasture	Iberian Mediterranean Coastal Region. Collsacabra, Girona
40	Mesophyll shrubland of boxwood and juniper *(Buxus senpervirens-Juniperus communis)*	Iberian Mediterranean Coastal Region. Collsacabra, Girona
46	Black pine grove with rhododendrum *(Pinus uncinata-Rododendrum ferrumequinum)*	Pyrenean subalpine level. Larra, Navarre
50	American red oak groves *(Quercus rubra)*	Iberian Atlantic Region. Bortziri, Navarre
51	Chestnut groves of *Castanea sativa*	Iberian Atlantic Region. Bortziri, Navarre
56	Hornbeam grove *(Carpinus betulinum)*	Iberian Atlantic Region. Bortziri, Navarre
64	Cantabrian Oak grove *(Quercus ilex)*	Iberian Atlantic Region. Urdaibai, Biscay
69	Reedgrass *Phragmites australis*	Iberian Atlantic Region. Urdaibai, Biscay
72	Meadow of *Zostera noltii*	Iberian Atlantic Region. Urdaibai, Biscay
74	Oak grove of *Quercus petraea*	Iberian Atlantic Region. Gárate-Santa Bárbara, Gipuzkoa
76	Cork oak grove of *Quercus suber*	Iberian Atlantic Region Gárate-Santa Bárbara, Gipuzkoa
85	Hazelwood grove of *Corylus avellana*	Iberian Atlantic Region. Gárate-Santa Bárbara, Gipuzkoa
97	Atlantic mixed forest	Iberian Atlantic Region. Mutriku, Gipuzkoa
104	Turkey oak grove of *Quercus pyrenaica*	Atlantic-Mediterranean transition Region. Merindades, Burgos
106	Portuguese oak forest of *Quercus faginea*	Atlantic-Mediterranean transition Region. Merindades, Burgos
108	Caatinga	Brazilian Semi-arid Region. Pai-Mateus, Paraiba, Brazil
109	Atlantic Mata	Brazilian Atlantic Region. Joao Pessoa, Brazil

Table 1. Specific examples of formations studied with corresponding code, formation and area values

Source: Elaborated by the author

What follows is a concise list the areas of study and the formations or vegetation landscapes analyzed and assessed:

1. Finland and Norway. As a result of a research sojourn in the University of Joensuu, a transect was devised to go through the territories of Finland and Norway from South to North. The formations studied were 9: 1. Sprucewood grove of *Abies alba*, 2. Sprucewood-birch grove (*Abies alba-betula pendula*), 3. Pine-birch grove (*Pinus sylvestris-Betula pendula*), 4. Pine forest of *Pinus silvestris*, 5. Birch-pine grove (*Betula pendula-Pinus sylvestris*), 6. Tundra, 7. Tundra in snowfield, 8. Pine-sprucewood grove (*Pinus sylvestris-Abies alba*) and 9. Sprucewood-Pine grove (*Abies alba-Pinus sylvestris*). The values were quite discreet although we can highlight that the highest score was 1,247.5 points obtained from the Sprucewood-Pine grove while the lowest was the 680 points of the Tundra-Snowfield.

2. A small research project was done in Artikutza, Navarre where the forestry formations were studied. Specifically, 6 forestry landscapes: 10. Ribera forest, 11. Oak grove of *Quecus robur*, 12. Beech grove of *Fagus sylvatica*, 13. Red pine repopulation (*Pinus sylvestris*), 14. American red oak repopulation (*Quercus rubra*) and 15. Repopulation of spruce with false cypress or Lawson cypress (*Picea abies-Chamaecyparis lawsoniana*). In this case also the scores were quite modest. The highest score of 1,215.3 points was registered in the Ribera forest while the lowest score was registered in the last unit and only reached 514.5 points. In general, the existence of strict protection policies of the forest mass,

the homogenization of the landscape and the primarily acid layers with steep slopes, result in relatively modest scores.

3. Research in the Chilean Patagonia as well as several research periods in the University of Santiago de Chile. The study focused on two very concrete sectors; within the Brunswick Peninsula and Torres del Paine National Park. The objective was to analyze and evaluate the largest number of formations possible. There were 12 formations identified and studied: 16. Southern Tundra, 17. Sourthern heathlands, 18. Southern peatland, 19. Mata negra shrub (*Chiliotrichum diffusum*), 20. Notro shrub (*Embotrium coccineum*), 21. Mata barrosa low shrub (*Mulinum spinosum*), 22. Mata guanaco low shrub (*Anartrophyllum rigidum*), 23. Lengar (*Nothofagus pumilio*), 24. Cohigual-Lengar (*Nothofagus betuloides-Nothofagus pumilio*), 25. Cohigual-Ñirre (*Nothofagus betuloides-Nothofagus antarctica*), 26. Cohigual de Magallanes (*Nothofagus betuloides*) and 27. *Ñirre* (*Nothofagus antarctica*). The score is relatively high in comparison with Northern forests and other units located around the same latitude but in this case in the Northern hemisphere. The unit with the best score was a mixed forest, the Cohigual-Lengar with 2,259.3 points and the lowest score obtained was at the mata negra shrub with 1,238.4. Remarkably, attention is drawn to the fact that all the shrubs scored above 1,000 points while in other areas scores remain between 500 and 800 points. This is thanks to a richness in species and the abundance of rare or endangered taxons together with a high level of native plants.

4. A series of formations in the Mediterranean area of Chile were studied during several different research visits in conjunction with a number of CONICYT projects in Chile. The inventories were taken in two protected areas: on the one hand La Campana National Park and on the other, the National Reserve of Rio Clarillo, while the third sector comprised an area not protected around Valparaiso (El Quiteño mountain pass). The study centered around the 5th and 6th regions and produced the following results: 28. Sclerophyllous laurophyll forest, 29. Hydrophilic laurophyll forest, 30. Sclerophyllous forest with palm (*Jubaea chilensis*) (figure 2), 31. Oak grove of Santiago (*Nothofagus macrocarpa*) and, lastly, 32. Sclerophyllous Mediterranean shrubland. On this occasion the values were quite opposing as the last formation only reached 607 points, one of the lowest registered, while the sclerophyllous forest with palm reached the highest ever obtained: 4,137.5 points. The large number of native species, rare and finicola, is noteworthy and gives this group of territorial criteria the most weight. In contrast the perception value scores are rather low except for the last formation termed *Jubaea chilensis* which is one of the identity symbols of Chile. Additionally, inventories taken in El Quiteño mountain pass list palms in true danger and in fact the alternative hazard reached the highest ever score of 25 points due to recurring fires.

Figure 2. Mediterranean sclerophyllous forest with palm (Jubaea chilensis). *La Campana National Park (Chile)*
Source: Elaborated by the author

5. A small study of two base formations located in the Andes mountain range was conducted using data from the same research projects mentioned under point 4. Namely, the locality of San Fernando in the 6th region of Chile. Only two forestry formations were analyzed; 33. Oak grove of pellin oak (*Nothofagus obliqua*) and 34. Mountain cypress grove (*Austrocedrus chilensis*). Both formations were studied and evaluated inside the Nature Sanctuary of Alto Huemul in the Colchagua mountain range. In this case the formation with the higher score is the oak grove with 1,949.2, very close to 2,000 points, while the cypress groves reached 1,564.8 points. The relictic character of the first group is worth mentioning. These oak groves have abundant trees over 200 to 300 years old and, in contrast with the rest of the vegetation have not been affected by the fires which are recurrent and a landscape-changing element of the highest order in the area.

6. In the Iberian Peninsula, one of the sectors studied for landscape evaluation was the region of Collsacabra, an area comprised by a series of structural reliefs close to the cape of Rosas and, therefore, in the outermost

eastern sector of the Pyrenees. In this Gironan sector the following formations were analyzed: 35. Beech grove with boxwood (*Fagus sylvatica-Buxus senpervirens*), 36. Oak grove with pubescent oak (*Quercus humilis*), two cultural formations such as the mesophyll pastures with (37) and without rocky outcrops (38), 39. Xerophyll shrub native of limestone outcrops, 40. Boxwood and Juniper mesophyll shrub (*Buxus senpervirens-Juniperus communis*), 41. Pubescent oak and beech boxwood mixed forest (*Quercus humilis-Fagus sylvatica-Buxus senpervirens*), 42. Deciduous mixed forest with boxwood, 43. Beech-oak grove with boxwood (*Fagus sylvatica-Quercus humilis-Buxus senpervirens*), 44. Kermes-holm oak *Quercus ilex* and, finally, 45. Holm-oak mixed grove (*Quercus ilex-Quercus humilis*). In general, the evaluations were relatively low considering that the substrata are notably basic. The unit with the highest score is the beech grove with boxwood reaching 1,606 points while the formation with the lowest score is the mesophyll shrub of boxwood and juniper with a mere 564 points. In this case the natural and cultural values are both modest. The criteria associated with anthropic hazards are relatively low in score due to the low density of the populations and their relative protection.

7. In the western sector of the Pyrenees, the Natural Reserve of Larra has been studied, in particular the alpine and subalpine vegetation tiers. In the context of this study the evaluation focused on different facies of the black pine tree open grove (*Pinus uncinata*). Three large facies from this type of open forest were analyzed and inventoried. The three units defined and evaluated are: 46. Black pine grove with rhododendrum (*Pinus uncinata-Rododendrum ferrumequinum*) in the shade, 47. Pine grove with gayuba (*Pinus uncinata-Artostaphylos uva-ursi*) (figure 3) in sunny spots and 48. Pine grove with rhododendrum and gayuba in those peaks where the orientation is to the four winds. Strangely enough, in this case, the formation with the best score was the one in the shade, the pine grove with rhododendrum. The explanation lies in the seasonal drought which over the seeping limestone gives way to a noticeable hydrological stress during the summer. This facies obtained 2,433.4 points while the remaining two scored 2,020 and 1,718 respectively.

8. The forests of Cinco-Villas in the region of Navarre were another sector evaluated as part of a research study and bachelor's thesis. This region is located to the Northeast of the Autonomous Community and has a temperate oceanic climate, we could define it as hyperhumid. Only 9 large forests were exclusively studied and evaluated within this area: 49. Beech grove (*Fagus sylvatica*), 50. American red oak grove (*Quercus rubra*), 51. Chestnut grove (*Castanea sativa*), 52. Riparian forest, 53. Turkey oak or Melojos grove (*Quercus pyrenaica*), 54. Oak grove (*Quercus robur*), 55. Mixed Atlantic forest, 56. Hornbeam grove (*Carpinus betuloides*), 57. False Acacia grove (*Robinia pseudoacacia*). In this study none of the units scored below 1,000 points, making this number precisely the lowest registered for the False Acacia grove. The Hornbeam grove scored the highest with 2,182.5 points. In general, the scores could be considered median in range given that the key group derives fundamentally from mesological criteria with a focus on protection and geomorphological processes within a region of high rainfall and steep slopes. In the case of the Hornbeam grove, the scores are very high in one of the territorial criteria, finicola, as these spots are the most Southern in their whole area of distribution.

Figure 3. Black pine grove (Pinus uncinata) *with gayuba* (Artostaphylos uva-ursi). *Pyrenees* (France-Spain)
Source: Elaborated by the author

9. The method focused in a first instance on the Biosphere Reserve of Urdaibai which originated the first studies and the fleshing out of the methodology itself in a doctoral thesis. At the same time, the partial and general registries derived from the study were implemented in land-use planning and management of the reserve. In this case the categorization was done at a large scale, a total of 15 different units or formations inventoried, characterized and evaluated. Additionally, the methodology was applied to a group of very varied formations located mainly in the marshlands of

Urdaibai, characterized by a temperate oceanic climate with more moderate rainfall than the previous units. The following are a list of the landscapes in question: 58. Cantabrian alder marshes (*Alnus glutinosa*), 59. Atlantic shrub/landa (*Ulex europaeus-Ulex galii*), 60. Mesophyll grazing meadows, 61. Oak grove (*Quercus robur*)-Atlantic mixed forest, 62. Tamarisk willow grove (*Tamarix gallica-Salix atrocinerea*), 63. Sandy area (with psammophilous vegetation), 64. Cantabrian holm oak cantábrico (*Quercus ilex*), 65. Monterey pine groves (*Pinus radiata*), 66. Sea purslane (*Halimione portulacoides*), 67. Sea rush (*Juncus maritimus*), 68. Marsh samphire (*Salicornia dolichostachya-Salicornia ramosissima*), 69. Reed forest (*Phragmites australis*), 70. Baccharis shrub (*Baccharis halimifolia*), 71. Small cordgrass (*Spartina maritima*) and 72. Meadows of *Zostera noltii*. The evaluation scores are rather high, particularly when considering that a large number of the formations are in direct contact with the sea or salt, and are located in small areas where a large part of the flora is endangered and classified as rare or very rare, while in the meantime this climactic vegetation is capable of averting river and marine erosion, to such an extent that in the fitocenic criteria, territorial and mesological for example, the scores are high. Additionally, the extensive occupation of the territory by different ethnic groups and civilizations has generated a large number of sites and secular ways to exploit the natural resources. All of that leads to very high cultural and natural valuations. There are 4 formations that surpass the 2,000 points, the Atlantic oak grove/Mixed forest sets the record with 3,478 points for this sector. In this case, originally the oak grove extended over the best topographical areas and expanded over the bottom of the river valleys and medium slopes. However, the intense anthropic expansion of the territory and deforestation to gain land, as well as coal and firewood, has meant that one of the potentially largest units has become one of the smallest. In turn, the lowest scores are units with *Baccharis halimifolia* brush, a species introduced from America to attach and protect dykes (442 points) and extensive Monterey pine groves with 508 points.

10. Another of the temperate Oceanic areas of study was ZEC in Garate-Santa Barbara, located within the Natura 2000 Network. A total of 20 different formations with highly contrasting facies in some cases were studied in the context of a transdisciplinary research project to evaluate as a whole the abovementioned site. In any case, the results were presented to the Basque Government for their possible incorporation into the management processes of this protected area. The landscapes studied and assessed were: 73. Mixed Atlantic lush broadleaved forest. 74. Oak grove of *Quercus petraea*, 75. Monterey pine plantation (*Pinus radiata*), 76. Atlantic cork oak gove (*Quercus suber*), 77. Mesophyll meadows for harvesting, 78. Mesophyll meadows for pasture, 79. Reed beds of *Juncus* sp., 80. Oak and Cork grove meadows (*Quercus suber-Quercus robur-Quercus pyrenaica*), 81. Young turkey oak grove of *Quercus pyrenaica* with shrubland, 82. Atlantic shrub/landa, 83. False Acacia grove (*Robinia pseudoacacia*), 84. Beech grove (*Fagus sylvatica*), 85. Hazel wood grove of *Corylus avellana*, 86. False cypress or Lawson cypress grove (*Chamaecyparis lawsoniana*), 87. American red oak grove (*Quercus rubra*), 88. Birch mixed forest, 89. Vineyard, 90. Chestnut grove (*Castanea sativa*), 91. Suburban forestry park, 92. Caserios (Basque traditional houses) and rural centers. There are 6 formations scoring over 2,000 points. All of which correspond to forestry landscapes with the exception of the reed beds where there were a significant number of rare finicola species. In any case, the highest score was registered in the mixed forest of broadleaves (2,614.5 points) which, given its wide reach and structural complexity, show significant cultural and natural values. The Atlantic cork oak grove also scores high with 2,317.5 points. A rare feature in itself due to its existence in a bioclimatic area which one would think as having unfavorable conditions for its appearance. There are only between 3 or 4 settlements in the Cantabrian Coast and Garate-Santa Barbara is one of the largest. The lowest scores belong to the caserios and rural centers with 494.5 points. The vineyard, the main crop in the area, reaches just over 1,000 points.

11. The municipality of Mutriku is also included within the Iberian Atlantic zone. In this case, as a result of an I+D+I research project, an evaluation of the environmental, ecological, landscape, economic and social, etc. aspects of the rural land of this municipality were requested by the Town Hall and the team responsible for drawing up the General Plan of Urban Management for the region. The objective, contrary to what normally occurs in drawing up the General Plan, was to order, plan, and outline management procedures for rural or non-urbanizable land. The LANBIOEVA method was adopted to evaluate the landscape aspect of the proposal. The units differentiated, characterised and

evaluated were the following: 93. Cantabrian Holm-Oak, *Quercus ilex,* 94. Oakwood, *Quercus robur,* 95. Beechwood, *Fagus sylvatica*, 96. Sprucewood, *Betula pendula*, 97. Mixed Atlantic forest, 98. Pinewood (*Pinus radiata*), 99. False cypress or Lawson Pine (*Chamaecyparis lawsoniana*), 100. Larch plantation, (*Larix decidua*), 101. Offshore Forest, 102. Atlantic/ Landa scrubland, and 103. Mesophyll grazing and harvesting meadow. In this case, the highest concentration of points was found in the Mixed Atlantic type (2,306.5). This can be attributed to those factors already commented on in the case Garate-Santa Barbara, while the lowest concentration of points correspond to Lawson Pine. In this case, the density of the plantation, the width of the tree-extension and the density and perennial character of the foliage which virtually prevents the passage of light, give rise to a structural simplicity which can only be compared with species poverty. The score registered came to 866,3 points.

12. As a result of a number of practical workshops centred around Espinosa de los Monteros, the LANBIOEVA method was also adopted for the analysis of the northernmost section of Las Merindades in Burgos. A transect was selected which included the most important forested landscapes in an area of transition between Atlantic and interior Mediterranean. This is a region with an important climate gradient, lying as it does between these two different climate types, with the conditions veering ever more closely to the Mediterranean type the further south one goes. The temperatures acquire a more continental character which are relatively cold in winter, not as warm as those further inland but at the same time higher than those registered where the land adjoins the waterway division. In this case 4 different formations were distinguished 104. Oakwood, *Quercus pyrenaica*, 105. Holm-wood, *Quercus rotundifolia*, 106. Portugese oak, *Quercus faginea* and 107. Mixed oakwood. The points registered were the lowest found in environments with formations of this type. The forests are generally very young, closely distributed, and with a dense tree extension, which, in general, has not allowed the development of other species, with the result that different layers have developed, giving rise to greater structural diversity. To this must be added the presence of acidic sublayers which dominate and which tend to produce very poor results. The highest score was registered in Oakwood with 1,216.5 points while the lowest corresponds with Portuguese oak with only 799.9 points, very close to Mixed oakwoods with 818.2 points.

13. Following an international scientific symposium celebrated in Brasil, a research sojourn was organised in an environment, the intertropical zone, which had previously been little studied using this methodology. Initially, it was thought the method in all probability could not be applied, both from the point of view of the inventory aspect as well as from the evaluation aspect. This was assumed because of the very great diversity, the structural complexity, the lack of information regarding the state of the taxons, etc. In any case the attempt did produce results though it must be admitted that it could only be applied to two formations, somewhat secondary formations, those denominated Caatinga and Mata Atlantica. The first of these is situated in a set of bioclimatic conditions which can be considered to be semiarid. This is a formation located outside the influence of the great mass of the Atlantic Ocean in the northeastern region of the country. Its facies is that of a relatively open formation, with few arboreal species, but many arborescent varieties and a great number of thorny taxons, together with abundant cacti and bromeliads.
Separately, a small study was also carried out in the Jao Pessoa Botanic Garden. This is of wide extension and a good representation of Mata Atlantica, an authentic tropical rain forest with oceanic influences and levels of rainfall far exceeding those of Caatinga. The highest score in this second formation is 2,920 points while Caatinga approaches 2,000 though not quite reaching it, specifically 1,809.5 (figure 4). Interestingly, while the Mata Atlantica does not show any contrasted facies, Caatinga does. Most of this formation is intensely pressurised by livestock and is typified by a very impoverished and very open subarboreal scrubland in a type of pastureland. However, the rockiest and most inaccessible areas, near the inselbergs, are typified by a relatively high diversity. We should point out the high scores obtained within the territorial criteria group, among which rare and endangered species stand out. The registers are more or less identical with those registered for different formations in Mediterranean Chile. Etnobotanic values are also worth noting. The population still utilize for the most part different taxons for different characteristics and there is an important cultural heritage related to the utilization of different plants. Nevertheless, at this same level, the perceptive evaluation of Caatinga and especially of Mata Atlantica is, strangely, very low.

VALUATION			PARAMETERS	1	6	10	11	18	23	30	32	34	35	37	40	46	50	51	56	64	69	72	74	76	85	97	104	106	108	109
INCON	INNAT	INFIT	DIVERSITY	4.0	4.0	6.9	5.4	3.0	4.2	7.0	6.3	5.0	5.0	10.0	8.0	8.5	3.7	6.0	8.0	9.0	3.0	1.0	4.0	7.5	8.0	9.0	9.0	8.5	5.7	5.0
			NATURALNESS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			MATURITY (x2)	18.0	20.0	18.0	17.7	18.0	18.4	14.0	10.7	18.0	18.0	8.0	8.0	20.0	9.0	9.0	9.0	20.0	20.0	20.0	20.0	10.5	15.0	18.0	18.7	20.0	15.9	18.0
			REGENERABILITY	7.0	10.0	7.4	7.0	16.0	14.0	10.0	4.0	9.0	7.0	3.0	6.0	10.0	7.0	7.0	7.0	7.0	3.0	7.0	10.0	6.5	7.0	7.0	8.0	10.0	7.5	7.0
			SUM (GLOBAL INFIT)	**29.0**	**34.0**	**32.3**	**30.1**	**37.0**	**36.6**	**31.0**	**21.0**	**32.0**	**30.0**	**21.0**	**22.0**	**38.5**	**19.7**	**22.0**	**24.0**	**36.0**	**26.0**	**28.0**	**34.0**	**24.5**	**30.0**	**34.0**	**35.7**	**38.5**	**29.1**	**30.0**
		INTER	RARITY (x2)	0.0	2.0	1.9	0.9	2.0	6.3	14.0	0.7	8.0	0.0	1.0	12.0	7.5	1.3	4.0	9.0	0.0	0.0	3.0	4.0	8.0	0.0	6.0	5.6	3.4	13.9	15.0
			ENDEMICITY	0.0	0.0	2.9	2.2	2.0	3.1	6.5	4.0	3.0	0.0	0.0	1.0	3.5	0.7	0.3	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	7.3	7.0
			RELICTISM	0.0	0.0	0.3	0.0	0.0	0.0	3.0	0.0	2.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0
			FINICOLA CHAR.	0.0	0.0	1.3	1.1	0.0	1.0	0.0	0.0	3.0	0.0	0.0	1.0	5.5	0.0	2.0	6.0	0.0	0.0	0.0	0.5	0.5	0.0	4.3	0.7	2.5	4.1	6.0
			SUM (GLOBAL INTER)	**0.0**	**2.0**	**6.4**	**4.2**	**4.0**	**10.4**	**23.5**	**4.7**	**16.0**	**0.0**	**1.0**	**15.0**	**16.5**	**2.0**	**6.3**	**16.0**	**1.0**	**0.0**	**3.0**	**4.5**	**8.5**	**0.0**	**10.8**	**6.2**	**5.9**	**25.3**	**28.0**
		INMES	GEOMORPHOLOGICAL F. (x2)	16.0	16.0	18.0	19.1	16.0	17.6	18.0	8.3	12.5	16.0	12.0	8.0	20.0	8.0	9.3	9.0	20.0	16.0	18.0	20.0	16.0	16.0	20.0	19.3	20.0	15.6	18.0
			CLIMATIC F.	9.0	9.0	6.0	9.3	5.0	9.4	8.0	5.7	7.0	9.0	5.0	4.0	9.0	9.0	9.7	10.0	10.0	5.0	1.0	10.0	8.5	9.0	10.0	10.0	10.0	7.3	9.0
			HYDROLOGICAL F.	8.0	8.0	6.0	9.4	7.0	9.2	9.0	5.0	6.0	8.0	7.0	4.0	9.5	8.0	9.3	10.0	10.0	9.0	10.0	10.0	7.5	8.0	10.0	10.0	10.0	7.0	9.0
			EDAPHIC F.	6.0	6.0	9.0	8.0	3.0	8.0	8.0	6.0	8.0	8.0	7.0	5.0	10.0	7.3	8.7	8.0	10.0	9.0	9.0	10.0	9.5	8.0	8.0	8.3	8.0	6.8	10.0
			FAUNISTIC F.	9.0	9.0	7.0	8.4	3.0	8.2	7.0	5.7	6.8	8.5	6.0	3.0	10.0	9.0	9.0	9.0	10.0	10.0	10.0	5.0	7.0	9.0	9.0	8.3	9.0	7.4	10.0
			SUM (GLOBAL INMES)	**48.0**	**48.0**	**46.0**	**54.2**	**34.0**	**52.4**	**50.0**	**30.7**	**40.3**	**49.5**	**37.0**	**24.0**	**58.5**	**41.3**	**46.0**	**46.0**	**60.0**	**49.0**	**48.0**	**55.0**	**48.5**	**50.0**	**57.0**	**56.0**	**57.0**	**44.1**	**56.0**
		INEST	SOIL LAYER RICHN. (x0.5)	5.5	2.0	6.1	6.2	2.0	4.5	7.0	7.2	6.0	5.5	4.0	5.0	5.0	4.7	6.0	7.0	6.5	2.0	1.0	6.5	5.8	8.5	8.0	7.2	8.3	6.8	7.0
			SOIL LAYER COV. (x0.5)	5.0	1.5	4.7	5.2	1.5	5.6	5.0	5.3	4.0	5.0	6.0	2.5	5.3	5.8	5.7	5.5	8.0	3.0	1.0	5.5	6.5	6.0	5.0	6.2	7.0	4.8	4.5
			MICROHAB RICHN..	3.0	4.0	4.7	2.1	3.0	4.0	1.0	2.3	3.0	3.0	1.0	2.0	5.5	5.7	4.7	4.0	6.0	1.0	1.0	4.0	0.5	3.0	6.0	1.7	1.5	4.9	6.0
			SPATIAL CONNECT.	12.0	22.0	3.4	9.9	6.0	44.0	20.0	4.3	5.0	8.0	2.0	1.5	13.0	1.5	1.3	3.0	16.0	3.0	3.0	0.0	3.5	0.0	2.0	12.7	9.5	13.1	8.0
			SUM (GLOBAL INEST)	**25.5**	**29.5**	**8.9**	**23.4**	**12.5**	**58.1**	**33.0**	**19.2**	**18.0**	**21.5**	**13.0**	**11.0**	**28.8**	**17.7**	**17.7**	**19.5**	**36.5**	**9.0**	**6.0**	**16.0**	**16.3**	**17.5**	**21.0**	**27.7**	**26.3**	**29.6**	**25.5**
	SUM (GLOBAL INNAT)			**102.5**	**113.5**	**93.6**	**111.9**	**87.5**	**157.5**	**137.5**	**75.5**	**106.3**	**101.0**	**72.0**	**72.0**	**142.3**	**80.7**	**92.0**	**105.5**	**133.5**	**84.0**	**85.0**	**109.5**	**97.8**	**97.5**	**122.8**	**125.6**	**127.6**	**128.1**	**139.5**
	INCUL	INPAT	ETHNOBOTANICAL VALUE (X2)	10.0	16.0	14.4	14.0	9.5	16.0	12.0	9.0	14.0	18.0	12.0	10.0	15.0	13.0	14.0	14.0	15.0	14.0	14.0	11.0	13.0	12.0	16.0	12.5	14.0	14.5	16.0
			PERCEPCION VALUE	5.0	7.0	7.3	6.4	3.0	8.0	5.0	4.3	7.0	10.0	5.0	1.0	7.5	6.3	7.3	7.0	7.0	7.0	7.0	5.0	7.0	5.0	8.0	6.3	6.0	6.1	5.0
			DIDACTIC VALUE	5.0	10.0	7.6	6.4	7.0	7.8	7.0	5.7	7.0	9.0	7.0	5.0	7.5	7.0	7.3	7.0	10.0	7.0	7.0	5.0	6.0	7.0	8.0	5.7	7.0	9.3	10.0
			SUM (GLOBAL INPAT)	**20.0**	**33.0**	**29.3**	**26.8**	**19.5**	**31.8**	**24.0**	**19.0**	**28.0**	**37.0**	**24.0**	**16.0**	**30.0**	**26.3**	**28.7**	**28.0**	**32.0**	**28.0**	**28.0**	**21.0**	**26.0**	**24.0**	**32.0**	**24.5**	**27.0**	**29.9**	**31.0**
		INCULEST	STRUCT. PHYSIONOMIC VALUE	1.0	0.0	2.6	2.0	0.0	1.6	2.0	1.3	2.0	2.0	0.0	0.0	1.0	2.0	2.0	3.0	3.0	0.0	0.0	2.0	1.0	2.0	3.0	1.0	2.0	1.0	1.0
			STRUCT. CULTURAL VALUE	1.0	2.0	2.0	1.7	0.0	0.4	0.0	2.0	2.0	2.0	2.0	3.0	3.0	0.7	2.0	3.0	5.0	1.0	1.0	0.0	1.5	1.0	2.0	0.0	1.0	7.6	5.0
			SUM (GLOBAL INCULEST) (X2)	4.0	4.0	9.2	7.4	0.0	4.0	4.0	6.7	8.0	8.0	4.0	6.0	8.0	5.3	8.0	12.0	16.0	2.0	2.0	4.0	5.0	6.0	10.0	2.0	6.0	17.1	12.0
	SUM (INCUL)			**24.0**	**37.0**	**38.5**	**34.2**	**19.5**	**35.8**	**28.0**	**25.7**	**36.0**	**45.0**	**28.0**	**22.0**	**38.0**	**31.7**	**36.7**	**40.0**	**48.0**	**30.0**	**30.0**	**25.0**	**31.0**	**30.0**	**42.0**	**26.5**	**33.0**	**47.1**	**43.0**
	SUM (INCON)			**126.5**	**150.5**	**132.1**	**146.1**	**107.0**	**193.3**	**165.5**	**101.2**	**142.3**	**146.0**	**100.0**	**94.0**	**180.3**	**112.3**	**128.7**	**145.5**	**181.5**	**114.0**	**115.0**	**134.5**	**128.8**	**127.5**	**164.8**	**152.1**	**160.6**	**175.1**	**182.5**
			DEMOGRAPHIC PRESSURE	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	2.0	1.0	1.0	1.0	1.0	1.3	2.0	3.0	4.0	4.0	4.0	10.0	10.0	10.0	4.0	1.0	1.0	1.0	2.0
			ACCESSIBILITY-TRANSITABILITY	7.0	4.0	4.3	4.0	6.0	6.2	5.0	4.0	4.0	7.0	6.0	2.0	6.0	5.0	5.3	5.0	3.0	4.0	5.0	2.0	4.0	3.0	5.0	6.0	4.5	5.4	8.0
			ALTERNATIVE HAZARD	1.0	1.0	3.9	2.4	7.0	1.4	10.0	1.0	5.0	3.0	6.0	3.0	6.5	5.7	5.7	7.0	3.0	7.0	10.0	3.0	4.0	3.0	5.0	1.0	1.0	3.9	6.0
			GLOBAL HAZARD FACTOR	9.0	6.0	9.2	7.4	14.0	8.6	25.0	6.0	11.0	11.0	13.0	6.0	13.5	12.0	13.0	15.0	10.0	15.0	19.0	15.0	18.0	16.0	14.0	8.0	6.5	10.3	16.0
CONSERVATION PRIORITY			**PRICON**	**1138.5**	**903.0**	**1215.3**	**1081.1**	**1498.0**	**1662.0**	**4137.5**	**607.0**	**1564.8**	**1606.0**	**1300.0**	**564.0**	**2433.4**	**1348.0**	**1672.7**	**2182.5**	**1815.0**	**1710.0**	**2185.0**	**2017.5**	**2317.5**	**2040.0**	**2306.5**	**1216.5**	**1043.9**	**1809.5**	**2920.0**

Table 2. Concrete examples of studied and assessed formations. Scores for each of the value criteria

Source: Elaborated by the author

14. There are projects and areas that have been studied for which the data is still being processed. In this case an area such as the Balkans where, as a result of a research visit, a transect was created, comprising countries such as Slovenia, Croatia and Monte Negro, both in protected areas: Postojna, Plitvice, Krka… and in areas without any kind of protection. There is a study in its initial stages in the process of evaluating different meadowlands within Spain: Andalusia, Castilla-La Mancha, Extremadura, Castilla-Leon, Comunitat Valenciana, Aragon, Navarre and the Basque Country.

Figure 4. Caatinga of Pai Mateus (Brazil)
Source: Elaborated by the author

15. Other research and evaluation projects are underway or in preparation for publications which are in this case related to specific formations or very specific and delimited sectors. In the first case we are referring to research performed in the Mediterranean area of Chile. As a result of the high score obtained in the Mediterranean sclerophyllous forest with palm (*Jubaea chilensis*), further research under the care of USACH was requested which has covered different population areas of the formation and analyzed and evaluated it. Secondly, we refer to the studies performed in the different fluvial areas of the Basque Country (Aragon, Bidasoa, Oria, Baias, Butron and Oja) in order to evaluate the biogeographical state of the riverbanks and the vegetation, both in sections and globally. Studies have been carried out in Nicaragua, Portugal and different sectors of the Iberian Peninsula and Morocco which will be finalized and published later but for which we do not yet have conclusive results.

6. Conclusion

The LANBIOEVA method is robust and perfectly applicable to different areas of study, as demonstrated by the adaptations to its methodology throughout the varied research that has been conducted over time. Inventory methods have been reviewed, but the most important adaptation has been the substitution of phytocenotic representativeness criteria for naturalness, which measures the higher or lesser degree of artificialness in formations while at the same time measuring the higher or lower number of foreign taxons in a site. Cultural, management and usage criteria, to name a few, have been consolidated particularly in Brazil and Chile where certain practices or elements had not been contemplated previously.

The large number of criteria and partial valuations provide the manager, or decision-marker, with a great amount of information in order to choose the most appropriate criteria within the context of the area to which they apply. Notably, the method is being used for management planning in protected and non-protected areas.

There are many diverse case studies, in the same way that the same formation can vary depending on different situations and values within a particular set of criteria. In general, forest formations show better valuations than in their later stages. Forests or units at a greater latitude display lower punctuations than those at a medium latitude but especially with those at lower latitudes. In the Mediterranean areas of Chile, Patagonia and Brazil, territorial criteria carry a significant weight. In European formations territorial criteria display high value even though in the case of the Iberian Peninsula sub-criteria such as rarity and finicola characteristics carry a certain weight.

Relatively well-preserved forests with high natural and cultural values scored highest. The maximum potential in PRICON was a 9,990-point score; but it is rare to find examples that go beyond 3,000. To date only three formations have reached or gone beyond that range: the Atlantic forest of Brazil, the Atlantic oak forest/Mixed forest of Urdaibai and the Mediterranean sclerophyllous forest with Chilean palm, with the absolute highest PRICON score due to its high environmental hazard factor.

Our future intention is to undertake a pending challenge: until now we have not applied the LANBIOEVA method to primary forests which are highly biodiverse, such as the

African, Indo-Asian or Ecuadorian Amazon jungles. We estimate that in these sectors the values could surpass the 5,000 or 6,000 points.

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From academia to the mass media. Demographic challenges in Spain today

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Abstract

In recent years, demographic issues have jumped from circulating among researchers and experts of the field in the academic world to fuelling debates in the media. Publications aimed at the general public, such as the written press and other media such as radio, television or even films, are paying increasing attention to demographic trends and certain phenomena that were previously seldom discussed outside of specialised research circles.

This paper seeks to focus the attention on one of the topics that has received the most media attention and is perceived as being one of the major demographic challenges of Spain today: the depopulation of extensive rural areas.

1. Introduction

It is frequent to find references to the existence of "demographic challenges" both in the scientific production and in the media and even among citizens. However, the content of these challenges may vary considerably depending on the space and time. It is evident that, on a global level, the current demographic challenges (the high demographic growth of certain regions, international migrations, accelerated urbanisation, disparities in fertility, the emergence of new infectious diseases…) would be different to those of Europe which, in turn, would have differences with the specific challenges of Spain. On the other hand, at different historical moments different issues are more prominent that others.

Therefore, demographic challenges are defined differently in different territories and at different times. And in many cases, the assessment of the challenges does not reside so much in demographic behaviour patterns *per se*, but in the evaluation of their consequences, in the perception of their meaning.

If a list were to be made of the possible demographic challenges in Spain today, we could find one for almost each major study topic of the population. The demographic decline and the depopulation of certain areas, the structural decline in fertility to below-replacement levels, migrations, demographic ageing…are all issues that can be perceived as demographic challenges that must be faced in the coming years.

Even so, it should be pointed out that population studies have not always received such visibility on a social and media level. In fact, a certain disassociation can be detected between the research carried out in universities and study centres and the public perception. This study seeks to analyse this difference based on a topic that is attracting much attention from a social and media point of view. Depopulation is a relevant topic which has been identified as one of the current population

challenges in Spain. It is an issue that has a long history as a demographic phenomenon and has been the object of study for a long time. But, in recent years, depopulation has become particularly prominent and is emerging as a reference topic in the demographic field, to the point where other equally relevant issues such as a sustained very low fertility level, the population decline, the role of migrations as a dynamising element (demographically and economically) or ageing are being pushed into the background. In order to contrast the perception of depopulation with the academic production, an examination of the written press has been conducted based on a newspaper archive. In this case the evolution in the daily newspaper *La Vanguardia* has been followed. Furthermore, we have reviewed the audiovisual production (films and documentaries) that addresses the topic of rural areas and depopulation in Spain.

2. The study of depopulation. The perspective from academia

Like in all disciplines, research in the field of population follows trends that are conditioned by different elements. These include the social and economic context determining the emergence of certain topics depending on the circumstances and the availability of sources; the emergence of certain analysis methodologies (or their coming into fashion); the influence of the international literature and, also the relevance of certain lines of study developed by research groups. Although not an exhaustive list, the combination of these factors helps us to understand the orientation of a good part of the scientific production of the population studies in Spain.

According to the above-mentioned parameters, population research has followed different paths in each stage. The review of the study of population across Spain, published by García Ballesteros at the end of the 1980s, examines the evolution of this discipline over time and mentions some pioneering studies dating back to the 1940s on the depopulation of mountainous areas (S. Llobet, 1949). The impetus given to the study of population by geographers from the middle of the last century with regional monographs contributed to the issue of depopulation, among other topics, becoming a subject of analysis. It was, in fact, the central focus of some contributions of reference, such as the study by Vidal and Recaño (1986) for Spain as a whole, and many contributions with a local and regional scale. The analysis of domestic migration from the mid-twentieth century to the 1970s and its consequences led to the topic of depopulation assuming its own identity among geographers, until it constituted a clear line of research which has given rise to staggered publications over the last few decades and in different autonomous regions. To name a few, from the classics, such as the studies by T. Vidal (1970, 1975) on Catalonia or those by Clemente (1980) and Alonso and Cabero (1982) and García Fernández on different parts of Castilla León to the contributions on Galicia by Hernández Borge (1994) and Rodríguez (1999), on Castilla-La Mancha by Romero (1980), Aguilar (2009) or the case of Aragón, with contributions such as those by Ayuda, Collantes and Pinilla (2000, 2001), Serrano (2007) or Lardiés, Pueyo, Hernández and Frutos (2018).

Figure 1. Recent publications on rural Spain

The demographic dimension is completed with contributions that emphasise the role of the public amenities and services (Reques, 2003), public policies (Bielza de Ory, 2003) and contributions focused on strategies to fight against depopulation (García Pascual, 2003).

There is a vast scientific production on rural areas and depopulation and the contribution of geographers to its study has been highly relevant. To this literature we should also add the launch of the journal *Ager* in the year 2000. This publication is linked to CEDDAR (Centre of Studies on Depopulation and the Development of Rural Areas) and is specialised in trends and problems related to rural areas including depopulation.

The Population Geography Group of the Spanish Geographers Association has addressed the topic in different meetings. The 11th Congress of the Spanish Population, held in León in 2008 under the slogan "ageing, depopulation and territory", dedicated a specific conference to the depopulation process. The topic has been prominent in different meetings: in the 8th Congress of the Spanish Population, topics related to rural spaces were addressed in a paper titled "*Las nuevas ruralidades*" (The new ruralities) (2012) and in the meeting in Alicante (2016) different studies on depopulation were presented in the conference "Territory and Population: continuities and recent changes in population dynamics".

Even so, depopulation in academic media in the first decade of the twenty-first century was given only minor attention, mostly due to the importance of other issues such as foreign migrations and the demographic transformations related to the economic crisis which began in 2008. Over the last five years, the publication of several books has significantly changed this scenario and has placed rural areas at the centre of the demographic and political debates. These publications followed the footsteps of a novel that paved the way for literature on depopulation: *La lluvia amarilla* by J. Llamazares, which, three decades before, described the final stage before the disappearance of a fictitious village in the Aragonese Pyrenees, Ainielle. These books include *Los últimos. Voces de la Laponia española*, by P. Cerdà, in 2015*; La España vacía. Viaje a la España que nunca fue*, by S. del Molino, in 2016 and *Palabras mayores. Un viaje por la memoria rural* by E. Gancedo in 2017.

Specifically, the book by S. del Molino has been fundamental in explaining the movilisation around the issue of depopulation which characterises the final stage, as the title of the book "España vacía" (Empty Spain) was a successful catchphrase and is now commonly used by the media. Some political bodies have also contributed, such as the Spanish Federation of Municipalities and Provinces which, in 2017, published a study on "*Población y despoblación en España"* (Population and Depopulation in Spain) and also a series of proposals contained in the "*Listado de medidas para luchar contra la despoblación en España" (List of measures to fight against depopulation in Spain).*

The academic world has also reflected this increased attention on depopulation. Relevant contributions have been published, such as the article by Recaño on demographic sustainability of rural Spain (2017) and the extensive section of the *Informe España 2018* by Delgado. Meanwhile, at the end of 2018, the Spanish Geographers Association launched a manifesto titled "Abordar el reto demográfico. Hacer frente a la despoblación" (Addressing the demographic challenge. Tackling depopulation), presented in Valladolid in December 2018 to raise awareness about the need to respond to territorial imbalances, taking an approach that contemplates the territorial, economic, socio-political and institutional dimensions of a complex process, namely depopulation, and not just its demographic facet.

For the year 2020, and in view of the media coverage of depopulation, this topic is to constitute the central theme of three geographic meetings of the Spanish Geographers Association: the Iberian Colloquium (Salamanca), with a speech on '*Despoblación, fragilidad y nuevas orientaciones del medio rural*' (Depopulation, fragility and new orientations of the rural environment), the Congress of the Population Geography Group (Huesca) titled '*Despoblación, dinámicas demográficas y vulnerabilidad social*' (Depopulation, demographic dynamics and social vulnerability) and finally that of the Rural Geography Group (Valladolid) under the slogan '*Espacios rurales y retos demográficos: una mirada desde los territorios de la despoblación*'(Rural spaces and demographic challenges: from the perspective of the depopulated territories).

From the point of view of the scientific production, the trends point towards a renewed consideration of topics focusing on rural areas that have the main theme of depopulation but that could also represent a substantial step forward if a planned and more diverse research agenda is adopted in terms of viewpoint and analysis methodologies.

3. Depopulation: some key demographic factors

As previously indicated, the depopulation process in Spain is a familiar topic among academics studying population who have confirmed the **polarisation** of the Spanish population over the last few decades.

At the beginning of the twentieth century, 35 % of Spain's municipalities had less than 500 inhabitants. One hundred and twenty years later, after spectacular demographic growth throughout the twentieth century, approximately half of Spain's municipalities have less than 500 inhabitants. The analysis of the demographic weight of groups of municipalities reveals an even more evident transformation: in 1900, municipalities with less than 10,000 inhabitants accounted for two thirds of the country's population. In 2019, the 7,378 municipalities with less than 10,000 inhabitants accounted for only a little over 20 % of the total population.

The analysis of the transformations corroborates the fact that the main beneficiaries of the demographic growth throughout the twentieth century were the urban areas and, particularly, the large cities and their metropolitan areas. A similar trend can be observed in other European countries, although with certain differences more related to the calendar than the process itself. The long-term result represents an important change in the distribution of the population, with territorial effects that form part of the depopulation process.

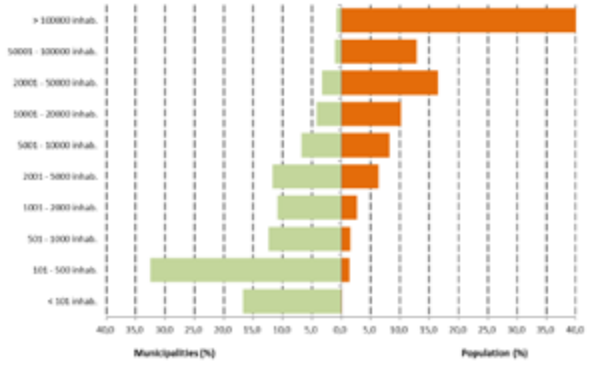


Figure 2. Population according to demographic size, 2019

Source: Own elaboration based on data from the INE Register of inhabitants

If taken in perspective, the depopulation process currently observed goes back a long way and responds —from a demographic point of view— to the effects of different phenomena. One of the key factors was the rural exodus that affected a good part of the Spanish rural areas involving a transfer of the population not only from rural municipalities to urban ones but to certain areas of the country that capitalised on the domestic migratory flows, particularly in the middle decades of the last century. The departure of the workforce and, particularly, the young adult population, had significant consequences as it meant the loss not only of inhabitants but the age and gender structures were affected and the natural dynamics were altered by the exodus of people in their reproductive years.

The slowdown in domestic migratory flows in the mid 1970s represented a pause or deceleration of the departure of inhabitants from many municipalities. But it did not represent the end of the demographic decline of part of the rural municipalities. The natural dynamics of older populations, with asymmetries between the sexes (a significant excess masculinity in traditional emigration areas) led to the continuity of a decreasing trend which has characterised certain spaces for decades.

An exponent of **the long history of depopulation** in certain Spanish rural areas is the representation of the municipal demographic maximums since 1900 (figure 2).

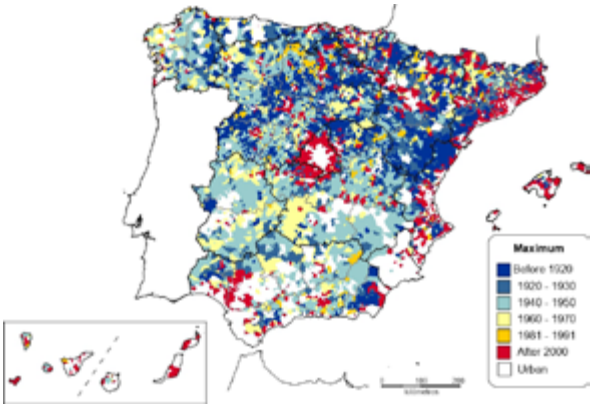


Figure 3. Demographic maximum of municipalities with less than 10,001 inhabitants 1900-2019

Source: Own elaboration based on data from the INE Population Censuses and Register of Inhabitants

Overall, in a third of the municipalities with less than 10,001 inhabitants, the population maximum was reached before 1930 and in almost 70 % it was reached at some time in the first half of the century. Particularly striking is the existence of areas in which depopulation occurred very early on, at the beginning of the twentieth century, such as Maestrazgo, between the provinces of Castelló and Teruel, or in parts of Castilla y León. But the depopulation phenomenon also appeared in Catalonia (inland areas of Tarragona, for example) and even in some municipalities

of Almería, where the crisis in the mining sector gave rise to the first emigration flows. In any event, we can observe how the decline began earlier in the southern half of the peninsula, a time factor that contributes to explaining some differences in the intensity of the process.

It is also important to point out the **dualisation of the rural spaces:** it is true that a good part of the municipalities with less than 10,001 inhabitants in Spain have experienced a process of demographic decline. But some more economically dynamic areas, with better conditions in terms of their proximity and accessibility to metropolitan environments have experienced a positive evolution and follow a path of demographic growth. Figure 3 shows sectors that break away from the concept of a rural world as a monolithic space. In fact, there is evidence of a certain reversal of the secular trend towards degrowth in rural municipalities that have absorbed immigration flows. These movements could respond to differentiated patterns: in some cases, the arrival of neo-rural inhabitants (locally significant but statistically insignificant on an overall scale), as a consequence of the processes of urban dispersion, particularly in environments close to the large Spanish cities (Madrid, Barcelona, Valencia, Zaragoza, Seville) but also evident in other provincial capitals and finally, at the turn of the century, foreign immigration, which is expanding slowly but clearly in the rural municipalities, even in relatively remote areas.

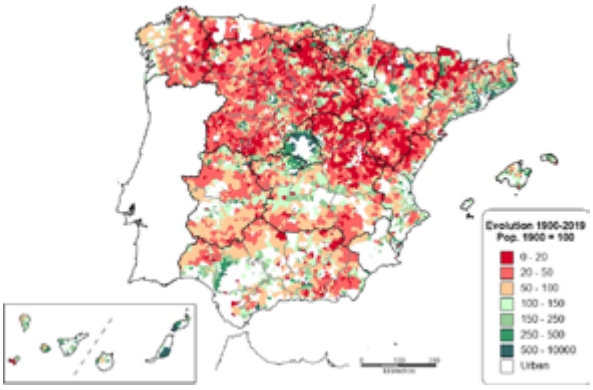


Figure 4. Demographic evolution in municipalities with less than 10,001 inhabitants (1900=100)

Source: Own elaboration based on data from the INE Population Censuses and Register of Inhabitants

The demographic recovery of some rural municipalities gave rise to the idea of a possible revitalisation as a future scenario for rural areas. In Spanish academic media, similarly to the international literature, a debate arose regarding the possibilities of a rural renaissance. However, the change in the economic climate and the new cycle after the recession put an end to some growth prospects. The recovery had been little more than an illusion in certain areas.

The demographic balance of a little over a century (figure 4) reveals a clear and well-known result: the loss of inhabitants is evident in almost all of the smaller municipalities. But perhaps an element to highlight is the **intensity** of this decrease in inhabitants, which has led to large areas seeing a reduction of their populations in a high proportion with respect to the initial point of 1900.

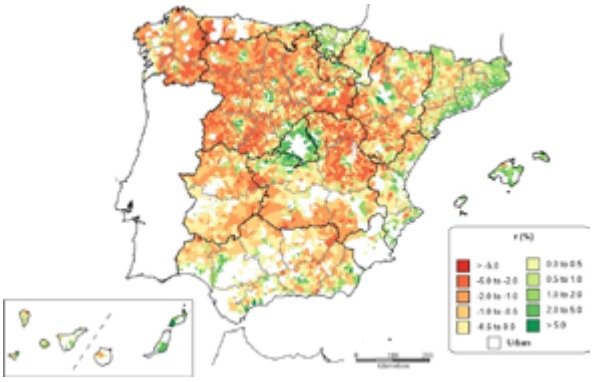
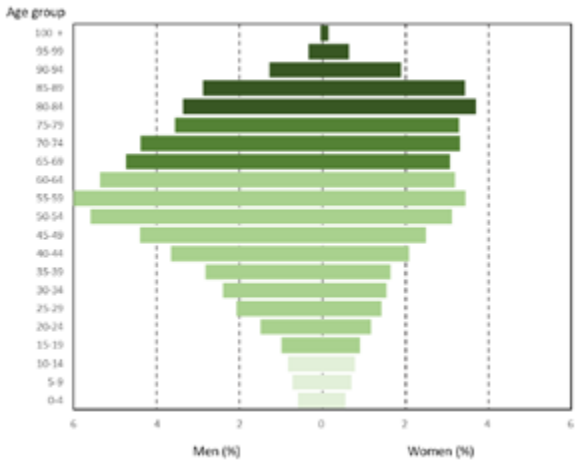


Figure 5. Cumulative annual growth rate (r %). Municipalities with less than 10,001 inhabitants (2001=-2019)

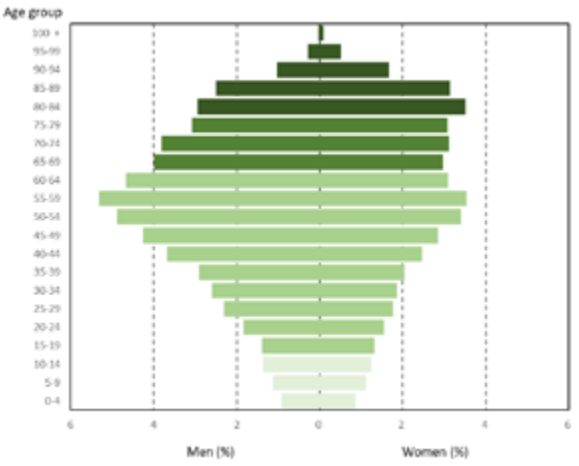
Source: Own elaboration based on data from the INE Population Census 2001 and Register of Inhabitants 2019

On the other hand, it is worth highlighting the **structural nature** of the demographic degrowth. Some of the key factors of the demographic dynamics in the rural municipalities reside in phenomena such as the rural exodus, which reached its peak in periods before the twentieth century. But the study of population variation, based on the cumulative annual growth rate in the twenty-first century between 2001 and 2019 is an image that indicates, on the one hand, diversity within a group which sometimes tends to be seen as a homogeneous whole and, on the other hand, the persistence of a decline which in some areas reaches very high levels. Two thirds of the municipalities of up to 10,000 inhabitants have experienced degrowth over the last two decades and a quarter of those that decrease reach levels of lost inhabitants of over 2 % per year, particularly in Castilla and León and inland Galicia (figure 5).

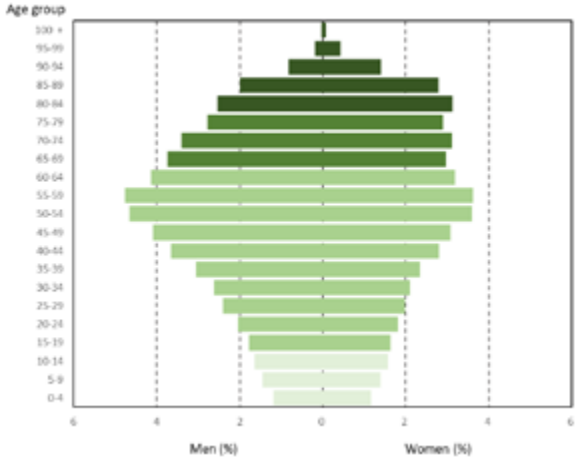
Finally, and with a view to future expectations, the structures according to age and sex (figure 6) share certain features with that of the whole of Spain (a narrow base, weight of the adult groups) but the **demographic ageing** and low birth rate are more acute. Specifically, those corresponding to municipalities with less than 500 inhabitants have almost inverted pyramid profiles, given the progressive reduction in the number of middle-aged inhabitants of under 50 years old. The fact that the



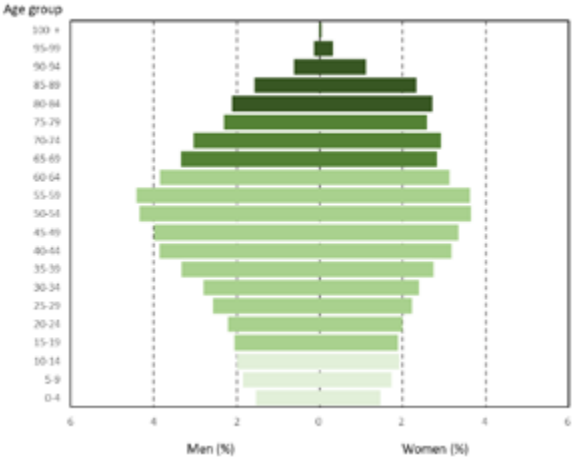
Municipalities < 101 inhab.



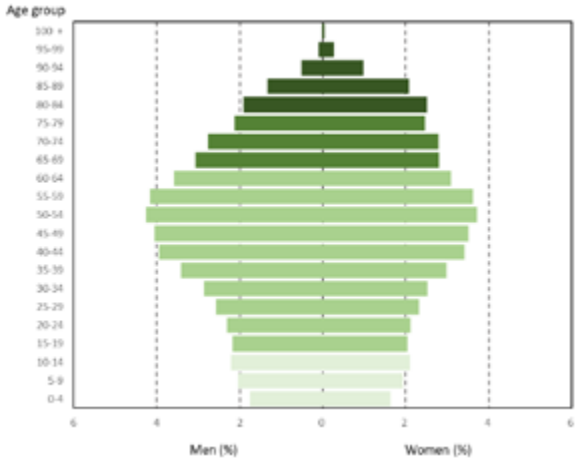
Municipalities from 101 to 200 inhab.



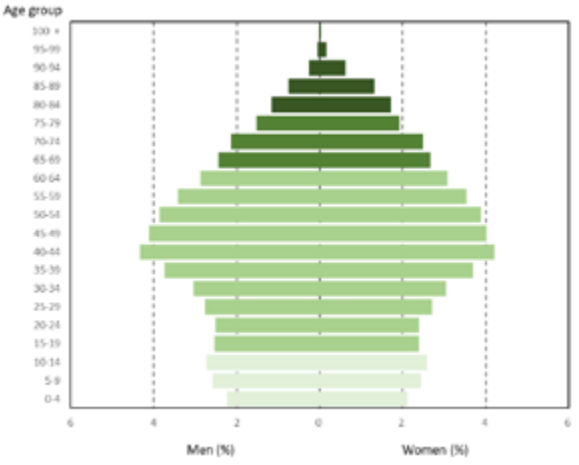
Municipalities from 201 to 500 inhab.



Municipalities from 501 to 1,000 inhab.



Municipalities from 1,001 to 2,000 inhab.



SPAIN

Figure 6. Structures according to age, sex and municipal size, 2019
Source: Own elaboration based on data from the INE *Register of inhabitants, 2019*

groups with the greatest weight are mature adults will not contribute to the recovery as the groups of reproductive age are formed by small cohorts that follow fertility patterns similar to those of Spain as a whole, and are, therefore, very low. The demographic structures according to age do not transmit a very hopeful message for the medium term. Without a significant inflow of immigrants that is sustained over time, the departure of inhabitants of working age is inevitable as a consequence of the natural dynamics of the negative balance that has prevailed for a long time.

4. The view of depopulation in the written media: the emergence of the subject in the newspaper *La Vanguardia*

Population and demographic issues have traditionally been relatively insignificant in the written press, particularly in the national newspapers. This does not mean that news related to these issues has not been published, but that, in general, this type of news has, for a long time, been limited to isolated articles with little public visibility and a low level of persistence, in the sense of its continuance over time in the media. Apart from the results of specific studies, a good part of the demographic news has been linked to the dissemination of new statistical data by the producing bodies, particularly the INE (Spanish Statistical Office). The refreshing of the data of census results or the registries of inhabitants and the annual publication of the Natural Population Movement statistics constitutes the basis of much of the coverage made by the press of the demographic situation.

Within this context, it is worth pointing out two exceptions: first, migrations and specifically the foreign immigration flow, as the economic and social size of these movements led the media to place greater attention on a phenomenon that was modifying many relevant aspects in the country; and second, it should be noted that in the local and regional, press, more connected to the territory, the news, comments or assessments of demographic issues have had greater coverage due to the proximity to the everyday life of the citizens.

Depopulation, as previously indicated, is an issue that has been widely addressed in academic sectors and by many disciplines including the contribution of Geography or Sociology. However, the study of depopulation had been pushed to the background, giving way to other more novel topics: foreign immigration, low fertility patterns, changes in family structures, the study of demographic ageing and longevity or the territorial effects of urban dispersion, to name a few; and with the recession their consequences on the demographic dynamics. This slightly residual position of the topic is also an element to consider in the analysis.

In order to gain a perspective of the situation of depopulation in recent years, a hemerographic review of the digital archives of the newspaper *La Vanguardia* has been carried out. This publication has an extensive and solid history. The selection of news stories, beginning in the year 2000 enables us to observe the recent emergence of the topic and also how the dimensions of the issue have become more enriched, particularly in recent years. The hemerographic search, based on keywords (depopulation, demographic degrowth, demographic decline, España Vacía (Empty Spain), España Vaciada (Emptied Spain)), generated results that have been reviewed in detail. As an element of contrast, a parallel search was carried out of references to fertility topics.

TOPIC	Year	N.º of references
Depopulation	2000	~ 5
	2005	~ 10
	2010	~ 5
	2015	~10
	2019	> **40**
Low Fertility	2000	~5
	2005	> **30**
	2010	~ 20
	2015	~ 5
	2019	~ 25

Table 1. References to topics related to depopulation and fertility in La Vanguardia

Source: own elaboration based on the Newspaper Archive of *La Vanguardia* (2012)

Contrary to political and economic themes —which fill the press every day— demographic news or references are much less prevalent. As previously mentioned, the theme of population receives attention only occasionally, at specific times and not necessarily for merely demographic reasons. The sizes expressed in the table show the levels acquired by the references. In relation to the issues reviewed —depopulation and fertility—, it is clear that the former has become more prominent recently and was hardly given any attention in previous years while fertility received greater coverage in 2005. In this year, the increase in the birth rate and fertility —linked to strengthened fertility with the arrival of immigrants and the economic climate— caused the newspaper to allude to this issue either directly (news focused on demographic issues) or indirectly (news related to other topics but with some connection to birth rates and fertility).

On the other hand, going beyond counting the references and articles, the interest resides in how the information is reported in the press. The fact that a news story mentions the term "depopulation" does not necessarily mean that it is the central theme of the story.

Depopulation		Low fertility	
Año 2000		Año 2000	
Entre arte de vanguardia y nudismo. Ossera, Lliurona y el Fonoll recuperan la vida tras años de abandono.	Neorural inhab.	El envejecimiento de Europa no se arregla sólo con inmigrantes, hay que tener más hijos	Fertility, immigration
Ochenta escuelas rurales luchan contra la falta de alumnos	Education	La demógrafa Anna Cabré advierte que sin más guarderías no habrá segundo hijo	Fertility, education
Esperando el maná de Baqueira. Les Valls d'Àneu creen que sólo la ampliación de la estación hacia el Pallars mantendrá con vida sus pueblos.	Winter tourism, depopulation	La natalidad de Catalunya despega en 1999 por las parejas jóvenes y por la inmigración	Birth rates, immigration
Año 2005		Año 2005	
La sombra de Delibes es alargada.	Literature on the rural world	Catalunya alcanza la cifra de nacimientos más alta del último cuarto de siglo	Birth rates, immigration
Reportaje en TV *El último, que apague la luz.*	Depopulation Documentary	Trabajo y familia ¿son reconciliables?	Female activity, family
Antinucleares Segunda Generación.	Location of nuclear plants in rural areas	Natalidad al alza	Birth rates, immigration
Año 2010		Año 2010	
La España profunda se muere. Los pueblos alejados de las autovías y autopistas siguen, sin remedio, perdiendo población.	Depopulation	La natalidad entra en declive . Los nacimientos empiezan a bajar en Catalunya tras 13 años seguidos de aumento.	Birth rates, immigration
Catalunya rural	Depopulation	Más pequeñas, frágiles y con menos hijos. Una de cada cuatro mujeres de la generación de 1970 acabará su vida fértil sin hijos.	Family, fertility
Tor. Tretze cases i tres morts	Literature on the rural world	El fracaso de los 2.500 euros. Las propuestas de la demógrafa Margarita Delgado para potenciar la fecundidad.	Family, fertility
Año 2015		Año 2015	
Pueblos deshabitados o en venta buscan nuevos vecinos	Depopulation	Nacen menos niños, ¿y qué?. No hay crisis demográfica, el problema es el desempleo	Fertility, birth rates
Cuando el bosque era vida… Sant Cebrià dels Alls (Gavarres) se fue despoblando durante la primera mitad del siglo XX	Depopulation	La natalidad crece tras cinco años de caída. La edad media de la maternidad continúa aumentando: 30,8 años.	Birth rates
El rastro de las casas de payés. Rescatan del olvido y documentan más de seiscientas masías del Prepirineo oriental.	Rural heritage	El Gobierno anuncia un cheque pensión de unos 55 euros al mespara las madres Las mujeres con más de un hijo cobrarían entre un 5% y 15% más en la jubilación.	Public policies, fertility
Año 2019		Año 2019	
Irreductibles rurales. Empresarios y Administración debaten sobre cómo fomentar el arraigo y frenar la desertización del campo.	Depopulation, economics	La mitad de las mujeres sin hijos hubiese querido tenerlos. Un estudio de la UAB cifra la "fecundidad insatisfecha".	Fertility
La España rural, que puede decidir el gobierno, toma el centro de Madrid. Los partidos se disputan un voto decisivo, en un país diseñado de espaldas al campo	General elections	La cifra de nacimientos en España llega al nivel más bajo de este siglo	Birth rates
La venganza de la geografía	Depopulation, politics	La corresponsabilidad, clave para subir la natalidad y bajar la brecha salarial. El 80 % de la diferencia de salario entre hombres y mujeres se debe a la maternidad	Female activity, family

Table 2. Selection of headlines Depopulation and fertility in La Vanguardia

Source: Own elaboration based on the Newspaper Archive of *La Vanguardia*

Among the references corresponding to the topic of "Depopulation", the themes addressed most frequently are those referring to the abandoned villages (a highly emblematic and extreme example of depopulation). Economic issues also arise (tourism, agriculture and the possible use of rural spaces for locating undesired facilities and infrastructures such as nuclear power plants or landfills). Other associated topics are related to education —the problem of rural schools— and the conservation of rural heritage. The literary production on rural spaces is an important element.

However, in the last year analysed, not only was a significant increase in the number of references detected, but the issues addressed in relation to rural spaces and depopulation also broadened. One of these topics is the visibility of social movements: platforms such as *Teruel existe* are highly active and have acquired unusual prominence. Second, the political dimension has become crucial. The strategic interest of these spaces for the political parties have led to the doubling of the references in political speeches and programmes, which has led to a higher visibility in the media and therefore in the press.

And closely related to this are the public policies aimed at curbing the depopulation process.

Meanwhile, the news referring to birth rates and fertility are more related to the fluctuations in the demographic indicators in the period observed. The rises and falls in the rates inspire part of the articles. Other references — particularly in the years in which more articles appear on the subject— are found to be related to public policies, in this case the subsidies to promote birth and fertility rates. The socio-economic dimension and the relationships between female activity and maternity also contribute to a greater visibility of news on this matter.

The analysis of the content of the articles reviewed also allows us to establish the correlation with the use of certain statistical, graphic and cartographic systems. The news most related to the presentation of new demographic information (updating of statistical information), is usually accompanied by graphs and tables. Cartographic resources are incorporated to a lesser extent. Finally, it is worth pointing out that the publication of news about the population is sometimes related to the academic production of research centres or specific researchers. In the case of the articles published by *La Vanguardia*, a good part of the specialists who are consulted in the articles belong to the Centre d'Estudis Demogràfics, a centre of reference in Catalonia in the field of demography.

5. The featuring of depopulated Spain in the audiovisual production

As indicated in the previous sections, the written media recently discovered the potential and scope of depopulation in Spain. However, the contribution of films and documentaries, the audiovisual sector, should also be taken into account, due to the capacity of dissemination of this media.

The objective of this study is not to present an exhaustive catalogue of films and documentaries that address the situation of the rural world, and specifically, the effects of depopulation. However, it is worth noting some of these films that have given rise to a fully consolidated line of studies and which would constitute a sub-genre of "Spanish rural cinema" (Crespo, J.M.; Quirosa, M.V. 2014). Without going back too far in the past, in this group we could include adaptations of novels, such as *Los santos inocentes* (directed by M. Camus in 1984) and *El disputado voto del señor Cayo* (directed by A. Giménez-Rico in 1986), both based on books by M. Delibes. However, due to its plot being more related to demographic themes, we can mention *Flores de otro mundo*, directed by Icíar Bollaín in 1999. This film was inspired by the caravans of women in places such as the municipality of Plan (Huesca). Filmed in Guadalajara, it tells the story of three women looking for a new life and love in rural Spain. Winner of the Critics Prize in the Cannes Festival and two Goya awards, this film represents a landmark in reinforcing cinema related to the current rural situation.

In the first decade of the twenty-first century, two new films gave fresh momentum to this genre: *El cielo gira*, directed by M. Álvarez (2005) and *Aguaviva*, by A. Pujol (2006). The first addresses the gradual disappearance of Adeaseñor, a village with 14 inhabitants in the province of Soria, while the second explains the initiatives to fight against depopulation in the village of Aguaviva, in the province of Teruel. Both films, which have a considerable amount of documentary content, similarly to *Flores de otro mundo,* received acclaim and awards and gave a voice to the inhabitants of rural areas.

A decade later, we are witnessing a relaunch of the rural film genre. To illustrate this, we can see that over the last five years, different productions have been made that address or are set in Spanish rural spaces. An example is *El olivo*, a film released in 2016, directed by I. Bollaín and which is set in contemporary rural Spain. The film addresses the issue of intergenerational transmission and the value of the landscapes and tells the story of a young woman who attempts to recover a millennial olive tree for her grandfather that the family had sold against his will. The following year, in 2017, *Trinta lunes* was released. This film is set in the Courel mountain range in Galicia and tells the story of two children who explore the line that separates life and death in an environment of abandoned houses and villages resulting from depopulation.

The central theme of some of the most recent productions is based on depopulation. This is the case of the documentary *Soñando un lugar* (2018) filmed in Aragón and *Resistiendo* in the Alto Tajo, in the province of Guadalajara. In the last year we can highlight the recent release of *Barbecho. En el corazón del despoblamiento* (2019). The documentary, promoted by the Union of Small Farmers and Livestock Breeders (UPA) and the Inter-branch Sheep and Goat Meat Organisation (INTEROVIC), received support from the Ministry of Agriculture, Fishing and Food. The objective of the documentary is to fight

Figure 7. Spanish rural films

against the invisibility of the rural world and contribute to mitigating depopulation, starting from the premise that the primary sector can be a future possibility for repopulating depopulated areas and preventing the depopulation of areas in danger of abandonment.

The full-length films and documentaries have been fundamental elements to raise awareness about the situation of certain rural areas, because in addition to being screened in cinemas, some of these productions have been shown in films festivals, which has amplified their impact, thanks to the awards received in these prestigious national and international events.

Also contributing to increasing the visibility of rural areas and the dissemination of certain aspects related to depopulation we can find television reports. The Spanish public television channel, RTVE, has produced programmes and reports for broadcast. The growing attention given to the subject has led to an increase in such reports in recent years.

Furthermore, and as a sign of the undeniable interest that this issue is awakening, we should also mention a television series currently being aired: *El pueblo*. This comedy, produced by Contubernium Films, was launched on the platform Amazon Prime in May 2019 and Telecinco in January 2020. The story explains the adventures of a group of urbanites who, for different reasons, have moved to a fictitious village in Soria, Peñafría. The series is based on relationships between the very few inhabitants of the village and the problems derived from adapting to rural

life. But going beyond the anecdotes and clichés that the characters sometimes tell, the existence of a series that is widely disseminated in the media effectively contributes to placing certain topics frequently considered as being secondary or marginal in the spotlight for large social groups.

Finally, it is worth mentioning the role of some advertising campaigns. As an indication, we can refer to a couple of examples, selected from those that received most media attention. In 2008, a small village in Teruel, Miravete de la Sierra, rose to fame. An advertising agency launched an Internet campaign which, under the slogan "The village where nothing ever happens", placed the village on the map and its dozen inhabitants. A few years later, in 2012, a soft drinks brand launched a campaign titled "Village orphans", which sought to promote rural tourism whereby municipalities with less than 2,500 inhabitants could adopt urbanites who do not have a village where they can go back to during their summer holidays. Depopulation is also the starting point of an advertising campaign of Correos Market, an initiative launched to facilitate the distribution of producers in rural areas. The slogan of the campaign #Yomequedo, (I'm staying) seeks to contribute to the visibility of local producers.

Along the same lines, and in the light of the media prominence of depopulation, different initiatives that use the possibilities of social networks to disseminate messages against depopulation have proliferated. A recent example is a video that went viral, filmed by young people of Castilla and León who have created a group of 'children of Empty Spain'. With the hashtag *#QueremosPoderVolver* (We want to be able to return). In less than two minutes the video addresses the problem of the emigration of young people who leave to study and do not return to their places of origin due to the lack of career prospects in their professional fields.

6. Final reflections

The apparent and traditional disassociation between the scientific production in the field of geodemography and its repercussion in the media is a trend that seems to have been correcting itself in recent years. The separation between research in the field of population and current issues is a gap that seems to be closing, at least with respect to some topics.

The view of depopulation, supported by extensive output in academic media, has also gained prominence in the literature and essays and in recent years it has gained a presence in the media, both in the written press and in audiovisual formats (films and documentaries). The review of the newspaper archive reveals that the population —or at least two of the demographic challenges of current Spain, depopulation and fertility— have media coverage. However, this coverage is clearer in those situations in which the demographic variable is linked to others such as politics, economics and the design or application of public policies.

The greater visibility of demographic issues and, specifically depopulation, has a kind of boomerang effect, as this media presence stimulates research in this field, as shown in the proposals of conferences in congresses, the increase in publications and the implementation of projects of related issues.

It seems, at last, that the population matters… In fact, after the results of the latest general election it has been incorporated in its own right as a state institution with the creation of a Vice-Presidency of Ecological Transition and Demographic Challenge. This is a significant step forward, but not without its risks. The first of them is that the topic may become banal. The indiscriminate use of the label "depopulation" sometimes leads to its use in territorial contexts or in situations where its use is not relevant.

A second risk is simplification. As already indicated, the terms "rural" and "depopulation" sometimes seem to be concepts that belong together. However, and despite depopulation being a frequent scenario in many cases, Spanish rural spaces are plural and their dynamics do not only have one direction. On the other hand, the "demographic challenge" is usually referred to as if there was only one, when the demographic reality of Spain is complex and it is advisable to use the plural form. Today, in Spain there are many demographic challenges.

Finally, we should focus the attention on the need for a shared agenda between political action and the lines of research. Only the development of joint strategies between researchers and politicians/specialists will lead to the furthered knowledge of the real situation of the municipalities being transferred to the implementation of public policies. This means leaving the comfort zone of statistics, diversifying perspectives and methodologies, addressing new topics and using the participation of the local actors. The challenge is still there.

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Geography and cooperation on the euro-african border. Intervention in a urban slum in Larache (Morocco)

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Abstract

The Atlantic port city of Larache is close to the southern side of the Euro-African *border*. Mediterranean in origin, with a Spanish colonial past, it retains its links with ports in the Gulf of Cadiz and with its new agricultures. These ties, along side a population that now exceeds 124,000 inhabitants, a substantial proportion of which lives in poverty in slums, mean that many people in Larache are *potential emigrants* to Spain or other European Union countries. The geographical cooperation described here is part of an interdisciplinary inter-university project to rehabilitate the slum settlement of Jnane Aztout, incorporated into Morocco's *Plan National Villes sans bidonvilles* (Cities without Slums) and is based on resident participation, seeking not only to promote a change in the everyday habitat of its *vulnerable residents*, but also to help create decent living conditions and encourage them to remain there, thus avoiding the often degrading *process of migration*.

Key words: Northern/southern border; migrations; social vulnerability; geographical perspective

1. Previous approaches

Before undertaking the specific task of rehabilitating the slums of Jnane Aztout (Larache), the integrating geographers of the interdisciplinary rehabilitation team already had previous knowledge that offered a starting hypothesis about the geographical context of intervention, a method for approaching exclusionary urban realities, and direct contact with Latin American teams who were developing parallel initiatives in that part of the world.

1.1. Starting premises in relation to the setting: hypotheses of geographical symmetry and the Mediterranean spirit of the Atlantic arc

The proximity of Africa becomes a draw for any curious Andalusian looking for knowledge, and this interest turns into a challenge for some geographers. We had already visited Morocco and even Algeria for tourist trips and holidays: cities, medinas, mosques, squares, commerce, archaeological traces and the desert had all captured our attention and become destinations for our travels. But we soon had two occasions to visit the shores of the Strait of Gibraltar for more specifically geographic research and teaching purposes:

- Andalusia's Regional Department of Culture and the Fundación Tres Culturas invited us to participate in the *Rihla Project. The Imprints of Memory* (Interreg III Programme A: Andalusia – Morocco. 2002-2006), which sought to recognise the heritage shared by the territories on both sides, with a common history and both belonging to a geographical space with very similar ecological, territorial and landscape features. The aim was to show the parallels between Morocco and Andalusia in terms of landscapes, cities, places, gastronomy, craftsmanship, music, and the arts.

- When the Association of Spanish Geographers tasked our university - Universidad Pablo de Olavide (Seville) – with organising the *XX National Geography Congress* (October, 2007), we had the opportunity to offer an itinerary that would show participants the Moroccan landscapes we had worked with as part of the Rihla Project, demonstrating that the Strait of Gibraltar acts as an axis of symmetry between the natural spaces, historical territories and landscapes on bothsides.

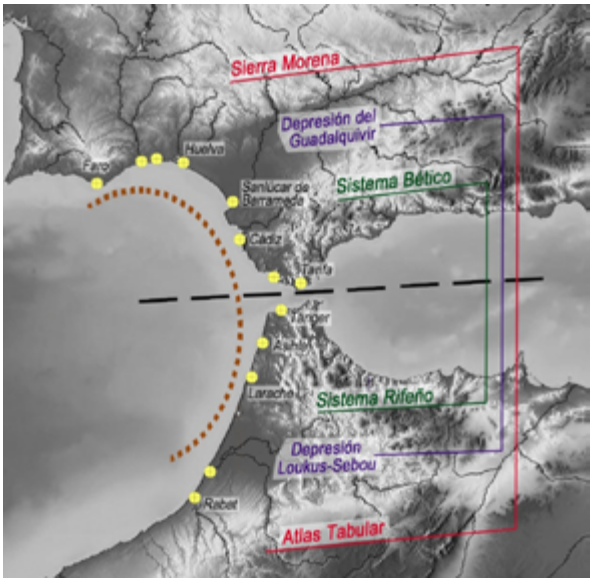

Figure 1. The Strait of Gibraltaras an axis of symmetry of landscapes and cities

Source: authors' own based on the Rihla Project (Ojeda-Rivera, Villa & Lamrani, 2007) and Imagery ©NASA 2018, Terrametrics

Our initial approaches taken in order to gain a geographical understanding of the working context enabled us to initiate cooperation inLarache, arguing —and remembering O. Ribeiro, who suggests the Atlantic Mediterranean character of Lisbon— the similarly Atlantic Mediterranean spirit of the port city of Larache that, like Faro, Ayamonte, Isla Cristina, Huelva, Sanlúcar, Cádiz, Barbate, Tarifa, Tangier, Asihla, and even Kenitra and Rabat, have absorbed the original Mediterranean culture, even though they are located beyond the Pillars of Hercules, in the arc of the Gulf of Cadiz that continues along the North West of Africa (figure 1). The radiant light from the great ocean and its sunsets on a marine horizon must have dazzled the first settlers to reach this Atlantic arc, causing them to pause and leaving an indelible mark on the numerous place names in a territory recently discovered by the Mediterranean culture, particularly *Luciferifanum* (Temple of the Doubtful Light), which is the name Strabo used for Sanlúcar de Barrameda, and the primitive Roman name for Larache: *Lixus*.

To this, we should add certain parallel historical processes, broadly speaking, in the construction of the respective models of territorial organisation:

- Identical ancient colonial models of exploitation —with factories and their hinterlands— for Phoenicians and Greeks, and a settlement for Romans.

- Mediaeval frontier models, fairly similar although with a few differences (Arabs vs. Berbers; Islam vs. Christianity) and with different centralising domains (Arabism and Christianity).

- Diverging modern models (colonial in the south and metropolitan in the north), although tending to converge in the present day (European peripheral and African spearhead).

Hence, geographically and historically, we are fairly close to a city such as Larache, ancient *Lixus,* the mediaeval Berber city, the centre of Spanish colonial Morocco and a port city similar to the mediaeval ports of the Algarve, Huelva and Cádiz.

1.2. Seeking replicability in a methodology to study the urban space and processes of inequality and segregation applied in Andalusia

Epistemologically, we sought to contextualise our task within a geographical discipline that is situated on the frontier of many fields of knowledge, and which assumes that there are issues that cannot be thoroughly understood through classical analysis alone, but which instead require experience and emotion to be brought into play (Dardel, 2013). With a view to gaining an understanding of complex issues, our discipline returns to its generalist origins and promotes a convergence of perspectives, approaches and disciplines (Morin, 2000), thereby seeking to develop a rigorous approach to urban realities such as social inequality, segregation, vulnerability and exclusion or marginalisation, which are not only complex but also concealed or excluded in official statistics, and as such they require an exercise in 'translation' (Sousa Santos, 2005) in order to bring them out into the light.

Grounded in theories and methods of analysis and interpretation that range from neomarxismt to postmodernism, so that, by seeking to combine them, we might understand the structures and mechanisms of social reproduction that occur within a city, considered

the paradigm of the 'capital space' (Harvey, 2007), as the specificities of the merely urban and the relevance of the historic, the perceptive, and the singular (Soja, 2008), when undertaking this task, we began with the following conviction: *urban territory is not only a context in which societies live with their respective laws or rules, but rather the physical-urbanistic environment and the social environment mutually condition one another, dynamically, constantly changing, establishing a dialectical relationship with one another.*

We decided to follow this dialectic vision, used in studies that interpret the urban setting through its public spaces (García & Torres, 2005; García, 2007; García, Ojeda & Torres, 2008), and using similar theoretical bases, we sought to show the different faces of inequality and social segregation, as well as manifestations of vulnerability and exclusion in the different areas of Andalusia and some of its cities; this led us to draft some general Territorial Development Reports (Torres & Ojeda, 2005) and other more specific documents (Torres & Ojeda, 2004).

We should also mention the PhD dissertation developed by Torres (2013), which used a mixed and integrative methodology, aimed at revealing that which had been concealed, incorporating and merging different perspectives and specific instruments:

- Quantitative analysis and geographic information systems allowed us to compare our analysis in nearby and distant spatial-temporal contexts.

- The interpretation or hermeneutics of the results based on a geo-historical and multi-scaled understanding of the phenomena observed, with direct immersions and deliberate characterisations within the framework of a qualitative and morphological classification. All of this had provided us with a replicable typology of neighbourhoods or districts.

In addition to the above, linked to the experiences and contributions of the authors of this text, we must also highlight the relevance of publications that help to situate us within the territorial context and pertain to the phenomena tackled here, both from a descriptive approach as well as an explanatory and interpretative perspective. Hence, the different geographical analyses conducted by M. Abdellaoui, (Abdellaoui, 2017; Boulifa, Abdellaoui and Chikhi, 2008) are interesting, as is the work on Moroccan migration conducted by M. Berriane (Berriane, de Haas & Natter, 2015) and M. Charef (2009), as well as studies related with cooperation policies (Iglesias, 2010; Miranda & López, 2016).

Hence, we worked with some key references about these frontier spaces, and, above all, with verified methods to approach complex realities that are silenced in our region and its cities. Based on this, we set ourselves the challenge of applying and adapting this methodology to the city of Larache as a whole, and to the specific case of the settlement of Jnane Aztout, demonstrating its possible utility in different circumstances.

1.3. Direct contact with other international experiences in marginal neighbourhoods

When undertaking this challenge, we had another source of support provided by our direct contact with interdisciplinary teams both locally and from Latin America. With regard to local teams, based on previous voluntary commitments made with the organisation Universidad y Compromiso Social, we formed a partnership with a team of architects and educators from the nearby Universidad de Sevilla, which took the form of post-graduate training programmes such as the Master's Degree in Social Habit Management and the AECID Teaching Project for Postgraduate Training in Social Habitat Management in Latin American and Spanish Universities (2011-12); the creation and development of the journal *Hábitat y Sociedad*; and knowledge and learning based on different intervention experiences in habitats. These initiatives offer projection and continuity within the Latin American context, with teams that have experienced parallel intervention processes in settlements and districts on the Mexican border (team led by Carlos González Lobo), in the North East of Argentina (team led by Víctor Pelli) and on the outskirts of Montevideo (team led by Salvador Schelotto).

The fluid and mutually enriching relationship with these teams drove our African experience, both in methodological and research terms, and with regard to practices. The learning derived in this regard from the Master's Degree in Social Habitat Management, coordinated at the Universidad de Sevilla by Esteban de Manuel Jerez, and from the international interuniversity cooperation generated through this postgraduate programme, was presented in 2011 at the XVII Meeting of the ULACAV Network (Barreto; Benítez; López; Pelli; Torres & Vallés, 2011).

We were also fortunate enough to be invited to take part in the Bicentenary celebrations of the Revolution of Quito (August 1809-2009), as members of the Committee of Experts that would select the International Citizen Development Cooperation Experiences, for the Congress *"The Living City as Urbs"*(Quito, 6-10 July 2009), which we took part in as guest speakers. This allowed us to gain first-hand knowledge of the processes and results of a group of intervention experiences developed in Latin American and African cities with a view to improving the lives of their most unprivileged inhabitants (Ojeda-Rivera, 2009).

All of these exchanges took place between 2012 and 2015, shaping the definitive configuration of a Thematic Network, entitled *Urban unboundings. Policy, project and sustainable management in cities on the outskirts (Code P411RT0328),* funded by the Ibero-American Programme of Science and Technology for Development (CYTED), coordinated by the Uruguayan architect Salvador B. Schelotto and developed by researchers from different disciplines within different universities and scientific institutions.

And finally, this international perspective, which enriched the rehabilitation project developed in Larache, was enhanced by the doctoral work of Marta Solanas —a research intern at our Department and member of the Jnane Aztout Neighbourhood Office— who, after several research stays in Uruguay, brilliantly presented her Ph.D. Thesis at the Universidad Pablo de Olavide at the end of January in 2016, supervised by the geographer Ojeda Rivera and the architect De Manuel Jerez, entitled: *Uruguayan housing cooperatives as a system of social habitat production and neighbourhood self-management.*

2. Comprehensive immersion in Larache to develop a singular intervention proposal as part of the *Villes sans bidonvilles* plan

As a result of previous experiences and collaborations, we understood the need to read and interpret the territory and urban spaces by means of a comprehensive and inter-scaled approach; to intervene in reality based on the view that habitat is a process of collective construction and a complex system (Ortiz, 2008; Pelli, 2010, 2006; De Manuel, 2010); to integrate quantitative and qualitative methodologies, focusing on the peculiarity and specificity of each geographical space or urban tissue as an experiential sphere of potential appropriation; and to prioritise an interdisciplinary framework and move towards a model of transdisciplinarity.

Over the course of this journey some events have been developed: Scientific and cultural cooperation agreements for the rehabilitation and improvement of living conditions in Jnane Aztout (Larache, Morocco); Comprehensive immersion in this district through the various phases of the geographical approach taken; Or the accompaniment of the transformation project and its culmination as a model of intervention. All of this was recognised at the XI Edition of the Dubai International Award For Best Practices (UN-HABITAT, May 2018), for the project *We are Medina: Learning from Jnane Aztout–Morocco. South-South Hispanic-Moroccan cooperation project for the urbanisation of the Jnane Aztout slums in Larache, Morocco*.

A recent article published in the *Boletín de la Asociación de Geógrafos Españoles* (Ojeda, Torres & García, 2019) provides a detailed account of the contributions made, firstly from a geographical perspective and in terms of subsequent transdisciplinary integration into the project and the transformation of Jnane Aztout. However, in order to provide a starting point to present the results, this next section highlights some of the key factors that underscore its singularity, its neighbourhood unity, and its relationship with the surrounding urban context, putting forward the capacity of Geography to provide a comprehensive interpretation of these singularities within a structurally dialectical sphere.

2.1. Landing in Larache and recognising an informal settlement with the essence of a neighbourhood.

The location of Larache, on the edges of the Gharb plains by the mouth of the River Lukus, which exposes it to Atlantic influences, and territorially articulated by the Tangiers-Rabat highway, has favoured an economy based on farming and fishing, as well as significant and historic trading activity, which has, nonetheless, begun to decline. However, this location not only offers functional opportunities; it also bestows singularity on this hugely attractive landscape (marshlands, salt flats, port cove, and the ancient Phoenician-Roman city of Lixus), which opens up new dialectics between local identity and the emergence of new sectors of activity.

In addition to this dynamic, it is subject to revisions and changes within a broader framework of its relationship with Spain and Europe (Iglesias, M., 2010; Miranda & López, 2016).

At first glance, Larache city-scale conforms to the standards of a typical North African city (Lacoste & Ghirardi, 1983): organic layout of the Medina and a few irregular settlements; geometry of the colonial city sewn into the city through a large and bustling public space; and new administrative-residential fronts running parallel to newly consolidated shopping streets. Immersion in its urban and social reality revealed a mixed and multi-functional structure, in spite of the emerging pressures of interior migratory processes, new economic logics, and urban development. We also witnessed an array of different urban slums, including historic ones closer to the Medina, which have evidently become more established and integrated, but also more recent examples on the outskirts, characterised by their provisional nature, greater environmental deficits, and more accentuated situations of marginality.

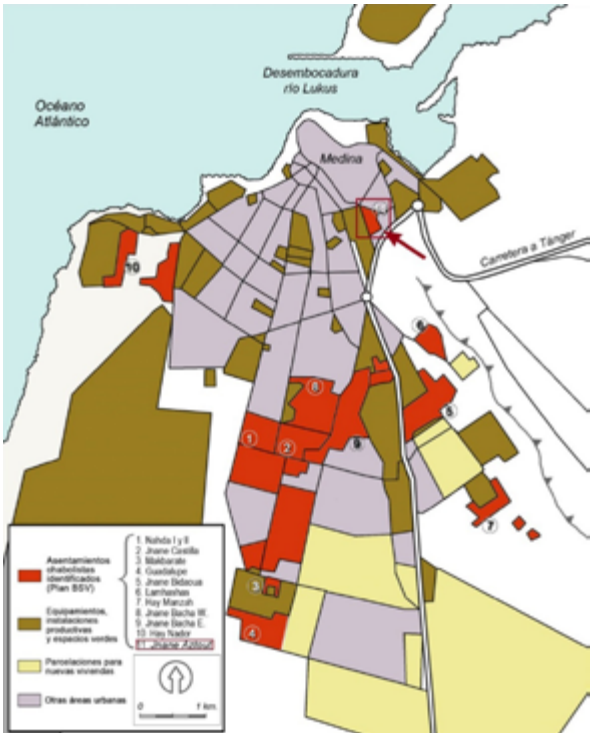

Figure 2. Urban structure of Larache and identification of the slum settlements catalogued in the VSB Plan

Source: Graphic representation based on the image and data from the DPHL (2004)

The document that compiles the general analyses and specific diagnoses for the *Villes sans bidonvilles* National Plan(VSB Plan), drafted by the *Délégation provinciale de l'Habitat de Larache* (DPHL) in 2004, estimates that, as of that date, the number of homes classified as slum housing was 5,484, representing 23 % of the city's population. To a large extent, the proliferation of substandard housing built in previous decades, and the persistence of insalubrious living conditions in general, can be explained by the rural exodus; in other words, it is due to immigration from rural communities close to the city; around 27 % of residents in Larache at the time were immigrants (DPHL, 2004).

A total of twelve slums were identified, which, as noted previously, differed vastly in nature: as well as the age of these settlements, they also differed in terms of their sizes, populations and densities. Whereas the most densely populated sites reached 1,000 and 1,200 homes (Jnane Bacha Ouest and Guadaloupé respectively), others were limited to 100 (Makbarate S. Larbi). Furthermore, this diversity was also patent with regard to land ownership: whereas some of them belonged to the State or the Municipality, others were owned by the military or were located on private lands. The peculiarity of Jnane Aztout is also manifested in this regard, since this is the only case in which the land is assigned to the religious institution of Habous.

From the framework of the VSB Plan it is been proposed and developed non-standardised intervention based on the structural and vital singularities of Jnane Aztout. In this regard, there is a fluid visual, functional and symbolic relationship between this neighbourhood and the surrounding area that is of particular note, as it its morphological similarity to the medina, its centrality and consolidation as an urban place, and the social cohesion, rootedness and organisational capacity of its residents. Accordingly, the intervention strategies developed played close attention from the outset to three principles that would materialise through a flexible approach: "support the permanence of the whole neighbourhood in this place, opting for an *in situ restructuring process* and not to rehouse the residents following relocation to another part of the city; defend the *relative maintenance of an original urban layout*, with symbolically significant spaces, linked to an underlying social structure, reflecting different types of everyday relations and a popular culture in the habitat; and advocate *housing design adapted to different family situations*, taking into account current compositions and foreseeable future evolutions, which would be related with their resources, possibilities and needs" (Ojeda, Torres & García, 2019: p. 13).

2.2. Emergencies and potentialities of a well-established community-neighbourhood.

Immersion in the reality of the neighbourhood from the perspective of recognising emergencies (Sousa Santos, 2005) led us to examine these essential traits in greater detail by means of different strategies, set out in the *Geographers and Environmentalists' Report* of 2006.

The vitality and cohesion of the neighbourhood is not only understood within its confines. On the contrary, the primary unique feature of this area is that its functional logics go beyond the walls of the old cemetery that defined its perimeter at the time. Jnane Aztout is not sewn into the Medina but into Larache as a whole, with well-defined flows: the Medina is the setting for tradition, the symbolic and spiritual, as well as shopping in the souk. The colonial city is the destination for voluntary (recreation and sociability) and necessary services (education, health, and administration). Much of the everyday activity that takes place is concentrated in the area immediately surrounding the neighbourhood, particularly the esplanade leading into the Medina, the Liberation square. Lastly, the port represents the world of work, and the possibilities of survival for the majority of families living in Jnane Aztout.

Figure 3. Functional and symbolic relations between Jnane Aztout and its urban surroundings

Source: Authors' own based on observations and direct interviews

The natural and morphological conditions of the neighbourhood are notable because its leeward location affords it shelter from Atlantic winds and humidity, whereas the sunny slope leading down towards the port, the estuary and the Roman city of Lixus favours everyday working relations but also a visual relationship, providing a privileged balcony looking over the founding landscapes of the city. These potentialities will have an impact once the limitations of the slope itself have been overcome in terms of internal communications within the neighbourhood.

From a morphological perspective, the physical isolation, poor hygiene conditions and precarious self-built constructions that are immediately obvious do not prevent us from seeing an irregular structure that has been well adapted to the graded curves of this place's morphology, in which, organically, open spaces have remained, turning them into meeting places. Constructive elements are also recognised —decorative elements or closed and open spaces which are used in some dwellings all symptomatic of logics of settlement.

Thirdly, involvement with the social spectrum of Jnane Aztout, which is established, settled and cohesive, compared to official estimations that ruled out the possibility of all residents remaining in this area, in accordance with the habitation thresholds established in the VSB Plan, led us to conduct a census, with the backing of families and the Widadiyat (residents' association), which was eventually endorsed institutionally. Its results are as relevant in terms of the recognition of emergencies as they are regarding the implementation of specific measures:

- The possible permanence of residents (357 in contrast to the 1,000 erroneously estimated in the core document of the VSB Plan (DPHL, 2004).

- The possibility of initial microanalyses at individual plot level, allowing certain foundations to be laid that can be subsequently adjusted in order to the develop of a project close to concept of urban recycling. This is based on the diagnosis of habitation needs with regard to the starting indicator of 70 m^2 dwelling space per family as established by the VSB Plan.

- Recognition of dynamic keys, based on family structure, which point to modest growth expectations, guaranteed the viability of the principles set out in the aforementioned plan. Hence, at the time of the census, families with just one nucleus, no more than 6 members and overage parents, accounted for 20 % of the total. In

Figure 4. Analytical sequence of the demographic-habitation structure of Jnane Aztout

Source: Geographers and Environmentalists' Report, 2006

other words, a moderate demographic progression. In contrast, structurally dynamic units comprising several nucleido not account for more than 5 % of the whole.

Finally, one fundamental starting point is determined by the organisational structures of the slum's inhabitants, endorsed as long as the implementation of the project does not create tensions with residents themselves. From the outset, the residents' organisational capability and community action was evident, exemplified in the encompassing role of their Widadiyat. The installation of a central Jaima for events and meetings, the many displays of hospitality, the willingness to learn-show, and the constant demands to play an active part are all symptoms of an exceptional *polis* manifested throughout the intervention: defining lines of positioning that are part of the learning process for all the participants —creative mental elimination of the slums, firstly, as a guarantee of their subsequent material elimination—, specifying strategies for local appropriation, the adopting of active roles by the professionals within the neighbourhood, and subsequently proposing for more complex formulas of self-management.

3. A new strategic framework in development and a neighbourhood that looks to its own future

Between the initial analyses and the final results of the intervention project, a technical process developed that gradually took on a role of support. However, the way in which the different spaces for action and reflection have developed, initiatives have been taken, and specific interventions have been generated (figure 5). Also constitutes a process in which all the steps taken (right and wrong) and the learning achieved are linked with the complexity of the project, with the sociopolitical contexts into which it is being inserted, and the —fundamental—

STAGES	SUBPERIODS	ACTION / REFLECTION SPACES / CONSTITUTION OF INITIATIVES / SPECIFIC INTERVENTIONS	MAP OF STAKEHOLDERS
2005 – 2008 Bases of Intervention	2005–2006	– 1st and 2nd Seminar: "Larache, City, Territory and Development", and Summer Workshops. Interest in the Medina is transferred to slum inhabitants. Opportuneness of the Plan Villes sans bidonvilles – Decision made to intervene in Jnane Aztout("We Are Also Medina""). SWOT analysis, strategies, technical study and intervention proposal. Studies that profile and guide the SWOT analysis (Census, environmental and landscape analysis, etc.) – Bonds of cooperation — Agreements. Creation of Technical. Neighbourhood Office and VSB Plan Monitoring Committee	ADICI — US Group. Support from Andalusia's Regional Government Departments Universities based on Seville (ADICII-GIEST and ACM) Governor and Delegation of the Ministry of Habitat in Larache, Widadiyat, and groups of aid workers
	2007–2008	– Rollout of Technical Neighbourhood Office. Development of Monitoring Committee – Specific cooperation agreement for the project to restructure the neighbourhood of Jnane Aztout – Urbanisation plan and redrawing of boundaries. Agreed Organisation Plan. Approval of housing building projects – INDH programme (National Human Development Initiative.) Increased opportunities for funding	Period of Ramadan: Need for progressive with drawal and 'time of silence' for groups of aid workers. Residents and their Widadiyat demand an active role Urban Community and Al Omrana (Agencyin charge of carrying out work)
2009 – 2013 Effective development of urbanisation and culmination	2009–2010	– Construction of housing, individual initiatives – Creation of the Cooperative for assisted self-builds. Finance and assistance programme (bank of materials, tools, and technical assistance) – Execution of urbanisation work – Wastewater evacuation infrastructures – Replacement of perimeter wall for the neighbourhood – Opening of main street with access to traffic	Core stakeholders maintained New sources of financial support (Alcala de Guadaíra Town Council, Andalusian Cooperation Agency)
	2011–2012. Finalización en 2013	– Construction of the drinking water supply network (Radell) – Construction of housing with the support of the Cooperative – Paving of roads and public spaces – Project completion seminar (May 2013)	

Figure 5. Timeline of the intervention project in Jnane Aztout. Spaces, initiatives, interventions and stakeholders
Source: Ojeda, Torres and García, 2019

need to contribute to the progressive empowerment of the affected population, whose main political space is found in the Widadiyat.

The way in which the different stakeholders have come on board is interesting proof of the need to pool efforts and resources from very different perspectives (politicians, experts, citizens), and to manage and avoid conflicts from similarly diverse and at times opposing positions and objectives (public-private, individual-collective, enterprise-aid workers, native-foreign). Be that as it may, the unfolding of events highlights the importance of involving different stakeholders, the protagonism of the resident population, and the recognition and dialogue that must take place between all parties.

Beyond this, we believe it is useful to reviewthe physical, social and political aspects (*urbs*, *civitas* and *polis*) of Jnane Aztout, from the perspective of geographers who have gradually incorporated perspectives of complexity and transdisciplinarity; as we did initially, contextualising the neighbourhood within the city and the Ville sans bidonvilles Plan, and now by incorporating the narrative of the stakeholders themselves.

Today, Larache is a stable city, yet one that is simultaneously advancing, which is clear from the tendency to maintain its built surface area, although official census figures for 2004 and 2014 point to growth of around 20,000 people, taking the number of residents up to the current figure of almost 125,000.

This dialectic between stability and moderate dynamism is clear in its functional tendencies. Hence, analyses of the *Strategic Development Plan for the Province of Larache* (2013) point to an economy that continues to be based on the primary sector (farming and fishing) albeit with signs of renewal, as shown by the development of irrigation, the creation of an agro-hub, and other projects, in addition to an insistence on commercial openness and investment.

The burgeoning strategic lines that were recognisable in previous years can still be observed: capitalising on its advantageous position with regard to the road to Rabat; activating the heritage potential of the Medina; and the exploitation of tourism, linked to the above, and especially to the port and the Lucis cove.

Furthermore, there are certain basic lines in relation to the development of the Ville sans bidonvilles Plan, into which the actions examined in this article would fit. The document entitled *Evaluation of the National Programme "Villes sans bidonvilles". Proposal to enhance performance* (2011) identified advances with regard to implementation, in turn acknowledging possible delays in cities such as Larache with regard to the estimated completion date of 2012.

Linked to the programme, a series of urbanistic transformations have taken place, synthesised in the eradication of some of the slums indicated in section 2 and translated statistically into a 10 per cent reduction in irregular and slum housing. Hence, in contrast to the figure of nearly 30 % represented by such dwellings in the 2004 Census, in 2014 this figure was down to 14.5 % in Larache. In spite of this, other indicators could be significant of continuing housing disadvantages. For example, close to 40 % of housing still lacks a bath or shower (Morocco Population and Housing Census, 2004 and 2014) (http://rgphencartes.hcp.ma/).

Undeniably, many of the morphological changes taking place in the urban fabric of Larache over the last 15 years have a direct relationship, especially in some

Figure 6. Example of materialisation of urban layouts resulting from different points and types of execution of the Villes sans bidonvilles plan

Source: Authors' own based on an ESRI orthophotograph 2019

Figure 7. Transformation of one of the main entry points. Image from 2006 (left), image from 2019 (right)
Source: photographs taken by Redouan Akjeje

areas, with processes of urban transformation derived from the VSB Plan. Hence, the presence of slums has reduced —albeit only marginally in some parts of the city— in favour largely of the implementation of regular structures and an anodyne urban tissues resulting from the generic execution of the plan's core principles (70 m^2 per family), tidying up of public spaces and building of basic infrastructure. The main exception is, precisely, the neighbourhood of Jnane Aztout (figure 6), which, in addition to greater architectural qualification, boasts a unique more organic layout and a scenario that is in constant transformation and personalisation; and, on a social and political level, a strong sense of belonging.

Capitalising on the perspective and the key position held throughout the process by Redouan Akjeje, representative of the Widadiyat who was permanently involved in the process and a significant intermediary between the interests and requirements of the different stakeholders (neighbourhood and institutions, residents and aid workers…), who also knew the languages spoken in the different areas (Arabic, French, and Spanish), we were able to ascertain a few value-judgements regarding certain aspects we feel are essential and which are highly expressive of the results of the project and the expectations generated:

- Full urbanistic integration of the neighbourhood has been achievedin relation to the Medina and the city of Larache as a whole. Its original centrality has been enhanced by eliminating the perimeter wall around the cemetery, opening up its roads and its visual connections with the surrounding areas. The photographs in figure 7 show the urbanistic transformation experienced in one of the main entry points into Jnane Aztout.

- Improvements made to dwellings and buildings in Jnane Aztout have led almost all the families who initially signed up to the project to remain in the neighbourhood. Hence the rootedness of the population in this area, an aspect linked to its place identity and singularity, becomes extremely significant. Some of the photos taken show the construction process (improvements made to buildings) that has taken place, maintaining values of personalisation and authenticity of resolutions (figure 8).

Figure 8. Construction of housing. Image from 2006 (left), image from 2019 (right)
Source: photographs taken by Redouan Akjeje

Figure 9. Changes in the 'central' square, dubbed 'Hospitality' square. Image from 2006 (left), image from 2019 (right)
Source: photographs taken by Redouan Akjeje

- The number of inhabitants, shored upby these new circumstances and perceptions, has become stable and even started to increase through natural dynamics. This is also a highly significant fact in the analysis and reflections set out in this article: the process of population decline taking place prior to intervention has been halted. Indeed, one of the reasons for the relative population stagnation was the absence of members (chiefly men) from the different families, who had emigrated to Spain or other European countries. Jnane Aztout appears to have reversed this situation. It is no longer a place that justifies emigration (Márquez, 2015), and has become an attractive place for new families looking to settle there.

- In relation to achievementsmade with regard to the public space, its interpretation as a setting for social response has been fundamental. A fact previously reported (García, Torres, García & García, 2014). The residents themselves took part in cleaning up the neighbourhood, collaborating in the recognition of meeting places that required consolidation. They were also involved in creating the first signage, and contributed to the design and execution of some sectors. The 'central' square of this settlement (figure 9), dubbed 'Hospitality' square, has gained special physical, social and symbolic meaning. On account of its original use, relative spaciousness and location, actions taken with regard to this square have had a major impact on improving the image of the neighbourhood in general. The public space has thus had a positive effect on the living conditions of the entire population, but in accordance with certain agreed usages, it has led to greater possibilities for women and children in particular.

- In short, the urban tissue of the neighbourhood has been substantially reappraised, boosted by recognition of its singularities and the tailoring of the intervention strategy developed. This fact has been covered by multiple stories in the press, especially following the prize awarded by UN-Habitat. Furthermore, the process carried out, turning a marginal settlement into a fully integrated neighbourhood in the city, has become an example for other areas to follow locally, regionally and internationally, which gives its inhabitants a tremendous sense of pride.

4. Conclusions

The contribution made by geographers to the cooperation project described here has been grounded in an open and multidisciplinary perspective afforded by our field of knowledge. Hence, the various contributions were made according to the need to fulfil specific requirements and, therefore, there was no exclusive consideration given to theoretical frameworks, concepts, methodologies or analytical techniques understood as being inherent to our subject. Indeed, over the time spanned by the intervention project, the versatility of Geography, situated epistemologically on the frontier of many areas of knowledge, made us acceptable advocates of the interdisciplinary dialogues needed to tackle complex realities rigorously.

Our previous approaches to the project setting and the phenomena affecting this reality were grounded in hypothetical assumptions with a relevant geographical dimension —territorial and landscape— translated into

concepts such as symmetry and a Mediterranean spirit, which complement other essential components such as frontier or periphery (López, 2016). Furthermore, we examined the replicability of methodologies for analysing the urban spacerolled out chiefly within Andalusia: concepts such as poverty, inequality, vulnerability and exclusion, or the phenomena studied such as segregation and social integration, have needed to be revised and rethought because of the peculiarity of the reality tackled in this specific project, the factors conditioning its distinct socioeconomic framework, and the cultural differences encountered.

However, this has not led us to disregard specific contents from a geographical perspective: quite the contrary. This experience has allowed us to continue testing out interpretations of space, territory and society on different scales, demonstrating the convenience of examining these interpretations in different settings. Indeed, the ability to ground our interpretationsin the singularities of the settlements (morphological similarity and dissimilarity with regard to the Medina, location, landscape perspectives, functional relations with the surrounding area, social rootedness, etc.) has been one of the most significant contributions made to the project. Equally, the integration of disciplinary abilities, the assumption of expert capacities and their institutional recognition, and the mutual conviction of experts and residents that the former strengthen the required protagonism of the latter, have been determining factors in reformulating the urbanistic intervention plan (VSB Plan) in Jnane Aztout.

In contrast to the tabula rasa proposed by the generic VSB Plan the defense of the idiosyncrasy of a real, living neighbourhood undoubtedly constitutes a great achievement. A neighbourhood that has been effectively appropriated by its residents. A neighbourhood where core structures and places are maintained. But whilst also a neighbourhood that require radical modification and improvement of elementary aspects of its habitat. A achievement, to which we have been able to contribute.

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Social and citizen implications in territorial governance: key elements in democratic governance

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Abstract:

In 2001 the commission of the European Union initiates a profound reform of the governance so that it becomes a more democratic process, betting on 5 basic principles: openness, participation, responsibility, effectiveness and coherence. In Spain it was not until the crisis (2008) and citizen movements (2011), when these premises began to take consistency. In the 2015 elections, territorial and social inequalities marked political programs. Urge to end corruption, unite the territories and address the most vulnerable spaces and groups. The coordination between different levels of government and the involvement of all territorial actors, became indispensable. After a legislature, we asked ourselves to what extent these objectives were achieved. Throughout this article we will approach the new models of governance applied in some Spanish cities such as Madrid, Barcelona, Valencia, Sevilla, A Coruña y Cádiz, specifically, the initiatives that have promoted citizen participation in the design of urban policies and social cohesion.

Key words: Governance; social and territorial cohesion; citizen participation; Spain

1. Introduction

The year 2015 has become an important date in the political history of Spain after reaching the local government of the main Spanish cities a series of political parties, whose origin or main militants, come from the citizen movements that were generated as a result of the economic crisis of 2008, especially since the 15-M movement.

These social movements took to the streets in protest of the economic model developed so far by the different administrations, which exacerbated the consequences of a global economic crisis. A neoliberal growth model that relied on risk investments, speculation linked to the territory and less public intervention (Méndez, 2015). The consequences and inherited problems fell on citizens (table 1), which saw companies closing and increased unemployment, whose rate became 26 % in 2012; they lost their homes, being affected by foreclosures and evictions - which in four years increased by 56 % and 157.8 % respectively); their welfare state deteriorated, as a consequence of austerity policies (Alaminos, Penalva and Domenech, 2014) and the reduction of public spending

		2008	2010	2012	2014	2016	2017
Unemployment	Unemployment rate	14.8	20.3	26.0	23.6	18.5	14.4
	Youth unemployment rate	30.7	43.3	55.4	51.4	42.2	33.4
	Long-term unemployed (thousands)	684.6	2,162.5	3,302.4	3,352.9	2,392.0	1,899.6
Poverty and social exclusion	Impossibility to go on vacation at least one week a year	36.2	42.7	46.6	46.4	40.3	34.3
	Impossibility toe at chicken or fish at least every two days	2.2	2.6	2.6	3.3	2.9	3.7
	Unable to meet unforeseen expenses	29.9	38.7	42.1	42.6	38.7	36.6
	Delays in the payment of expenses related to the main dwelling	7.1	10.4	9.9	11.7	9.8	8.8
	S80 / S20 ratio	5.6	6.2	6.5	6.8	6.6	6.6
Housing	Foreclosures	58,686	93,636	91,622	80,785	48,410	30,094
	Evictions	27,251	49,227	70,257	69,233	67,030	69,693
Public spending	Public expenditure Education (% of total)	11.3	10.9	9.5	9.5	9.8	…
	Public expenditure Health (% of total)	14.8	14.8	13.6	14.2	15.1	…

Table 1. Social welfare indicators in Spain

Source: National Statistics Institute

on basic services such as health or education (which happened to be 11.3 % of public spending in 2008 to 9.5 % in 2012); social exclusion processes increased and there was an increase in social inequality. The middle class saw how their purchasing power was progressively reduced and could not meet unforeseen expenses or allow themselves to eat meat or fish twice a week. It was clear that the gap between rich and poor was growing, increasing by almost 1 point the ratio between the income of people with higher incomes, and the income of 20 % of the population with lower incomes.

The borderline situation to which the population was subjected resulted in social tension. Citizens realized that the crisis was going to last longer than previously thought, and cases of political corruption kept coming to light. Tens of thousands of people began to occupy the most central and emblematic squares of the cities. They were outraged and demanded a change in the prevailing governance model, and the implementation of new social and welfare policies (Lois and Piñeira, 2015). The struggle for the recognition of diversity, equality, the recovery of the right to the city and public space, which had become a space for profit (Janoschka and Mateos, 2015), became the main demands of the citizens (Subirats, 2016).

The answer came in 2015 provided by the proclaimed parties of change. Their irruption in the political sphere allowed to hope that a new way of governing the cities was possible. Transparency, the eradication of corruption, citizen participation, the stoppage of evictions and the attention to the most vulnerable population marked the political agenda of these parties. Thus, their policies focused on a double objective:

a) Implement a reform of the urban governance model, which follows the recommendations of Europe (European Commission, 2001) in order to guarantee democratic processes based on openness, participation, responsibility, effectiveness and coherence; and develop new routines in decision-making that maximize the effects thanks to the correct design, application and monitoring of policies with an impact on society and the territory. (European Commission, 2001; Farinós, 2008).

b) Promote initiatives that converge on an increase in social and territorial cohesion at the intra-urban level, thanks to economic development, higher employment rates and improved quality of life.

However, after four years, Spanish citizens in general still do not see significant changes in the way they govern and aspects such as corruption and fraud, unemployment, the economic situation and the parties remain their main concerns, regardless of changes of government and / or

	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007
Unemployment	56.8	65.8	73.3	77.9	79.4	78.5	81.1	83.3	82.4	82.7	75.3	43.8	37.6
Politicians	31.1	24.3	23.5	23.4	21.8	26.9	30.3	17.8	20.6	14.9	8.9	8.9	12.4
Corruption	24.7	35.1	33.8	39.2	55.5	39.5	17.7	12.3	2.4	2.9	0.4	0.7	1.9
Economic problems	21.1	23.0	25.2	23.2	24.5	30.5	38.9	53.7	53.1	47.0	51.9	39.2	18.3
Health	11.5	9.9	13.3	11.6	10.2	11.6	12.1	8.1	3.6	3.7	4.5	5.5	4.2
Immigration	11.1	3.2	3.8	3.2	2.3	2.2	2.5	7.5	12.8	16.6	19.3	23.7	34.5
Social problems	9.4	8.8	10.5	11.7	9.8	7.5	5.2	4.7	3.9	3.3	3.5	4.4	3.3
Quality of employment	9.1	9.5	6.6	4.6	3.7	2.3	1.6	2.2	2.7	3.2	3.9	12.3	9.8
Education	8.0	6.8	9.5	10.2	7.1	7.4	5.8	5.6	4.0	4.4	3.2	4.4	3.0
Pensions	7.6	4.8	5.2	2.7	2.0	2.4	2.1	2.9	4.2	2.1	2.1	3.5	2.3

Table 2. Main problems that currently exist in Spain

Source: CIS (2018)

the emergence of new parties in some local governments in cities such as Madrid, Barcelona, Valencia, Cádiz, Seville, A Coruña, Santiago de Compostela, Ferrol, Pamplona (CIS, 2018) (table 2).

Thus, the problems of 2015 seem to remain latent, a circumstance that has caused a disappointment in the population, which has been found in the electoral results of May 2019, in which political forces such as Ahora Madrid or the Marea Atlántica lost their mayorships. In table 3 it can be seen that, in the case of Madrid, if in 2015 Ahora Madrid party reached the municipal government with 519,210 votes (31.85 % of the votes), after four years in the government it has lost 15,220 voters and one seat , like Barcelona in Comú, which lost 20,180 voters, with a participation that is 5.56 % higher than in 2015. In another hand, the Marea Atlántica party that reached the municipal government of A Coruña with 36,842 votes (30.89 % of the votes) has lost 4 seats and numerous voters, as in the rest of the Galician cities of change (Santiago and Ferrol). This tonic is broken in the cases of Valencia, Seville and Cádiz. In the first, the Compromís party has added 10,437 voters which has meant another seat; in Seville, the PSOE has added 20,695 voters, which has meant obtaining 2 more seats; while, in Cádiz, the Por Cádiz party has won 5 seats, reaching almost the absolute majority.

Throughout this article, we will focus on the new governance models proposed for cities such as Madrid, Barcelona, Valencia, Seville, A Coruña and Cádiz, and on the measures that have been implemented in order to achieve greater cohesion social and an improvement in the quality of life of the inhabitants. We will check if they have

	2015		2019		Participation	Majority
	Votes / councilors		Votes / councilors			
Ahora Madrid	519,210 (31.85 %)	20	503,990 (30.94 %)	19	-0.68 %	29
Barcelona en Comú	176,337 (25.21 %)	11	156,157 (20.71 %)	10	+5.56 %	21
Compromís	95,958 (23.28 %)	9	106,395 (27.44 %)	10	-5.79 %	17
PSOE Sevilla	103,238 (32.14 %)	11	123,933 (39.24 %)	13	-0.75 %	16
Marea Atlántica	36,842 (30.89 %)	10	25,290 (20.23 %)	6	+2.68 %	14
Por Cádiz	18,277 (27.98 %)	8	26,498 (43.59 %)	13	-2.58 %	14

Table 3. Result of the 2019 municipal elections

Source: El País

been consistent with the proposed purposes and the limitations they had when correcting inequalities and injustices on key issues such as housing, evictions or basic services.

2. Methodology

This article is based on a mixed approach. On the one hand, documentation regarding the new models of urban governance and the challenge of achieving greater social cohesion in our cities has been consulted; while the electoral programs presented for the 2015 municipal elections have been reviewed in order to analyse the initiatives that the different political forces proposed to mitigate the effects of the crisis, vulnerability and promote social cohesion. In parallel, a field work has been carried out consisting of conducting semi-structured interviews with policy makers and technicians of local administrations, citizen platforms and social groups that took place between September 2018 and April 2019. For each one a different model of questionnaire was designed. Specifically, they have interviewed the mayor of A Coruña, technicians responsible for the Directorate of Decentralization and Territorial Action and Department of Culture of the City of Madrid; Mayor's Office in Cádiz; General Coordination of City Hall in Seville; Pla dels Barris in Barcelona; mayor's office, Department of Urban Planning, Metropolitan Transportation Authority, Management of the Cabanyal Plan in Valencia. With regard to platforms and social groups, interviews were conducted with Mortgage Victims' Platform (PAH) in Madrid, Seville, Valencia and A Coruña; Regional Federation of Neighbourhood Associations of Madrid, neighbourhood associations of all the cities under study and in each of them in two neighbourhoods with different socioeconomic characteristics; squat movements such as the Casa de Pomarejo in Seville, La Ingobernable in Madrid or Csoa L'Horta in Valencia; cultural associations, or groups and social platforms that support a common goal such as Entrebarris, Per L'Horta both in Valencia. All this has allowed us to know first-hand the degree of implementation of the initiatives included in the electoral programs, and to deepen the problems that limited or slowed them down. Finally, all this information has been complemented with the contributions of experts, representatives of non-governmental institutions that work day by day with vulnerable groups; and representatives of citizen associations and platforms that fight to eradicate territorial inequalities, presented at the seminar "The new models of urban governance: utopia or reality?", held in Santiago de Compostela in October 2018, specifically at the discussion table "Resilience and citizen participation "in which the mayor of A Coruña, the former mayor of Lalín, as well as representatives of the Galician Network against Poverty (EAPN Galicia), PAH Pontevedra, FRAMV of Madrid, Pla dels Barris, Imagina Madrid participated, Office of Rehabilitation of the Cabanyal, Department of Urban Planning and Mobility of Vilagarcía de Arousa and Department of Equality, Economic Development and Tourism of Santiago de Compostela.

3. Social cohesion: concept and variables for analysis

When defining social cohesion, we find that there is no definition agreed by the scientific community. This is due to several factors: first, a double and sometimes little differentiated use as an analytical concept, intended to investigate and describe the mechanisms that contribute to integration in complex and plural societies, and as a normative model or political objective. On the other hand, it is a concept with multiple dimensions of analysis ranging from economic to political, through socio-cultural. Third, the generation of social cohesion occurs at different levels, from systemic or structural to that of everyday life (Morata, 2018).

To understand it from a political perspective, we can take as a reference the strategy and action plan for social cohesion approved on July 7, 2010 by the Council of Europe, where social cohesion is defined as "the capacity of a society to guarantee the welfare of all its members —minimizing disparities and avoiding marginalization— to manage differences and divisions and ensure the means to achieve the welfare state of all members. In recent years, this concept has entered political agendas to address issues related to poverty, inequality and social exclusion. However, Giardello (2014) warns that this is a perspective based on a top-down approach, focused on the role of the state in creating a socio-political environment in which citizens can express themselves and enjoy services and a better quality of life. And that in this context the fact that different actors can be activated and promote initiatives that can lead to inclusive or exclusive cohesive processes can be neglected.

From the sociological point of view, social cohesion is interpreted as the perception that individuals have of belonging to a common territory, as well as the degree

of consensus of the members in the community. It also relates to the subjective well-being of people, affirming social participation as a relevant community identification mechanism (Elliott *et al*., 2014).

From an economic perspective, De Castro (2013) understands that the economy must be at the service of the social model that is sought, that is, a model that in the countries of the European Union identifies with the concept of «Welfare Society» . This well-being universalizes basic rights for life: health, education, political and citizen participation, etc. However, reality shows that the economy is not subject to being an instrument, but that it aspires to be the axis of political evaluation, which in practice constitutes a serious obstacle to the realization of the desired social model.

Meanwhile, Lockwood (1999) argue that it is possible to identify two levels of social cohesion analysis: on the one hand, a macrostructural level, which considers aspects such as the welfare crisis, the increase in inequalities, the precariousness of the labour market, as well as the acceptance of common rules and values an intercultural society. On the other, a meso or micro level at the city, neighbourhood or local community level, in which social networks of primary character (related to family, neighbours and friends) and secondary (associations, third sector) coexist. In any case, the micro dimension does not exclude that macro, because between the two dimensions there is a circular process.

If we look at the indicators/elements that directly affect the degree of cohesion achieved, Godinez (2013) identifies six basic dimensions of social cohesion:

- Inclusion: it can be described as a bridge between "the social" and "the economic". The practices and situations of market exclusion, especially the labour market, constitute a clear threat to social cohesion. But inclusion also refers to the process of changing the circumstances of life and adapting to the needs of all people and also towards changing relations between people (Morata, 2018)

- Equality: Social cohesion implies a commitment to distributive justice and equity. A society that does not guarantee equal opportunities to all its citizens generates dynamics of social distancing.

- Legitimacy: Social cohesion is a collective construction; It is not reduced to a sum of juxtaposed individuals. In this dimension, the strategic action of institutions (both public and private) is recognized as mechanisms or intermediation spaces. Social cohesion depends to a large degree on the legitimacy of these institutions and is threatened when they are not representative.

- Participation: Social cohesion implies the broad involvement of citizens in public matters. The lack of incentives and causes for citizen participation is often considered a threat to social cohesion.

- Recognition: This dimension concerns the positive mediation of identity differences. Citizens who perceive that others accept and recognize them contribute to social cohesion.

- Belonging: This dimension is related to the deployment of a sense of "social connectivity" in which citizens share basic values and commitments.

As can be seen, the first two dimensions refer to the economic sphere, the two following to politics and the last two to sociocultural. Three areas that are also included in other studies that complement the indicators to consider. Among them, the report Leisure, Sociocultural Action and Social Cohesion (Morata, 2018), the economic scope is measured based on income equity, inequality, poverty and employment; the politician is measured based on life opportunities, which are specified in the supply of basic services (education, health, housing) and participation (social support networks, participation in networks and groups, political participation); and social attention to aspects such as quality and life (personal security, family situation, use of time, communication networks, satisfaction with life), social capital/cooperation (trust in people and institutions, respect for diversity, belonging) and degree of autonomy/ empowerment (income sufficiency, lost social ties, future projection, social mobility).

The Social Polis platform (www.socialpolis.eu), takes as a reference fourteen items in relation to social cohesion: social and welfare services, economic development and labour markets, housing and urban planning, health, transport , telecommunications, security, environment, governance, education, diversity and identity, social and territorial inequalities, creativity and innovation, leisure and socioculture.

In all cases, the common objective is to ensure the right to the city and the reconstruction of the balances between its areas that the market tends to divide and segment.

Cities	2011				2001			
	Population	Vul. Pop.	Neigh. Vul.	% Vul. Pop	Population	Vul. Pop.	Neigh. Vul.	% Vul. Pop
Madrid	3,198,645	720,000	91	22.51	2,938,723	600,181	78	20.42
Barcelona	1,611,013	455,375	47	28.27	1,503,884	345,927	45	23.00
Valencia	792,054	326,185	39	41.18	738,441	53,524	8	7.25
Sevilla	698,042	183,675	27	26.31	684,633	315,132	36	46.03
A Coruña	245,053	62,850	7	25.65	236,379	20,422	4	8.64
Cádiz	124,014	80,675	9	65.05	133,363	104,782	11	78.57

Table 4. Population and number of vulnerable neighbourhoods in the cities under study

Source: Vulnerable Neighbourhood Atlas

For this, it is key to map the neighbourhoods that are in a situation of greater vulnerability, in order to define projects or strategies that reverse this situation. In this sense, the Atlas of Vulnerable Neighbourhoods in Spain edited by the Ministry of Development takes on special relevance. It is interpreted that vulnerability should be understood as the combination of objective and subjective factors, with labor and residential exclusion being two of the key elements for its trigger. The authors subdivided urban vulnerability into four dimensions (Alguacil, Camacho and Hernández, 2014):

- Sociodemographic vulnerability, which is broken down into three variables: demographic aging, the complexity of the structure of households and the "boom" of foreign immigration from undeveloped countries
- Socio-economic vulnerability, broken down into three other variables: unemployment, job insecurity and low levels of training for working classes
- Residential vulnerability
- Subjective vulnerability

Based on this definition of urban vulnerability, three indicators were established to identify vulnerable areas in Spain by grouping adjoining census sections that maintained a certain urban homogeneity: the unemployment rate, the percentage of illiterate population without studies; and the percentage of homes that do not have a toilet or bathroom. Once delimited and through the analysis of 20 indicators (five for each of the four vulnerability groups) it was possible to define the most vulnerable neighbourhoods in Spain.

In the case of the cities under study in this article, the situation of vulnerability has worsened in almost all of them (table 4). The most striking case is Valencia, because in 2011 there are 34 percentage points more than relative population residing in vulnerable neighbourhoods that 10 years before. In absolute terms, there are 250,000 new residents in these neighbourhoods, which means that those existing in 2001 have been multiplied by six. In addition, in 2011 there are 7 neighbourhoods with severe vulnerability, compared to 1 in 2001. Seville and Cádiz, break this negative trend, registering a certain improvement over 2001. However, the reason is not due to a real improvement in quality of life of its inhabitants, but that the rise in the reference value of unemployment at the state level has left out of the catalogue of neighbourhoods that have not had any net improvement in their unemployment rate.

In this context, urban policies are highly mediated by the social content of the cities in which it is applied and by the expectations of the social groups that lead public opinion. Local governments have had to reconfigure their policy in that citizenship demands greater prominence and participation, as well as greater consideration towards those groups that are distanced from access to some basic goods such as work, education or housing (Iglesias *et al*., 2011). That is why in the following sections we will approach the agendas proposed by the different political forces before the 2015 municipal elections and try to assess their degree of implementation in the cities under study.

4. What policies for social cohesion

In 2015, cities such as Madrid, Barcelona, Valencia, Seville, A Coruña or Cádiz registered a total turn in the urban governance model with the coming to power of new leftist political forces. The situation of social vulnerability that dragged on since the beginning of the 2008 crisis and the

numerous protests by an increasingly organized civil society, requesting a change, brought about a turn in the approach of the policies of these parties. A change that became evident in the 2015 electoral programs in which the proposals aimed at correcting territorial imbalances and social inequalities were prioritized, in order to achieve greater social and territorial cohesion at the intra-urban level; In addition to a change in management models and the involvement of citizens in decision processes. In this section, we will analyse these programs and see which have been the main lines of action defined for each city in terms of cohesion and social welfare.

Table 5 shows in a schematic way, the general lines by which different parties bet for the recovery of the urban and social fabric, grouped into five blocks. In the first, related to the administration-citizenship relationship, improvements in administrative functioning through the facilitation of procedures, greater accessibility to services and the intention of creating a more open and transparent administration. Actions aimed at regaining the confidence of the population, proving to be a renewed, fair institution that offers equal opportunities.

The second block is related to participation, in order to achieve an integration of citizenship in decision processes. Different forms of participation are presented: citizen forums, neighbourhood or district councils, and participatory budgets. For this, some programs try to provide communication tools to citizens through online platforms or through the creation of municipal district / district offices.

The third block has been called territorial balance. It includes initiatives aimed at improving degraded areas, incorporating new endowments and equipment, and recovering disused public spaces or buildings by granting them a new functionality through the city's neighbourhoods through, and improving public transport.

Finally, the last two blocks refer to housing and social aspects. With regard to housing, the main lines of action are aimed at offering decent housing, obtaining a rehabilitation of the housing stock, increasing the public housing stock, controlling the problem of rental prices, as well as avoiding and stopping evictions. of first homes for economic reasons, at least without a housing alternative. With regard to the social field, the measures they present are in many cases focused on certain groups, such as young people, senior citizens or immigrants.

However, it should be noted that a priori the comparison of programs is not easy, because they have very different structures. In cases such as those in Valencia and Seville, an excessive breakdown of the initiatives in many thematic blocks —which in some cases reaches up to 20— complicates the analysis, especially since the objectives and lines are displayed within each of them of acting. In other cases, such as Madrid, Barcelona and Cádiz, the blocks are reduced to 3-4, and their themes focus on aspects such as rights and social inclusion, a nearby, cohesive and habitable city; city model or citizen welfare, among others. In the cases of Madrid and Barcelona, even the actions to be developed in each of its neighbourhoods and districts are detailed. Finally, in the case of A Coruña, 99 measures are proposed, which, as they are broken down, indicates the area of action.

Analysing the proposals of the different political forces, it is striking that employment is no longer emphasized as a key element to achieve social cohesion, which certainly is. There are measures in all programs to train employees, generate conditions for quality employment such as reduced working hours, greater reconciliation of work and family life or incentives to companies with good practices, among others. But, finally, they have not been included in table 5 because they consider that in this area there is a greater dependence on third parties (entrepreneurs) when carrying out these measures. However, in areas such as management, participation, housing and social improvement, they fall within the competences that the administration can handle more directly. In all programs there are coincidences (table 5):

a) Management: it is committed to transparency in municipal accounts and projects initiated, the fight against corruption and a decentralization of local administration by neighbourhoods/districts.

b) Participation: through participatory budgets and the inclusion of citizens in urban rehabilitation/renovation processes and collective use of commons.

c) Territorial balance: thanks to the improvement of mobility.

d) Housing: all agree on the brake on evictions, the promotion of social rents, the promotion of public real estate parks, promoting measures that reduce the stock of empty homes.

e) Social: universal access to basic supplies and services, integrate disadvantaged groups, promote municipal social income, pay special attention to disadvantaged groups.

	Management	Participation	Territorial Balance	Housing	Social
Madrid (Ahora Madrid)	Economic management audit and debt restructuring	Budgets and participatory processes	Promote territorial cohesion	Guarantee access to decent housing	Universal access public services
	Brake on the sale of public assets and restructuring of municipal building uses	Promotion of digital tools for participation	Promotion of local plans based on a participatory analysis of the situation and needs of each neighbourhood	Not evictions	Improves basic services, Health, Education and social services
	Decentralization of management	Collective management of common resources	Reorganization of buildings and public facilities	Stop selling public housing	Guarantee basic supplies (water, electricity, energy)
	Transparency and anti-corruption measures	Participatory urban planning	Rethink mobility	Expand social housing park	End social inequalities and between neighbourhoods
	Remunicipalisation of services			Promote long-term rental and social rent	Enhancing neighbourhood life and community action
	Repeal Law 27/2013 on rationalization and sustainability of local administration				Improvement of certain groups (young people, older people, in exclusion, vulnerable, …) Creation of structures of citizen empowerment, local and metropolitan level
	Repeal of Organic Law 2/2012 on Budget Stability and Financial Sustainability				
Barcelona (Barcelona En Común)	Public investment in the most disadvantaged neighbourhoods	Promote the common management of equipment and public spaces	Prioritize public investment in the most disadvantaged neighbourhoods	Not evictions	Guarantee minimum supplies
	Municipal taxation fairer and more ecological	Greater citizen participation (financing, decision-making bodies, …)	Boosting urban regeneration in the most disadvantaged neighbourhoods	Energy rehabilitation of homes and neighbourhoods	Municipal income
	Remunicipalisation of some services	Involve citizens in the reforms implemented in the neighbourhoods	Integral and sustainable public transport model	Social rent and housing in cooperative regime	Plan fight unemployment
	Transparency and anti-corruption measures		Connect Barcelona with its natural periphery	Promotion of public housing	Guarantee access to basic services (health, education)
	Administrative decentralization				Promote public services
					Improvement of certain groups (migrants, refugees, affected people trafficking, …)
Valencia (Compromís)	Social needs studies and action plans	Citizen participation	Rethink mobility	Housing measures for youth	Reorient and improve services (social canteens, food banks)
	Urge repeal Law 27/2013 on rationalization and sustainability of local administration	Right to information	Change the city model	Social rentals	Services for the elderly
	Improve financing at different levels	Participatory budgets		Plan against empty housing	Improve social services
	Improvement and coordination of administrative services	Economic redistribution according to neighbourhood contribution		Public housing promotion	Fight for human rights
	Transversality, coordination and interdisciplinarity between different agents	Participation in urban planning issues			
	Economic and performance transparency				
Sevilla (PSOE)	Ethical code	Boost participation	Social planning	Urban rehabilitation and renovation	No energy poverty
	Administrative Decentralization		Sustainable mobility	Promote rental of homes	Social integration
	Transparency and access to information			Do not evict	Social advice
	Rejection Law 27/2013 of rationalization and sustainability of local administration			Agreements with financial institutions to paralyze evictions	Improvements of social services
					Youth support

Table 5. Continued on next page

	Management	Participation	Territorial Balance	Housing	Social
A Coruña (Marea Atlántica)	Transparency processes	Budgets and participatory processes	Rethink mobility	Do not evict	Municipal social income
	Administrative Decentralization	Digital platform of participation		Access to housing plan	Measures guarantee basic supplies
	Municipal audit and control			Empty housing tax	Improves situation certain groups
	Public nature of the services				Improvement and promotion of basic services
	Recovery of spaces for public use				Aids energy rehabilitation of homes
	Promotion of network operation				
Cádiz (Por Cádiz Si se Puede)	Payment of debts and debt management	Budgets and participatory processes	Sustainable mobility	Not evictions	Ensure access to basic services
	Remunicipalisation services			Solve problem empty homes	Social services and equipment
	Transparency in accounts and actions			Eliminate the sub-housing	

Table 5. Main proposals for action included in the municipal electoral programs of 2015
Source: Authors based on the electoral programs of 2015

5. A critical approach to new urban policies

After four years since the 2015 municipal elections, a series of interviews carried out with institutional and civil officials, have allowed us to assess the extent to which the proposals contained in the political programs have been carried out and which have been the main problems that local managers have had to face when developing practices that are more in line with the new governance models, committed to the right to the city and the construction of the common (Blanco, Gomà, Subirats, 2018)

In the area of management, after coming to power, the municipalities modified their internal organizational structures and changed the name to different areas of government, according to the social reality and economic situation of the moment (Piñeira, Lois and González, 2018). The common objective was to attest to a restructuring of the local administration and a changing trend in priorities, which thereafter would focus on citizenship and intra-urban territorial inequalities.

Another of the most repeated measures was the creation of transparency portals on the online platforms of municipalities, to give visibility to economic aspects and public processes (award of contracts, finances…). A fact that has been verified by consulting the official web pages where there is a transparency section.

Decentralization was another of the initiatives that acquired the greatest strength in cities such as Madrid, A Coruña and Seville. In them there was an interest in bringing the administration closer to the public through the establishment of municipal offices in the neighbourhoods and direct contact with the demands of its residents. Unlike Barcelona, where the District Boards had powers, financial and management capacity to promote improvement projects in the neighbourhoods; In Madrid, Valencia and Seville, the District Boards had limited capacity for intervention, and therefore the need to provide them with more functions was considered. However, budget shortages, lack of facilities and not having enough qualified staff slowed that process down. In the case of A Coruña or Cádiz, in which there were no District Boards, the initiative proved unfeasible, in the first because the lack of budget and qualified personnel joined the opposition's rejection, and in Cádiz, because the situation of social emergency in the city focused on government action.

Likewise, local administrations have opted for the recovery of public properties that were deprecated, underused or abandoned. They have been rehabilitated and have been endowed with a cultural functionality, where co-management or self-management have been the selected forms. With this, several objectives are achieved: recover degraded spaces, bring the administration closer to the public —working directly with it on urban projects— and empower the population. In the case of A Coruña, the mayor highlighted the case of the Metrosidero plants,

which have become municipal facilities self-managed by the youth and where all the activities proposed by the citizens have a place. In Barcelona there is the Borsí building, which thanks to the demands of the El Borsí citizen platform for the people, managed to negotiate with the public administration that said property coexist a library and a community management space. In Valencia an old factory in disuse has become a laboratory of emerging culture and social economy, activated and managed collectively, called Calderería. Factory of alternatives. While, in Madrid, we can cite the Imagina Madrid project, promoted by the Culture and Sports Area of the Madrid City Council, which aims to transform the city's public space through urban intervention and cultural activation actions. It is a commitment to explore new forms of intervention in the public space in which cultural production, environmental sustainability and social planning.

As far as participation is concerned, the idea of creating more democratic governments through the promotion of citizen participation in decision-making processes became the main axis of change. The objective was to govern with and for citizens, promoting proximity policies that are better adapted to the territorial and social reality. In this sense, the star initiative was participatory budgeting, a budget item destined to execute projects proposed by the inhabitants, which in most cases respond to urban improvement and remodelling actions. An example is the O noso patio project in A Coruña, a participatory process launched with the aim of collectively rethinking schoolyards. It is a project promoted by a group of teachers and families who, in collaboration with municipal technicians and with the schoolchildren themselves, managed to make a model that reflects the wishes and needs of the educational community for their schoolyard.

However, in some of these processes the results are not as expected, and begin to be criticized from a triple perspective:

a) To know the problems and strengths of the neighbourhoods, the neighbourhood forums were launched, where citizens could meet with the local responsible, to transfer requests and concerns. However, the adult-older population has misgivings explaining what they see wrong and although they are aware of the problems in the neighbourhood (cleaning streets, cutting trees, improving sidewalks, etc.) they dare not say so.

b) On the other hand, over time the number of attendees has been reduced, either due to fatigue and the time involved in attending continuous meetings, or because there was a feeling that their participation was not reflected posteriori. The people who attend are almost always the same and on many occasions, they are linked to a political party, so that there is a certain "politicization" in the decisions. As for the associations that collaborate, they have entered a phase of exhaustion when they are summoned to hundreds of meetings, which they already consider an obligation to attend, because if they do not it seems that they are no longer interested. Thus, neighbourhood assemblies are increasingly in a very weak position. Very different were those that arose as a result of 15M that arose from a process and did not really have the same connotations as other types of assemblies.

c) Likewise, although it is true that participatory budgets were aimed at promoting equal opportunities and equity, and that they generated great expectation, the truth is that they are showing certain weaknesses when assessing winning initiatives. The proposals to be made must be submitted in writing and signed digitally after registering with the email. In this sense, we must think that a large population of the neighbourhoods that need them most does not have email and is not managed with ICTs, which means that there is an important bias in relation to neighbourhoods that have improvement initiatives and the ones that get the most votes. To this we must add the need to have a technical language when writing the proposals and have some knowledge to adapt the measures to the regulations. That is why, in Barcelona, before approving the Pla dels Barris a diagnosis has been made based on the collaboration between the administration and the social fabric of each of the neighbourhoods.

In the area of territorial balance, although there was a radical change in the scope of urban policy intervention, moving from a metropolitan scale to the neighborhood, some cities like A Coruña, did not lose sight of the importance of coordinating with the different actors of its metropolitan area. And it is that the urban reality in these spaces does not understand limits on a paper, and the processes of urban segregation exceed these limits, being a joint problem. These segregation processes create a heterogeneous scenario where rich and poor tend to concentrate in different spaces, which complicates cohesion.

In other cities, such as Valencia, Madrid and Barcelona, large-scale urban development projects were stopped

to respond to the diversity of sensitivities, intervene in the most vulnerable spaces and promote public-social collaboration (Piñeira, Lois and González, 2018). Consequently, in Valencia the Special Plan of the Cabanyal was paralyzed, which curiously demolished 200 protected buildings of the 600 that were in order to extend the avenue of Blasco Ibáñez to the sea. In Madrid, projects such as Mahou-Calderón, which wanted to tear down the football stadium, build two 36-story skyscrapers and eight other 20-story towers that do not adhere to height restrictions or respect the obligation to reserve land for social housing construction; and the Madrid Puerta Norte-Chamartín project promoted by Banco Bilbao Vizcaya and the ADIF railway infrastructure management company in the area surrounding the Chamartín train station has been renegotiated. Some projects that accentuated the differences between the north - zone of higher incomes - and the south, where the indexes of greater vulnerability are located and in which according to the Regional Federation of Neighbourhood Associations of Madrid "is where everything is always located that the city needs, but it bothers him, like sewage treatment plants and incinerators. " Precisely, with the aim of alleviating this north-south dichotomy, a Territorial Rebalance Fund was designed (Madrid City Council, 2016) which, through a series of indicators, developed a ranking of neighbourhoods with greater needs. Then the principle of asymmetry was applied to allocate to each district a different budget for possible interventions aimed at promoting employment, through training initiatives and employment workshops; improve public spaces and provide services; and social intervention through culture and sport. In the case of Barcelona, the Plan dels Barris was designed to serve the most vulnerable neighbourhoods. Among its objectives was to promote integrative educational projects, address the main social inequalities that cause health problems; promote culture as a tool for social transformation, link it with local services and equal participation of all groups; promote local development linked to people's needs; and deal with urban deficits and low-quality housing (Barcelona City Council, 2016).

Finally, it should be noted that in the area of territorial balance, mobility has been another key element to consider. Infrastructures are the backbone of the territory, and actions aimed at improving its system and greater sustainability, favour territorial and social cohesion. Just look at the Barrio de Nazaret in Valencia, to understand how an infrastructure (Formula 1) has caused the isolation and disconnection of this neighbourhood from the rest of the city, turning it into a bubble of poverty, degradation and social conflict. A situation that is trying to reverse with the works of a subway line to the neighbourhood, and the improvement of bus lines, which is a continuous demand from its neighbours.

Housing is one of the most delicate issues of the moment, and perhaps together with the use of the most important to achieve social cohesion. Currently, having a job does not guarantee you being able to access decent housing, since the temporary and precariousness of the contracts are an important barrier when applying for a mortgage or public housing. In relation to the latter, the outlook in Spain is worrying compared to other European countries. According to PAH data in 2018, only 1.1 % of housing in Spain is public, while in Holland it reaches 32 %, France at 17 %, Austria at 23 % and the United Kingdom at 18 %. On the other hand, much of it is in the hands of the so-called vulture funds, as some municipal housing companies chose to sell it.

The problem is that before the outbreak of the housing bubble, the promotion of public housing was a secondary aspect. Therefore, when the crisis broke out and thousands of families were affected by foreclosures and evictions, administrations were aware of the problem they were facing, as they did not have their own real estate park to offer them with social rents. In Madrid, for example, although the rebalancing fund contemplates the acquisition of housing through social rent, the initiative takes a considerable delay when having to build them. In other cities, such as Valencia, aware of the problem, they have created the housing department and have thought about promoting housing cooperatives. In the case of Barcelona, the regulations have been modified so that the promoters of new housing, rehabilitation and new constructions on urban land are obliged to provide 30 % of affordable housing, an issue that the urban planning law so far only forced on land developable, when it was practically non-existent. In Cádiz, the commitment to offer housing to the vulnerable population was partly fulfilled, by promoting the municipal housing company Procasa the construction of 70 homes for social rent. A limited figure compared to the existing demand, but that could not be expanded due to the need to attend to the existing social emergency in the city. Finally, in Seville, the housing company Emvicesa has chosen to allocate a part of the newly created housing for sale and another for social rent. However, from PAH Sevilla the shortage of social housing is denounced, the restriction of the criteria to access it, and the lack of help for the relocation of people with limited resources.

A person applying for social housing must have a minimum income. If in the application process you remain unemployed, you lose the right to have it. In this regard, we must highlight the struggle of the Affected Mortgage Platform (PAH) so that the constitutional right to access a home is fulfilled. To do this, the sale of properties to banks, the retroactive payment and evictions must be stopped. It is necessary to obtain a housing alternative and guarantee basic supplies. All cities have turned in this direction, giving aid to pay bills for electricity, water and gas, and have reached agreements with banks to not evict people before having a housing alternative.

In any case, the housing problem is not limited to the acquisition of housing, but also to rents. Prices have increased, and the effects of tourism are causing a change in leasing models. Traditional housing rentals (for residents, students) are being replaced by tourist rentals. Faced with this situation, cities such as Madrid, Barcelona or Valencia have launched a Plan for the reorganization and limitation of tourist apartments. In addition, there is a tenant and tenant union that advocates for guaranteeing the social function of homes through the firm protection of residential use ahead of economic or speculative use of any kind, as well as the protection of fair rentals.

Finally, in the social field, there have been numerous actions carried out by the different political forces. Many of them are aimed at providing infrastructure and equipment to these most vulnerable neighbourhoods, which generally have a significant deficit, as well as the improvement of existing services. Education, health and social services aimed at youth, the elderly, gender equality or certain more vulnerable groups such as immigrants, disabled or victims of gender violence, are the main focus of action proposed in their measures. In all cities, the integration of vulnerable groups through culture and sports has been sought. In addition, agreements have been set up with water and electricity companies to guarantee their population their supply. But perhaps, among the cities analysed, the most striking case has been that of Cádiz. When the new leaders acceded to the mayor's office in 2015, they found an emergency socio-economic reality, with some 700 children who were hungry and in a state of malnutrition. In this context, the fundamental priority was to face the social emergency, making special interest in three areas: housing, electricity and food. For this they increased the budget for social services by 30 %.

Despite all this, experts from the third sector maintain that the problem is not being addressed correctly since:

a) We are facing a misunderstanding assistance by the administrations and citizens. It is useless to give people food and clothing if their problem is that they do not have a job and a home to shelter.

b) People in situations of poverty and / or exclusion must face administrative violence. That is, when having to apply for any help, minimum income, or housing assistance, they need to go through numerous procedures and give explanations again and again to claim a right.

c) There is an unease among the affected groups, because they see that even though politicians meet with them, their promises are not fulfilled or insufficient. Thus, for example, although in Galicia the groups claim that the housing supplement is 25 %, after many meetings the administration has only granted 10 %.

Thus, we can conclude that although in the electoral programs of 2015 there was a common background regarding the governance model to be developed and the policies that were a priority, the success achieved in each of the cities studied was very different (table 6), either because of the situation from which they started, or because of the internal cohesion in the partisan coalitions

		Madrid	Barcelona	Valencia	Seville	A Coruña	Cádiz
Management	Transparency						
	Decentralization						
Participation							
Territorial balance							
Housing							
Social intervention							

Table 6. Assessment of the success of the proposed policies. Green: satisfied and with high impact; Orange: satisfied, but with limited impact; Red: dissatisfied

Source: Authors

that reached the municipal government, the financial and management capacity, the degree of decentralization, the associationist tradition, etc.

There is no doubt that in the larger cities —Madrid and Barcelona— there was a greater will and strength in promoting a new way of making a city. Since coming to power, they tried to make their management transparent, promote the decentralization of the administration and serve the most vulnerable neighbourhoods by promoting territorial rebalancing plans. Even so, the differences were notable between them. On the one hand, the atmosphere within the coalition that governed the Barcelona city council was calmer than the one in Madrid, where tensions were happening. In Barcelona, administrative decentralization was a reality, while Madrid, despite having District Boards, started from an excessively centralized model of government, with work synergies difficult to change. Something similar happened in Valencia and Seville, where the Municipal Boards only managed some licenses and their function was limited to citizen and political participation through representatives of each political party in the municipal government. On the other hand, even though in these cities the new municipal corporations were aware of the disadvantage in which some neighbourhoods were located, they did not create specific intervention plans on them, so their vulnerability situation persists in the time.

Regarding smaller demographic cities, such as A Coruña and Cádiz, the differences were also notable. Although a priori one can think that in Cádiz the new policies did not have the desired success, nothing is further from reality. Although it is true, that decentralization mechanisms were not put in place, and housing remains an unsolved problem —as in the rest of the cities— the truth is that the actions carried out in the area of social emergency had a great impact on society, and at the polls, since the party Por Cádiz Sí se Puede go from having 8 councillors in 2015 to 13 in the 2019 elections. Quite the opposite happened in A Coruña, where Marea Atlántica lost the government. And, in that city, the actions that were carried out were limited, isolated and with little social impact. Despite the mayor's efforts to interact with the population, discuss with them on the radio about the problems of the neighbourhoods, and intervene in some spaces or buildings to promote cultural activities, the truth is that the majority of the population had no knowledge of these initiatives, and he had the feeling that he had not improved with respect to 2015.

6. Conclusions

When in 2015 we began talking about new models of urban governance, social cohesion and citizen participation became fundamental pillars of this model. We are, then, in a period in which the attention to civil society and the recovery of the damaged trust of citizens in their institutions, have become key elements of democratic governance. Definitely, all parties must bet on implementing in their agendas the horizontality of power and the connection with the public as articulating axes of their public policies.

We have seen that throughout the last four years the political forces that have arrived at the municipal governments have tried to put in place different mechanisms to guarantee them and thus reduce the social, economic and residential vulnerability in which the neighbourhoods were located. However, the results are far from satisfactory in that: it is still unknown what impact the measures taken in the improvement of social welfare have had; There has been some disappointment and fatigue on the part of the associative fabric and citizenship in some of the processes implemented, such as those of a participatory nature. Perhaps these are the reasons that explain the least representativeness —or even the loss of the government— that the coalitions so far have had in the 2019 municipal elections in cities such as Madrid, Barcelona or A Coruña.

In this context, the dilemma of what public policies that the new local governments will adopt will be considered, if social cohesion and citizen participation will continue to be key elements in their management models; if vulnerable neighbourhoods and degraded areas of cities will continue to be the focus of their policy intervention; and what will be the future of territorial rebalancing plans initiated in the previous legislative period.

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Mechanisms of recovery and maintenance of the rural population. About the province of Malaga*

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Abstract

This paper aims to evaluate the role that social assistance from different sources has in the demographic stability of many rural municipalities and in improving their quality of life. As a result, in the general calculation of the income in these areas, especially those known as deep rural areas, external income not derived directly from productive activity holds a prominent position, particularly those derived from the agricultural unemployment allowance and pensions. The distribution of this aid in the province of Malaga has a leading role in the preservation of many rural municipalities, stopping the demographic haemorrhaging caused by migration processes of other times.

Key words: Rural depopulation; agricultural unemployment subsidy; income agrarian; vulnerability / demographic stability

1. Introduction

Nowadays, in Spain, there is an attentive examination of rural depopulation[1] due to the extension of large and endangered "empty spaces", which are especially present in the interior of Spain and are exponents of the productive crisis in the context of the modernisation of the Spanish economy in the second half of the last century. However, in places where it has become noticeable, the rural depopulation process has resulted in a situation of vulnerability in many rural centres in terms of demographic stability in addition to demographic gaps. This situation is caused by the fact that their small populations are the ones whose future is most threatened by the changes in our society's demographic model.

In this context, it is worth drawing attention to the relative stability of the population of many other poorly developed rural areas, with weak economic activity and often little diversified, which is quite common except for successful experiences of local development, which are frequent but not generalised. In light of these situations, it is interesting to identify the elements that are contributing to the stability of the most vulnerable rural areas.

For that reason, this study aims to analyse one of these elements, that is, the influence of external income on the stability of rural areas, using the province of Malaga as a field of study.

2. State of the art: the scientific-institutional interest in depopulation

The population growth at the beginning of the 21st century kept the demographic problems of rural areas out of the

1 There is a wide and diversified literature on the current demographic challenge linked to depopulation and/or ageing: Bustos (2005), García (2011), Recaño (2017), Delgado et al (2017 a, 2017b), FEMP (2017), Gómez (2017), Molina Ibañez, M. (2019), Molina de la Torre, I. (2019).

debate, and it was the immigration trend that attracted all the attention in Spain. Nevertheless, the drop in population in recent years and the effects of the economic crisis have diminished the illusion of immigration as a panacea for solving the population shortage in rural areas (Recaño, 2017), and the problem of rural depopulation has been brought back to the forefront, as shown by the impact it has had on scientific-academic papers, the media, associations, institutions, political debate, etc.

The analysis of this reality from a scientific and academic perspective, as pointed out by Molinero (2017), has evolved over the last 30 years from a clearly optimistic and generalist approach to a different "dramatising and alarmist' approach linked to the depopulation and desertion of these spaces considered globally and without any territorial distinction. This latter approach has been encouraged by various journalistic works of enormous significance but which simplify a reality that is much more diverse and complex than the one they show. As Molinero points out, this perception of the facts does not reflect the reality of the Spanish rural area since they overlook the differences that exist in a territory where a dynamic rural area, an intermediate rural area and a deeply rural area coexist, the latter being the one that can become a demographic desert.

From a different point of view, there are enough solvent and well-documented demographic studies in the fields of geography, sociology, etc., which have both measured the magnitude of the problem and identified it, with an excellent diagnosis of it (Goerlich *et al*., 2016; Recaño, 2017; Camarero, 2009; etc.).

These studies, from a purely demographic perspective, show the complexity and reality of the demographic situation in Spain. They show that the reality of the Spanish rural areas has evolved very differently from one territory to another in the past decades. Whereas there are areas that have recovered a certain social and economic dynamism thanks to the good combination of internal and external factors, there are others in which the phenomenon of depopulation has also continued, resulting in the subsequent processes of ageing and masculinisation. In this sense, the Spanish Federation of Municipalities and Provinces (FEMP, 2016) estimates the number of municipalities at risk of extinction in the short and medium-term at 4000, of which, according to Recaño (2017), there is a group of municipalities with less than 1000 inhabitants (1840 specifically) at "risk of irreversible depopulation", on the verge of extinction.

In recent times, concern about the demographic challenge linked to ageing and depopulation has reached deep into both civil society and public institutions and administrations (national and international). Proof of this is its recognition since the beginning of the new century by international organisations such as the OECD and the EU.

In this context, the efforts that the EU has been making for more than two decades to face this problem, which affects many of its Member States, through reports, strategies, resolutions, working documents, etc., have acquired considerable significance. One of the first documents was the 1995 Report on the demographic situation in the EU (European Commission, 1995) and the subsequent resolution on the report (European Commission, 1997). However, it has been in the present century, and especially in the second decade, that attention to this issue has been most marked; in this period, the Green Paper "Confronting Demographic Change" (European Commission, 2005), the document entitled "Europe's Demographic Future" (2007), and more recently the document entitled "The EU's Response to the Demographic Challenge" (European Commission, 2016) which was followed by the report "Deployment of cohesion policy instruments by regions to address demographic change" (European Commission, 2017) are worth highlighting. With these last documents, depopulation acquires a leading role for the first time as a matter of state on the continental agenda. The document states that, when defining and establishing these policies and the corresponding aid, not only economic criteria, such as GDP but also demographic criteria, such as the dispersion or ageing of the population, should be taken into account.

Despite this deployment of actions, the EU itself acknowledges that the response given to the demographic challenge so far has been "partial and underdeveloped". However, it must be pointed out that, with them, the EU acknowledges that demographic change is one of the greatest to be faced; likewise, the risks of this demographic change are beginning to cause economic, social, ecological and budgetary problems that will mark the future of public pension and health systems, which are, after all, the future of the European Welfare State.

In Spain, this awareness had also reached the sphere of public authorities, developing different reports, initiatives, etc., since 2013 when the European Union warned the Spanish government that it should take action against this phenomenon. As a result, in 2015 a committee of experts, on the recommendation of the Spanish Senate, estimated

that a density of less than 10 inhabitants/km^2 was an indicator of the depopulation of a municipality. This same year, the Spanish Senate unanimously approved the "Study Paper for the adoption of measures for rural depopulation in Spain".[2] This document contains a concise analysis of the severe problem of depopulation that was afflicting many provinces and areas of Spain, as well as some recommendations for action. However, this remained a declaration of intent as it did not materialise into concrete actions.

Furthermore, this year the "Report of the Special Commission for studies on measures to be developed to prevent depopulation of mountain areas" was released.[3] The following year, 2016, the "Special Commission of the Senate on Demographic Evolution and its Consequences in Spain"[4] was created with the specific objective of studying the demographic evolution of Spain and prioritising the problem of depopulation in the political debate. It was assigned to a group of researchers from the Institute of Economics, Geography and Demography to carry out different studies and statistical reports and to promote their appearance throughout 2017 and 2018 at different times in the Spanish Senate.

More recently, in 2018, the "Commissioner for the Demographic Challenge" was created after the Conference of Presidents of the Autonomous Communities approved in 2017 a "National Strategy against the Demographic Challenge" in order to integrate them into the National Strategy against the Demographic Challenge that was scheduled to be presented before May 2019 (MAPA, 2018).

This same concern can be observed in many of the initiatives launched by regional administrations, notably, the creation of the Forum of Spanish Regions with Demographic Challenges (FREDD), which made an institutional declaration on the demographic crisis in 2013. Likewise, all these institutions have created different structures and bodies aimed at dealing with this situation (AGE, 2018), including the network of sparsely populated areas of southern Europe (SSPA), or the European Network of regions affected by demographic change.

Civil society is also openly involved through foundations and specific associations and projects. Associations have been created, such as "Asociación contra la despoblación rural de España" [Association against rural depopulation in Spain]; "Arraigo" [Rooting] project; "Ágora" project; and "Abraza la Tierra" [Hold the Earth] Project and foundation, "El Hueco" [The Gap] project, etc. (AGE, 2018)

Similarly, the Spanish Federation of Municipalities and Provinces (FEMP) addressed this problem in 2016 in its report called "Population and depopulation in Spain", in which it analyses in detail the demographic evolution registered in Spain between 2015 and 2016. Later in 2017, it drew up a list of measures to combat depopulation in Spain (FEMP, 2017). In this report, the FEMP proposed 79 actions to address rural depopulation in 7 work areas. It also took part in the organisation of three conferences on rural depopulation: Montádez (Cáceres, 2016), Huesca (2017) and Palencia (2018), which showed different formulas and proposals in order to stop the demographic decline suffered by the rural environment.

At an academic level, the creation of a specialised journal on this subject it is worth mentioning, the *AGER* journal (*Journal on Depopulation and Rural Development*), published by CEDDAR (Centre for Studies on Depopulation and Development of Rural Areas). We should also add *Presura*, a journal for the repopulation of empty Spain which, in turn, has organised three national fairs for repopulation. Finally, in December 2018, the AGE (Association of Spanish Geographers), together with the College of Geographers of Spain, published a manifesto entitled "Addressing the demographic challenge, facing depopulation".

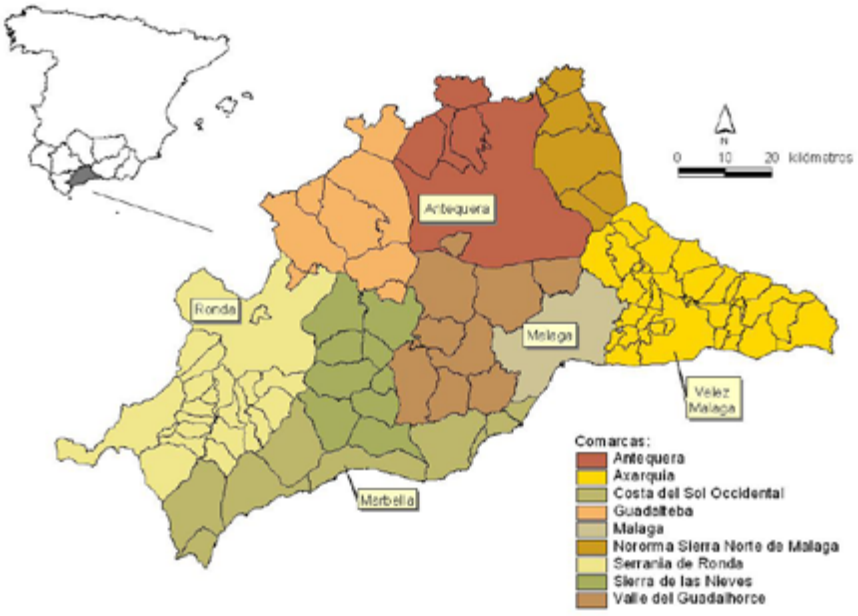
3. Decline and vulnerability of the rural population in the province of Malaga

Malaga is a Spanish municipality located on the Andalusian Mediterranean coast, nestled in the mountainous formation of the Cordilleras Béticas, with a coastline of 184 km, which includes a capital city and 13 other municipalities. The northern area is part of the Intrabetic Basin, with flatlands and an average height of 500 m. This area is known as the Antequera Depression,

2 BOE 17 abril 2015, n.º 505

3 BOE 13 de julio de 2015, n.º 561

4 BOE 30 noviembre 2016, n.º 41



Map 1. Location and municipal and regional structure of the province of Malaga
Source: Prepared by the author

which the Provincial Council divides into three regions: Antequera in the centre of the plain, and Nororma and Guadalteba on the eastern and western sides of the mountains, respectively. In the south, the eastern part of the province is historically known as La Axarquía and is formed by an extensive mountain slope facing the sea that descends from the foot of the Tejeda and Almijara mountains. In the western part, there is a group of mountain ranges comprising the regions of Ronda and Sierra de las Nieves, to the south of which extends the coastal strip known as the Western Costa del Sol. Between the two mountain formations, the southern centre of the province is an area of lesser height and inclination, sloping softling into the valleys of the rivers Guadalhorce and Guadalmedina, known as the Hoya de Málaga, which opens up to the coast and the capital of the province (map 1).

Despite the presence of the mountains, Malaga is the sixth Spanish province in population (1,630,000 inhabitants in 2017) with a density much higher than the Spanish average, thanks to continued growth under which there are, however, two divergent trajectories. The first one corresponds to the littoral zone, related to the intense growth produced since the 1960s with the tourist development that was added and promoted as well as that of Malaga city. The other trajectory is the one that follows the rural population in the extensive space of the interior of the province, with a widespread decline since the mid-20th century as a result of a continuous rural exodus.

The depopulation process linked to the rural exodus seems to have been restrained in the early years of the 21st century, given that almost all the regions have gained some population and there are fewer municipalities with losses. However, this occurs in a context that does not ensure demographic stability due to the weakness of natural mobility with the resulting ageing sequel, since 68 of the 100 municipalities have negative natural balances. This negative effect increases the vulnerability of rural populations, especially the smallest ones because they suffer natural losses (see figure 1) and ageing more. The relative stability of rural depopulation in the interior areas is linked to positive migratory balances, which contrasts with the classic model of rural exodus, with which they also coexist.

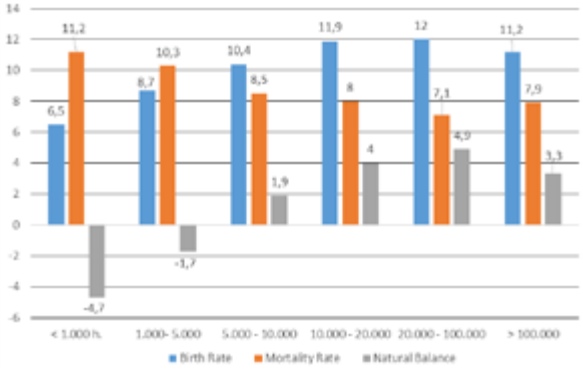
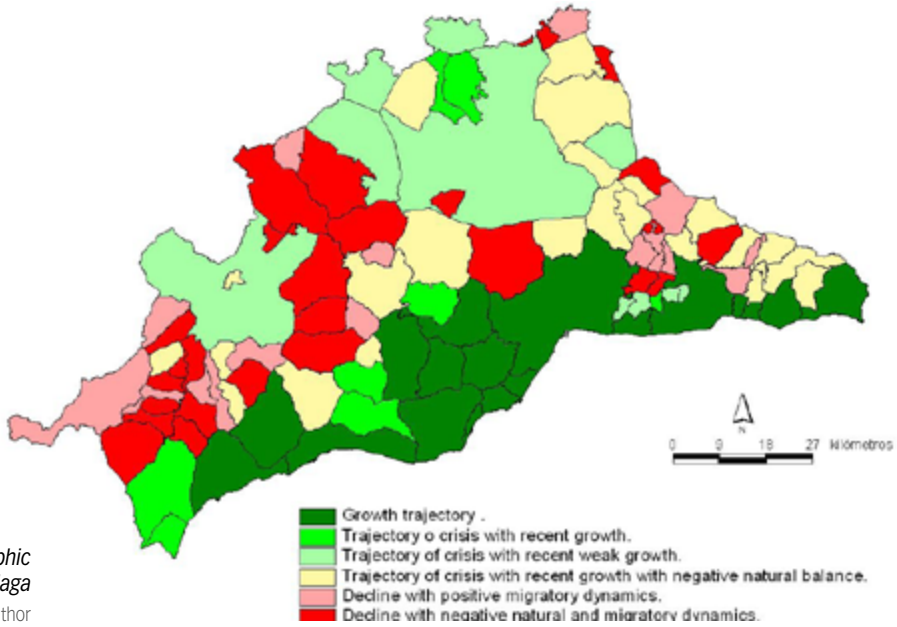


Figure 1. Natural mobility by demographic size of municipalities (average rate 2001-2017)
Source: Register of inhabitants (2001-2017). INE. Prepared by the author's



Map 2: Trajectories of the demographic growth in the province of Málaga

Fuente: Prepared by the author

The image of the province, positive in the framework of the Spanish population, is due to the amount of population in the coastal urban area (Costa del Sol and the coast of La Axarquía) and the crown of the capital (under Guadalhorce). They offer essential as well as natural immigration growth and lower levels of ageing.

The rural population of the interior areas does not offer similar demographic stability. Its most stable segment is a block of ten populations with very weak but positive natural and migratory mobility, which has allowed them a slight growth in this century. It includes the two historic cities, Antequera and Ronda, and several of the larger interior villages of the Antequera Depression which appears as the least demographically vulnerable interior space. However, the most common image (that of 65 of the 100 municipalities in the province) is one of greater vulnerability: small populations located in the mountains (especially frequent in Ronda and La Axarquía), with negative balances in their natural mobility, whose decline is concealed by their migratory balances. Forty of these negative natural growth populations experience positive migratory balances. They are generally modest contributions, and in many cases (16 of the 40) do not compensate for the losses they suffer naturally. However, it is more significant that thanks to them, 24 municipalities have achieved some growth and have contributed to the restraint of rural depopulation. In general, they experience only moderate growths, but occasionally immigration has generated very intense growths, symbols of the considerable rural urbanisation in the Axarquía that also affects other mountain areas. The significant proportion of foreigners in their population numbers (mainly from Western Europe) is a reflection of the migratory model that feeds these growths, as is the fact that immigration does not translate into an appreciable improvement in ageing.[5] The vulnerability of the rural population of the interior of Malaga is evident if we take into account the number of municipalities (41 out of 100) that deepen the demographic decline that they have been carrying since the previous century. Some, as has been pointed out, have mitigated their decline with positive migratory balances, but those that reproduce the most classic model of rural decline are more numerous (25 against 16), with natural and also migratory losses, which in some (10 of the 25) translates into significant annual losses. Together they are municipalities of little population (only three have more than 3000 inhabitants, predominating those of less than 1000 inhabitants, those of a sharper decline), with a wide distribution in the interior areas of the province, especially in the mountain area (map 2).

The map confirms the high vulnerability of the small rural populations that occupy the interior of the province, which suffer from negative natural mobility. The picture is naturally completed by high levels of ageing that become even more dramatical in the smallest localities (figure 2). The new residents linked to the urbanisation

5 The new migratory models, which were already perceived at the end of the twentieth century, outlined this effect (Camarero, 1999; Ocaña and Navarro, 1999).

of some areas does not solve the problem, and the reduction of the rural exodus is the only factor that could avoid a rapid collapse of many of them. This is the reason why the mechanisms to reduce this exodus, such as the social benefits that are analysed in this paper, are so interesting.

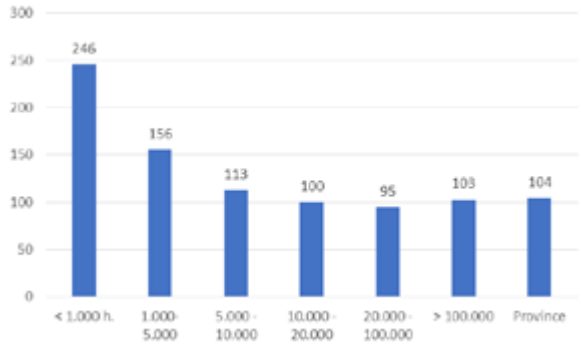


Figure 2. Ageing rate[6] of the municipalities according to the number of inhabitants

Source: Register of Inhabitants (2001-207). INE. Prepared by the author

4. Analysis of external social flows in the province of Málaga

Currently in rural areas, the income generated by agricultural activity is subsidiary to other sources of income, apart from the non-agricultural work carried out by family members of the farm owners, a considerable part or complement is the income from pensions, benefits or production aids, which are contributing towards improving the living conditions of the rural population, anchoring it in the territory. From the set of aids, we are going to study two of them due to their extension and territorial importance: the agricultural unemployment benefit and pensions.

The main identity and cornerstone of modern welfare states is the existence of public instruments that contribute to a better and fairer wealth distribution among all citizens. The protective action of the Spanish Social Security System is made up of two main types of benefits, which are contributory and non-contributory benefits, depending on whether or not a prior contribution is required.

The Spanish Special Agricultural System (SEA) has been part of the contributory system since 2012. Within it, workers have different coverage, including the agricultural unemployment benefit for temporary agricultural workers in Andalusia and Extremadura[7] that have a minimum of contributing days covered, a welfare benefit introduced in 1984 (Decreto 3237/83) as an alternative to community employment, which has been in force since 1971 and the aim of which was to provide agricultural workers with unemployment benefits. This system has undergone several modifications, the most important one being the reform of May 2002, restricting access to the SDA (Agricultural unemployment allowance), which would lead to the introduction of the Agricultural Income (REA), an economic aid similar to an allowance, under RD 426/2003 of 11 April.

Pensions, which come from the Spanish Social Security System (40.7 % of the Spanish State Budget in 2017), although not an exclusive benefit in rural areas, contribute significantly to the stability of rural settlements. This benefit covers several aids, such as permanent disability, retirement, widowhood, orphanhood, family favour, the first two of which may or may not be contributory. Within this structure, retirement pensions are the greatest burden, accounting for more than 70 % of the total state budget).

As an integral part of a more comprehensive work, some of the key aspects that have emerged from the in-depth analysis of these benefits will be set out below.

4.1. Agricultural benefits, their impact on populations without productive diversification

Of the external incomes analysed as potential factors in the stabilisation of the rural areas, the one identified as "agricultural benefit" could be considered the smallest element due to its low amount of money. However, its impact on the stability of the rural population may be much more significant than what might be inferred by its amount of money at first sight.

The external income that reaches the province of Málaga for this concept accounts for approximately € 72 million, a

6 Ageing index. Ratio of people aged 65 and over to people under 15, multiplied by 100.

7 There is an excellent and varied literature which analyses the origin, evolution, characteristics, etc., of this service. The references that can be consulted include among others: Cansino (1997, 2001), Cejudo *et al*. (2016a, 2016b), Palenzuela (1991), Izcara (2007), Larrubia *et al*. (2002).

figure barely comparable with transfers in the form of pensions (2,680 million). However, the incidence of income derived from this social policy is very effective in rural society for different reasons: first, because it addresses working-age rural workers directly whose discontinuity in occupation (seasonality, underemployment) points them as a group of potential emigrants, as already occurred in the past. The second reason is that these recipients represent a social segment with low incomes, so that, even if they are low, the amount of the income received from these aids can be of some importance within the recipients family financial situation and have contributed to the active agricultural population support, and also mask the existence of the problem of the agricultural underemployment.

Two approaches are adopted to confirm the real existence of this underemployment: on the one hand, the distribution of SEA members and, on the other, their relationship with the job offer in the agricultural sector through the UTAs/exploitation.

For the first approach, it is enough to compare the figures of the agricultural members of the Spanish regions, which shows that Andalusia and Extremadura, the only two Spanish Autonomous Communities that receive this type of aid, present with a proportion of agricultural members (around 16 % and 15 %, respectively), a figure which is three times higher than the Spanish average (4.25 %). Andalusia has 60 % of Spanish workers registered as agricultural workers. This figure is clearly disproportionate even considering this region's sizeable agricultural extension or the value of its agricultural production, which clearly links the agricultural benefit with the high degree of membership to the SEA.

In this context, the province of Málaga, due to the existence of a vast coastal area and intensive agriculture of high profitability, shows a very moderate proportion of agricultural workers (5.7 %). However, it internally presents very different intramunicipal situations, with large internal sectors with high dependence on agricultural occupation if we consider the proportion of members in this sector. Thus, compared to 5.7 % in the province, the average of municipal values amounts to 43 %, and a quarter of municipalities offer values from 50 to 74 %. At a regional level, the average values range from 10 to 20 % of the region of Guadalhorce, Ronda, Antequera or La Axarquía, or from 40 to 50 % of those of Guadalteba and Nororma. The key to these differences lies in the urban development of their populations (see table 1), which is more intense in the former than in the latter. From this, we can infer the importance of this dependence in all the interior of the province and especially in the nuclei of little urban development.

Natural Areas	Regions	SEA Members	
		N.º	%
Northern Area: Intrabetic Basin (Antequera Depression)	Antequera	5,278	19.1
	Nororma	4,762	50.4
	Guadalteba	3,438	41.0
Eastern Area: mountain and coastline	Axarquía	10,250	19.2
Central Area: Guadalhorce Valley-Hoya de Málaga	Guadalhorce	3,272	10.5
	Málaga	1,801	0.7
Western Area: mountains	Ronda	1,730	13.9
	S.ª de las Nieves	954	23.8
West Coast	Costa del Sol	689	0.4
Province		32,174	5.7

Table 1. SEA (Special Agricultural System) Members by regions

Source: Spanish Ministry of Labour, Migration and Social Security, 2016. Prepared by the author

This fact points to a situation of surplus agricultural assets and raises the question of whether or not the amount of the agricultural workforce responds to a real demand from agriculture. A reference by the number of AWUs (annual work units within the agricultural fields) provided by the Spanish Agrarian Census is given to endorse this assertion. According to this source, the province of Málaga has 20,500 UTAs, compared to 32,000 members of REA, which gives us an average of 1.6 agricultural members/UTA. A value that confirms the existence of a surplus of more than a third of agricultural workers and that justifies high unemployment rates or a general situation of underemployment in this sector.

As usual, the average of the province blurs the essential differences among its municipalities. Some do not have this surplus, and at the opposite end, there are about

thirty municipalities with several members per work unit (figure 3).

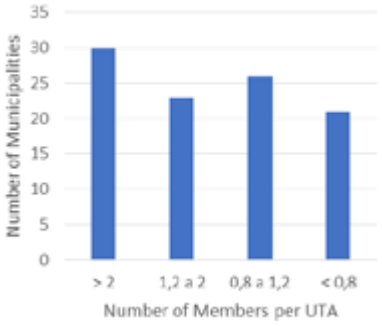


Figure 3. Municipalities by number of members (SDA – REA)/UTAs

Source: Spanish Ministry of Labour, Migration and Social Security, 2016. Register of inhabitants (INE). Prepared by the author

This distortion is less likely in regions (table 2). Only two regions, both very important as far as agriculture is concerned, Antequera and Axarquía, offer a ratio of members per work unit very similar to the high provincial average (1.6 workers/UTA). Above them, there are two regions in the northern area of the province: Nororma and Guadalteba, with 2.54 and 2.0 UTA members, respectively. The others either have a smaller surplus (as in Ronda and Guadalhorce, or do not have that excess (Costa del Sol and Sierra de las Nieves).[8] In light of these differences, the explanatory factor is the degree of diversification of local activities, associating the higher weight of agricultural underemployment with the scarce employment alternatives provided by the remaining activities.

The next step is to look into what these aids represent for agricultural members. The province of Malaga receives 72 million euros per year for this concept, but more than the amount itself, what is most important is what it means for individuals and local economies. For this purpose, the value of net labour income has been taken as a reference. The amount of the benefit in the province of Málaga is not apparent, as it only represents 0.85 % of the earned income. However, for many municipalities, clearly related to their lesser productive diversification, it can be conjectured that the economic impact of these aids could be much more important locally.

It is necessary to descend to the analysis of the ratio between benefit and income at a municipal level to confirm this possibility. In this relation, it is significant that in a large number of municipalities (25 % of them), the proportion of labour income rises above 15 % and, occasionally, reaches 20-30 % (figure 4). These are the municipalities with specific local economic conditions, i.e. low economic diversifications and high dependence on unprofitable agricultural activity. Two-thirds of them coincide with small municipalities of La Axarquía, while the rest are dispersed in the remaining areas except for the coastal areas.

Natural Areas	Regions	N.º of members of SEA-REA	N.º of UTAS	UTA Members
Northern Area: Intrabetic Basin (Antequera Depression)	Antequera	5,278	3,612	1.5
	Nororma	4,762	1,875	2.5
	Guadalteba	3,438	1,748	2.0
Eastern Area: mountain and coastline	Axarquía	10,250	6,166	1.7
Central Area: Guadalhorce Valley-Hoya de Málaga	Guadalhorce	3,272	3,026	1.1
	Capital	1,801	680	-
Western Area: mountains	Ronda	1,730	1,517	1.1
	Sª de las Nieves	954	1,180	0.8
West Coast	Costa del Sol	689	765	0.9
Province		32,174	20,568	1.6

Table 2. Number of SEA and UTA Members by counties

Source: Spanish Ministry of Labour, Migration and Social Security, 2016. Agriculture Register, 2009. Register of inhabitants (INE). Prepared by the author

Figure 4. Ratio of Subsidies/Income from work (5)

Source: Spanish Ministry of Labour, Migration and Social Security, 2016

8 The functional dependence of this mountain area with respect to the neighbouring Costa del Sol results in some distortions derived from the difference between the number of members working and residents in the region amounting to 6.621, and only 3,880 members by place of work in it.

Natural Areas	Counties	Pensions per 100 inhabitants	Over 65 years of age		% of foreign people (2017)
			N.º of elderly	% of elderly	
Northern Area: Intrabetic Basin (Antequera Depression)	Antequera	20.8	10,324	16.1	5.4
	Nororma	31.3	5,726	20.4	5.5
	Guadalteba	26.7	4,654	19.2	3
Eastern Area: mountain and coastline	Axarquía	17.4	37,644	18.1	13.8
Central Area: Valle del Guadalhorce-Hoya de Málaga	Guadalhorce	16.6	19,780	14.2	11.1
	Málaga	19.3	96,782	17	7.4
Western Area: mountains	Ronda	21.2	9,998	19	3.7
	S.ª de las Nieves	23.6	4,285	20.5	10.9
West Coast	Costa del Sol	12.1	82,804	15.8	26.1
Province		17.7	271,997	16.7	14.3

Table 3. Number of pensions by counties

Source: Spanish Ministry of Employment and Social Security. Department of Equality, Health and Social Policies. Prepared by the author

It can be concluded that, for a large group of municipalities, this income has a practical meaning, and we could suggest that it is one of the factors that explains that 40 % of them have maintained a certain growth so far this century overcoming the declining trend of the 20th century, in addition to covering with social retribution the periods of inactivity of the underemployed farmers.

4.2. Pensions: The importance of the elderly, a factor of economic stability

The Spanish pension system is a key piece in the articulation of the Welfare State, and although the difficulty of its revaluations and the uncertainty of its future is a very current matter of discussion, in this paper, this subject is approached only from a very specific perspective: that of its impact on the sustainability of the rural population.

The purpose is to show the territorial dimension that this service acquires due to the high ageing of many rural regions, which is usually accompanied by a deficient productive activity. The combination of circumstances by which the external income that comes to small rural municipalities this way can be a considerable component of their economies, not only for sustaining the high proportion of the local population that receive it but also for the dynamising the local economy by its inducing effects on some economic activities.

Two approaches are proposed to achieve this purpose: firstly, the social impact of pensions, and, secondly, their impact on the local economy.[9]

Concerning the first approach, the impact of pension is assessed through the relationship of their number with that of the local population. The municipal distribution of this perception shows the existence of great variability, with extreme values ranging from 4.1 to more than 75 pensions per 100 inhabitants. The most interesting information, apart from the fact that the average of villages is already high (35.5), is that in 25 % of the municipalities the threshold of 30 pensions/100 inhabitants is approached or very widely exceeded. Age is shown as the natural explanation for two reasons, because it is the leading cause of the cessation of activity, and because the proportion of the population in a situation of widowhood increases with age.

Data in table 3 show that the social incidence of pensions varies significantly at a county level and make visible the relationship of such differences with the importance of the elderly population.

9 Pensions represent a complicated picture in terms of recipients and salaries, but among all of them, it is retirement pensions that constitute the main chapter, and given that their structure is repeated al all the levels analysed, we have chosen not to consider their different types, but rather the aggregate of all of them.

Population Volume of Municipalities	Population	Members of Labour Registration	Average unemployment		Declared Net income	
			N.º	Unemployment Rate	Amount (€)	Average per inhabitant (€)
<1000	13,394	3,055	1,142	27,2	41,1	3,069
1000-10000	172,059	49,401	14,051	22,1	707,0	4,109
10000-20000	110,213	26,721	10,935	29,0	491,5	4,459
20000-100000	624,775	167,011	55,262	24,9	3,895,3	6,246
>100000	710,174	319,020	74,210	18,9	4,990,0	7,026
Suma	1,630,615	565,208	155,600	21,6	10,124,8	6,214

Table 4. Labour Market and Incomes. Differences according to the demographic volume of the municipalities

Source: Spanish Ministry of Employment and Social Security. Department of Equality, Health and Social Policies (2016). Population Register (INE). Prepared by the author

In most of the province, pensions have a high social incidence, with a volume of 2 to 30 pensions/100 inhabitants, except for the regions of Guadalhorce and the Costa del Sol, whose difference is associated with lower ageing linking to the high growth of their population. These are, in most cases, small nuclei, with less than 10,000 inhabitants, being especially significant in those with less than 1000 inhabitants, offering an average of 34 pensions/100 inhabitants. Although it should be pointed out that, in some mountain areas affected by rural urbanisation processes that take in retired foreign residents, the ratio of pensions per inhabitant decreases as these do not come from the Spanish State.

This image provided by small rural villages makes sense when considering pensions as a mechanism for territorial redistribution of wealth and intergenerational solidarity.

The second approach to this variable, as discussed, is through its impact on the local economy. With the volume involved (€2679.2 million), it is possible to foresee that it is a source of appreciable wealth in local economies, both in itself and for its possible inducing effects.

The importance that this economic flow may have in small local economies is closely related to their economic weakness, which can be justified through two elements: the labour market (measured in members and the unemployed) and wealth (measured in a volume of declared income and in its ratio per inhabitant).

The economic inferiority of small villages is perceived in a very direct way in the average income per inhabitant, since in the group of municipalities with less than 10,000 inhabitants, they are 25 % lower than the provincial average, and they are reduced below 50 % of the average in municipalities with less than 1000 inhabitants (table 4)

The smaller villages, generally inland and less dependent on seasonal tourist activity, reproduce what is undoubtedly a great weakness in the provincial labour market, the extraordinary unemployment rate that in municipalities of less than 1000 inhabitants reaches 27.2 %. However, the seriousness of these rates does not fully reflect the weakness of the labour market, since it should be added that a very significant segment of its working population is linked to agriculture, which conceals significant underemployment.

In the distribution by villages of the relationship between pension income and declared income, two elements must be taken into account in order to detect to what extent pensions weigh in the rural economy: the value of the median (48.1 %), because it shows that half of the municipalities almost double the value of the provincial average in this ratio and that in 25 % of provincial municipalities, pension income is equivalent to 65 % or more of declared income.

The profile of the municipalities that lead in the pension income ratio, with values higher than 65 %, is even more marked, and are mostly small villages (19 of the 25 are less than 1000 inhabitants), mountain areas and, in addition to having a considerable proportion of elderly (about 25-30 % of the population), offer especially low income levels from 2000 to 3000 euros per inhabitant.

Natural Areas	Regions	Pensions on net income (%)	Amount of net declared income			Over 65 years of age %
			Total (million €)	Average per tax return[10] (€)	Average per inhabitant (€)	
Northen Area: Intrabetic Basin (Antequera Depression)	Antequera	30.9	357.6	14,343	5,592	16.1
	Nororma	44.6	123.4	9,769	4,404	20.4
	Guadalteba	43.5	110.9	11,054	4,572	19.2
Eastern Area: mountain and coastline	Axarquía	26.2	1,209.5	14,594	5,802	18.1
Central area: Valle del Guadalhorce-Hoya de Málaga	Guadalhorce	27.7	714.8	14,358	5,139	14.2
	Capital	28.8	4,067.4	18,515	7,148	17.7
Western mountain area	Ronda	32.1	303.6	14,155	5,773	19
	S.ª de las Nieves	44.7	86.7	10,703	4,145	20.5
Western coastal area	Costa del Sol	20.4	3,151.1	16,691	6,010	15.8
Province		26.5	10,124.8	16,376	6,209	16.7

Table 5. Relationship between pension income and net income declared by county

Source: own elaboration

The values of the ratio between pensions and incomes at a regional level (see table 5) show again the contrast between the interior areas and the Costa del Sol[11], today a highly urbanised area, where the pension income ratio is reduced to 20 %. It is the only region below the provincial average for having a much lower proportion of elderly, thanks to its dynamic growth, and clearly higher incomes, only superseded by those of the capital. All the other counties have an average ratio which is higher than the average ratio of the province or is very close to it, presenting lower levels of income than those of the coast or the capital.

In this context of economic weakness, pensions, which should be a minor element from an economic perspective, represent a substantial support for the sustainability of rural populations, confirming that they are the most vulnerable municipalities, that are the most dependent on pension income, due to the natural relationship between economic weakness, demographic decline and ageing.

5. Conclusions

After having analysed two of the main mechanisms of the Spanish Social Security System (SEDA-REA, pensions) that are contributing to the maintenance of the population of many rural municipalities in the province of Málaga, we will now point out some considerations stemming from their analysis.

The main conclusion that we can draw from the preceding analysis is that many rural municipalities see their family income complemented by external incomes from different sources. This has allowed an inflexion to take place in the rural abandonment process from the 1980s of the last century, despite the signs of vulnerability of the rural population, and the stagnation and/or recovery of the rural population has been a reality. In the above analysis, we have been able to confirm that the province of Málaga has maintained in the present century high growth rates (1.4 % accumulated per year), and it has also maintained the polarisation of this rate on the axis of the coast and the capital (scenario of some of the most significant growth in these years), although the novelty is that there is greater stability of rural population. Two data support this assessment: firstly, all the regions (except for Guadalteba) have grown to a greater or lesser extent, and secondly, the reduction to almost half of the municipalities that loose population is also very significant.

The analysis of the SDA and REA shows that Málaga rural areas present considerable agricultural underemployment and this is not a condition for agricultural activity but a consequence of the limited options for alternative jobs. This fact reinforces the idea, which has been shown in several studies, about the vicious circle of structural unemployment (Román, 2004; Romero, 2009), where the

10 It is known as "average gross income"

11 The Eastern coast is masked within the wide region of La Axarquia.

unemployed work half of the year in the agricultural field and the other half of the year, they receive subsidies. Both in the province of Málaga and in Andalusia as a region, the contrast between an intensive, mechanised and innovative agriculture in the coast increases, compared to a subsidised agriculture that maintains a temporary workforce with the help of the SDA/REA, to which the CAP aid must be added at higher levels than which farms require.

With regard to the analysis of pensions, the main conclusion is that in an environment such as the rural, with weak incomes, when the labour market cannot absorb the demand of the active population, the presence of the elderly and the pensions they incorporate reach a very considerable economic significance, and must be seen as a beneficial effect on the fragile social balance.

Both mechanisms developed in Spain, as a result of the development of the Welfare State, have considerably raised the standard of living of the rural population, and, therefore, their level of consumption. This allows a rural family of modest size (couple, two children and grandparent/s) to live with "certain comfort", since their income is made up of the agricultural benefit that can be received by several members of the family, to which the retirement pensions of the elderly, as well as some illegal work is added.

These approaches lead us to make some reflections. In the first place, this situation of both structural and cyclical underemployment should be assessed by the political authorities to face an economic, social and territorial conversion (Cejudo, 2016a). Secondly, although the role of these aids has served to fix a temporary wage-earning population, with no prospect of employment in other activities, young population employment has not been taken into account in these rural areas, which has been shown to be very difficult and highly dependent on the little modernised and evolved agricultural sector. Therefore, a greater training in these areas is not presented as an opportunity, but rather as an obstacle, involving a gradual abandonment of this population from its place of origin. Finally, further research needs to be carried out to show what would happen if one day, the current Spanish system of agricultural unemployment disappears or dramatically changes its conditions; or, if, in the light of the critical situation of our pension system, public money flow should be limited.

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Transformations in large Spanish metropolises in the 21st century: from suburbanization to demographic and social fragmentation?*

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Abstract

After a deep economic crisis, the Spanish economy starts showing signs of recovering in 2014. Despite this improvement has not reached the entire population, it has had an impact on the housing market, activity and employment. Residential mobility has also started to grow again, as a consequence of this economic recovery, and this has not only had important socioeconomic, demographic and residential implications but, at the same time, —and this is our hypothesis— flows have become more unstable, more complex and more fragmentary. In other words, the direction of flows, the reasons for moving, the socioeconomic categories and the ages of migrants have diversified. These new mobilities are reconfiguring large Spanish urban areas, generating new inequality and fragmentation processes, which strengthen their social polarization.

Key words: large urban areas; migratory flows; economic cycles; inequality; urban fragmentation; Spain

1. Introduction

The present text intends to reflect on the impact of economic cycle phases —here summarized as expansion, crisis and post-crisis periods— on recent (last two decades) demographic and socio-residential dynamics in large Spanish metropolitan areas, though some of the processes analysed are also applicable to the other urban areas in the country. The text aims to be a state of the art, while putting forward the subject's pending research challenges. Though the topic is interesting from an academic point of view, it is essential to design public policies. Special importance will be given to *residential mobility*, understood in the broadest possible sense. In other words, making reference to any change of place of residence (whether international, internal, or intra-metropolitan / intra-urban migration) and not in the narrowest sense that limits it to the changes of residence within the same urban unit (Palomares-Linares *et al*., 2017)[1]. Moreover, residential mobility is interpreted as a transmission vector of the economic cycle, which transforms urban spaces from a demographic, economic and social point of view.

1 Palomares-Linares *et al*., (2017) differentiate *residential mobility* from *migrations* by considering migrations as population exchanges (immigration and emigration) between urban units and the outer world, be it the rest of the country or abroad. However, present authors consider that all residence changes, regardless of their place of origin and destination, condition and transform Spanish urban areas. In this sense, during the first decade of the 21st century, international migration is especially relevant, even though the vast majority of residential changes are short distance ones and therefore take place inside the same urban area.

Authors have been working on this research subject during these last years, period in which all three have directed and co-directed several research projects that share similar themes and a common thread —the one analysed here. They have produced dozens of publications on the subject including review papers, books and book chapters, conference papers, and workshop and seminar contributions. Population Geography and urban studies taken from the geographical and sociological perspectives are the nexus connecting the three authors who have written this article, and who were already interested in the evolution of Spanish urban areas during the economic and demographic expansion phase, that is to say, from the mid-1990s until 2007. However, economic recession reinforced their common interest on linking Spanish urban demographic and social dynamics to the economic situation. Indeed, this global economic and financial crisis called "The Great Recession" —due to its geographic extension and intensity—, was particularly vicious in Spain from 2008, because it increased inequalities and highlighted the fragility of many of the neighbourhoods, which became increasingly vulnerable, worsening the population's standard of living.

Finally, according to our own research results, in the past four or five years, there have been, together with economic changes, transformations in urban dynamics. As the economic cycle begun to change, initiating what has been called the "post-crisis" period, —in which, despite most people have not improved their standard of living, macroeconomic parameters have picked up—, there has also been a turning point in urban dynamics, maintaining the authors' interest on the topic. Indeed, residential segregation and polarization, and spatial fragmentation continue or have even increased in spite of economic recovery. Additionally, as it could not be otherwise, the effects of this recovery, and particularly those of their impact on the real estate market, have influenced the emergence of "new residential mobilites". Our hypothesis is that this is a new urban development phase, not a mere return to the previous situation before the crisis. These "new mobilities" would be playing a key role in the socio-residential reconfiguration of Spanish urban agglomerations. Given the importance of their socio-economic, demographic and residential implications, they deserve to be analysed in detail, both from the policy-oriented and academic point of view.

The objective of the article, summarized in the first paragraph, determines its structure. After the present introduction, there is a conceptual framework section (2) where some of the theoretical reflections on the urban development process and its connections to, among other factors, economic circumstances are collected. It is followed by section 3, which describes the evolution of the large Spanish urban areas during the last half century, culminating in the economic expansion phase and the so-called "real estate bubble". Section 4 focuses on the consequences of the economic crisis on urban dynamics. It is the most important part, since it is the subject to which the authors have devoted more time —and on which they have published more— in recent years. Section 5 addresses pending challenges or new research lines to be developed to analyse the effects of economic recovery on demographic and socio-spatial processes in large Spanish urban areas. Even though this matter has already started to be analysed, the time elapsed is still short. The article ends (section 6) with a final reflection as a way of summarising and concluding.

2. Conceptual framework: the relationship between economic cycles and urban development

The effects of the global economic crisis on different social areas is one of the most widely studied topics in social sciences and one that has undoubtedly generated an immense amount of publications. Here, we intend to collect reflections on its impacts —and those of the subsequent and incipient economic recovery— on mobility and its demographic and socio-residential consequences.

There is certain consensus that the global economic and the financial crisis that has come to be known as "The Great Recession" worsened deindustrialization and reinforced globalization, favouring inequality (Piketty, 2014; Bretones *et al*., 2015). This crisis partly originated in a financial bubble that multiplied investments in globalized markets allocating them to secondary accumulation markets linked to the production of urban space in order to make large short-term profits. The urban related origin of the economic crisis could explain why some of its most negative effects also concentrated in large cities, showing the extent of urban vulnerability (Méndez, 2017 and 2018; González Pérez, 2010). One of the consequences was an increasing residential polarization, mainly deriving from socioeconomic inequality and taking shape through urban related mechanisms and structures (Maloutas, 2012). Some of these mechanisms are wealth distribution policies,

housing policies, social structure tensions, productive system characteristics and real estate market dysfunctions. Subsequently, post-crisis economic recovery has been accompanied by a real estate sector upturn, which has also been felt in Spain. Housing has become an attractive investment option for small investors and, above all, large funds, rather than a basic need to be satisfied (García Montalvo, 2016). Therefore, housing prices have increased —particularly in large cities—, triggering new mobility processes.

Regarding residential mobility, it responds to several causes, some beyond the effects of economic factors. On the one hand, there are life course changes —leaving one's parents' home, couple formation, the birth of a child, retirement and ageing— which allow to relate mobility and biographical events (Clark, 2016; Tyrrell and Kraftl, 2015). On the other hand, family transformation processes linked to the Second Demographic Transition (Lestheghe and van de Kaa, 1986), that is to say, changes in the way of living and residing, have also influenced residential movements. Indeed, the increasing amount of union break-ups (Feijten and van Ham, 2007) and single parent and one-person households (Jamieson and Simpson, 2014) certainly influence people's mobility decisions. Classic contributions such as those of Frey and Kobrin (1982) or Buzar *et al*. (2005) take a deeper look into this issue. Finally, other contributions highlight the relevance of family ties as residential change determinants, as movers would look to be near to family support networks (the *entourage* mentioned by Bonvalet and Lelièvre, 2012).

Therefore, it could be inferred that recent family transformations could lead to increasing residential mobility worldwide. However, recent literature on the subject (Champion *et al*., 2017) confirms that this is not the case, neither for any type of mobility or geographical context. In fact, in some developed countries residential mobility rates are presently lower, and some authors (Bell *et al*., 2017) believe these dynamics are not only limited to high-income countries.

It is also discussed whether mobility patterns are more affected by global structural forces, or by the national / local context. In Spain, where residential mobility is relatively low, metropolitan movements did not decrease as much as would be expected during the crisis period (Bayona and Pujadas, 2019). This could be the consequence of increasing residential insecurity (Módenes, 2017), greater than in other European countries, because vulnerable groups were larger and the economic crisis, deeper. Once the crisis has been overcome, mobility rates seem to grow again (Garcia Coll and López Villanueva, 2018), while socio-residential strategies diversify and links between metropolitan spaces mutate (Thiers and Gil-Alonso, 2017).

Given the short length of the economic recovery period —according to national account macroeconomic figures, published by the INE, it begun in 2014, when the GDP grew 1.4 % annually—, references to it are very recent, though increasing in number. They show that, beyond the above mentioned demographic causes and life course events, residential mobility also depends on other extremely relevant institutional factors such as housing market characteristics, access to mortgage loans and housing policies (Clark, 2012 and 2017; Feria and Andújar, 2015), which are especially affected by economic phases. For example, in Spain, where, as in other Mediterranean countries, young people find it considerably difficult to gain access to housing (Módenes *et al*., 2013), obstacles augment in the current post-crisis because of the rising price of home ownership and rents. This especially affect large cities, where tourist pressure concentrates (Colomb and Novy, 2016) favouring that part of the housing stock is rented to tourists and not used for residential purposes, therefore reducing their supply.

In sum, these extremely diverse mobility features —origins, destinations, ages, socioeconomic category, life course stage…— have had an enormous demographic and socio-economic impact on urban residential settlement patterns. These spatial implications vary with economic cycles. For example, in Spain, the economic crisis mitigated suburbanization trends that had not only characterized large urban areas in the previous decades (García Docampo and Otero, 2012; Pujadas, 2009; Nel.lo, 2007), but also intermediate size towns (García Coll *et al*. 2016). Despite some authors interpret it as an incipient urban population recentralization process (López-Gay, 2014; Wolff, 2017), it does not imply that the 'stages of urban development' interpretative scheme (Van den Berg *et al*., 1982) is validated. Authors who have compared several European urban area trajectories indicate that urbanization, suburbanization, disurbanization and reurbanization phases of this model do not necessarily occur —as this scheme claims— one after the other. Indeed, these authors confirm that, currently, there are European countries with urban areas in each of the phases. Instead, it would be economic development, and not a theoretical model, that determines core and periphery demographic dynamism

(Kabisch and Haase, 2011; Rérat, 2012; Wolff and Wiechmann, 2018).

The same could be said for Spain, where despite the economic crisis affected the whole country, there were certain areas —those that most grew during the expansion phase because of the housing bubble— that were more touched than others. As a result, Spanish urban areas are presently situated at different urban growth phases (Gil-Alonso *et al*., 2016), and the diverse types of intra and interurban residential flows have different directions (Bayona *et al*., 2018).

More relevant for public policies is the impact of residential mobility on urban population spatial segregation patterns according to their socioeconomic characteristics, as it is a determinant of urban concentration, segregation, or polarization processes (Florida, 2017; Hochstenbach and Musterd, 2017; Musterd, 2017). Several recent papers address this issue and especially urban social-residential segregation (Rubiales, 2017, in Madrid and Barcelona; Sarasa *et al*., 2018, and Ruiz-Almar, 2018, in the Metropolitan Region of Barcelona; Nel.lo, 2018, in the case of Catalonia). However, fewer relate socio-residential restructuring dynamics and residential mobility forms (Sharkey, 2012; Musterd, 2016), most focusing on specific cases (Di Virgilio, 2014 studies Buenos Aires; Bonvalet *et al*., 2016, the case of Paris; Andújar, 2017, that of Madrid; López Gay, 2018, that of Barcelona).

In this sense, there is a research line that has hypothesized on the existence of a "suburbanization of poverty". Some authors have studied it as an independent phenomenon (Kavanagh *et al*., 2016; Bailey and Minton, 2017; Porcel *et al*., 2018) and others have related it to the increasing wealth of city cores as a consequence of gentrification (Randolph and Tice, 2014; Hochstenbach and Musterd, 2017). However, interpreting it only as a way of expelling poverty to peripheries may be considered an oversimplification, as recent theoretical and empirical contributions show that residential mobility plays a crucial, though extremely complex, role in reconfiguring relationships between metropolitan spaces (López Gay, 2017). Indeed, residential mobility would be generating new "fragmented" attraction and repulsion spaces inside urban areas, beyond the mere core and periphery division. In the past, differentiating between these two later areas was enough, as it allowed to build theoretical models claiming that, after the urbanization stage came suburbanization, and disurbanization after that, followed by reurbanization. However, these schemes cannot be used to explain the current growing flow complexity.

3. Urban changes in Spain up to 2007: from urbanization to massive suburbanization that ended in a "housing bubble"

In developing countries, cities are presently growing extremely fast, both because of natural population growth —young people are still a big part of the population—, and, above all, as a consequence of migratory growth —large amounts of rural migrants moving to them. Thus, in a few decades, megacities with many millions of inhabitants have emerged in countries where, until recently, the vast majority of the population lived in the countryside. However, this urbanization process is similar —though on a much larger scale and more concentrated in time— to that of developed countries in the last centuries, particularly since industrialization began —in the 18th century in Britain, and in 19th century in the rest of Western Europe. As for Spain, it underwent this process later than other European countries, as urbanization was mostly a 20th century phenomenon, which accelerated in the 1950s, 1960s and 1970s (García Docampo and Otero, 2012). The 1973 oil crisis, transforming a global industrial economy into a post-industrial and services one, began to have an impact on the Spanish economy in the second half of the 1970s. This coincided with the end of massive rural-urban flows emptying rural areas. Thus, in the 1980s and much of the 1990s, large Spanish cities stopped growing —the largest, even lost population— and intermediate size ones continued to increase, though at a much lower pace. Simultaneously, there was a strong suburbanization process, whereby urban cores —the main city of each urban area— began to lose population, while their peripheries —previously formed by rural municipalities— incorporated to the urban phenomenon, frequently as less dense or even urban sprawl suburban areas. Madrid and Barcelona, especially, but also Valencia, Seville, Malaga or Bilbao, generated large suburban areas that other smaller cities, such as most Spanish provincial capitals, replicated on a much smaller scale (Pujadas, 2009; Nel·lo, 2007).

Adopting the 'stages of urban development' scheme developed by several authors such as Hall (1971), Klaassen and Scimemi (1981), Berry (1980) or Van den Berg (1982), it was in that period that the *urbanization* phase —in which urban centres grew at the expense of surrounding rural areas— gave way to the *suburbanization* one —where suburban peripheries grew more than urban cores, which ended up losing population. According to the scheme's

logical sequence of stages, it should have been followed by a *disurbanization* phase, in which both urban cores and their peripheries lose population.

However, in the second half of the 1990s, Spanish urban areas did not only not lose population, but began to gain it —starting what could be called a *reurbanization* phase without prior *disurbanization*. This would have been basically caused by the coexistence of two phenomena; large international migration flows and a momentary rise in the number of births, as a consequence of both the birth of these immigrants' children and the fact that Spanish baby boomers —born in the 1960s and 70s— reached the age of having their own offspring. Large Spanish cities began to demographically grow again, a phenomenon that they had not experienced since the mid-1970s. However, periphery municipalities gained more population because of strong suburbanization processes by Spanish nationals that were also, directly and indirectly, fed by foreign immigration. Indeed, foreign immigrants mainly settled in large urban cores —in particular Madrid and Barcelona—, as they had a larger and more diversified rented housing stock, and a wider and more efficient public transport network. As foreigners started to settle in the cities —and urban homes got rented or sold— nationals began to move to peripheries, reactivating suburbanization. In a second stage, foreigners also incorporated to this flow.

Therefore, during the first decade of the 21st century, large Spanish metropolises were characterized by the exaggerated and chaotic growth of their peripheral municipalities —the highest rates being found in small suburban municipalities and those situated furthest away from urban cores. This urban sprawl was fed by the "real estate bubble" (Burriel, 2008). However, despite large cities also grew, they, paradoxically, continued to lose Spanish nationals. Finally, even remote rural areas or those simply not affected by the suburbanization process, which were not located in the tourist coastal areas, saw how, during the economic and demographic expansion years, ageing and depopulation processes seemed to remit, as foreigners started to settle in them (Bayona and Gil-Alonso, 2013). Nevertheless, that mirage did not last long.

4. The impact of the Great Recession on spanish urban areas

The global economic crisis known as The Great Recession, whose effects were not visible in Spain until 2008, had a significant impact on the demographic and socio-economic characteristics of Spanish metropoles. Migration dynamics slightly weakened, losing the relevance it had had as spatial reconfiguration factor, during the previous economic expansion phase. Therefore, core city and periphery demographic structures tended to homogenize. By contrast, differences between Spanish metropolises grew, because of their diverse degree of maturity in the metropolitanization and suburbanization processes, and their polycentric or monocentric nature.

This would explain why the age structure of Madrid and Seville has a higher spatial segregation index than that of Valencia, Bilbao and Barcelona. In other words, why different age groups living in Madrid and Seville metropolises tend to settle in different areas —older groups in big city centres and couples with children in peripheral municipalities— while those of Valencia, Bilbao and, especially, Barcelona, are more homogeneously distributed throughout all the metropolitan area, although the oldest age groups are always the most segregated (Gil- Alonso *et al*., 2018).

4.1. Migration and residential mobility pattern changes

The impact of the crisis on the housing market —new housing stopped being built, mortgages were enormously restricted, unemployment reached unprecedented levels and average income per household fell— undoubtedly affected metropolitan residential mobility (Pujadas *et al*., 2016a), although it decreased less than would be expected (Bayona *et al*., 2018). In fact, there was indeed a decline, though mainly associated to a structural effect —dwindling generations born in the 1980s and 1990s reached the age of leaving their parents' home— and to a reduction in the number of foreign immigrants. Their net migration growth rates with other countries turned negative (Bayona *et al*., 2017), their internal migration reduced and interprovincial flows were also modified (Bayona and Gil, 2016). By contrast, age-specific migration rates of Spanish nationals did scarcely vary, so essentially those that deceased were immigrant rates (Bayona *et al*., 2018).

Although mobility reduced its intensity during recession less than it was expected, reasons for moving, and residential needs and options multiplied and fragmented. Migration flows changed direction and did no longer seem to respond to the classical residential project of heading towards new housing in urban peripheries (Gil-Alonso *et al*., 2016). Consequently, suburbanization weakened

and flows acquired spatially diffuse patterns (Pujadas and Bayona, 2017): central municipalities lost much less native population because of suburbanization than before the crisis, while peripheral towns continued to have positive though dwindling migration growth.

At the same time, large cities became particularly appealing for —though not exclusively— highly educated young adults, because these urban areas were less affected by the economic crisis, had a more dynamic and diversified labour market, and wider (then) affordable rented housing stock (López-Gay, 2016). In this sense, the case of Madrid should be highlighted for attracting Spanish-born nationals and Barcelona, for doing so with Europeans (Thiers and Gil-Alonso, 2017). Changes in residential mobility of elderly people should also be mentioned, as it also experienced transformations during those years (Pujadas *et al*., 2016b).

These changes in metropolitan residential mobility during the economic crisis had an impact on urban demographic structures, strengthening ageing in most census sections, though not in the most gentrified ones that rejuvenated when national and foreign young-adults settled in them (Gil-Alonso *et al*., 2018).

4.2. Residential segmentation and spatial polarization: the effects of the economic crisis

The socio-residential structure of Spanish metropolises also changed with the economic crisis. Suburbanization lost its previous relevance, socioeconomic characteristics of urban inhabitants became more homogenous —a large part were impoverished—, and urban real estate market changed. As a result, residential segregation diminished, social polarization increased and economically weak populations augmented their vulnerability (Porcel and Navarro-Varas, 2017). In fact, segregation had already fallen before as a consequence of the expansion of the middle classes in the 1990s (Porcel and Navarro-Varas, 2016). Economic recession, and its effects on unemployment, salaries and the labour structure, strengthened this process by slowing down the real estate market and blurring residential change patterns in metropolitan areas by social class (Porcel and Navarro-Varas, 2017).

The economic crisis affected urban cores and suburban peripheries differently. In the former, there were microsegregation processes, as dual, more polarized neighbourhoods appeared —the intensification of gentrification processes in large cities' historic centre being the clearest example (Antón *et al*., 2018). At the same time, new vulnerable spaces emerged in peripheries and the existing ones got consolidated (Ruiz-Almar, 2018), a vulnerability that was partially fuelled by the arrival of those expelled from their places of residence by gentrification. This made us wonder whether poverty was suburbanizing (Porcel *et al*., 2018) or "urban fragmentation", accelerating.

As for differences between Spanish metropolises, research shows that Madrid and Barcelona metropolitan areas have had very different socio-residential dynamics to those observed in, for example, Bilbao, Valencia or Seville, that have less mature metropolitan processes. In spite of it, socio-residential polarization has increased in all five large Spanish urban areas (Porcel and Navarro-Varas, 2017), as well as in Portuguese ones (Vale and Malheiros, 2017).

Finally, while some authors highlight the role of social categories in structuring urban areas (see, for instance, López-Gay, 2016 in the case of Barcelona), others point to life course events and family support networks as the most important factors to explain how population is distributed throughout space and how residential mobility is affected (Navarro-Varas *et al*., 2017 and 2016).

4.3. The impact of economic crisis on urban sprawl

The consequences of the economic crisis on Spain's on urban sprawl and more specifically on low-density suburban housing developments ("*urbanizaciones*"), which rapidly expanded during the economic growth period (Pujadas, 2009), deserved the attention of some urban researchers as they hypothesized that recession would probably have transformed them into new vulnerable areas. Indeed, some had deficient services, infrastructures or public transport, others were simply un-finished, or municipalities were not able to provide basic services to them. As their inhabitants mainly depend on private transport —public transport is not cost-efficient in low-density areas— it makes them particularly vulnerable to increasing transport costs. This is particularly relevant as these housing developments were built increasingly far from core cities (López Villanueva *et al*., 2017a).

Results obtained from an *ad-hoc* survey conducted in Metropolitan Region of Barcelona (RMB) housing developments and data from secondary sources showed that, economic crisis processes affecting in the rest of

the RMB also reached these residents. Despite there is no evidence that the crisis had a greater impact on these areas, it has been observed that zones where upper-middle classes dominate supported the effects of recession better than the rest (López Villanueva *et al*., 2017a).

On the other hand, as residents of this type of periphery have aged, their residential needs have changed, and these now would be more compatible with another type of housing. However, respondents declared that they had little intention of changing their place of residence or returning to the city, confirming they planned to age where they lived (López Villanueva *et al*., 2017b). This apparent contradiction could be explained by the strong family networks and *entourage* they have established through time (García Coll and López Villanueva, 2017). However, this also poses new challenges to local administrations, which need to meet new demands from a changing population (López Villanueva and Pujadas, 2015).

Finally, research demonstrates that the economic crisis reduced net migration to this type of periphery, even though they never had negative growth, like the densest cites did (García Coll *et al*, 2016). Therefore, despite the onslaught of the economic crisis, low-density suburban housing developments never stopped being attractive. In fact, data since 2014 show that positive net migration towards to these areas is presently growing. Moreover, economic recovery and increasing housing prices in large cities are currently contributing to revitalize urban sprawl, consequently demonstrating the persistence of this model (Garcia Coll and López Villanueva, 2018).

5. Urban challenges within the post-crisis period: a research agenda

A new economic recovery phase has slowly been entering and spreading throughout the country, even though, as it has already been indicated, it has not reached the entire population and inequalities have not necessarily begun to reduce everywhere. However, it has initiated significant demographic, mobility, segregation and polarization changes. Recent available data confirms that large Spanish urban areas are gaining population once again both through migration from rest of Spain and from abroad, while suburbanization has also picked up (Thiers and Gil-Alonso, 2017 and 2019).

According to these latter data, these past years, historical cores are being increasingly gentrified and rejuvenated, while the rising price of home ownership and rents has expelled part of the population from large cities —or at least from certain neighbourhoods (Porcel *et al*., 2018). Inhabitants leaving core cities are settling down, voluntarily or because they have no other choice, in suburban neighbourhoods, sometimes located in remote and / or isolated zones, but which are increasing their traditionally positive migratory growth (López-Villanueva *et al*., 2017b).

All these new dynamics raise new questions for social researchers who, from Geography —or other disciplines, such as Demography or Sociology— approach urban processes.

Firstly, regarding residential mobility flows: what kinds of international, national, intra-metropolitan and intra-urban migrations are currently increasing or decreasing compared to the previous crisis and pre-crisis phases? Who are these movers and what demographic features do they have? Therefore, researchers should analyse the existence and degree of consolidation of new residential mobility dynamics in large metropolises on the basis of flow intensity and direction, and migrant characterization. This would allow to establish a typology of new mobilities, and study movers' features in greater depth —sex, age, educational level, geographical origin, among others.

Secondly, in relation to metropolitan population and household dynamics, structure and composition: which urban core and periphery areas grow and rejuvenate and which continue to age and reduce their population? What types of household increase and which decrease, and how are they spatially distributed within urban areas? These questions show that metropolitan population structure changes in both urban cores and peripheries should be identified and analysed in more detail. This would permit to study rejuvenation dynamics and ageing processes, even at the census section level. In addition, general knowledge of the composition of diverse types of households should be also increased, while focusing on those that, according to the Second Demographic Transition, and taking into account new mobilities, will tend to grow or change their composition.

Thirdly, related to the impact of these diverse types of movements on socio-residential reconfiguration processes in Spanish metropolises: how has the socio-residential structure of large cities changed as a result of capitalist

productive system transformations? What is its present distribution, within the present post-crisis context? How do housing affordability problems, gentrification and touristification affect metropolitan socio-spatial structure? Are inhabitants with scarce resources being expelled from core cities to urban peripheries or at least being obliged to move to another neighbourhood? These questions show the need to further analyse metropolitan residential distribution by social class, focusing for instance on income inequalities through the core-periphery axis, in order to confirm or rule out the existence of poverty suburbanization processes. In addition, researchers should attempt to identify how metropolitan residential mobility dynamics are linked to real estate market price changes, the emergence of apartments for tourist use and the growing importance of SOCIMIs —acronym of *Sociedades Anónimas Cotizadas de Inversión Inmobiliaria*, that is to say, real estate investment funds that have become global capitalism instruments acting in local housing markets. In addition, there should also be more knowledge on how migrants' educational and income level transform social-residential structures in Spanish metropolitan areas and influence segregation and polarization processes as well as the generation of vulnerable and/or fragmented spaces.

Finally, with regard to the international context, it is worth asking whether the rest of developed countries —or at least others within a similar backgrounds as Spain— have undergone comparable urban processes as those formerly described, or whether Spain's case would have specific characteristics. Therefore, comparative analysis, at least at a European level, should be deepened.

6. Summary and conclusion

The global economic and financial crisis that is known as The Great Recession and its multiple effects reached Spain in 2008, abruptly ending the previous decade's urban demographic growth and rejuvenation dynamics that took place as a consequence of large international immigration and suburbanization flows.

As a result of the economic crisis, international migration changed sign, while fertility resumed, in 2009, its long-lasting decreasing path. In 2012, Spain, which at that moment had negative migratory and natural growth rates (according to INE data), began to lose population for the first time in many decades. This had an impact on urban demographic dynamics[2], ending urban population growth and changing settlement patterns. Indeed, the end of the large foreign immigrant inflows and the reconfiguration of interprovincial migrations —with migrant-emitting provinces becoming receiving ones, and *vice versa*— coincided, in the case of metropolitan areas, with diminishing suburbanization trends. Thus, most suburban municipalities began to have the lowest positive migratory growth in decades and in some of these towns, especially the smallest ones, that were situated furthest away from the urban core cities and that had most recently incorporated to urban sprawl, even had negative growth.

Three factors caused this suburbanization diminution: Firstly, housing demand began to reduce because of population impoverishment as a consequence of economic recession. Secondly, the "real estate bubble" burst leaving many housing developments located mainly in peripheral municipalities unfinished. Finally, mortgages also became more difficult to obtain. This had a significant impact, as practically all these suburban housing developments were destined to be sold in the free market. By contrast, the rented housing market, mainly placed in large cities, reactivated during crisis years.

Consequently, Spanish metropolises started to lose less population through internal migration in what has been interpreted as an initial urban population *recentralization* process —despite they continued to have negative intra-metropolitan growth, it was progressively less negative. In addition to reducing suburbanization, Barcelona and, especially, Madrid, became, during the deepest economic crisis years, the main receivers of internal flows, as they had large, diversified labour markets, based on the service sector —relatively less affected by the crisis than those cities and areas which depended more on industry and construction. These two metropolises received both Spanish nationals —especially in the case of Madrid— and foreigners —here the role of Barcelona stands out as it lost fewer Latin Americans and gained Europeans and Asians (Thiers and Gil-Alonso, 2017).

2 Rural demographic dynamics, which is not the object of this text, also underwent strong changes: once foreign immigration stopped arriving at a record pace and some of those who had settled departed, secular ageing and depopulation trends resumed leaving thousands of small Spanish municipalities at risk of disappearing (Recaño, 2017). The concept of "empty Spain" has recently acquired great relevance (Del Molino, 2016) reaching the front line of the political agenda, at least for the 2019 elections, when the concept of "the emptied Spain" became fashionable.

As young highly educated people were attracted to cities during the economic crisis, urban core's role as human capital concentration poles was reinforced in that period, intensifying their internal diversification and gentrification processes, and particularly that of historic centres undergoing urban regeneration. By contrast, metropolitan and large cities' vulnerable neighbourhoods saw how young university graduates left and were replaced by less educated nationals or foreigners (López-Gay, 2015). Therefore, there was a double —demographic and socioeconomic— *fragmentation* inside metropolitan cores and peripheries.

On the one hand, as for *demographic fragmentation,* three or four decades ago, metropolitan cores were the most aged neighbourhoods while working-class ones (particularly tower block developments) had much younger inhabitants —rejuvenation that later moved to peripheries, where new massive housing developments were subsequently built. However, during the economic expansion and crisis periods, some urban cores rejuvenated as a consequence of gentrification and / or foreign immigrant flows, while many neighbourhoods built in the1960s and 1970s aged. On their side, peripheral municipalities experienced different trajectories depending on their recent demographic and real estate history (Gil-Alonso *et al*., 2018).

On the other hand, *socio-residential fragmentation* involved that, during recession, there was an increasing polarization between wealthy and disadvantaged neighbourhoods —both in cores and in peripheries. This does not contradict the fact that, during those years, urban segregation levels fell, as a consequence of middle class impoverishment.

Since 2014 approximately, we are currently in a new period called economic recovery or *post-crisis* phase. Although it has not benefited the entire population, it has had an impact on the housing market, activity and employment, and is generating changes in mobility flows, which have had important socio-economic, demographic and residential implications. In effect, as a consequence of economic recovery, both international and internal migration intensity has picked up once again —the former even recovering positive growth. These new migratory trends have had an impact on residential mobility, which —and this is our hypothesis— would have become more unstable, more complex and more fragmented. In other words, the direction of flows, the reasons for moving, the socioeconomic categories and the ages of migrants have diversified.

These new migration dynamics would be both the cause and the consequence of the rising price of home ownership and rents in urban areas and, more specifically, in the most demanded and/or gentrified city neighbourhoods. Will these elevated costs of living in cities generate a *suburbanization of poverty*? Evidence available so far, though partial, would show that there is presently a large variety of spatial situations —social exclusion zones being created both in urban cores and peripheries; the same being applicable to wealthy areas. As a consequence of this variety of situations, Spanish urban areas are increasingly fragmented, becoming growingly similar to —despite the distance there still is, and if a solution is not found— North or Latin American metropolises.

In sum, new mobilities would be spatially reconfiguring metropolitan core cities and peripheries, strengthening social polarization, creating more demographic and socio-spatial fragmentation, and more inequalities inside these areas. If confirmed, all these processes would indicate that we are not returning to the situation before 2008, but entering a new scenario. These new circumstances and events would pose both new challenges to political actors and new questions to urban researchers, whose answers can help to improve the design and implementation of public policies intending to enhance urban inhabitants' well-being.

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Escaping the Capitalocene: sustainable development, green capitalism and degrowth*

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Abstract

Anthropogenic climate change, the sixth mass extinction of species or the exhaustion of hydrocarbons are symptoms of the socio-ecological crisis which are rooted in capitalism. Therefore they are considered as being characteristic of a new geological age called the Capitalocene. The socio-institutional responses to this situation developed in recent decades have essentially consisted in proposals of sustainable development, green capitalism and degrowth. While the former two are composed of mitigation and adaptative measures aligned with the dogma of growth, degrowth questions capitalism and is based on diagnoses and radical proposals. The structure of this article is based on an explanation of the etiology of the socio-ecological crisis, its principal symptoms and the dissection of certain prognoses of palliative scenarios.

1. Introduction

The scientific consensus reached by the research fields that conduct critical globalisation studies is that the origin of the current socio-ecological crisis resides in those spaces favoured by globalised capitalism. This is particularly due to the economic growth imperative, in terms of accumulation and consumption, which is inherent to capitalism. Growth provides spatial and/or time solutions that help to resolve the problems of the over-accumulation of capital by displacing it through time and space, therefore, contributing to resolving crises in the short term (Harvey 1982).

However, at the same time, growth intensifies the social metabolism, which implies the appropriation, transformation, transport, consumption and excretion of energy and materials. This is the case, for example, of the mass tourism destinations, based on the development of the property environment, among which Spain stands out for its growing attraction of international tourist, migrant and capital flows (Murray, 2015). This vigour subjects the economy and society to heightened dynamics of the capitalist cycles of acceleration and crisis - such as the property bubble, its bursting in 2008 and the new tourism bubble.

The principal expressions of the socio-environmental tensions associated to the growth imperative are anthropogenic climate change —or global warming—,the sixth mass extinction and peak oil, derived from the presumption that the human species does not depend on natural cycles and is able to pollute, extinguish and exhaust any other component of the ecosystems. The crisis that these actions generate has given rise to the terms Anthropocene and Capitalocene which are rooted in the current economic system. The first section of this article defines these concepts and explains their symptoms, understood as contradictions of capitalism (Harvey, 2014).

Going beyond the definition of the diagnosis of the current socio-environmental crisis and its etiology, the critical geographical studies —closely related to political ecology, ecological economics and political economy (Newell and Cousins, 2014)— seek to describe the prognosis of proposals for preventive, palliative or solution-designing actions and alternative scenarios to the trend that is likely to be characterised by: "The internal devaluation and cheapening of the workforce, pro-independence centrifugal tensions between rich and poor territories, aggravation of military conflict in all of its forms…" (Santiago Muíño, 2018, 45). With this objective, we analyse and compare, the contributions of sustainability, green capitalism and degrowth through which "escape plans" are being designed to flee from the socio-ecological crisis of the Capitalocene.

2. Anthropocene and Capitalocene

James O'Connor (1988) defined the collision of the capitalist imperative of undefined growth with the frontiers of nature as an external contradiction that determines the failure of capitalism. This argument is also defended by David Harvey (2014), together with other contradictions that augur its end. In this way, it is explained that the paradigm of unlimited growth, inherent in capitalism, is considered as the cause of the current socio-environmental crisis. Based on this diagnosis, the definition of the Anthropocene as a new geological age —after the Holocene, both in the Quaternary period of the Cenozoic Era— identifies the human species as the cause of the ecological crisis, particularly climate change and the extinction of wildlife species (Crutzen and Stoermer, 2000). The current geological age is characterised by: 1) the 40 % increase in carbon dioxide (CO_2) concentration in the atmosphere over the last two centuries which has led to an increase in the average temperature of the Earth of between 1 ºC and 1.1 ºC and an increase in sea level of 20 cm with respect to the pre-industrial age; 2) the transformation of between a third and half of the land and ocean area by human activity; 3) the regulation and/or transfer of the world's principal rivers; 4) the artificial production of more nitrogen than is established naturally; 5) the exploitation of a third of the primary production of coastal fisheries; 6) the human use of more than half of the world's accessible fresh water; and 7) the threat of extinction of 25 % of plant and animal groups (Kolbert, 2015; Crutzen, 2002; IPBES, 2019). Clarifying its etiology, the term Capitalocene indicates that the origin of this crisis is found in the capitalist economic system (Moore, 2017), which underpins growth and capital accumulation in an unequal geographical development (Smith, 1984) and in the appropriation of natural goods, the "four cheaps": labour, food products, energy and raw materials (Moore 2015).

In the next section we will elaborate on the explanation of climate change and the oil peak; factors that epitomise the Capitalocene.

2.1. Anthropogenic climate change

Climate change focuses the public debate on the socio-environmental crisis, supporting the definition of a new geological age called the Anthropocene, or Capitalocene to better clarify its etiology. It is a variation in the statistical and general circulation patterns of the atmosphere and the oceans, which are reflected in the meteorological variables: temperatures, humidity, rainfall and wind. The Earth has experienced highly pronounced climate changes throughout its approximately 4,500 million years of history, with cold geological periods in the Precambrian age, glaciations at the end of the Ordovician period (which gave rise to mass extinctions as we shall see later), warm periods in the Mesozoic or Secondary age and the majority of the Ceneozoic or Tertiary era and its cooling in the current Quaternary period. Its causes are the variations in solar radiation, tectonic and biotic activity.

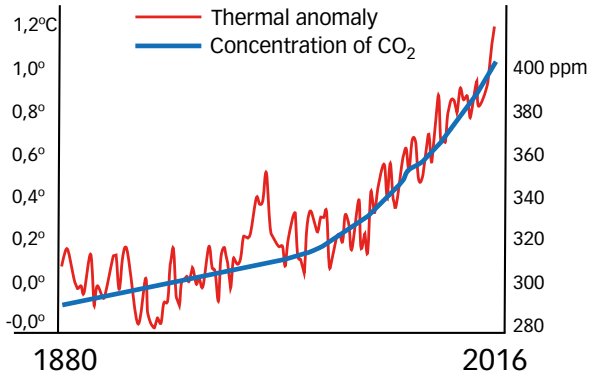
Louis Agassiz (1840) defined the "Ice Ages", consisting in the glacial periods of the natural climate variability pattern. Piotr Kropotkin (1876; 1914), in turn, identified the effects of climate change on the continental drying in Asia, based on his field work in the Rivers Lena and Amur and the endorheic basin of the River Tarim. Based on the scientific assumption of these changes, links have been established between the recent climate changes and the decline of historical civilisations, for example, in Turkistan and Mongolia in Asia or the Maya civilisation in America (Diamond, 2005). But the debate developed further and the arguments were undermined with the diffusion of environmental determinism that associated ethnic and cultural characteristics to climate, leading to fascist proposals of eugenics and racial engineering.

But going beyond the changes generated by natural processes, certain human activities —such as the burning of fossil fuels and livestock farming— have been causing climate change since the beginning of the Industrial

Revolution. Their effects have been significant in the increase in atmospheric temperatures. The most widely accepted explanation of this latest climate change is the anthropogenic greenhouse effect.

The process of global warming is due to the alteration of the contents of greenhouse gases (GHGs) such as, for example, water vapour, CO_2 or HCFCs), capturing energy and preventing their return to outer space. The Industrial Revolution gave rise to the mass burning of fossil fuels (coal, oil, and natural gas), which liberate CO_2 and other GHGs. China, the United States, the European Union and India are currently the world leaders in terms of CO_2 emissions. The atmospheric concentration of CO_2 exceeded its natural variability range (between 260 and 285 ppm) at the end of the nineteenth century, and was higher than 400 ppm in 2016 (graph 1).

Global temperatures and CO_2



Graph 1. Increase in the concentration of CO_2 and in the temperature of the earth's atmosphere, from the beginning of the Industrial Revolution

Source: NASA GISS, NOAA NCEI, ESRL, https://cambioclimaticoglobal.com/estudios-y-evidencias-del-calentamiento-global (consulted on 24/09/2019). Global temperatures averaged and adjusted to the basal levels of the beginning of the industrial era (1881-1910)

Certain scientific groups, beginning with Paul Critzen, Nobel Prize Winner for Chemistry in 2002, have proposed that this anthropogenic alteration of the atmosphere marks the beginning of a new geological age, the Anthropocene (Crutzen and Stoermer, 2000). But this definition links the etiology of the crisis to the human species as a whole, while the definition of the term Capitalocene (Moore, 2015) links it to the capitalist economic system.

The anthropogenic greenhouse effect has made the average global temperature of the planet increase by 0.8°C over the last 100 years (graph 1). According to the report of the Intergovernmental Panel on Climate Change of the United Nations (IPCC, 2013), by the end of this century, the average global temperature will increase by between 2 and 3 ºC. The confirmation of the current climate change will lead to a variation in the territorial distribution of climates, with serious consequences for nature and human activities. The overall increase in the temperature of the planet will have effects on the general atmospheric circulation and oceanic currents (such as the El Niño Southern Oscillation —ENSO— or the thermal-haline circulation which, among many other effects tempers the climate of the North Atlantic). These changes will particularly affect impoverished countries, threatening their agricultural production and forcing more population displacements to richer countries which do not know how to stop these waves of desperation. Some of the most popular sun and beach tourist destinations, such as the Mediterranean, will suffer from a loss of climatic comfort in the summer, with a higher number of tropical nights (with minimum temperatures of over 20-25 ºC) and extreme temperatures during the day (over 45 ºC). The anthropogenic greenhouse effect generates a reduction in ice and snow cover (particularly appreciable in the Arctic) and an increase in the average sea level. The de-thawing process and the dilation of the oceans has already caused the sea level to rise by an average of 3.2 mm per year between 1993 and 2010, which could increase to one metre at the end of the twenty-first century. In coastal marine environments, the beaches, groundwaters, port facilities and airports close to the coast can deteriorate due to the rise in the sea level. The islands formed by coral reefs are also flooding due to the rising sea level; this is the case of some small island countries in the Pacific Ocean, such as Kiribati, Maldives, Vanuatu or Tuvalu, where the situation is aggravated as these states do not have any other territory to where their populations can emigrate. It is also predicted that the atmospheric hazard associated to extreme episodes will increase, particularly flooding, droughts, storms or landslides.

It is predicted that vegetation zones and the climate will be transformed by climate change, which will also affect agricultural and livestock production, for example, with the reduction in yields in semi-arid regions. However, in the shorter term, wildlife species are already beginning to be affected by climate change. This is the case of the voluntary or accidental naturalisation of non-native species through the transport of goods and people, which then become wild and even invasive. Climate change facilitates the expansion of the distribution of certain foreign plant and animal species which pose a threat to the indigenous species, as is the case, for example, in Europe with the introduction of predators such as the coati (*Nasua*

nasua), originally from South America, the American turtle (*Trachemys scripta*) or the Asian hornet (*Vespa velutina nigrithorax*). The behaviour of birds also indicates the changes derived from climate change, which has caused them to migrate and lay their eggs earlier in the year. Furthermore, the difficulties for their migration have been aggravated for example, by the advance of the Sahara desert or the loss of habitats in semi-arid environments due to the prolongation of the droughts. A third of the CO_2 emitted by humans has been absorbed by the oceans, acidifying them. It has been calculated that by the end of this century the acidity will have increased by 150 % with respect to the values at the beginning of the Industrial Revolution (Kolbert, 2015, p. 126), which will affect calcifying organisms such as shells or external or internal mineral skeletons constructed from calcium carbonate.

The measures implemented to mitigate and adapt to climate change seek to reduce emissions and prevent the increase in the average temperature, with the backing of the United Nations, through the Rio de Janeiro Convention (1992), the Kyoto Protocol (1994) or the Paris Agreement (2015); for example, the latter sets the objective of attempting to limit the increase in average temperatures of the atmosphere to 2 ºC. Other actions that are being contemplated are: reforestation to increase the absorption of CO_2, the construction of dykes to contain the increase in sea level, the transition to more efficient development models that substitute the fossil fuel energy sources in order to reduce the GHG emissions and substitute oil (from the transition to the use of renewable energy sources to the proliferation of the use of nuclear energy) or geo-engineering operations aimed at increasing our effect on the climate with solar radiation management or the elimination of atmospheric CO_2, for example fertilizing the oceans with iron. The most technological options, such as the use of nuclear energy or geo-engineering have very high costs and risks. The high cost of storing spent fuel, the exhaustion of the mineral sources and the accidents in nuclear power plants (Chernobyl in 1986 or Fukushima in 2011) show that they are infeasible as an alternative energy source for fossil fuels.

The political actions to combat anthropogenic climate change are failing. The Paris Agreement (UNFCCC, 2015) is only voluntary, with no controls, follow-up or penalties for non-compliance (Nieto *et al*., 2018). The analysis of the contributions established in the Paris Agreement on a national level concluded that in 2030 the emissions will have increased by 19.3 % with respect to the base interval (2005-2015); which would be an increase of at least 3 ºC in 2050 (IPCC, 2014). Furthermore, its geographical distribution highlights the unequal development: "The responsibility for climate change rests with the Developed Countries and their production and consumption patterns. However, the incorporation of China and India in these patterns, often to satisfy the demand of Developed Countries through environmental load displacement, makes it even more difficult to comply with the Paris Agreement (Nieto, *et al*., 2018, p. 81).

While the public administrations of the countries that most contribute to greenhouse gas emissions have refrained from complying with the agreements (as in the case of the Summit held on climate action in New York in September 2019, with the USA, China and India), the scientific institutions continue to contribute diagnostic elements and specific proposals; for example, with respect to the more appropriate uses of land to supply healthy and sustainable food, particularly reducing the production of vegetable oils and meat which has doubled since 1961, while tropical deforestation is advancing (IPCC, 2019). The environmentalist social movements also apply political pressure to promote regulatory changes that prevent the worsening of global warming. This is what has occurred in recent years with the Youth Climate Movement, also known as *Fridays For Future*, which is an international movement, mainly made up of students who protest to call for action against global warming.

2.2. The sixth extinction

The expansion of humans has caused the extinction of many species of other living beings, which is accelerating as the changes in land uses intensify which alter their habitats (particularly through deforestation or the draining of wetlands), together with a heightening of pollution or the voluntary or accidental introduction of non-native species. The most devastating effects of human action can be found in island territories, with an estimated reduction of 30 % of land mammal species and 50 % of birds (Folch and Camarassa, 1993-1998, vol. IX, pp. 432-433). Six hundred and eighty species of vertebrates have extinguished since 1500 and, according to the Living Planet Index, also with respect to vertebrate species, their reduction has accelerated since 1970, by 40 % for land vertebrates, 84 % for continental aquatic vertebrates and 35 % for marine vertebrates (IPBES, 2019). When insects are included in the calculation, it is estimated that tropical deforestation causes the extinction of 14 species per day, that is 1 every 100 minutes (Kolbert, 2015, p. 199).

Similarly to climate change, the history of the Earth shows continuous but moderate extinction rates with peaks of mass extinction (Kolbert, 2015). The geological records show fossil concentrations of the species that extinguished in five mass episodes at the end of the Ordovician (between 485 and 444 million years ago), Devonian (between 417 and 354 million years ago), Permian (299-251 million years ago), Traiassic (251-201 million years ago) and Creaticeous (145-66.4 million years ago) periods. The fossil deposits of the fifth mass extinction are accompanied by iridium concentrations one hundred times higher than the normal level, which raises the hypothesis of the impact of a large meteorite against the surface of the Earth, resulting in the extinction of 11 % of the families of living beings, including the dinosaurs. The mass extinction at the end of the Permian period —the greatest of the five large extinctions—, which is associated to global warming due to the mass release of carbon into the atmosphere, possibly of volcanic origin, and to changes in the chemistry of the ocean which acidified, extinguished 52 % of the existing families, equivalent to 90 % of the species of the Earth at that time.

But the sixth extinction has a new cause, the human species. It is also occurring much faster than the previous five, 10,000 times higher than the background rate of extinction of the last 600 million years (Wilson, 1989). The rate of extinction of amphibians could be up to 45,000 times higher than the background rate, "one-third of all reef-building corals, a third of all fresh water molluscs, a third of sharks and rays, a quarter of all mammals, a fifth of all reptiles and a sixth of all birds are headed towards oblivion" (Kolbert, 2015, p. 26). Hunting began to be the principal anthropogenic cause of the extinction of species, from the Pleistocene, with the expansion of the Palaeolithic cultures that exterminated large mammals such as the mammoths, woolly rhinoceroses, hyenas, saigas, lions, leopards, tigers, wolves, bears, beavers, wild bulls, bisons, guanacos or even other species of hominids such as the Neanderthal. The expansion of humans —for example, of the Polynesian Maori in the Pacific and Oceania (Hawaii, Fiji, Tahiti, Tonga, Samoa, Easter Island, New Zealand…)— also extended the populations of non-native species (rats, pigs, mongooses, rabbits, goats, snakes, snails, ants, fungi…), with devastating effects for the indigenous species. To give a recent example, the Pitiusan lizards (of the *Podarcis* family) are being depleted by the snakes introduced by the tourist-residential development of the Balearic Islands. The International Union for the Conservation of Nature (IUCN) developed an inventory —Red List— of the state of conservation of threatened animal and plant species on a global level, according to which around 25 % of the groups (equivalent to around one million species) of land, fresh water and marine vertebrates, invertebrates and plants are threatened with extinction (IPBES, 2019) (figure 1).

Figure 1. The monk seal (Monachus monachus) *is the only seal species of the Mediterranean and is threatened with extinction, with a population of mature individuals of between 350 and 450, according to the Red List of Threatened Species of the IUCN (Karamanlidis and Dendrinos, 2015)*

Source: Macià Blázquez, Cape Three Forks (The Rif, Morocco), 7/8/1991

Measures to mitigate this anthropogenic transformation of the environment, intensified with capitalism, have been implemented since the nineteenth century with the protection of natural spaces and the strict protection of half of the planet has even been considered (Wilson, 2016). The criticism of these types of proposals from a social and environmental justice perspective (Büscher and Fletcher, 2019) questions the N-S dominance relationship based on the following arguments, which reinforce its close link with the capitalist system: 1) Extractivism and consumerism are not resolved by separating humanity and nature; 2) the best conserved nature and deserving of protection can be found in poorer countries and protecting it means depriving their populations from accessing the natural resources of their territory; 3) the inhabitants of the most biodiverse ecosystems, which are those that are proposed for preservation, share less responsibility in the causes of the ecological crisis.

The belonging to and dependence of human beings on the biological and geochemical systems of the Earth lead us to the conclusion that by disrupting them "cutting down tropical rainforests, altering the composition of the atmosphere, acidifying the oceans… we're putting our own survival in danger" (Kolbert, 2015, pp. 283), transforming from the agent of the sixth extinction to becoming one of its victims.

2.3. The peak oil

Climate change is no more than a symptom of metabolic socio-ecological disorder. The increasing human appropriation of exosomatic energy —that generated outside of the human body— has paced history, with a sharp spike in the Industrial Revolution, which is based on the use of fossil fuels. The formation of the current global capitalist system has only been possible through the dominance of the fossil energy resources (Fernández Durán and González Reyes, 2018). Therefore, the carbon, natural gas and oil deposits constituted a key element in industrialisation. The Hercynian tectonic implication of sediments of the Carboniferous period exposed them to mining activity in an almost latitudinal belt which in Europe extends from Ireland to the Urals, defining the regions that most exploited them to feed large furnaces that used the coke as fuel, for example in the Ruhr basin. On the other hand, the Jurassic rocks are storage vessels for gas and oil in the Volga plains, the valleys of the Rivers Don and Pechora or the North Sea. These fossil mineral resources are produced after a slow sedimentary transformation of the remains of organic material and diagenesis due to pressure and heat. Oil, for example, is produced through the anoxic mineralisation of the organic remains of zooplankton and algae (particularly during the Cenozoic or Tertiary Age), transformed after dozens of millions of years of sedimentation and captured in oil traps (impermeable rocks, anticlinal structures, salt diapir margins) that form the current deposits. These slow geological processes on a human scale convert them into non-renewable resources. The peak oil refers to the surpassing of the maximum oil extraction rate, due to the exhaustion of its stock associated to the constant increase in demand. The bell shape of the curve (formulated by King Hubbert in 1956) presupposes that extraction grows first exponentially, then falls as the stock is consumed, with an inflection in the "peak" from the moment when more than half of the initially available stock has been extracted. Depending on the source consulted, this peak will be exceeded between 2006 and 2020. The decline in reserves is calculated to begin after this extraction peak. The situation is expected to be particularly serious due to the shortage of liquid fuels for transport; motor vehicles, planes, trains and ships. The use of non-conventional resources, such as tar sands from which oil is extracted through hydraulic fracturing has the inconvenience of its low energy efficiency. While in the nineteenth century the extraction of 100 barrels of oil required an energy investment in its extraction of the equivalent of one barrel (that is, an energy efficiency of 100:1), oil obtained from tar sands has very low energy efficiency rates of between 7:1 and 3:1 (Vetesse, 2018).

The current phase of mining extractivism is characterised by the exploitation of mineral deposits with lower ores in the desired substances and the extension of necessary substances, that have a diluted presence in the earth crust, for manufacturing new technology components, such as electric vehicles (lithium and cobalt), solar panels (silver, telluride, indium and gallium) or aerogenerators which require neodynium (Naredo, 2019, p. 200-201). Mineral deposits are oddities in the earth crust and the study of their historic and current exploitation indicates imminent peaks in the exhaustion curve of their stock: 2024 for natural gas, 2061 for uranium, etc. (Valero and Valero, 2014).

3. Sustainability, Green Capitalism and Degrowth

The historical reference of the social assumption of the socio-ecological crisis is the publication of "The Silent Spring" by Rachel Carlson in 1962, a forerunner of the environmentalist movement. This was followed by more studies on the impacts of the human species on the biosphere; the analysis of the economic process from thermodynamics (Georgescu-Roegen, 1971), the demographic bomb (Ehrlich, 1968), the origins of socio-ecology (Odum, 1971), the first Club of Rome report (Meadows *et al*., 1972), "Only One Earth" (Ward and Dubos, 1972) or "Small is Beautiful, 1973), among others.

The institutionalisation of the ecological discourse implies the loss of its forcefulness, beginning with the First United Nations International Conference on the Human Environment (held in Stockholm in 1972). The United Nations Environment Programme (UNEP) was created, proposing development, understood in terms of economic growth, as a mechanism for resolving ecological problems, which was attributed to the poverty in Third World countries (in the terminology used at that time).

The proliferation of meetings and speeches came to be known as a conformer of an institutional "eco-cracy" (Murray, 2012), through which the North dictates policies to the rest of the world, based on ambiguous concepts such as sustainable development.

3.1. Sustainable development

In the year 1983, the World Commission on the Environment and Development was established within the framework of the UN General Assembly. The Commission was led by the Norwegian social democratic politician Harlem Brundtland, who had the task of issuing a report on the relationships between the environment and development. At that time, the establishment of a regime of accumulating neo-liberal capital (Dollar Wall Street Regime) stabilised the prices of oil and raw materials, leading to lesser concern for the exhaustion of raw materials in these institutional forums and greater concern for waste and pollution (Naredo, 2006). The environmental catastrophes of the explosions of the pesticide manufacturing plant in Bhopal in 1984 and the nuclear power plant in Chernobyl in 1986 support this approach to ecological crisis, focusing on pollution and inefficient management in the Third World and the Soviet socio-economic model.

The Brundtland Report (WCED), 1987) prior to the third summit of the UNEP which was to be held in Rio de Janeiro in 1992, catapulted the concept of sustainable development. The poverty and super-population of the Third World were identified as the principal ecological threat and economic growth was pinpointed as the solution to them both: "Poverty reduces people's capacity to use resources in a sustainable manner; it intensifies pressure on the environment. Most such absolute poverty is in developing countries; in many, it has been aggravated by the economic stagnation of the 1980s. A necessary but not a sufficient condition for the elimination of absolute poverty is a relatively rapid rise in per capita incomes in the Third World" (WCED, 1987: 49-50).

Through this definition, sustainable development is taken as the self-sustained growth of the apologist of capitalism Walt Whitman Rostow (1960), as the only path for Third World countries to follow, trailing behind the path forged by the industrialised countries. A few years earlier, Harry S. Truman used the term underdevelopment for the first time to refer to the Third World countries in his state of the nation speech on 20 January 1949, with which he marked his global hegemonic agenda, referring to the new United Nations Organisation, its support to European reconstruction (with the Marshall Plan) and the creation of the North Atlantic Treaty Organisation (NATO) (Rist, 2002). Within this context, Truman also proposed the extension of technological support to "underdeveloped" regions, which, according to the biological metaphor, were in an embryonic or unfinished state in relation to the industrialised countries, in order to stress the strength of their example to follow within the context of the Cold War. The N-S dominance model has evolved based on the financial hegemony, through which development constitutes a positional advantage; while sustainability was perceived as the attempt to resolve environmental problems in line with increases in per capita income, according to Kuznets' curve "whereby economic development would no longer be seen as the *cause* of the environmental problem but would become its *solution* (Naredo, 2006, p. 43); so sustainable development "only made sense as a misleading instrument to sterilise the critics" (Naredo, 2006, p. 106).

In this respect, the ambiguity of the term sustainable development has been criticised because it does not question the foundations of the prevailing socio-economic system, which would explain why it was well received (Naredo, 2003) and the virtuous cycle that it presented between economic growth and ecological conservation (Martínez Alier, 1994). Thus, the term sustainable development does not contemplate the link between the accumulation of wealth and the wastefulness of the North based on the exploitation of the South, with global ecological and social unsustainability (Sachs, 1998). In any event, North-South cooperation is based on charitable assistance. A level of aid of 0.7 % of GDP has been established as a goal and has become a demand of the alter-globalisationist movements but has almost always been disregarded or even boycotted.

The ambiguity of the term sustainable allows its "weak" use by orthodox economic thought, based on the notion of the economic process as being independent, while its "strong" use considers the economic process as being integrated in the ecological system (Daly and Cobb, 1989) (table 1). Weak sustainability has been critically defined by Murray (2012) based on the following proposals: 1) bequeathing to future generations a scenario that will enable them to reach standards of living at least equivalent to ours; 2) maintaining consumption levels without reducing wealth in the long term; 3) ensuring that this wealth is based on maintaining the value of manufactured, human and natural capital stock, which may substitute one another, based on their expression in monetary terms; 4) ensuring that this "substitutability" between the different types of capital presupposes a high technological and scientific capacity and ecological resistance.

On the other hand, strong sustainability consists in the integration of the economic and ecological analysis, considering ecodependent humanity as every form of life

Characteristic elements	Weak sustainability	Strong sustainability
Natural capital; manufactured capital, human capital	Substitutable	Complementary
Economic system	Autonomous and independent	Within the Biosphere and dependent
Commensurability	High	Weak
Measurements	Monetary (through cost-benefit analysis)	Biophysical
Predicted resilience of the ecosystems	High	Low and/or moderate

Table 1. Summary of the weak and strong sustainability characteristics
Source: Murray, 2012, p. 416

on Earth. This strong approach to sustainability is based on the weak commensurability of the components of the relationships between the human species and nature; with natural and manufactured capital being complementary and not completely substitutable. Assuming the limits of global systemic resilience (Rockström *et al*. 2009), implies also accepting the limits to growth of the activities of the human species (table 1).

In this sense, proposals have been developed that combine the approach of ecological challenges and social justice from a strong sustainability perspective. For example, the so-called "Environmentalism of the poor" (Martínez Alier, 2005) is based on the "ecological debt" that the industrial systems, dominated by the global North, have acquired with the global South, which provides natural resources, labour and, even, savings. The proposal of Martínez Alier links the demand for a greater respect for the rhythms of nature so as to support the conditions for survival of the most disadvantaged, guaranteeing evaluation systems of chrematistic incommensurability from ecological economics and political ecology. Second, biomimicry is inspired by the natural processes of redesigning human activities: "The principles of biomimicry could be: 1) sufficiency (not consuming more than the available resources); 2) estimating the end of the material cycles; 3) preventing xenobiotics (pollutants that are not naturally occurring); 4) applying criteria of proximity to all of the vital dimensions; 5) just enough energy (neither an excess or deficit) and solar energy; 6) promoting high biological and human diversity and interconnection as a principal safety strategy; 7) learning from the past and the context, living in history; 8) having a "pace of life" that fits with the natural cycles; 9) taking group action rather than acting from an individualist perspective; 10) considering human limitations (applying the principle of caution); and 11) reinforcing the capacity of metamorphosis" (Fernández Durán and González Reyes, 2018, vol. 2, p. 348).

3.2. Tension in the Summits

In 1990, the asbestos entrepreneur Stephan Schmidheiny created the Business Council for Sustainable Development (BCSD), which lobbied in favour of the interests of the transnational corporations at the Earth Summit organised by UNEP in Río de Janeiro in 1992. Agenda 21, which is one of the principal documents generated by the Summit, contemplates these companies only as drivers of sustainable development (Chatterjee and Finger, 1994), omitting any criticism of their position of monopolistic dominance and their growing global power. The BCSD applied pressure for the agreements to be limited to "voluntary reductions" rather than legislative reductions of toxic emissions, favouring the right to corporate privacy and the total support of "free trade" (Carothers, 1993: 14-15). At the same time, in 1992 the United Nations Centre on Transnational Corporations (UNCTC) that had been created in 1974 was brought to a close. Transnational corporations were no longer considered as abusers but as inducers of solutions for social and ecological conflicts (Sachs and Sanarius, 2007).

The World Summit on Sustainable Development, Rio+10 was held in Johannesburg in 2002. In this summit, the BCSD increased its role with the launch of its initiative Business Action for Sustainable Development, which, according to Corporate Watch (2000), was aimed at greenwashing multinational companies. One of the most innovative aspects of the Earth Summit Rio+10 held in Johannesburg was the reinforcement of the Type II agreements. These agreements are characterised, first, by not being binding, unlike the Type I agreements, they are voluntary. Second, they can involve social agents —transnational corporations, non-governmental organisations (NGOs), scientific bodies, etc.,— not only states, which is another characteristic of the Type I agreements. The Type II agreements of the World Summit of Sustainable

Development were designed to promote collaboration between the big non-governmental associations (BINGO), the transnational corporations and the states (Vélez, 2004), developing the agreements of the World Trade Organisation (WTO) with the support of "free market environmentalism" (Balanyà, *et al*., 2002: 275-276). These Type II agreements are based on voluntary action and corporate self-regulation, which has also become known as "Corporate Social Responsibility", opposing international governmental obligatory regulation.

We can find an example of these agreements in the purchase of external debt of impoverished countries by the large NGOs engaged in nature conservation, with the support of transnational corporations interested in cleaning their image and controlling territories rich in natural resources. The agreement is made in three parts: between the indebted states, the large NGOS that provide legitimacy and the transnational corporation that provide the capital and impose conditions. The impoverished countries are rich in raw materials which they exploit and export as almost their only source of finance. Meanwhile, the large NGOs and transnational corporations represent the interests of the most privileged social sectors, mainly of the wealthier countries, which we can call the global North, that consume more and therefore can be considered as being in debt in ecological terms. From this perspective, the "debt for nature swaps" invert the relationship between the wealthy Northerners (ecological debtors) and the people of the Third World (ecological creditors)" (Dillon, 2000: 136).

The legitimising role of the large NGOs is due to the fact that they give priority to the interests of the North, such as nature conservation, but neglect aspects such as social justice. As Aziz Choudry explains with respect to one of the BINGOs, "Conservation International is uncritical about the impact of economic injustice on the environment and biodiversity. It proposes market solutions to address environmental destruction that has been caused or exacerbated by free market capitalism" (2004, p. 21). Paradoxically, nature conservation is used as a decoy and a cosmetic element to disguise the loss of sovereignty of the impoverished countries (Blázquez-Salom, 2007).

The most recent World Summit was held again in Brazil in 2012, initiating the process to replace the Millennium Development Goals with the new UN Sustainable Development Objectives. The notion of the green economy or green capitalism was adopted as the central focus of the Summit, maintaining the principal objective of "creating conditions for sustainable, inclusive and sustained economic growth"[1]

3.3. Green capitalism

Green capitalism seeks to address climate change by promoting renewable energies that reduce the global emissions of CO_2 by at least 40 % of the current levels, contributing to creating labour opportunities and also supporting increasing standards of living (Pollin, 2018). Its objective is the decarbonisation of the economic system, replacing the non-renewable and polluting energy sources (such as hydrocarbons), assuming that it is possible to dismantle and decouple the economy from the consumption of raw materials, closing the circular economy cycles and also assuming that it would be possible to use more efficient technologies (The New Green Deal Group, 2008; UNEP, 2009).

The proposals of green capitalism have gained prominence due to the systemic crisis of 2008 with the support of the US President, Barack Obama and under the auspices of the United Nations (The New Deal Group, 2008; UNEP, 2009). More recently, it has taken the shape of draft laws such as the one presented by the democrat congresswoman Alexandria Ocasio-Cortez *et al*. (2019), in February 2019 to the US Congress in order to commit more public investment to the construction of infrastructure and industry (particularly relating to water and electricity supply, transport, etc.), creating job positions with the objective of mitigating the social crisis of the impoverishment of the American working class, contributing to combating the increase in GHG emissions.

The dematerialisation of the economy on which the proposals of green capitalism are based consists in the search for mechanisms to reduce the material and toxic load of the economy, under the assumption that it is possible to maintain increasing chrematistic growth, in accordance with Kuznets' environmental curve. According to green capitalism, technology and science will have to find ways to obtain the afore-mentioned dematerialisation of the economy, such as, for example, through improving energy efficiency and material substitution.

1 https://sustainabledevelopment.un.org/post2015/transformingourworld (consulted on 11/10/2019).

The critical analyses of the proposals of green capitalism are concerned with the limitations in their approach. The environmental economics on which it is based is founded on the economic logic of an isolated universe of monetary values, which gives priority to monetary profitability based on fragmented reasoning (Naredo, 2006). This is the case of the approach to solutions to climate change, unrelated to the exhaustion of fossil fuel resources: "the discourse against climate change (and poverty) has been used to deactivate the response to relate it to a pro-market programme that does not clash with the dynamics of capitalism, but reinforces them: 1) more State to fight against climate problems (which attracts the progressive sectors); 2) more market to enable new growth and business areas; and 3) more technology to make it feasible" (Fernández Durán and González Reyes, 2018, vol II: 64).

Other authors also focus their critical analysis of green capitalism on its disregard of the peak oil and the entropic limitations of the laws of thermodynamics (Parrique, et. Al, 2019), with only short-term fragmented approaches to resolving climate change (Turiel, 2019). In terms of the energy return of renewable energy sources, it is calculated that this could be 20:1 (Mander and Heinbert, 2009), much below the peak of oil extraction in the nineteenth century (100:1) or its accumulated maximum of approximately 44:1 at the beginning of the 1960s (Santiago Muíño, 2018). The dematerialisation and decoupling of the economy of certain countries, in terms of material consumption, in relation to their gross domestic product, is achieved locally through international trade which transfers the most demanding production activities in terms of materials and energy to periphery countries, relocating them by way of geographical externalisation. Therefore, the accumulation of capital of the corporate-financial power cannot be understood without the material extraction processes in the peripheral areas, which has tripled on a global scale over the last 50 years (1970-2017)— but these materials are mostly consumed in the central spaces (Murray, 2020). According to the World Development Movement (2012), green capitalism is a "green language to cover the attempts to create new markets out of biodiversity and ecosystems". Going further, neo-liberal capitalism (which has now become green), as the dominant regime of accumulation since the end of the 1980s, is accused of being based on dogmas of fragmented reasoning and on relativist, sceptical and cynical post-modernism which is isolated in a universe of monetary values, disregarding the metabolism of society and social inequality (Naredo, 2006).

4. Degrowth

Degrowth is a proposal for a radical socio-political transformation that has emerged from a conjunction of social movements and critical academic reflection. On a macro-economic level, "degrowth refers to a trajectory where the "throughput" (energy, materials and waste flows) of an economy decreases while welfare, or well-being, improves" (Kallis, 2018: 9).

With this objective, the reconfiguration of the organisation and social practices that degrowth proposes implies changes in scale that favour the local level and ecosystemic processes over industrial ones (Blanco-Romero, 2019).

From a degrowth perspective, it may be considered that growth has an intrinsic relationship with capitalism, which leads us to think that "Growth is part and parcel of capitalism: abandoning the pursuit of growth requires a transition beyond capitalism" (Kallis, 2018: 163).

In practical terms, degrowth proposes a "planned economic contraction" (Alexander, 2012), aimed at changing the social metabolic regime. Contrary to the "decoupling" or "dematerialisation" proposals (Parrique *et al*., 2019), degrowth seeks the re-politisation of sustainability and the radical transformation of the political economy (Asara *et al*., 2015). Degrowth is not the same as economic decline or recession —as certain authors claim (Pollin 2018)—, given that Involuntary declines are not degrowth in themselves, and countries in recession or depression are not degrowth experiments (Kallis, *et al*. 2018: 294). Consequently, degrowth includes calls to (re) construct societies and economies around the principles of creation and governance of common goods, care and coexistence (D'Alisa *et al*. 2014).

The discourse of degrowth is basically "to understand critically and undo the phenomenon of growth —a material, ecological, historical, discursive and institutional phenomenon that is at the heart of the Western imaginary and its colonial dominance— and to propose alternatives to it." (Kallis 2018: 9). Therefore, degrowth questions the faith in techno-scientific solutions to all problems related to environmental deterioration and social inequality; a technolatry through which the aim is to escape further away and more quickly from the biophysical limits and the human condition, disregarding the destruction processes under way (Riechmann, 2016). In the same sense, degrowth seeks to go beyond the social protection

deployed by the state, in order to advocate an autonomous and emancipating policy pursued beyond the limits of state institutions (Fraser, 2013; Valdivielso and Moranta, 2019).

Degrowth is rooted in bioeconomic analyses, according to which the economic process is understood from an evolutionary perspective, subject to the laws of nature and, in particular, to the second law of thermodynamics, the law of entropy. The first aspect to point out regarding the bioeconomic analysis of the economic process is its subjection to irreversible flows of energy and materials, which makes it dependent on very scarce natural and energy resources mostly obtained from the earth crust. Second, this analysis can be used to identify its influence on the creation of inequalities between the social classes (Georgescu-Roegen, 1995 [1977]). Murray (2012, p. 407) summarises the proposals of the bioeconomic programme of "minimising future remorse", based on the contributions of Georgescu-Roegen (1995 [1977]) and Óscar Carpintero (2007): "1) Cessation of the production of all instruments of war. 2) Reduction of the population to levels that can be fed only by organic agriculture. 3) Underdeveloped countries should be helped to eliminate hunger and its dreadful consequences (against hunger, factories instead of food). Rich countries should renounce their extravagant way of life. 4) While awaiting the arrival of a new, clean and abundant source of efficient energy, the population of any place should stop its excessive consumption of heating, lighting or speed. This will save energy, but also economise on materials. 5) Humanity must eliminate its thirst for "bigger and better" and the contradictory gallery of artefacts. 6) Cure ourselves of the influence of fashion. Georgescu-Roegen understands fashion as a mental illness. Fashion is probably the greatest energy waster of society. 7) Cure ourselves of the illness that Georgescu-Roegen called the "shaving razor syndrome", according to which we want to shave more quickly to have more time to design a razor that shaves even more quickly and thus continue in an endless and empty progress." (2012, p. 407).

Orienting its application to the tourism industry, degrowth is specified in post-capitalist and post-neoliberal policies (6 DDs), for places suffering overtourism, defended by social movements and critical academics (figure 2): 1) the Decommodification of tourism in aspects of everyday life; 2) after this Detouristificaiton, the development of a re-touristirfication based on fairer social and environmental patterns; 3) the reduction of Disparities, particularly through the collectivisation of the means to access accommodation; 4) the definition of sanctions to excessive consumption and waste; 5) the Dignification of working conditions, 6) the Detailed regulation of the occupation and use of land, to limit the accommodation capacity and transport infrastructures in order to contain growth and, in the cases where saturation is exceeded, establish degrowth measures (Blanco, *et al*., 2019).

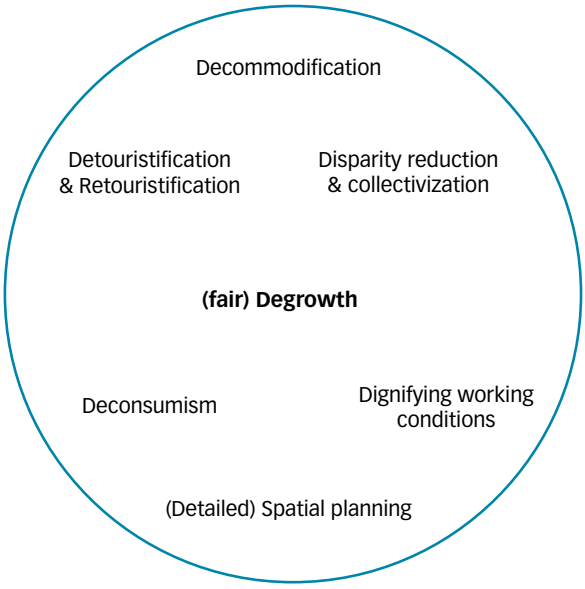


Figure 2. Degrowth, "DD", policy alternatives to face overtourism
Source: Blanco-Romero, 2019

5. Conclusions

The scenario of a civilisation collapse is not on our agenda, despite the past offering many cases (Diamond, 2005). According to the conclusions of the research, it may be escaped by: 1) self-deception, maintaining the status quo, accepting the dogmas, the technoloatry, the chrematistic commensurability of weak sustainability or the green project for solving problems of capitalism, internalising environmental services to expand business frontiers, with the false promise of resolving environmental problems; 2) evaluating the risks and adopting preventive measures, accepting that the human species belongs to the biosphere, evaluating the strong sustainability of the relationships between humanity and nature by establishing their metabolic balances and proposing post-capitalist socio-economic structures in the application of a degrowth programme.

With respect to the Spanish geographical environment and in the current context of a resurgence of a new tourist-property bubble, the proposal of alternatives to the growth imperative —after post-growth,

post-capitalism, post-development or degrowth— the intellectual challenge will become more pressing than ever (Fletcher, et. al, 2019). Academia, and in our case Geography, has taken root in the social movements in order to propose more sustainable future scenarios, designing tourism and urban models that will contribute to escaping the Capitalocene.

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Overtourism in coastal destinations. considerations about beach spaces and water demand management

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Abstract

The coastal mass tourist destinations attract an increasing flow of capital and visitors but as a result undesired effects also occur (environmental deterioration, social conflicts, inflation). Physical space (beaches) and water are the most demanded resources and hence those under the most pressure, sometimes being at risk of degradation or overexploitation.

There is therefore a need to perform a deep and reflective analysis on how to re-address this tourism model and provide ideas, methods, strategies and tools with which these territories can face the future so that they can evolve within a framework of ecological, social and economic sustainability.

To meet this objective, this paper provides some considerations regarding the use of territorial management tools focused on the analysis of the physical space (beaches) and water demand. To this end, the assessment of the recreational carrying capacity of beaches and the hydrosocial cycle in coastal destinations are studied.

Key words: overtourism; beaches; recreational carrying capacity; hydrosocial cycle

1. Overtourism in coastal destinations

The concept of overtourism is currently a common topic in the scientific literature referring to tourism studies, since many places are affected by this phenomenon of tourist saturation.

Overtourism describes destinations where local residents and also tourists and visitors feel that there are too many people and that the quality of life in the area or the quality of the tourism experience and the traditional lifestyle of the residents have deteriorated to an unacceptable. The density and intensity of tourism are considered the main causes of overtourism.

The alarm regarding this issue was triggered initially by the saturation of destinations of high ecological value, where the resources that constitute the main attractions are fragile and were beginning to show signs of degradation, this fact being the subject of a number of academic studies and also legally recognized, as featured in the United States National Parks and Recreation Act of 1978, which establishes the need to include recreational carrying capacity in the management plans, thus being a

pioneer in its field. Lindberg, McCool and Stankey (1997) have devoted much of their scientific production to analyzing and revisiting these issues on a number of works.

However, the situation has become a topic of public interest in recent years, when it has affected urban environments and social sustainability has been compromised. Thus, cities such as Venice and Barcelona have been in the headlines of numerous media when residents have denounced the unsustainable living conditions due to the excessive number of tourists in the city.

Regarding coastal destinations, citizens have not complained so much, although the environmental deterioration due to overcrowding has been evident on beaches around the world. Researchers and scientists from various disciplines (geologists, geomorphologists, climatologists, ecologists, biologists, engineers, etc.), however, have been drawing attention to this fact for decades, especially in relation to the postulates that emanate from the theory of climate change and its consequences in coastal areas.

In addition, it must be remembered that the relationship between tourism and water has traditionally been conflictive. Moreover, it should be noted that not only is the availability of physical space a limiting for tourism development, but the balance between tourism and water is a fundamental issue and has often been a conflicting relationship, especially in destinations where water demand exceeds supply, as is the case of regions of 'sun and beach' tourism in areas with arid and semi-arid climates. This imbalance sometimes becomes apparent in problems of water supply that have affected the image of the destinations, or when this competes with other activities such as agriculture, hydroelectric production and domestic supplies (Gössling *et al*., 2015).

The answer to these imbalances has been the constant expansion of the sources of water supply: the sinking of wells and exploitation of aquifers, intra- and inter-basin transfers, and water collection from non-conventional resources such as desalination and the reuse of reclaimed wastewater.

Moreover, new alternatives are starting to be introduced on a local scale, such as the use of rainwater or the reuse of wastewater at home (Domènech *et al*., 2013; Arahuetes *et al*., 2016). The incorporation of these new resources might guarantee the water supply for the tourist system. This has happened, for example, in mature tourist destinations on the Spanish Mediterranean coast where drought is a structural feature (Olcina *et al*., 2016).

This adaptation to the risk of drought has required measures concerning eco-efficiency (optimisation of supplies, price policies, incorporation of non-conventional resources, circular economy) and others related to sufficiency, by applying tourism consumption patterns and developing awareness policies (Hall, 2009).

For all these reasons, the objective of this paper is to advance in the reflection on overtourism in coastal destinations, the focus of the study being on the main territorial resources involved in the activity: water and beaches. The approach followed is based on the analysis of the recreational carrying capacity of the beaches and on the hydrosocial water cycle, because they are tools for understanding the expansive processes and setting the limits to the growth of tourism.

Therefore, the results of the study will allow a scientific debate on the problems of overcrowding and the limits to growth.

2. Methodology

This work is based on a literature review, on previous research conducted by the authors and on previous experience in the development of applied projects.

The literature review revealed that the phenomenon of overcrowded beaches and its consequences is a usual topic among not only tourism researchers but also geomorphologists, engineers, ecologists, geomorphologists, economists and sociologists, among others. However, few interdisciplinary approaches have been undertaken. Since many authors have analysed other environmental, perceptual and economic approaches, the decision was made to focus this study on the physical carrying capacity. It should be noted, however, that there is no integrated methodology that fits all situations, but from the reading of the papers it is clear that the projects are addressed with some flexibility ('adapted methodology') since the space-time situations and psychosocial circumstances of the users are different in each case, although they are all based on some key elements and follow the same principles.

The management of water resources in coastal tourism destinations has been analysed following the guidelines established in previous projects carried out by the authors. As in that earlier research, this subject is considered a matter that is not exclusively physical, but of an economic, political and social nature, and one that opens up new perspectives for the sustainable management of coastal tourist destinations.

3. Overcrowded beaches and recreational carrying capacity

Currently, many beaches around the world present problems of the overcrowding usually associated to mature mass tourism destinations, where large-scale constructions, infrastructures, intensive land development and extensive urbanisation and housing construction take place.

Recreational Carrying Capacity (RCC) is one of the most recognised tools in Tourism for the management of natural and cultural resources, in order to guarantee the environmental, social and economic sustainability of the tourist activity. This tool, according to the vast majority of authors who have addressed this issue, addresses tourist density and the question of determining the maximum number of visitors that can simultaneously take part in a quality recreational experience without running the risk of degrading the attractions and supporting resources or their surroundings, and under conditions that ensure comfort and satisfaction for the visitor (Viñals *et al*., 2016).

Regarding the RCC of beaches, many studies have been conducted over the last four decades or so. Of them, the work of Pearce and Kirk (1986), which was a pioneering study in growth contention strategies for coastal tourism, could be highlighted. It is also a recurring topic in publications that focused on the Integrated Management of Coastal Areas (Williams and Micallef, 2009). This issue often appears in studies dealing with the tourism management of beaches. Consequently, since the work by UNEP (1997) was published, many others have been produced around the world (Jurincic, 2005; Botero *et al*., 2008; Needham *et al*., 2008; Williams and Lemckert, 2007; Rajan *et al*., 2013; Sridhar *et al*., 2016; McCoy, 2016; Chen and Teng, 2016; among others). There are also numerous studies focused on the coasts of Portugal and Brazil (Silva, 2002; Silva *et al*., 2007, Zacarias *et al*., 2011; Dias e Cordeiro *et al*., 2012; Silva and Ferreira, 2013; Pessoa *et al*., 2013; Ferreira and Ferreira, 2013; Pereira da Silva *et al*., 2016; Medeiros *et al*., 2016; Corrêa de Sousa *et al*., 2017; among others).
In the case of Spain, the recreational carrying capacity works developed for Mediterranean beaches should be noted (Yepes *et al*., 1999; Roig, 2002; Yepes, 2002; García Guindulain, 2005; Cloquell, 2006; Roca *et al*., 2008; Jurado *et al*., 2009; Tejada *et al*., 2009; among others). Recently, there are also works that focuse on the use of new technologies (sensors, drones, etc.) to study and manage the carrying capacity of beaches (Aldoukhi *et al*., 2012; Torrens, 2014; Huamantico Cisneros, 2016; among others).

It must be emphasised that this topic is being approached again considering the effects of climate change on coastal areas, as mentioned above, because this phenomenon will certainly decrease the surface area of the beaches available for recreation.

One of the main challenges in the study of the RCC of beaches is the estimation of the number of users, known as Visitor Flow Analysis (Visitor Flow through a Frequency Analysis). This is based on good decision-making and management of tourism destinations and depends on consistent, reliable and high quality information about visitor use. Some primary concerns about the concept of Visitor Flow are the number of people frequenting the beach; that is, how many people visit a geographical space (counts), what they do while they are visiting, how long they stay (recreation visits and overnight stays) and characteristics of the 'typical' visitor. Regarding this last issue, it must be highlighted that it is necessary to know the different types of beach users, because this fact has important repercussions on the territory (water demand, tourism services, etc.) and on the economy of the destination. Thus, we can classify users in the following categories:

- The first category includes a variety of users whose characteristics are that they all stay overnighting at the destination:
  - Local Residents: these are the persons living at the destination
  - Tourists in secondary residences: these are the owners of the dwellings and spend some days per year at the destination
  - Tourists using apartment or holiday rentals

  - Tourists in hotels and other types of accommodation

- The second category consists of excursionists (one-day visitors), that is to say, all users who do not stay in the destination overnight, and are therefore one-day visitors.

With regards to the use of the beach, residents, tourists and one-day visitors are considered as a single collective because they occupy the space following the same proxemic standards. That is, to estimate the recreational carrying capacity of the beach, the same interpersonal space is usually attributed to all users who perform resting activities, and other different interpersonal space is considered for those who perform more dynamic activities. In both cases we need to take into account the conditions of psychological comfort. (Viñals *et al*., 2014). It should be noted, however, that the proxemic standards are not only set based on physical parameters of the space, but also, they can vary according to the user perception about crowding.

However, if all types of users can be analyzed following the same proxemic spatial standards, it is not the case when analyzing the water consumption of the different types of users. Therefore, when evaluating the repercussions on the water demand and other services it is necessary to discriminate, since tourists consume water resources at the destination while excursionists do not.

Going back to the topic of knowledge of the number of tourists and one-day visitors, it must be said that to find out the number of tourists can be made from the registrations in hotels and other types of accommodation. However, knowing the number of one-day visitors is more complex because they are not registered anywhere and are also an important part of the flow, especially during the weekend and the holidays of the high season. In recent works carried out by the authors of this work, it can be observed that some beaches, of only 4 km in length, receive a number of one-day visitors on days of high frequency exceeding 18,000 people (Viñals *et al*. 2019) and this can only be known if face-to-face counts are carried out in *situ* or through the support of new technologies.

The importance of frequentation studies is crucial when conducting a recreational carrying capacity study. Muhar (2002), Cessford and Burns (2008) and Le Corre *et al*. (2012) mention that, being much needed, they are not usual tools in the context of tourism management. A pioneer of this type of study is the USDA Forest Service (USA), which has been conducting them since the 1970s. In the case of beaches, some authors have paid attention to this topic, as is the case of Le Corre *et al*., (2012), Navarro *et al*., (2012; 2013), Torrens (2014), Fernández and Bértola (2014), Skriver Hansen (2016), Morgan (2018) and Botero *et al*., (2018), among others.

In relation to the spatial analysis of the beaches for recreational purposes, some specificities must be highlighted, since not all the sandy space is suitable for catering for recreational beach activities. The intensive exploitation of beaches for recreational purposes assumes, as Valdemoro and Jiménez (2006) already stated, that beach carrying capacity is mainly influenced by the subaerial surface that is available. Therefore, Environmental Zoning is a very important spatial planning tool to identify the best beach uses in the most suitable places. In this sense, Viñals *et al*. (2017) point out that it is important to identify the 'Useful Surface for Recreation' (USR) which, in the case of a beach, is the strip of space available for recreational activities after having excluded spaces dedicated to conservation, unsafe or vulnerable areas, etc. In a second approach, you reach the 'Suitable Surface for Recreation' (SSR) which is the one where due to its intrinsic attributes it is ideal to perform the activity of 'sun and beach', as well as some other recreational activities, or to locate facilities and/or to install transit zones.

Yepes (2002) stated that there were three main zones for Mediterranean beaches: active area, resting area and free spaces. The first area covers the 10 m closest to the shoreline, which is free of hammocks, umbrellas and other elements, to facilitate access to the sea and the transit of walkers and bathers. Therefore, this area, for reasons related to security and access, is excluded from the USR. The resting area is immediately after and parallel to the previous one, and is where umbrellas, hammocks, awnings and other portable elements that facilitate the resting of the users can be placed. The optimum width on Mediterranean beaches would be approximately 25 m, this value being variable depending on the characteristics and surface of each beach. Further back from this strip, the high temperatures that the surface sand usually reaches discourage users from resting on it. Therefore, it cannot be considered a USR area.

Therefore, according to the zoning suggested by this author (Yepes, 2002), the SSR of Mediterranean beaches is only 25 m wide and it is over this surface that Recreational Carrying Capacity must be evaluated. Indeed, in all cases, this surface is smaller than it appears.

Another important issue is that the recreational facilities and tourism services, as well as the accommodation offer of a destination, are not taken into account in the RCC assessment of the beaches. Authors like Van der Borg and Russo (1999) and Massiani and Santoro (2012) analysed this service and accommodation offer in historical centres and called this concept the Tourism Carrying Capacity. It refers to the maximum number of tourists that a destination can accommodate according to the availability of infrastructures and tourist services (number of beds and restaurant services, available drinking water, etc.). It may be said that no integrated methodology considering both (Recreational and Tourism) Carrying Capacity assessments has been developed to analyse coastal destinations because most research has focused on the physical capacity of the beach. It would be a very interesting topic to compare the results of both analyses and assess whether there is a balance between the accommodation offer and the level of construction that exists, in relation to the capacity of drinking water supply and the physical capacity of the beaches.

Regarding overcrowding indicators for coastal destinations, the overtourism phenomenon is clearly of a quantitative nature. Following the two previous perspectives of the carrying capacity, some indicators could be established at different scales:

- Beach Crowding Index: this is a Recreational Carrying Capacity Indicator that has to do with the visitor density. It refers to users per beach surface (km^2 of Suitable Surface for Recreation). The concept of users includes residents, one-day visitors and tourists, and considers variables such as People who can be hosted by the beach At One Time (PAOT), users' rotation coefficient, and limiting factors related to the beach management. This index has cumulative environmental effects as well as social effects in relation to the comfort of the visitors and the quality of the experience.

- Tourism Intensity Index for the Coastal Destination: this is a Tourism Carrying Capacity Indicator that establishes a ratio between the number of tourists and local residents. This analysis is strongly related to the social sustainability of the destination.

It must be noted that it is very difficult to assign a threshold to an individual or combination of indicators that could serve as a predictor (early warning tool) of overtourism (Peeters, 2018) because each destination presents different conditions and circumstances.

4. The hydrosocial cycle in coastal tourism destinations

Linked to the physical capacity of the beaches, as a basic resource of littoral areas, it is necessary to analyze the availability of water resources of the tourist destination, as it is a limiting factor as important or more than the space, especially in arid and semi-arid regions.

In this sense, the hydrosocial cycle is a methodological approach suitable for the analysis of the physical, economic and power relations related to the water cycle. Beyond the physical flows characterising the urban metabolism approach (water supply, processing, distribution, consumption, purification, reuse, effluent discharges, export), there are also other aspects involved such as monetary issues, water governance and business models; in short, it is necessary to take into account the inflows and outflows of the water in the system and the role of the different stakeholders. Thus, the optimal theoretical model of the urban hydrological cycle must include the following phases (figure 1):

- *The water inflows to the urban system*: this refers to raw water, the blue water from different sources (surface and underground waters). These waters require a purification treatment for human consumption (Water Purification Plant). After treatment, the water is distributed through the network for consumption (drinking water). Likewise, other water contributions of different relevance should be considered, such as bottled water (the most commonly consumed in certain regions) and rainwater.

- *Urban water consumption*: this may include varied domestic, commercial and municipal uses. In the case of tourism destinations, domestic and commercial uses present some specificities compared to conventional urban systems. The existence of seasonal occupation entails a temporary change in urban consumption patterns (increase in water volume supplied, marked seasonal distinction). It is also well known that the different types of accommodation (hotels, campsites, apartments, etc.) and the urban model (concentrated *versus* diffuse models) have strong implications for consumption. For example, the consumption per person in single-family houses can multiply by four that of an individual tourist staying in a hotel (Rico, 2007). On the other hand, tourist water expenditure is related to leisure facilities (golf courses, water parks, etc.) or as a defining factor of the landscape.

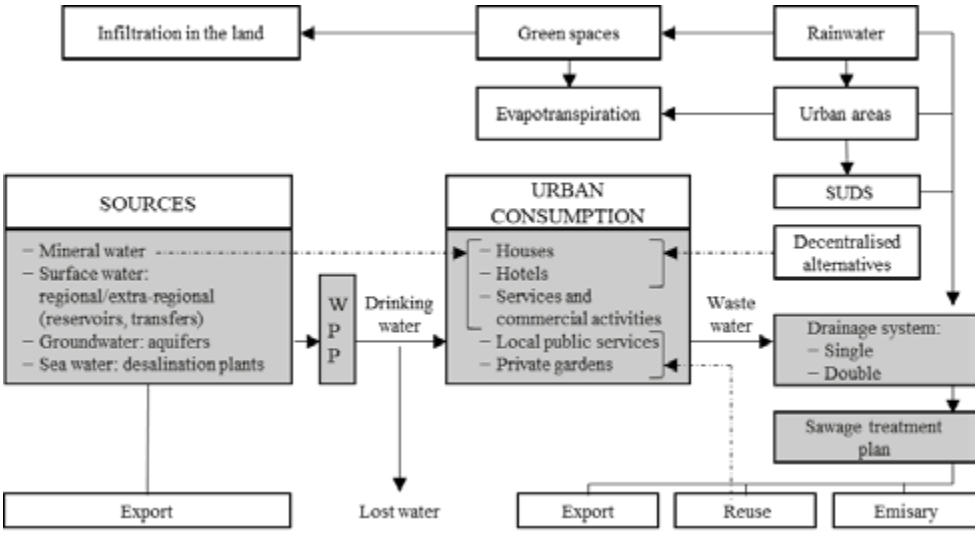

Figure 1. The urban hydrosocial cycle. Theoretical model

(Source: Own elaboration from Arahuetes, Villar, Hernández, 2016)

- *System outputs*: are the third stage of the cycle. The water outflows of the system constitute the third stage of the cycle. They are those resulting from the wastewater and the rainwater that have been drained. Different techniques can be implemented to increase drainage and purification of wastewater for its regeneration and reuse. The tertiary treatment (which may involve ultrafiltration and nanofiltration, photocatalysis, electro-disinfection) may allow its return to the urban cycle and recreational uses or also for uses that do not need such high quality (agriculture and environmental uses).

  Furthermore, the application of Sustainable Urban Drainage Systems (SUDS) can increase the volumes of rainwater available for reuse, which are drained through independent networks. If the reuse does not take place, the end of the cycle will entail the discharge of the treated water into rivers or the sea.

- *Re-entry of outflows in the hydrosocial cycle (Reuse)*: Water of sufficient quality can return to the urban cycle for specific uses: the irrigation of parks and gardens, street cleaning, environmental uses, recreational uses (irrigation of golf courses, etc.) or agricultural uses.

  The use of rainwater and the reuse of grey waters begin to emerge in some areas as a way to guarantee water supply and minimise environmental degradation (Domènech, 2011).

When approaching the implementation of indicators of hydrosocial sustainability in coastal tourist destinations, it is necessary to incorporate both elements of the metabolic study, and those of the management of the cycle (table 1) in order to track the tourist saturation.

In the case of coastal tourism destinations, the analysis is of twofold interest:

a) The tourism sector as a water consumer. The consumptions per tourist according to the characteristics of the establishments (size, category, facilities and common areas), origin of the water supply, seasonal behaviour, considerations of water saving policies, and possibilities and degree of reuse are aspects that tourism companies must monitor and evaluate for greater efficiency in their water management.

b) The tourism territorial model. Tourism activities can generate several models that determine significant repercussions on water resources. The characterisation of these models considers the complex and mixed patterns of territorial occupation and its density, the building types, the different categories of accommodation offer, and the different segments of tourism demand. This combination is reflected in two basic models: the compact city, and the diffuse or extensive city. The first is characterised by a high density of land occupation due to the construction of high-rise buildings. The diffuse city model presents an extensive occupation of the territory, in which there is a predominance of the construction of residential urbanisations with single-family houses oriented towards the second residence market or for rental.

DIMENSION	INDICATORS	
RAW WATER	Volume	Total Flow (volume) From sources (origin) (Absolute Modules and %)
	Quality	Suspended solids
CLEANING WATERS	Yes	Treatment Costs Quality of the effluent
	No	
LOSSES		Total Flow (volume) %
COMSUMPTION	Volume	Total Flow and water per person/day Consumptive uses. Total Flow and water per person/day Territorialisation: Water-use zoning. Urban models
WASTEWATER PURIFICATION AND TREATMENT	Yes	Treated Volume (%) Connected Population (total and %) Level of Purification. Treatment Systems. Quality of the effluent (wastewaters) Drainage Network: unitary / individualised (sewage and rainwater) SUDS. Recovered flows. By extension of techniques.
	No	
WATER REUSE		% (reuse towards emissaries) Uses of reused water
GOVERNANCE	Water supply, wastewater purification and treatment management	Public/Mixed/Private Maintenance costs of the system: public private (€/year) Water costs for each source supply Energy Costs Water and treatment services prices Water prices in relation to the standard of living (sectorisation: by neighbourhoods and districts)

Table 1. Hydrosocial Indicators
Source: Authors' own elaboration

The compact city allows for a more efficient management of the integral water cycle on a local scale. The length of the distribution networks is reduced, which facilitates the control of the network and reduces losses. Likewise, diffuse city models increase consumption per person / day, as the density of private gardens and pools increases.

On the one hand, the presence of an important offer of regulated accommodation establishments (hotels, apartments and campsites) distributed through commercial channels can determine a dynamism that allows the tourism activity to be maintained throughout most of the year. On the other hand, destinations based on apartment rentals have higher seasonality rates and require an oversizing of the water supply and treatment infrastructures, which will be underused for much of the year. In addition, the consumption of water related to one-day visitors remains difficult to quantify, while reliable data are not available to know the volume of this type of users.

5. Conclusions

Tourism must assume a firm commitment to the principles of sustainable territorial development and the circular economy. This means setting thresholds of transformation and adopting limits to the growth which prevent the consolidation of models of unsustainable economic growth that are environmentally undesirable, such as those that have occurred in many tourism regions around the world (for example, the northern shore of the Mediterranean Sea). Consequently, in addition to the application of regulatory frameworks, the incorporation of pro-degrowth environmental standards would be necessary. Another relevant issue is the development of social awareness policies for tourists and local societies regarding the need to transmit the idea that mature destinations do not need to be continually growing, but must optimise their resources to initiate an adaptation stage in accordance with their real endogenous potentialities. Paradigms such

as those of ethical consumption or slow consumption would fit in with this objective. It is also time to measure success not according to visitor arrivals, but the value that their presence brings to a destination in terms of profitability and local employment.

To achieve these objectives, it is crucial to design analytical methodologies and theoretical frameworks such as those presented in this work that allow a better understanding of the complexity of the processes associated with tourism consumption. This is particularly true in areas of high environmental sensitivity and limited and valuable resources such as beaches and water.

Future scenarios such as those proposed by the IPCC point to the possibility that rainfall and water availability in mid-latitude countries will be reduced in the medium term (IPCC, 2008; Olcina, 2012). Additionally, the Ministry of Agriculture, Food and Environment (2014) forces to a deep reflection in relation to forecasts for the loss of area of coastal spaces due to coastal flooding and erosion due to sea level rise associated with the climate change, especially on the Mediterranean coast. This fact, together with the constant increase in the arrival of international and domestic tourists, advise the design of tools that allow a proper environmental management of coastal destinations.

On the other hand, the development of eco-efficient technologies and the implementation of new sources of supply, and the continuous investments in the restoration of beaches to maintain a useful area for recreation at any price, create the false illusion that certain resources can be infinite and no longer involve a limitation to growth.

The overall understanding of coastal spaces and their dynamics, as well as the hydrosocial cycle, the scalar analysis of it, and a better apprehension of the metabolism of tourist destinations, is necessary to design and apply new indicators of carrying capacity of these spaces and water consumption, with the aim of improving the overall management of destinations. Future works where these instruments are applied in coastal destinations should be carried out. This allows us to assess the validity of the tools and indicators presented hereby, and progress in their implementation, so that they can become progressively dynamic instruments to manage coastal destinations.

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The forest industry in the circular economy. Analysis of the case of Galicia, the forest reserve of Spain

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Abstract

In recent years, one of the initiatives that has reached a higher degree of consensus and is supported by different organisations and the public administration is the circular economy. An initiative whose main goal is to unite the economy with sustainability, generating added value to raw materials, favouring recycling and reducing waste. The goal is to create a political framework aimed at generating sustainable, inclusive development that allows for the creation of growth and employment. In Spain, there are already several reports on the circular economy; certain sectors include a series of characteristics that connect them more directly to said economy, such as the forest industry, where wood is the main raw material, something that is renewable, reusable and recyclable. Therefore, this study offers an initial assessment of the situation of Galicia's forest industry within the circular economy. A territory classified as the forest reserve of Spain.

Keywords: industry; forest; circular economy; Galicia; Spain

1. Approach to the characteristics of the circular economy

Since the Industrial Revolution, production models have been based on the use of different natural resources that are transformed within a production chain, generating two types of products. On the one hand, the goods or products that are consumed, and on the other, the various forms of waste derived from the production phase. Such waste is normally transferred to landfills or collected in certain places prepared to a greater or lesser extent for this purpose.

Therefore, we are faced with economic activity that generates a large number of diverse environmental problems arising from the management of such waste: polluting the air, water, and soil alike. At the same time, non-renewable natural resources are running out and causing problems such as deforestation, destruction of habitats and loss of biodiversity (Anttila, P. & Verkerk, H., 2010; Geng and others, 2012; Hetemäki and others, 2017; Ministry of Economy, Industry and Competitiveness, 2018).

In view of this reality, there is a certain international consensus on the need to move forward in the establishment of a development and growth model that optimises the use of resources and reduces the generation of waste. A clear example was the signing of several agreements such as the Paris Agreement on climate change, the 2030 agenda for sustainable development or the Ministerial Declaration of the United Nations Environment Assembly "Towards a Pollution-Free Planet" at the end of 2017 (UN, 2019).

Therefore, the term "circular economy" has been conceived and consolidated as a process which optimises the use of resources and promotes the efficiency of production systems. While also guaranteeing economic growth, the welfare of society and the preservation of natural capital (Akerman, 2016; EMF, 2014; Geissdoerfer and others, 2017; Kharas, H., 2017; Korhonen and others, 2018).

Another characteristic that affects the circular economy is the need to consolidate coordination between government bodies, the economic sectors, and society as a whole. Spanish economic geography has been studying this matter for decades and it has gone through different stages of analysis before being classified as network economics (Albertos, 2002; Albertos and Salom, 2006; Caravaca and others, 2007; Caravaca, 2017; Méndez and Climent, 2002; Méndez and others, 2008; Méndez, 1994, 2003; Miramontes and Alonso, 2003 and 2015; Salom, 2003; Salom and Pitarch, 2018; Salom and Albertos, 2014; Silva and others, 2003). In this context, it is important to point out that the transition to a circular economy requires the adoption not only of technological innovations but also organisational and social developments that are essential to drive the necessary change in production and consumption models.

Another territorial reality on a worldwide scale that is "forcing" a redirection of the economic structure towards the circular economy are the demographic projections indicating that in 2050, when we exceed 9,100 million people, it will take almost 3 planets to provide the natural resources required to maintain current lifestyles (World Bank, 2016).

If we combine these demographic trends with the basic consequences of global warming, we can detect other serious problems relating to the supply of food and drinking water. Such as the emergence of a series of migration flows and population concentration in very specific territories and large cities, mainly of Latin America and Asia (UN, 2019).

From a more monetary viewpoint, there are also a series of events taking place that we have to keep in mind. Such as the rising cost of raw materials and energy sources, as there will be an increase in demand and a decrease in supply. This will cause instability in the socio-economic system. For example, the Ellen MacArthur Foundation has confirmed that the price of metals, food, and non-food agricultural products in the first decade of the 21st century was higher than in any other decade of the 20th century (EMF, 2015).

In this regard, and in accordance with the European Environment Agency (EEA), the fragile nature of the European economy is important as it depends on a constant flow of natural and material resources, including water, crops, metals, minerals, energy and the object of this study: wood (Mantau, 2010 and Prins, 2010).

At present, failure to take advantage of the resources that can be recovered from the generated waste or develop more efficient processing methods translates into a highly significant economic and competitive loss for the European economy.

Organisations such as the Ellen MacArthur Foundation, the World Economic Forum or the EEA are pointing out that the circular economy will generate economic and business opportunities and create new jobs.

The scenarios and projections carried out indicate that by 2030, the Circular Economy will generate a profit of 1.8 billion Euros in the whole of the European Union, which means 0.9 billion more than the current linear economy model (EMF, 2015).

Along these lines, within the EU, the European Commission points out that the Circular Economy will not only have environmental benefits associated with waste management but will also provide economic and social advantages. In fact, the Commission estimates industry savings in raw materials of 600,000 million Euros (8 % of the annual turnover of the EU in 2015). As well as the creation of employment associated with the new model for around 590,000 people (European Commission, 2015).

But they also reiterate that to make these opportunities a reality, coordination among all agents is essential, as is promoting the leadership of government agencies,

facilitating the transition to companies and society for the implementation of new practices, as well the generation and application of technologies. This will only be possible if companies and the public authorities work together to enter or develop niches of economic specialisation, become integrated into new value chains and promote certain practices aimed at preserving and recovering natural capital (Ministry of Economy, Industry and Competitiveness, 2018)

Clearly, what the economic geography was already showing through the study of SPLs (Local Production Systems), innovative territories and or networks: where the relationship between all agents involved in economic activity and a specific territory becomes the key differentiating factor. The circular economy follows these lines, but, perhaps it prioritises environmental and recycling matters.

2. The circular economy in Spain

The importance of the Spanish economy in the EU places Spain in a good position as an international benchmark in the process of implementing the circular economy, promoting industrial development linked to the management of raw materials and waste treatment.

Following the serious economic crisis suffered by different global economies, Spain's gross domestic product (GDP) began to recover in 2014 based on domestic demand, private consumption, investment in capital goods and a fall in the price of raw materials, especially oil. The Spanish economy accounted for approximately 8 % of the EU economy in 2016, which makes it the fifth-largest economy in the EU and the fourth largest in the Eurozone (Eurostat, 2016a). Regarding population, Spain, with more than 46 million, represents more than 9 % of the EU population (Eurostat, 2016b). That same year, Spanish GDP grew by 3.3 %, almost twice the average of the Eurozone. The macroeconomic forecasts for the current period, 2017-2020, point to the maintenance of the growth rate, with a sustained pattern based on both national and external demand.

In any case, despite this positive general data, if we analyse specific environmental sustainability indicators, the situation in Spain is not so positive. For example, the ecological footprint is an indicator that encompasses the set of impacts on the environment, measured in terms of the surface area required to produce the resources consumed and absorb the waste generated per capita. According to the Global Footprint Network, the ecological footprint per capita in Spain in 2013 was 4 hectares, which marks a turning point for the downward value of the last 5 years. Therefore, Spain ranks 58th worldwide with regard to ecological footprint per capita. In terms of the global ecological footprint, Spain ranks 18th and produces less environmental impacts than Australia, Canada, Germany, France and the United Kingdom, which relates directly to the different levels of economic development and industrial activity (Global Footprint Network, 2017)

Another example is the biocapacity indicator, which is the production surface area available in a country. When the ecological footprint, understood as the demand for natural resources, exceeds biocapacity, there is an ecological deficit, which means that a country consumes more resources than it produces. Consequently, we are in a territory with unsustainable development. Spain needs almost 2.4 times more surface area than it has to maintain the current standard of living and population, which ranks this territory 29th and 86th worldwide within the per capita biocapacity (World Bank, 2016).

This data suggests that Spain is not a country with a wealth of usable natural resources compared to other countries in our environment, which forces us to strengthen all those measures directed at improving efficiency in the use of raw materials and energy.

Using 2014 as a reference again, 2,502 million tonnes of waste were generated in the European Union, of which only 900 million, 36 %, were reused. In terms of the recycling rate by nation, there is great diversity, ranging between 5 and 80 % between countries (Eurostat, 2015).

In the case of Spain, according to the same statistical source, 111 million tonnes of waste were generated in 2014, 4.4 % of the EU total. This means that, according to data from the National Statistics Institute (INE), almost 50 million were treated in specialised waste management plants, of which 27 were destined for recycling, 20 for dumping and 3 for incineration (INE, 2015). In other words, in that year, more than 54 % of waste was recycled in Spain. While the European average that year was 36 %. Meaning that we were above average, but still wasting much of the resources in a context where raw materials are increasingly scarce and expensive. In addition, if we further analyse the evolution of the total number of tonnes

of waste and tonnes recovered, we observe two trends that are none too rosy. First, that in the last 6-year period there was an upturn in waste generation when supposedly, less and less waste derived from industrial activity should be generated. Second, that the tonnage of recovered waste has evolved exactly the same way. Therefore, we can interpret that certain waste being generated cannot be treated and managed or that there are no specialised plants in Spain for this purpose (chart 1)

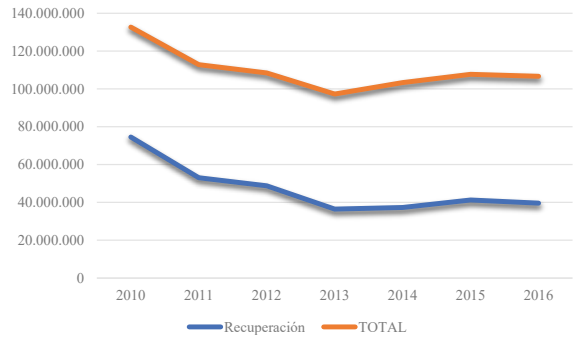


Chart 1. Evolution of the tonnes of waste generated and recovered in Spain between 2010 and 2016

Source: prepared by the author based on data from INE (2018)

We approach the Spanish Circular Economy Strategy within a context in which, at state, regional and local levels, there are already initiatives on which a circular economy model can be built coherently, as is the case in Galicia. Irrespective of the territorial scale, we can observe that in all initiatives the circular economy aims to concentrate its efforts at the beginning of the chain: in the design phase, to achieve product durability, reuse and recycling. In this context, government bodies are proposing different plans, such as the R&D&I State Programme, initiatives to support the development of cross-cutting technologies or innovation in processes and products (Ministry of Science, Innovation and Universities, 2019).

Nevertheless, not all sectors have the same potential to adapt to a model of circular production, consumption and reuse. Many sectors have already started to incorporate recycling practices that reduce demand for new raw materials and help alleviate the ecological deficit. However, we are still a long way from being able to establish a global circular economy model. In this sense, it is increasingly common to find circular economy models that specialise by sector and are modified and differentiated from others according to the resources they need and the waste they generate (Ministry of Economy, Industry and Competitiveness, 2018).

At present, we often find cases in which certain materials, which until recently were managed as waste, have become the raw material of new products that are introduced in the market, in the cosmetics, agri-food and bioproduct sectors.

A general weakness in the transition to the circular economy and one that should be avoided is that of burdening companies with new efficient processes that, in turn, can hinder their growth in size. As larger companies tend to have better productivity and a greater capacity to contract, invest and expand internationally. Perhaps, this is another downside inherent to Spanish business compared to other countries. Because at this time, the Spanish business network mainly includes smaller companies compared to the main countries of the EU and has a significant number of micro-enterprises. This characteristic of the small size of Spanish companies, which is due to various causes, translates into lower investment capacity, especially in R&D&I and into greater difficulty to undertake internationalisation projects. This diagnosis is the basis of the Business Growth Report published by the Ministry of Economy, Industry and Competitiveness in July 2017 (MINECO, 2019).

Another strong characteristic of the Spanish Circular Economy Strategy, in addition to having a multidisciplinary nature and aspiring to become the reference framework for government organisations, companies and citizens, is the implementation of a special planning procedure for a group of sectors which does not include the forest industry, such as: construction, agri-food, the industry as a whole, consumer goods and tourism (Ministry of Economy, Industry and Competitiveness, 2018).

Consequently, without entering into a detailed examination of the business structure of large companies in Spain by sector, we can observe a certain consistency that justifies the choice of these sectors to some extent.

All of the planning procedures of each of these sectors, in order to transition correctly to the circular economy, include a section that emphasises the need for the collaboration, participation and involvement of society as a whole, of government bodies, associations, all types and stages of economic activity such as manufacturing, production, distribution and waste management, social agents and consumers with the dual implication that they are the ones who decide what products they buy, and also what they do with the waste. Every one of the agents that are usually taken into account by economic geography to identify the industrial characteristics of a given territory,

regardless of their specific location in one place or another. However, being aware of the relationships they have with government agencies, other companies, associations and so on, is indeed a decisive factor.

3. The forest industry in Spain and its actions, to be included in the circular economy

Wood is a renewable, sustainable material that can be used, reused and recycled. Consequently, it is a key raw material for the model of transition towards a circular economy that promotes global competitiveness, sustainable economic growth and the generation of new jobs.

In addition, wood products are on the rise, in fact, the growth in demand for forest products is a reality. World production of main wood products is showing its greatest growth since the global economic crisis of 2008. Therefore, it is understood that the production of the main forest products (rolled wood, sawn wood, boards, pulp and paper) has recovered. At this time, the value of world trade in forest products amounts to 255 billion dollars, which represents a 3 % growth compared to 2013. The greatest growth is observed in the areas of Pacific - Asia, Latin America and North America. China stands out as a producer and consumer (FAO, 2019).

It is also important to know how forests are changing in the world, as the net forest area has increased in more than 60 countries and territories, most of which are in temperate and boreal areas. The greatest loss has taken place in the tropics, especially in Africa and South America. 93 % of forests are natural forests. However, the proportion of planted forests is on the rise. Forest plantations that are sometimes classified as 'bad' when actually one of the potentialities of wood and the forest industry is that we can create as much raw material as we consume, or more, as long as it is done in a responsible manner in accordance with the characteristics of the territory. But this is an idiosyncratic feature of wood compared to other highly consumed raw materials that are not renewable, such as gas or oil. Another characteristic on a global scale is the consolidation of new uses for wood, such as the energy sector, where wood is becoming the main source of renewable energy. The bioeconomy in relation to biomaterials, and new products such as laminated sheets, modified wood or high-quality products. However, wood could become a scarce commodity and appears to be following that path. For example, in Europe in 2030, it is estimated that there will be a wood deficit of 300 million m^3 (table 1).

	2010	2020	2030
Demand	825.5	1,145.4	1,425.4
Potential	993.9	1,048.4	1,109.4
Difference	168.4	-97	-316

Table 1. Evolution of wood production and demand estimates from 2010 to 2030 in Europe (in millions of cubic metres)

Source: prepared by the author based on data from Mantau (2012)

Therefore, territories that are capable of supplying wood will have a key role in the global circular economy. In fact, from two points of view; first, as producers of a scarce raw material and, second, as a possible future investment for certain territories with suitable characteristics for its production, such as Spain and Galicia.

In view of this scenario, the need for knowledge of the Spanish forest industry and its situation within the transition to a circular economy, if possible, becomes even more interesting.

Despite the fact, as indicated earlier, that the forest industry is not among the sectors initially selected within the sector planning procedures carried out by the Spanish Circular Economy Strategy. There are a series of actions that are being standardised, making the sector more sustainable and balanced between production and waste generation. In addition, the characteristics inherent to this industry and its main raw material wood make it one of the sectors with the greatest potential and options for a perfect transition to the circular economy. With the weakness that in Spain, small and medium-sized enterprises predominate within the forest industry and even the number of independent operators is significant (INE, 2019)

To give a brief explanation of the general characteristics of the forest industry in Spain, we have to state the obvious that the Spanish territory is predominantly forest. In fact, the forest area in Spain occupies 56 % of the total land surface, approximately 27.6 million hectares (SECF, 2019). In addition, this area is showing an annual increase of an average of 180,000 hectares as a result of two factors: reforestation carried out since the second half of the 19th century and the first half of the 20th century,

as well as the abandonment of rural areas since the 60s (20th century), and especially the agricultural and livestock activity. Together with the forest area, the number of trees, tree masses and therefore the volume of wood in Spanish forests is increasing at an average of 13-17 million m^3. Forestlands also represent the majority of protected territory in Spain: 40 % of forest area is protected and included in the Natura 2000 Network, which in figures represents more than 11 million hectares, out of a total of just over 15 million hectares included in the Network (SECF, 2019).

In short, most of Spanish territory is forest land, it is highly protected and its natural resources are increasing year on year, both in terms of surface area and supply.

Another current characteristic of forest areas is the change in values that forests are introducing in Spain, the recreational and environmental use of forests exceeding in economic terms the value of the direct goods generated. In fact, the III National Forest Inventory indicated that the socio-economic importance of forest externalities in recent decades could come to overtake the direct production of forests in certain areas of Spain (SECF, 2019).

The environmental policy in Spain has generally had a clear double effect on forest surface areas. On the one hand, it has progressed in limiting the use of forest spaces and conditioning traditional forest uses, with an orientation towards social demands that originated in urban areas, but without assessing the consequences, in terms of socio-economic development, which these limitations have for rural environments. In addition to the negative effect that the decrease in traditional uses has had on the ecological evolution of tree masses.

And on the other hand, we find that the crisis that affects the rural environment is causing a constant depopulation and demographic ageing since the middle of the 20th century. This change of model has affected mountain areas especially, mostly forest land. The preservation of existing forest activity and its promotion within the framework of a bioeconomy model would be one of the most effective policies for rural development in these areas.

Another associated problem is society's rejection of the use of certain forest resources (hunting, wood, fishing, eucalyptus tree, etc.), in particular if it involves the "death" of the tree or animal or non-native species. These are all respectable opinions, but not ones we share without question. We are more of the idea that it is necessary to analyse and study specific forest land and then propose the most appropriate and balanced use or uses according to the characteristics of that land. Rather than simply declaring that the eucalyptus tree or intensive wood production, for instance, are 'bad' actions to develop a land from an environmental and/or socio-economic viewpoint. The environmental education of recent decades has not proven to be as positive as expected and has remained more a catalogue of good intentions.

The number of studies that highlight the economic and social importance of the forest sector is vast and widely known. However, it is important to remember that the economy and employment dependent on the forest sector are essential for rural development in many areas of Spain with scarce economic opportunities, as is its processing industry.

In fact, in general, the turnover of the forest sector in 2016 was estimated at approximately 20,000 million Euros, with 130,000 employees in the primary and secondary processing industry and with more than 80,000 jobs in forests and forest-based activities. All this, not including an unspecified number of forest owners, that is much higher than one million people. These figures remained more or less stable throughout the 21st century, except in the period of the economic crisis that began in 2008, causing a collapse in forest products, with the fall in demand bringing a crash in prices. Although all of the country's sectors indeed suffered the crisis, the forest industry experienced a significant 'shock' because its performance rates were already well below its possibilities. However, in general, wood processing companies usually have the know-how and capacity to adapt to new market demands which give them certain potential compared to other sectors, as they enable them to overcome crisis periods such as the one mentioned (CONFEMADERA, 2019).

Another peculiarity of the Spanish forest sector is the diversity of its products, which can be classified into two broad categories: wood and timber products on the one hand, and non-timber products on the other.

Wood and timber products constitute the main sector in economic and employment terms, although it is highly diverse, with very competitive sub-sectors and sub-sectors undergoing a restructuring process or in need thereof. By group, we can establish:

A) Sawn timber: the crisis in the construction sector has defined its evolution, with a first period of expansion in

terms of business volume, but without undertaking, in general, the structural reforms required for modernisation. Following the crisis, the number of sawmills and the amount of sawn wood produced in Spain have declined and dependence on the packaging industry has increased compared to that of quality carpentry.

In addition, throughout the entire period, it has been impossible to compete with imports. The perspective in Europe is that of greater specialisation and added value of the product. Due to the scenario, the Spanish industry must establish a competitive strategy that enables greater production to be exported to Europe or other countries and not only manufacture sawn timber but also finished products with greater added value. In Galicia, this was the sub-sector that suffered the most with the economic crisis and many sawmills closing down for good.

B) Boards and veneer: although the outcome in Spain has been different depending on the type of board, the construction crisis resulted in a global manufacturing decline in the 2000-2015 period in most cases and decreased employment. The exception are boards intended for packaging, which has maintained its volume. Large export companies have come out of the crisis in better condition than small firms. There has been a slight improvement in recent years, with an increase in sales and short-term business in the domestic market. It should be noted that the leading board and veneer production company in Spain is located in Santiago de Compostela: FINSA S.A., which is also one of the best examples of how a wood processing company has adapted to new demands and markets. In fact, at present FINSA has departments producing all types of wood products (structures, floors, boards, etc.).

C) Pulp and paper: the sector has overcome the crisis picking up where it left off, in terms of turnover and is currently competitive at a level comparable to other European companies. More than half of Spanish production is short-fibre pulp with a strong dependence on exports. The demand for round wood is mainly from eucalyptus trees, which remains stable, and to a lesser extent from coniferous trees, with a declining trend. Paper production has increased and consumption figures have been maintained. It is mainly manufactured with recycled material, whose collection and use is clearly a dominant factor. The main challenges are to become a part of the circular economy, be recognised in terms of socio-economic importance by the authorities and society and solve the uncertainties surrounding co-generation. Again Galicia stands out from the rest of Spain due to the activity of the ENCE plant in the city of Pontevedra. At present, there is a lot of talk about this plant because it is in negotiations to obtain an extension to continue its activity; otherwise it will have to move to another place.

D) Forest biomass: due to the drop in oil prices and new regulations in the renewable energy sector, its development has been paralysed, mainly in power generation, although, in the case of thermal production it is maintaining constant growth. Given the great potential of the wood and firewood sector in Spain, in which harvesting is less than 40 % of growth, and its potential in the new bioeconomy, the future seems clear and favourable, although it demands clear political willingness and a stable framework. Galicia is home to many pilot experiences involving machinery prepared to harvest from the Galician forests the materials required to produce fuel for biomass plants. There were also initiatives to make it the energy source for public spaces and infrastructure. As well as the provision of biomass plants to cover and provide service to the entire territory of Galicia.

As for non-timber products, in general, these are productions at regional or local level, highly significant for the preservation of many rural areas, but that require specific policies for each of them:

A) Cork: production shows strong fluctuations, but with a declining trend in recent decades. It is also important to highlight the decline in quality and prices during the first decade of the 21st century. Soon, production in Spain should increase as a result of the reforestation carried out with the support of the CAP. Also, the market has no problems absorbing the increase in supply.

B) Resin: more than 80 % of production in Spain is concentrated in Castilla y León; it has also grown exponentially in recent years, from just 2,000 tonnes in 2010 to more than 12,000 tonnes in 2016. The decline in exports from China and the rise in prices for producers are the main causes of this change in trend. On the other hand, the raw material and derivatives deficit is highly significant in the EU, so there is ample scope to expand its development to new resin

extraction areas. Large Portuguese and Brazilian companies have entered the Spanish market in recent years.

C) Forest fruits:

- Pine nuts: production has declined significantly in recent years, as a result of diseases that are currently the most important limiting factor. The business sector is concentrated in the province of Valladolid and to a lesser extent in the provinces of Huelva and Córdoba.

- Chestnuts: production is affected by diseases. Production and the main processing companies are concentrated in Galicia (Lugo and Orense) and León, although there are also significant industrial centres in Extremadura and Andalusia. The sector's biggest problem is the fact that it is based on smallholdings. Product demand is growing and market prices are stable.

- Acorns: the most abundant fruit, which is distributed throughout Spanish forests. In addition to the relevant role it plays in extensive farming of Iberian pigs, it also a key food for other species of extensive livestock farming, as well as for wildlife. At this time, acorn supply is not enough to meet demand.

D) Forest pastures: the crisis affecting extensive livestock farming in Spain is causing a drop in use in many areas and the subsequent decline in surface areas. The drop in the prices received by farmers has made many livestock farms unfeasible and they are either closing down or being pushed towards intensive production.

E) Hunting: the increase in forest areas and rural abandonment has resulted in big game growing significantly in recent decades, to the point that there is a need for a stronger control policy over game species than is currently in force due to problems with the capacity of the natural environment to sustain populations. However, small game has declined due to the increase in predators (big game) and the disappearance of traditional agricultural ecosystems inherent to them; their numbers are currently maintained through artificial release of animals. The economy associated with this sector, mainly outsourced services, is very important for the preservation of rural environments.

F) Fungi and truffles: the mycology sector has grown remarkably and has great potential to continue doing so if its use is regulated. The estimated turnover of the mushroom sector amounts to 200 million Euros per year, although the actual amount is surely higher, as there are no transparent marketing channels and there is also a high percentage of self-consumption and local consumption. As for truffles, wild production is currently very small and what has indeed developed exponentially is truffle cultivation, the surface area has doubled and is concentrated in certain regions of the Iberian System.

Regarding the transition of the Spanish forest sector to the circular economy, it can be said that for 200 years, forest management has been an example of sustainability and balance between wood production and consumption. But at present, this raw material is involved in a series of interactions with other industrial activities that give it greater weight within the circular economy, such as the use of wood for construction instead of steel, aluminium and concrete. Something that has been happening for many decades in the US, Canada, northern Europe or Japan. Within the textile and fashion industry, the replacement of synthetic fibres with vegetable fibres. As well as the use of biodiesel and natural resins instead of oil. In addition, we should emphasise that forests present another endemic component compared to other land uses, which is their ability to absorb carbon. It is estimated that in Spain they can "recycle" 10 % of such emissions, helping to curb climate change or global warming, and contribute to water resource management and preservation, rural development, forest fire reduction and promotion of extensive livestock farming.

Based on this, there is an obvious need for a forestry policy to improve and increase the use of an underused resource. This evidence has been collected in another paper which closely relates to the circular economy, the Spanish Bioeconomy Strategy (Ministry of Economy and Competitiveness, 2016), which, in order to maximise the use of available renewable organic matter, suggests increasing the use of wood, bioenergy and biomaterials, and highlights its favourable effect on employment. Right from the start, they stress the fact that forests are the planet's main "biological infrastructure"; they are the largest sump of terrestrial carbon and the main terrestrial source of oxygen, water and biodiversity. In short, forests play a key role in ensuring the resilience of natural capital at local and global levels.

With regard to its situation within the circular economy, wood and other forest materials comply with the fundamental requirement of being renewable, reusable and recyclable raw materials, making them strategic within the circular economy of a country like Spain. In addition, these raw materials should preferably be located in the vicinity of production, processing and consumption centres, in order to reduce the use of fossil fuels and the transportation costs of the raw materials to such centres.

However, Spain is currently using its forest resources at a low and uneven rate (in the case of wood, not even 40 % of the annual growth of this resource is used). It is believed that increasing the sustainable management of forest resources distributed throughout the territory generates positive economic synergies, in addition to preventing the risk of forest fires and creating employment in the rural world, which in turn helps to combat the current deforestation process suffered by entire regions, most of them being predominantly forest-based. As can be seen clearly in Galicia.

The use of products obtained from forest raw materials managed according to sustainable methods reduces the need for the use of non-renewable raw materials and the enormous energy inputs required for their manufacture (concrete, steel, etc.). Current regulations regarding public contracts include the possibility of establishing environmental clauses in contracting procedures.

Within the wide range of activities included in the forest industry, one of the ones with a greater potential for growth, forest biomass, is being closely followed by different public and private organisations. As this source of energy is derived from forest resources and is a renewable source, cheap and neutral in terms of its contribution to the greenhouse effect. It can be obtained at short and medium distances, thus reducing transport costs and energy supplies. It is believed that this measure will produce significant savings in current maintenance costs of public buildings and homes, by replacing fossil fuels, and will contribute to avoiding an increase in emissions of air pollutants.

Regarding the situation of wood waste management in Spain, 1,200,000 tonnes of wood waste are produced annually. Of these, 290,000 tonnes/year correspond to wood packaging waste, of which 75 % have been recovered, 186,000 recycled and 30,000 recovered for energy purposes.

There are various types of wood waste:

- Off-cuts: pieces of wood of varying shapes and dimensions ranging from several centimetres to more than one metre. These are mainly generated in the secondary wood processing industry, carpentry and furniture factories.

- Sawdust and chips: sawdust is a powder that is generated during processing and cutting processes. Wood chips are slightly larger.

- Pallets: wooden pallets are horizontal platforms that are used to transport goods; the entire industry generates waste in the form of pallets. Although, for a number of years now, they have been reused as decorative features and even furniture (dining tables, bedside tables, etc.).

- Wooden containers: they can be small, such as fruit boxes, or large, such as those used to transport machinery.

- Furniture, doors, etc.: these are generally bulky and heavy waste. It is generated by people disposing of their furniture.

- Construction/demolition debris: wood is used in construction for form-work, beams, supporting elements, doors and windows, etc., which is usually discarded after its first use.

- Pruning waste: tree maintenance and upkeep, both in forests and urban centres; generate wood waste in the form of logs, branches and leaves.

- Reels: cables and hoses for large conduits are rolled up onto wooden reels which subsequently become waste once used. Although the amount is insignificant, like pallets, some are used as furniture.

- Treated wood: sleepers, lamp posts and so on that have received some kind of treatment for purposes of durability, resistance, etc., are more difficult to recycle.

Therefore it is clear that the forest industry in Spain is an activity that has great significance in terms of the environment, occupation of hectares, socio-economic elements relating to the operation of companies and the number of workers; and this raw material is both recyclable and renewable. And so it includes all the basic characteristics to make a “smooth” transition to the circular

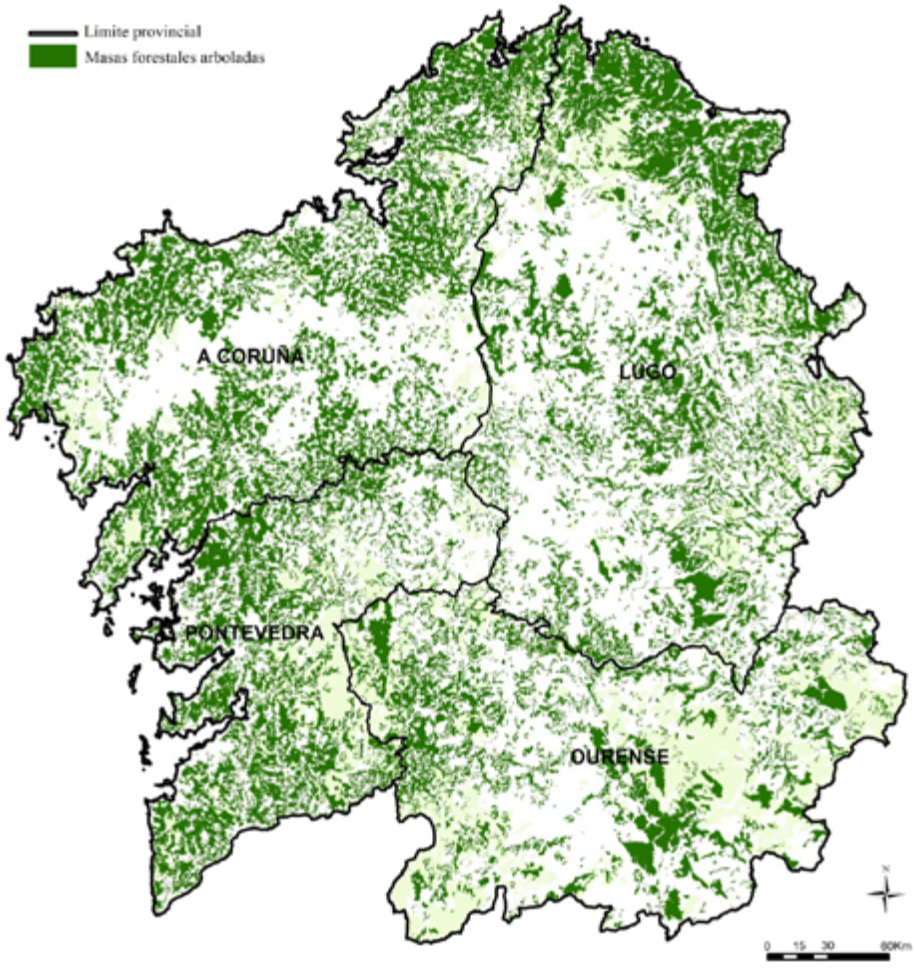
economy. Different groups, including the College of Forest Engineers, wood technology centres or national government, are considering actions towards the circular economy such as the focus on biomass, wood for construction or reforestation consistent with the characteristics of the territory. But perhaps in a biased, uncoordinated and even individualistic manner that does not follow the guidelines that from the outset indicate that for the development of a circular economy, the relationship between all agents (public and private) must be as fluid as possible.

4. What is the situation of the Galician forest within the circular economy?

We raise this question right at the end in order to analyse a case study and discover whether the territory where 50 % of the wood harvesting of all of Spain is carried out presents very different characteristics to those of the rest of the country in relation to the forest industry and the circular economy.

Forest area in Galicia has barely registered changes in the last twelve years, according to the IV National Forest Inventory. The Community has just over 2 million hectares of forest area of which 70 % is woodland, while 600,000 hectares are unproductive. The latter figure being a weakness that, well-managed, could provide the territory with an opportunity to increase its competitiveness within the forest industry and, even develop these areas hand-in-hand with the forest sector. As they correspond to mountain areas and depopulated spaces (map 1)

Regarding provincial distribution, although they are all significant, the eastern provinces, which in turn correspond to the least developed from a socio-economic viewpoint, are those with the highest number of forest hectares. A value that is ever more important as it gives the forest sector the possibility of generating wealth in these areas of marked rural character, except in the provincial capitals (table 2).



Map 1. Territorial distribution of the forest area in Galicia

Source: prepared by the author based on the IV National Forest Inventory (MAGRAMA, 2011)

	A Coruña	Lugo	Ourense	Pontevedra
Wooded areas	415,380	488,681	309,828	210,203
Non-wooded areas	86,205	168,160	265,435	86,785
Total	501,586	656,842	575,264	296,988

Map 1. Forest area in Galicia by province

Source: prepared by the author based on the IV National Forest Inventory (MAGRAMA, 2011)

Without the need to make a more thorough analysis of the Spanish forest industry here, it can be said that Galicia is the sector's driving force in Spain. As half of the harvesting of the whole of Spain is carried out in Galicia, even if it only represents 8 % of Spain's forest area. In terms of industrial activity, wood processing companies can be grouped into two groups according to activity. One, the companies that carry out primary processing of the raw material such as sawmills, manufacturers of veneer and board, as well as paper pulp. While the other group is formed by the companies that carry out secondary processing, namely, carpentry and furniture factories. In addition to being the place with the highest rate of harvesting, Galicia is also the autonomous community that accounts for almost 40 % of the primary processing industry of Spanish wood, divided into 43 % of national production of sawn timber, 33 % of board and 35 % of paper pulp. Although largely due to the activity of two large companies located in Galicia, FINSA, S.A. that specialises in board production (although it is becoming increasingly diversified) located in Santiago de Compostela, and ENCE that manufactures paper pulp in its factory in Pontevedra. While Galician secondary processing companies do not exceed 8 % of the total of Spain. This low percentage is caused, among other reasons, by tradition and connection to various sectors, such as tourism or construction, that "help" leverage other communities like Valencia or Catalonia within furniture manufacturing. However, it should be noted that in Galicia there are several large companies with important international activity furnishing hotels, shops or boats all over the world (CONFEMADERA, 2019). In fact, Galicia is the autonomous community with the highest exports of products from the wood processing industry in Spain, with a value exceeding 800 million Euros (ICEX, 2019).

Another significant value that shows the dynamism of the Galician forest industry is that between 2010 and 2017, wood harvesting numbers have been on the rise, reaching over 100,000 in 2017 (chart 2). This generated more than 420 million Euros in wood sales for the owners. An income that enables the improvement of the quality of life of many owners, mostly elderly people, in places where there few possibilities of procuring financial resources.

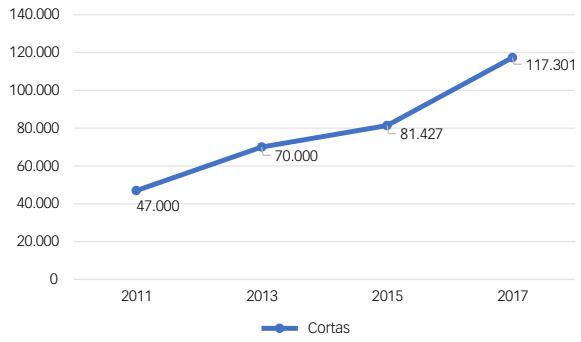


Chart 2. Number of forest owners who carried out tree harvesting from 2011 to 2017

Source: prepared by the author based on data from CONFEMADERA, 2019

As for turnover figures of the wood processing industry in recent years, it remains between 1,900 and 2,000 million Euros. With greater prominence of primary processing companies with an average of 1,500 million, and secondary processing at 400 million Euros. Based on this, the forest sector is a strategic activity for Galicia, according to the IGE (Galician Statistical Institute) representing 10 % of the industrial added value and 12.4 % of industrial employment. Also, in many cases, it is an industrial engine in rural municipalities of Galicia. For instance, in the local economies of more than 50 rural municipalities, the wood industry represents 30 % of its industrial activity (XERA, 2018).

In relation to the transitional phase of Galicia's economic structure towards the circular economy and, specifically, of the forest sector, we detect certain awareness regarding this matter and interest in its implementation, mainly from the Government. In fact, the regional government, the Xunta de Galicia, is drafting "A Estratexia galega de economía circular", a document that will promote energy efficiency and resource optimisation, as well as the processing of waste into new raw materials in order to prolong the life-cycle of products. For this purpose, the Xunta foresees an update in environmental and resource assessment regulations and will collaborate with SMEs

to promote investment in R&D&I initiatives, as well as strengthening awareness campaigns among the public, focused not only towards recycling but also towards responsible consumption.

Therefore Galicia's commitment to the Circular Economy is underway and proof of this is the recent designation of the Galician Government to coordinate, alongside Catalonia and Comunitat Valenciana, a working group on Circular Economy and European funds, created within the framework of the Network of Environmental Authorities of the Ministry of Agriculture and Fisheries, Food and Environment.

The European Commission included the circular economy on the environmental and economic agenda, through the EU Action Plan for the Circular Economy; therefore, Galicia must play an active role in this regard and propose initiatives that support this waste management model. In Spain, the Network of Environmental Authorities is the forum for cooperation and coordination between environmental authorities and those responsible for programming and managing community funds, at different administrative levels. In addition, the Xunta contacted the business sector specifically to seek their involvement in the implementation of the circular economic model and to promote measures to reduce and reuse waste.

As for concrete actions to adapt the forest industry to the circular economy, in addition to individual-scale actions of some of the large companies such as ENCE or FINSA. The "Consellería de Medio Rural" of the Xunta de Galicia aims to strengthen the quality of the Galician forest sector by certifying the wood harvested from publicly managed forests. Consequently, there is already an agreement between the Xunta de Galicia and those responsible for the forest certification model FSC (Forest Stewardship Council), an international non-governmental and independent non-profit organisation that aims to promote sustainable forest management that is respectful of the environment. The new «label» will inform consumers of the origin of the products marketed that come from sustainably managed forests. For this reason, as explained by the Regional Government, it is a tool for promoting the export of these added-value products.

Another action relating to the circular economy is the development of different power generation plants with biomass combustion. As well as the installation of several biomass boilers in certain public buildings. In addition to these public initiatives, biomass management and processing is present in Galicia (Miramontes and Alonso, 2011).

Finally, it should be noted that the Government, in collaboration with the CIS-Madeira (Galicia's Wood Industry Technological Centre), Galicia's wood cluster and the University of Santiago de Compostela, are developing different wood construction projects. In fact, a childcare centre and a healthcare centre have already been built using wood and there are other similar constructions underway.

5. Conclusions

Following this work, one of the clearest conclusions was to confirm that wood can be defined as the raw material of the future. Because its characteristics are those of a natural resource: recyclable, renewable, reusable and inexhaustible. It is also comfortable because it offers great thermal and acoustic insulation. Wood is healthy because it creates optimal environments. And sustainable and efficient in terms of product manufacture, requiring lower energy consumption. Given the technological development that it has experienced in recent years, overcoming many obstacles at construction level or enabling the development of innovative projects such as the construction of homes, childcare centres and healthcare centres in wood.

Therefore we are facing a unique opportunity for the forest sector and Galicia as a whole, to feasibly integrate one of its strategic sectors within the global circular economy. As the forest industry, in terms of any socio-economic indicator, has great significance within Spain and Galicia and, although various actions are being carried out to move the sector towards a circular economy. It is still in its initial stages. In any case, the conclusion that can be derived from all of this, at least from government bodies and the agents connected to the forest industry, is that we know the way forward.

Galicia has the best weather and terrain conditions for the production of forests, and thus, for obtaining these new forest products. Galicia has a production network with the capacity to efficiently manage a greater volume of forest resources.

The Galician processing industry has spent years supporting an efficient use of raw materials, through recycling and the use of by-products.

The same can be produced from biomass as from oil and in Spain, we have a vast amount of forest resources

evenly distributed throughout the territory. In turn, in Spain, we have the necessary technology to make the most of such resources, and therefore for this forest bioeconomy to occupy the position it deserves, it only lacks political impulse and a stable regulatory context enabling it to be put into operation. On a private level, 60 % of the energy consumed by Galician wood industries comes from the recovery of by-products and biomass.

Therefore, following this initial approach to the study of the Spanish forest industry and the case of Galicia in its transition to the circular economy, there are certain characteristics to be taken into account for future research. On the one hand, the fact that the forest industry is very important for the socio-economic structure of both Spain and Galicia. Furthermore, wood is a raw material that will shortly have even greater significance in terms of the development of certain activities, either linked to traditional wood processing or unrelated to it. Spain being a territory where forestry use is dominant. On the other hand, the Spanish forest industry and, especially that of Galicia, include characteristics that appear to be more suited to making a smooth transition towards a circular economy. Given that, as mentioned throughout this work, wood is renewable and recyclable, in addition to presenting other characteristics that are not found in other raw materials. However, we have seen that the steps that have been taken by the government to integrate this industry into the circular economy are still small and that any private initiatives have been carried out individually. Consequently, we find it scientifically interesting to remain alert to the changes that this industry will present in Spain and Galicia where different documents and regulations are being developed to properly manage the transition of the forest industry towards the circular economy. In addition to this preliminary assessment, we also conclude that the way forward is known, we are aware of the need for all agents to be integrated, to look for all the uses of the raw material, its recycling phases, etc.

To conclude, we include a consideration made more than 25 years ago, in which we find similarities with the pioneering circular economy: "The stewardship and use of forestlands in a way and at a rate that maintains their productivity, biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil now and in the future relevant ecological, economic and social functions at local, national and global levels and that does not cause damage to other ecosystems" (Ministerial Conference on the Protection of Forests in Europe, Helsinki, 1993)

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Methodology for the identification of the degree of consolidation of urbanised land in the coastal strip of the Comunitat Valenciana. Hypothesis for a shrinking urbanism*

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Abstract

In recent years we have experienced an intense process of urbanization in Europe that has had special intensity in the Mediterranean regions. The Comunitat Valenciana, and especially the strip that makes up its coastline, is a good example of this increased activity with the coexistence of thousands of tourists who visit us every year or who establish their residence on these coasts. But this expansive growth has stumbled on the economic crisis that began in 2008 and has led to an unprecedented sluggishness in the markets. We are faced with new scenarios where planning can become de-growth just like new construction in renovation. This research offers a methodology of quantitative analysis of remote sensing with a supervised classification process and the use of cadastral bases, to identify the degree of occupation and real development of the urbanisable land located on the coastal strip, thus assessing the consequences that the reversion of some of these soils to their initial condition could have.

Keywords: growth; decrease; urban planning; Mediterranean coastline; methodology

1. Introduction

Urbanisation processes in the coastal area of the European Mediterranean have been particularly intense in recent years (Vera, 1988; García-Bellido, 2005; Fernández, 2006; Martí & Nolasco, 2011; Membrado, 2011; Ponce & Martí, 2011). In the peak period of the property bubble, between 2000 and 2006, around 1 000 km2 of land was consumed annually on the continent (EEA, 2010). In Spain, the rate of growth was very high, highlighting the regions of the Mediterranean coast, with an intense tourist use and a weight of the construction sector and the market for second homes very prominent. Within this area, the case of the Comunitat Valenciana can be taken as paradigmatic of a process of economic development based on clearly unsustainable construction. Documents such as Recommendation 2002/413/EC on Integrated Coastal Management in Europe, the "Auken Report" of the European Parliament, or "A toda costa" (2018) by Greenpeace coincide in expressing their concern about the impact of extensive urbanisation in Spain, placing special emphasis on the situation of the Comunitat Valenciana. As Rullán (2011) comments, the analysis of the building that

has received such an enormous amount of urbanization has been able to be accounted for thanks, especially, to the statistics provided by Colleges of Architects and by the Ministry of Housing (see Burriel, 2008; Fernández Durán, 2006; Gaja, 2008, Miralles, 2014 among others) and from cement consumption records (Rullán, 2008: 603-5).

This phenomenon of overexploitation and overoccupation did not arise precipitously, but was the result of a long sequence of 60 years that today can be analyzed. Some approximations speak of three expansive economic cycles, associated with three real estate bubbles (Miralles, 2014). These cycles are detailed in five phases according to the proposal of Blázquez *et al* (2019): The Spanish tourist miracle as an example of an accelerated growth process (until 1975); the decentralisation of policies and the first impulse to protectionist measures (1975-1989); the restructuring of destinations: planning of initiatives without the capacity/will to carry out structural transformations (1990-1997); the urbanizing tsunami and the debate on tourism models (1998-2007); the crisis as a catalyst for neoliberal approaches (2008-2014); instruments to contain growth and new intervention mechanisms to cope with tourism saturation (from 2014 to the present). After the urban tsunami (García, 2005; Fernández, 2006; Gaja, 2008; Fernández & Cruz, 2011; Górgolas, 2019), the consequences have been disastrous in many cases. Some are more visible today than others: future urban sectors half finished, urbanization without buildings, skeletons of buildings and empty estates, etc. The bubble has also had effects on the urbanism of the city councils, generating important expectations of growth that have oversized the real capacity of the demand. Many plots have been reclassified as developable and today remain empty in a large percentage without expectations of transformation. In other cases, the land has come to be developed, but not built, assuming a significant cost for the municipal coffers that must maintain and conserve a space without use, but ownership.

Following the work of Rullan & Artigues (2007); Rullán (2011) and Blázquez *et al.,* (2019), on the measures implemented by the territorial administrations of the autonomous communities of the Spanish Mediterranean coast in terms of activity containment, especially in the upward phases of the cycles, there seem to be three groups: One of these measures simply blocks the reclassification of a specific part of undeveloped land to other types of land; others limit quantitatively, without mapping, the amount of land that can be classified as developable; while some others directly reclassify land from developable to undevelopable. In the case of the coastal strip of the Comunitat Valenciana, after Decree 58/2018 May 4, the Consell, which approves the Territorial Action Plan of the Green Infrastructure of the Coast of the Comunitat Valenciana (PATIVEL) and the Catalogue of Beaches of the Comunitat Valenciana, we are in the case of blocking the reclassification of part of the undevelopable land and reversal of land for development to undevelopable. This measure is similar to the one carried out in 2005 in Catalonia with the Urban Master Plans of the coastal system. In the Catalan case, 2 plans were developed (Nel.lo, 2010) whose ultimate consequence was that they reclassified to coastal undeveloped land only 1174 hectares of developable land (862 undelimited and 312 delimited, but without partial plan approved). In other words, the two Catalan coastal plans declassified 17 % of the total land available for development, then, the coastline (Rullan, 2011).

In this context, in recent years, reflection on the idea of Shrinking cities, degrowth or urban retraction has burst onto the scene. In the discipline there is not a very consolidated agreement on the precision and use of these terms, based on this paper to fix its definition, in the works of Fernández & Cunningham-Sabot (2018). In them it is clear the affirmation that the exhaustion of the model of unlimited growth has led to the search for alternatives to the urban form that the crisis has taken in Spain (vacant dwellings, neighbourhoods built with hardly any inhabitants, urbanised or planned land without execution or simply classified as urbanisable by urban planning), introducing new meanings to the term degrowth. We find urban plans that propose a "degrowth model" (as opposed to the disproportionate growth of recent years) to describe a decrease in the area of land for development with respect to current urban planning or a declassification of land (not developed) linked to adjusting development forecasts to the real needs of urban growth (Fernández & Cunningham-Sabot, 2018).

The last amendment of 21 February 2019 of Law 5/2014 of 25 July on Land Use, Urban Planning and Landscape, maintains the classification of land in urban, urbanizable and non-urbanizable. The aim of this work is to apply an automated method of identification of the degrees of consolidation of urbanized land in the coastal strip of the Comunitat Valenciana. For this purpose, the 61 coastal municipalities of the Community are analysed (figure 1). The hypothesis behind the research is based on the assertion that not all developable land has the same degree of consolidation, manifesting different urban

Figure 1. Provincial division, coastal comarcas and coastal municipalities under study
Source: Prepared by the authors, 2019

scenarios. In turn, not all areas of the territory have the same conditions and probabilities of transformation over time of these soils for consolidation as urban, which justifies the interest in knowing the different modalities of cases, their magnitude and location.

2. Land use in the Comunitat Valenciana

In the Comunitat Valenciana, the Territorial Action Plan of the Coastal Green Infrastructure (PATIVEL) has conducted an exhaustive analysis of the urban situation in which are the land affected by the Plan. This information has been collected taking into account the state of urban planning of each sector, both in urban land and developable within the scope of connection summarized in the following table 1:

In total, ten have been identified ten different situations depending on the degree of development and management in which each of the soils is found. Without a doubt, the work carried out is exhaustive and allows us to know the legal and administrative situation of each one of the soils, although it requires a complete municipal consultation that becomes outdated with the passage of time. This has been done to support the PATIVEL.
The measurement methodology proposed in this article does not allow to know the legal situation with such accuracy and supposes an approximation to the real measurement of the surfaces. However, it guarantees an easy update in time and allows a scalar extension to the whole Comunitat Valenciana, question, from our point of view, of special interest. In order to carry out this working hypothesis, a methodology of quantitative analysis of remote sensing with a supervised classification process was used. The method used is structured according to the following sequence: a) calculation through remote sensing of the Normalized Difference Vegetation Index (NDBI); b) combination of the results with the construction layer of the Cadastre (urban and rural); c) supervised qualification process. This concatenation of sequences allows us to

SUELO URBANIZABLE									
SECTOR	01.SIN ORD. PORMENORIZADA	02. OP EN TRAMITACIÓN	CON ORDENACIÓN PORMENORIZADA					VIGENTE	RESUELTO
			03.SIN PAI	04.EN TRAM	CON PAI APROBADO				
					05.SIN REPARCELACIÓN	CON REPARCELACIÓN			
						06.SIN OBRAS DE URBANIZACIÓN	07.CON OBRAS DE URBANIZACIÓN		

Table 1. Situation of land for development in the coastal strip of the Comunitat Valenciana
Source: PATIVEL, 2014

classify the urbanizable soils according to the following categories: with vegetation; without vegetation; asphalted surfaces; built surfaces, establishing from the result, a set of quantitative valuations and conclusions.

From the point of view of the date of analysis and the temporality of the data, reference information has been used for 2018. The following sources were used:

- Territorial boundaries. Extracted from the Reference Cartography of the Valencian Community through the Valencian Cartographic Institute (ICV) with publication date 18/02/2018 for the Regions. Extracted from the Central Registry of Cartography of the National Geographic Institute (IGN) for the municipal delimitations.

- Urban planning information: Current urban planning of the Comunitat Valenciana, based on the urban planning approved by the Territorial Urban Planning Commissions. The scales are between 1:5.000 and 1:25.000.

- INSPIRE Cadastral Information: According to the INSPIRE Data Specification on Buildings (Technical Guidelines 3.0), a building is considered to be any construction, superficial or subterranean, with the purpose of housing people, animals and things, or the production and distribution of goods or services and that are permanent structures in the land. to be able to use as reference all the buildings, both rustic and urban that the Cadastre has recorded.

- Information on land use: SIOSE (Land Occupancy Information System in Spain) for the year 2014.

- Satellite images: Mosaic Image Sentinel-2 of 10 meters resolution. Geographical area where it is located: Comunitat Valenciana. (Spain). Date obtained: 24 August 2018. Reference systems: ETRS89. Projection systems: UTM huso 30N. Processing level: Level-1C

- Photographic images: Orthophoto RGBI and RGB of the Comunitat Valenciana at 25 cm resolution. Flight date: 13/06/2018 to 30/07/2018. Reference systems: ETRS89. Projection systems: UTM huso 30N. Storage formats: ECW (RGBI - 4 bands) and TIFF (RGB - 3 bands). Color depth: 8 bits per band. Provinces of Castellón and Valencia as part of the PNOA 2018 project. Publication date: 13/09/2018

The study was carried out on land polygons classified as urbanisable in urban planning according to the cartography available for it in the Valencian Cartographic Institute (ICV). Therefore, the results and discussion carried out in this section do not correspond to the whole territory of the Comunitat Valenciana, but exclusively to the pockets of developable land located in coastal municipalities.

3. Findings

3.1. First Stage. Analysis of satellite images. Calculation of NDVI and NDBI indexes

In this first stage of application of the methodology, we have worked with several indexes of images trying to select those that identified with the highest possible quality, the types of soil object of attention in the study. Image indexes can be defined as derived images that are calculated from other multi-band images. The resulting images highlight a particular phenomenon that is present and attenuate other factors that degrade the effects of the image. We first used the Normalized Differential Vegetation Index (NDVI) (Rouse *et al*., 1974). This index is based on the peculiar radiometric behaviour of the vegetation, related to the photosynthetic activity and foliar structure of the plants, allowing to determine the vigorousness of the plant. The NDVI values are a function of the energy absorbed or reflected by plants in different parts of the electromagnetic spectrum. The spectral response of healthy vegetation shows a clear contrast between the visible spectrum, especially the red band, and the Near Infrared (NIR).

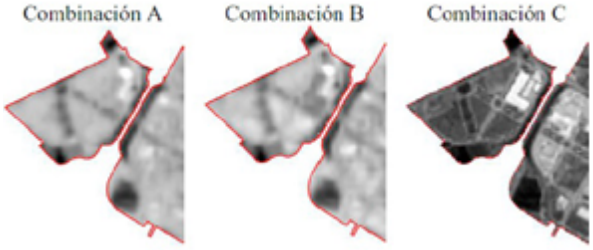


Figure 2. Detail of the application of the NDBI index. Combination A (Bands 12 and 8A); Combination B (Bands 11 and 8A); Combination C (Bands 2 and 8). Detail of the region of L'Horta Oest

Source: Socorro, 2019

This index has been a reference point to work with another index of similar characteristics, but with a better result for urban analysis (Vigneshwaran, S., & Kumar, S. V., 2018). As Beers (2019) comments, the NDBI, or Normalized Difference Index of Buildings, allows the estimation of zones with built surfaces or in construction development as opposed to the habitual naturalized zones with vegetation or naked. In Vigneshwaran, S., & Kumar, S. V. (2018) it is stated that the

analysis of the different combinations of bands revealed that band-2 (blue) and band 8 (NIR) were good for extracting built-up areas compared to other possible combinations. It was shown that when the index value ranged from -0.29 to -0.09, the index value indicated the built-up areas and they were clearly distinguishable in comparison with other land cover. (figure 2). In our practical experience we have been able to confirm this assertion because after testing with the 2 most common combinations (A and B), clearly the combination C, supported by the previous authors, offered a much better quality result.

3.2. Second Stage. Use of cadastral cartography to improve the definition of built-up áreas.

The next step in the analysis consisted of assessing whether cadastral mapping, globally or selectively, could help to improve the identification of built-up areas. Thanks to the use and disposition of the INSPIRE Building layer of the Cadastre, it is possible to have a continuous cartography of all the analyzed territory, with all the buildings both rustic and urban of the coast of the Valencian Community registered by the General Direction. In addition, this information can be consulted in function of time, for which reason this information has been valued according to the time bracket of the study. The working hypothesis was based on the idea that the NDBI index layer could improve the quality and precision of the results if it was combined with the building obtained from the Cadastre, for the same date of analysis. This process forced to rasterize the vectorial layer of the Cadastre establishing as geometric resolution (pixel size 10 m), in such a way that all those lower edified surfaces would be despised. The result obtained was highly positive since it completed the original photographic identification as can be seen in figure 3:

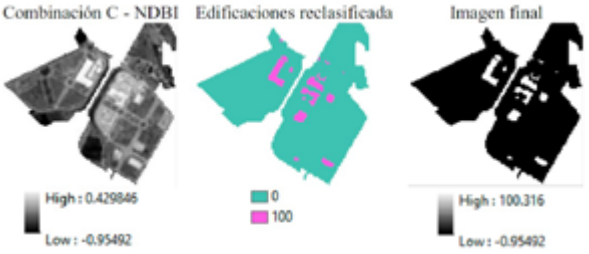


Figure 3. Detail of the combination of the NDBI index and the buildings of the INSPIRE Cadastre

Source: Socorro, 2019

3.3. Third Stage. Supervised classification process for identifying the nature of soils

At this stage, a supervised classification of the result of the combination of the NDBI index with the INSPIRE Cadastre's reasterized building layer has been carried out. By means of a spatial statistical procedure, the aim is to identify a set of categories that we have previously defined according to the interest of the study. In our case, the proposed classification was as follows:

- Soil with vegetation: where the orchards and vegetable lands will be contemplated as forests and shrubs, and therefore without earth movements.
- Soil without vegetation: where those lands that do not have vegetation or whose orchards are uncultivated will be contemplated. Soils that have been altered by some type of human activity will also be detected in this class.
- Asphalted soils: soils that have asphalt and urbanization such as roads, streets or parking areas and paved.
- Built land: areas of the land with built buildings.

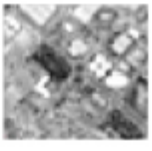
Tipo de suelo	Índice NDBI	Ortofoto	Tipo de suelo	Índice NDBI	Ortofoto
CON VEGETACIÓN			ASFALTADO		
SIN VEGETACIÓN			EDIFICADO		

Table 2: Examples of soil types for the supervised classification

Source: Socorro, 2019

The identification procedure of the categories consists of a process of "training" or learning by similarity carried out with the software of work on the orthophoto of reference year 2018. The sample collected represents 15,200 pixels of each class. Given that the pixels used are of square geometry and size of 10 meters we would be talking about a sample of 10*10*15.200 = 1.500.000 square meters (150 ha) for each type of soil.

3.4. Fourth Stage. Checking the reliability of the method used

In order to verify the reliability of the method used in the analysis is reliable, a series of random tastings or checks were carried out for each province. Specifically, 3 intentionally distant and different zones were selected for each province. In each of them, a manual identification was made by observation of the 2018 orthophoto, classifying the soils in the four categories proposed in the third stage of the study. This manual classification was contrasted with the automatic classification obtained by the proposed method and the results were discussed. The classes that can be observed in tables 3 follow the following codification:

- Soil with vegetation: code 1, colour green
- Soil without vegetation: code 2, light yellow
- Asphalt soils: code 3, colour grey
- Built environment: code 4, colour red

As a result of table 3 we can make the following comments regarding the reliability of the method. If we look at Zone 0 and Zone 8, we can see marked in red numbers, a significant difference in relation to Class 4 (C4) corresponding to the building. In the manual method, buildings are identified that have not been detected in the automatic process. The difference in results is not due to an error that invalidates the method but to the chronological difference and update between the 2018 orthophoto and the INSPIRE Cadastre layer. Although in the orthophoto, by means of the manual method, the construction of buildings is distinguished by observation, in the automatic method, the non-identification of these buildings by the Cadastre, points out the difference. In the rest of the areas it is not possible to perceive a significant difference except in classes 1 and 2 (C1 and C2). These classes refer to vegetated soils and unvegetated soils, including orchard areas. Again in this case, the error has to be pointed out in the difference in the date of data collection between the Sentinel photos (late August) and the PNOA orthophoto (June/July), showing differences in fields that were not cultivated before and were later.

We therefore consider that the method of identification is valid, although it is important to have updated starting data and dates as close as possible to minimize the errors produced by a comparison of spaces with changes.

4. Discussion

4.1. Methodological discussion

The methodology of spatial analysis with GIS tools used in this research constitutes a technique already consolidated in the territorial analyses carried out in both geographical and urban analyses (Chuvieco, Bosque, Pons, Conesa, Santos, Gutiérrez, Salado, Martín, de la Riva, Ojeda and Prados, 2005; Temes & Moya, 2016).

Specifically, we can contrast the methodology of quantitative analysis of remote sensing with the supervised classification process used in this study, with other methods of photointerpretation used for similar purposes (Villar & Ojeda, 2012; Oriol, 2015). The main advantage offered by the method used in this work is the use of a semi-automatic analysis process that allows reproduction in other areas. Once the phases of the exposed method have been consolidated and the sources identified, the process can be replicated in other areas, thus offering the opportunity for contrast and comparison. On the other hand, being a method based on an image identification algorithm, we guarantee the homogeneity of criteria in all the treated orthophoto. However, as a deficit with respect to the method of photointerpretation we have the least precision in the identification of polygons linked to a type or class of soil. To this lower precision is added the difficulty of identifying changes in a diachronic analysis. In the case of photo-interpretation analyses, as Villar & Ojeda (2012) commented, topological consistency can be guaranteed without modifying the limits of pre-existing polygons. Another difficulty to be overcome refers to the necessary homogeneity in the analysis of different orthophotos. The use of our identification algorithm is sensitive to the existing chromatic range in the reference orthophoto, which makes it necessary to coordinate the chromatic

ZONA 0					
CLASE	MANUAL	%	AUTOMÁTICO	%	DIF
1		11.30		3.64	-7.66
2		53.63		60.12	6.49
3		29.73		36.24	6.51
4		5.34		*0.00*	*-5.34*

ZONA 1					
CLASE	MANUAL	%	AUTOMÁTICO	%	DIF
1		26.34		17.63	-8.71
2		53.77		66.48	*12.70*
3		18.74		15.52	-3.22
4		1.15		0.38	-0.77

ZONA 2					
CLASE	MANUAL	%	AUTOMÁTICO	%	DIF
1		35.94		40.47	4.53
2		29.29		25.35	-3.94
3		21.58		22.25	0.67
4		13.18		11.93	-1.26

ZONA 3					
CLASE	MANUAL	%	AUTOMÁTICO	%	DIF
1		4.46		6.86	2.39
2		27.37		30.46	3.09
3		52.95		53.72	0.77
4		15.22		8.97	-6.25

ZONA 4					
CLASE	MANUAL	%	AUTOMÁTICO	%	DIF
1		59.27		41.04	*-18.23*
2		39.73		58.32	*18.59*
3		0.78		0.53	-0.25
4		0.21		0.11	-0.10

ZONA 5					
CLASE	MANUAL	%	AUTOMÁTICO	%	DIF
1		3.59		6.05	2.45
2		56.02		56.45	0.43
3		36.47		36.05	-0.42
4		3.92		1.45	-2.46

ZONA 6					
CLASE	MANUAL	%	AUTOMÁTICO	%	DIF
1		9.80		6.93	-2.87
2		18.15		29.89	*11.74*
3		40.64		39.42	-1.22
4		31.41		23.76	-7.65

ZONA 7					
CLASE	MANUAL	%	AUTOMÁTICO	%	DIF
1		0.00		0.18	*0.18*
2		23.03		26.36	3.33
3		49.21		47.60	-1.61
4		27.77		25.87	-1.90

ZONA 8					
CLASE	MANUAL	%	AUTOMÁTICO	%	DIF
1		86.95		81.72	-5.24
2		1.33		16.92	*15.59*
3		11.34		1.37	-9.97
4		0.38		*0.00*	*-0.38*

Table 3: Comparison of selected cases by manual and automatic method

Source: Socorro, 2019

range well from the beginning in order to avoid distortions in the results. On the other hand, in a similar way to the works of Oriol (2015) in our study we also started from the previous identification of a urban planning layer made, this time by the ICV. In our case, this layer allowed us to concentrate the analysis strictly on these polygons, saving time and reducing errors in the identification process.

4.2. Contextualisation of the results in the Comunitat Valenciana

The territorial approach to the whole of the Community divided into provinces and counties, was a first step to be able to assess, a posteriori, if the situation in general contrasted with the coastal area. tables 4-5-6 and figure 4 summarise the datas

COMARCA	ÁREA TOTAL	Área C1	C1 %	Área C2	C2 %	Área C3	C3 %	Área C4	C4 %	Total %
TOTAL Comarca 26	6,244,733.58	2,152,793.05	34.47	2,857,450.10	45.76	992,893.37	15.90	241,597.07	3.87	100
TOTAL Comarca 27	16,451,028.27	4,169,019.07	25.34	7,989,714.17	48.57	3,589,852.01	21.82	702,443.03	4.27	100
TOTAL Comarca 28	8,797,624.02	1,049,670.04	11.93	5,372,575.15	61.07	2,050,017.78	23.30	325,361.04	3.70	100
TOTAL Comarca 29	28,567,515.23	3,204,926.49	11.22	14,232,023.87	49.82	9,609,748.45	33.64	1,520,816.42	5.32	100
TOTAL Comarca 30	53,004,508.06	25,340,537.70	47.81	20,114,411.20	37.95	5,956,461.68	11.24	1,593,097.49	3.01	100
TOTAL Comarca 31	55,314,667.57	15,015,859.19	27.15	28,602,256.85	51.71	10,037,077.44	18.15	1,659,474.09	3.00	100
TOTAL Comarca 32	39,486,521.01	3,787,312.64	9.59	18,924,385.78	47.93	14,632,026.89	37.06	2,142,795.71	5.43	100
TOTAL Comarca 33	33,154,186.05	2,554,591.09	7.71	19,469,023.40	58.72	9,366,484.42	28.25	1,764,087.14	5.32	100
TOTAL Comarca 34	83,921,515.37	8,370,457.67	9.97	36,878,447.06	43.94	32,134,092.69	38.29	6,538,517.95	7.79	100

PROVINCIA	Área Total (ha)	Área C1 (ha)	C1 %	Área C2 (ha)	C2 %	Área C3 (ha)	C3 %	Área C4 (ha)	C4 %	Total %
Alicante	32,494.23	6,564.52	20.20	15,444.03	47.53	8,836.87	27.20	1,648.82	5.07	100

Table 4: Summary of soil classes Province of Alicante

Source: Prepared by the authors, 2019

COMARCA	ÁREA TOTAL	Área C1	C1 %	Área C2	C2 %	Área C3	C3 %	Área C4	C4 %	Total %
TOTAL Comarca 1	302,458.09	47,837.73	15.82	152,450.56	50.40	71,080.46	23.50	31,089.35	10.28	100
TOTAL Comarca 2	361,062.48	190,173.11	52.67	148,211.65	41.05	15,250.68	4.22	7,427.04	2.06	100
TOTAL Comarca 3	67,625,302.97	32,427,226.60	47.95	31,866,059.24	47.12	2,521,505.01	3.73	810,512.12	1.20	100
TOTAL Comarca 4	3,668,496.03	1,460,681.75	39.82	1,736,531.24	47.34	349,537.38	9.53	121,745.66	3.32	100
TOTAL Comarca 5	43,179,116.76	20,058,027.03	46.45	17,651,407.66	40.88	4,027,393.44	9.33	1,442,288.64	3.34	100
TOTAL Comarca 6	41,423,362.00	16,035,866.95	38.71	15,156,470.48	36.59	7,567,657.00	18.27	2,663,367.57	6.43	100
TOTAL Comarca 7	7,555,624.18	2,469,026.41	32.68	3,951,305.85	52.30	898,228.20	11.89	237,063.72	3.14	100
TOTAL Comarca 8	418,192.19	302,751.53	72.40	91,354.94	21.85	18,537.18	4.43	5,548.54	1.33	100

PROVINCIA	Área Total (ha)	Área C1 (ha)	C1 %	Área C2 (ha)	C2 %	Área C3 (ha)	C3 %	Área C4 (ha)	C4 %	Total %
Castellón	16,453.36	7,299.16	44.36	7,075.38	43.00	1,546.92	9.40	531.90	3.23	100

Table 5: Summary of soil classes Province of Castellón

Source: Prepared by the authors, 2019

COMARCA	ÁREA TOTAL	Área C1	C1 %	Área C2	C2 %	Área C3	C3 %	Área C4	C4 %	Total %
TOTAL Comarca 9	214,723.96	118,411.70	39.77	84,663.79	39.43	9,578.80	4.46	2,069.67	0.96	85
TOTAL Comarca 10	5,241,817.80	1,238,928.93	23.64	3,193,478.51	60.92	645,013.10	12.31	164,397.26	3.14	100
TOTAL Comarca 11	52,069,974.01	14,353,871.18	27.57	26,461,921.93	50.82	8,517,499.58	16.36	2,736,681.32	5.26	100
TOTAL Comarca 12	22,543,960.41	7,263,670.48	30.13	10,798,390.08	49.80	3,888,205.32	18.40	593,694.53	1.67	100
TOTAL Comarca 13	10,716,720.58	2,971,690.02	27.73	4,474,514.15	41.75	2,431,310.06	22.69	839,206.36	7.83	100
TOTAL Comarca 14	15,170,856.59	3,114,156.41	34.39	6,253,352.91	36.47	4,088,701.57	17.04	1,714,645.70	0.97	89
TOTAL Comarca 15	7,900,320.73	1,360,251.00	17.22	2,833,090.21	35.86	2,900,789.45	36.72	806,190.07	10.20	100
TOTAL Comarca 16	8,999,928.53	2,739,632.30	30.44	3,133,049.15	34.81	2,381,422.42	26.46	745,824.66	8.29	100
TOTAL Comarca 17	11,830,520.16	5,038,176.40	42.59	5,946,541.82	50.26	657,506.77	5.56	188,295.17	1.59	100
TOTAL Comarca 18	21,377,579.42	7,922,026.44	37.06	10,664,005.97	49.88	2,309,300.98	10.80	482,246.02	2.26	100
TOTAL Comarca 19	2,729,289.75	919,736.96	33.70	1,686,643.46	61.80	96,801.63	3.55	26,107.70	0.96	100
TOTAL Comarca 20	32,723,918.12	14,476,741.61	44.24	11,207,591.39	34.25	5,219,063.10	15.95	1,820,522.01	5.56	100
TOTAL Comarca 21	9,633,530.59	3,428,276.53	35.59	2,894,792.89	30.05	2,343,012.71	24.32	967,448.46	10.04	100
TOTAL Comarca 22	2,147,188.99	886,068.39	41.27	1,028,654.38	47.91	192,152.82	8.95	40,313.40	1.88	100
TOTAL Comarca 23	11,651,977.48	4,190,065.24	35.96	4,434,235.78	38.06	2,416,901.75	20.74	610,774.72	5.24	100
TOTAL Comarca 24	23,397,696.40	6,093,629.35	26.04	10,640,139.13	45.48	5,177,736.39	22.13	1,486,191.52	6.35	100
TOTAL Comarca 25	23,454,335.86	11,008,376.80	46.94	6,243,391.28	26.62	4,781,785.21	20.39	1,420,782.57	6.06	100

PROVINCIA	Área Total (ha)	Área C1 (ha)	C1 %	Área C2 (ha)	C2 %	Área C3 (ha)	C3 %	Área C4 (ha)	C4 %	Total %
Valencia	26,180.43	8,712.37	33.28	11,197.85	42.77	4,805.68	18.36	1,464.54	5.59	100

Table 6: Summary of soil classes Province of Valencia

Source: Prepared by the authors, 2019

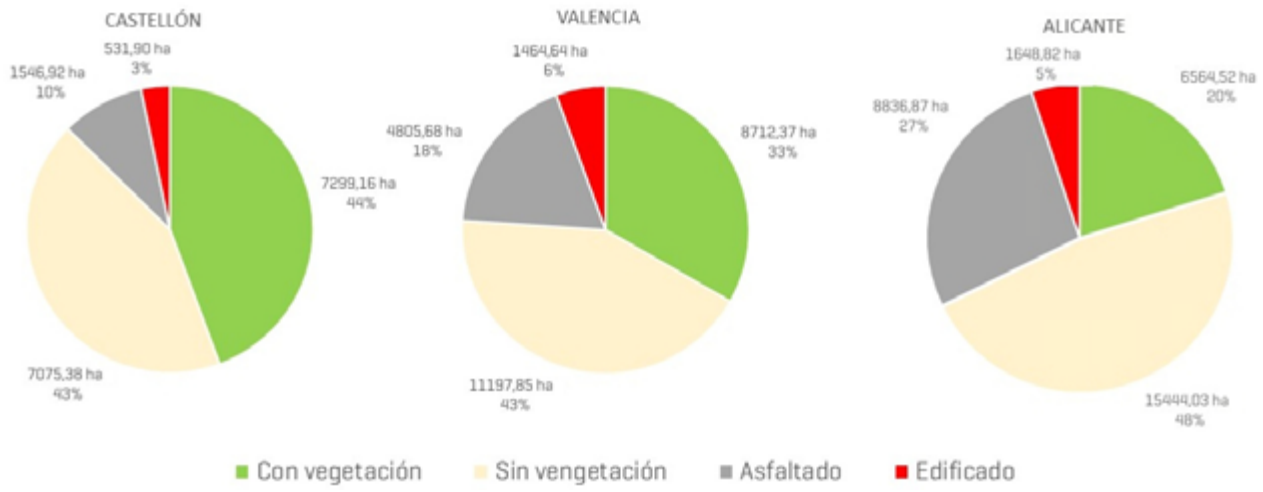


Figure 4: Pie charts with the proportion of land classes by province within the developable land

Source: Prepared by the authors, 2019

From these data we can deduce that in the province of Castellón there is a predominance of soils that can be developed without any type of treatment or intervention (C1: with vegetation), followed by soils without vegetation, but neither urbanised (C2: without vegetation). Between the two it represents 87 % of the developable land. This figure responds well to the dynamics of land transformation and real estate activity typical of the Valencian provinces. In the opposite situation, pointing also to the greater dynamism in the market, especially due to the weight of tourism, we can observe the province of Alicante. Against is the province of Alicante, given opposite situation, also pointing to the greatest dynamism in the market, especially by the weight of tourism, proof of this is that we can see the province of Alicante. In it we find a greater proportion of developed land for development is with 32 % (C3: Asphalted land, C4: built land). In an intermediate situation, the province of Valencia stands out for being the one with the highest built occupancy in urban land with 6 %, while the total developed land add up to 24 %. In summary form we can say that 23 % almost ¼ of the urbanizable lands of the Valencian Community have been transformed (23 %) are to date 2018 transformed, leaving the rest without urbanization or building.

On the other hand, if we study the data by county we can see how there is a certain correlation between the highest percentages of urbanization and building. The regions of Vega Baja, L'Alacanti, Els Ports, La Plana Baixa, L'Horta and La Ribera Baixa have urbanised and built land. The counties of L'Horta Oest, L'Alcoià and El Alto Palancia present land with urbanization executed, but with little or little urbanization. In all cases they are inland regions without contact with the coastline.

4.3 Analysis of coastal municipalities in the Comunitat Valenciana

As stated by numerous specialists (Obiol, E., & Pitarch, M. D. (2011); López Olivares & Ferreres, (2011); Tuset & Temes, 2014) and as defined by Decree 1/2011 approving the Territorial Strategy of the Valencian Community (ETCV), the large territorial areas of the Community are geographical areas that synthesise all the urban, environmental and landscape elements that make up the territory. On the one hand, we have the Plana Litoral, also known as Cota 100, made up of the municipalities that are approximately below this altitude above sea level; the rural system, made up of inland municipalities with special attributes, precisely defined in the territorial strategy, and the rest of the territory known as the Intermediate Strip.

In the 61 coastal municipalities, which account for 14 % of the surface of the Community, live more than 2.7 million inhabitants, 53 % of the total population that rises to more than 81 % when considering the height of 100 meters above sea level. For its part, the density of coastal municipalities is about 825 inhabitants / km^2. This density greatly exceeds 1,000 inhabitants/km^2 during the central months of the year due to the influence of the tourist population, which reveals an enormous pressure on a reduced space in which there is strong competition

COMARCA	ÁREA TOTAL	Área C1	C1 %	Área C2	C2 %	Área C3	C3 %	Área C4	C4 %	Total %
TOTAL Comarca 30	26,140,251.78	10,951,400.82	41.89	10,955,229.72	41.91	3,408,922.43	13.04	824,698.80	3.15	100
TOTAL Comarca 31	39,617,154.71	9,834,672.73	24.82	20,693,201.23	52.23	7,878,940.56	19.89	1,210,340.19	3.06	100
TOTAL Comarca 32	18,220,045.24	1,999,260.81	10.97	8,437,187.57	46.31	6,551,188.60	35.96	1,232,408.26	6.76	100
TOTAL Comarca 33	28,085,251.05	2,330,784.91	8.30	16,180,483.68	57.61	8,055,297.92	28.68	1,518,684.54	5.41	100
TOTAL Comarca 34	48,507,847.42	4,752,087.01	9.80	22,072,667.93	45.50	17,417,822.22	35.91	4,265,270.26	8.79	100

PROVINCIA	Área Total (ha)	Área C1 (ha)	C1 %	Área C2 (ha)	C2 %	Área C3 (ha)	C3 %	Área C4 (ha)	C4 %	Total %
Alicante litoral	16,057.06	2,986.82	18.60	7,833.88	48.79	4,331.22	26.97	905.14	5.64	100

Table 7: Summary of soil classes of coastal Alicante municipalities

Source: Prepared by the authors, 2019

COMARCA	ÁREA TOTAL	Área C1	C1 %	Área C2	C2 %	Área C3	C3 %	Área C4	C4 %	Total %
TOTAL Comarca 3	55,116,961.18	27,376,613.42	49.67	24,964,834.28	45.29	2,097,593.90	3.81	677,919.58	1.23	100
TOTAL Comarca 5	28,972,772.75	12,662,572.19	43.71	12,644,685.55	43.64	2,713,703.71	9.37	951,811.30	3.29	100
TOTAL Comarca 6	17,710,970.63	8,186,549.27	46.22	6,475,004.12	36.56	2,375,950.15	13.42	673,467.10	3.80	100

PROVINCIA	Área Total (ha)	Área C1 (ha)	C1 %	Área C2 (ha)	C2 %	Área C3 (ha)	C3 %	Área C4 (ha)	C4 %	Total %
Castellón litoral	10,180.07	4,822.57	47.37	4,408.45	43.30	718.72	7.06	230.32	2.26	100

Table 8: Summary of soil classes in the municipalities of Castellón litoral

Source: Prepared by the authors, 2019

COMARCA	ÁREA TOTAL	Área C1	C1 %	Área C2	C2 %	Área C3	C3 %	Área C4	C4 %	Total %
TOTAL Comarca 12	17,138,987.04	4,947,736.20	28.87	8,494,777.37	49.56	3,250,823.37	18.97	445,650.10	2.60	100
TOTAL Comarca 13	6,519,768.00	2,431,014.83	37.29	2,333,262.45	35.79	1,417,552.58	21.74	337,938.14	5.18	100
TOTAL Comarca 15	7,900,320.73	1,360,251.00	17.22	2,833,090.21	35.86	2,900,789.45	36.72	806,190.07	10.20	100
TOTAL Comarca 21	5,497,172.47	1,814,910.10	33.02	2,007,935.13	36.53	1,320,242.50	24.02	354,084.74	6.44	100
TOTAL Comarca 25	16,401,373.74	7,393,025.82	45.08	4,553,936.99	27.77	3,430,395.62	20.92	1,024,015.32	6.24	100

PROVINCIA	Área Total (ha)	Área C1 (ha)	C1 %	Área C2 (ha)	C2 %	Área C3 (ha)	C3 %	Área C4 (ha)	C4 %	Total %
Valencia litoral	5,345.76	1,794.69	33.57	2,022.30	37.83	1,231.98	23.05	296.79	5.55	100.00

Table 9: Summary of soil classes of coastal Valencia municipalities

Source: Prepared by the authors, 2019

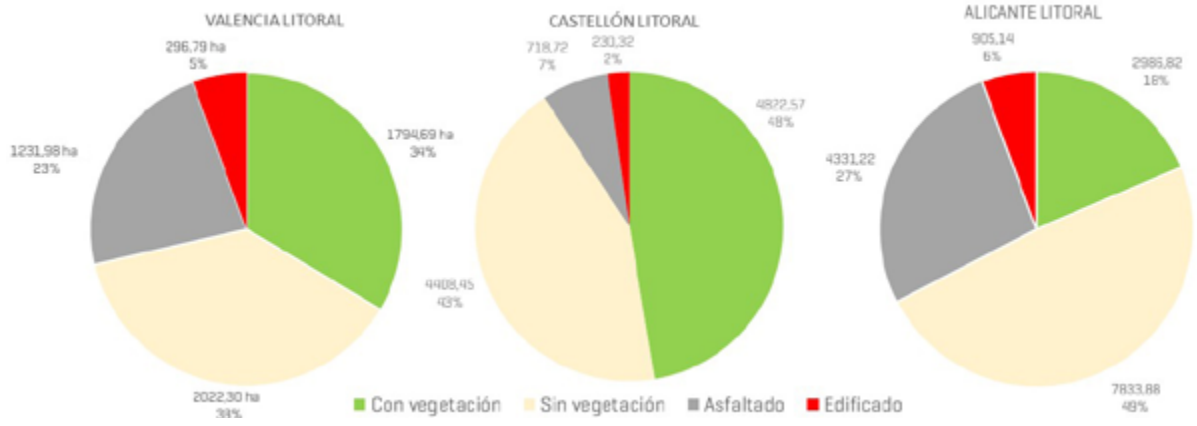


Figure 5: Pie charts with the proportion of soil classes by coastal municipalities within the development land

Source: Prepared by the authors, 2019

between different land uses (ETCV, 2011). If the figures for land occupation by artificial uses are analysed, the results reinforce the demographic and urban duality between the coastline and the interior. Thus, the first 10 kilometres of coastline are home to 50 % of the total urbanised land of the Community, while the strip from 30 kilometres up to the end of the territory is home to barely 14 % of the urbanised land. However, the urban growth responsible for this territorial duality is nuancing this trend in recent years. In fact, the urban growth of the first 5 kilometres of the coastline has been 11.7 %, in the period 2000-2006, less than half of the overall growth of the territory, whose bands of 5-10 and 10-20 kilometres are those that have grown most intensely, a process that has not been alien to the increased protection of areas of environmental interest of the coast (ETCV, 2011).

Based on these antecedents that justify coherence from the point of view of geography, economy and transforming intensity, we have focused the analysis for the 61 coastal municipalities. We can discuss the results (tables 7-8-9 and figures 5).

Analysing these data we can deduce that in the municipalities of the coast of Castellón there is still a predominance of land that can be developed without any type of treatment or intervention (C1: with vegetation), followed by land without vegetation, but neither urbanised (C2: without vegetation). Between the two it represents 91 % of the developable land, 3 percentage points above the average for the province. This data responds again to the lower dynamics of growth of Castellón with respect to the other two provinces. Once again, the behaviour of the municipalities on the Alicante coast are the ones that show the greatest transformation in urban land, with 33 % (C3: Asphalted land; C4: Built land). The small percentage increase with respect to the average of the province is due to the increase in construction mainly powered by tourism and second homes. In the case of the Valencian coast is again in an intermediate position, although there has been a notable increase in the percentage of urbanized land 23 %, keeping the land built at 5 %. In total 28 % of transformation of developable land compared to an average of 24 % in the province of Valencia.

4.4 Singular situations according to soil categories in coastal municipalities

On the basis of the data obtained from the analysis, the most disadvantageous cases of developable land at municipal level in each province were selected. We understand the following as the most disadvantageous cases:

1. Municipalities where category C3 (Asphalt soil) is high and category C4 (Built soil) is low. These are municipalities in which urbanization has been carried out, but the building has not prospered.

2. Municipalities in which category C1 (soil with vegetation) + C2 (soil without vegetation) is predominant. These are municipalities in which the transformation of land for development has been halted or has not begun.

Table 10, 11 and 12 show for each province, limited to coastal municipalities, the relation in percentage and in absolute value of soil classes C3 and C4. The columns are ordered according to the C3/C4 ratio, so that the municipalities in which this ratio is higher are in first position. On the other hand, the 5 municipalities in which the values of class C3 or class C4 are the highest are indicated in grey. The municipalities that stand out for their disproportion between urbanisation and the building carried out are: Santa Pola and Finestrat (Alicante); Cabanes and Peñíscola (Castellón); Albalat dels Sorells and Guardamar de la Safor (Valencia). This disproportion is very large in some cases and highlights the problem of maintenance and conservation of infrastructure with very low intensity of use for the municipalities (figure 6). On the other hand, in tables 13-14-15 we can see the municipalities on the coastline of the Comunitat where urban land has developed less. Although the urban planning is included both in absolute value (hectares) and in percentage, we have focused on exemplifying them in the latter. In this way we have the following relationship: Santa Pola and Jávea (Alicante); Peñíscola and Benicasín (Castellón); Foios and Puig (Valencia). If we look at figure 6 we can see that the proportion of unprocessed land in these municipalities is very important. Particularly noteworthy is the case of Peñíscola (García, Temes, Simancas & Peñarrubia, 2018), in which it coincides in standing out for having urbanised areas, but with very little building and, on the other hand, for having very little development of developable land (figure 7). In the light of cases such as these, we propose some lines of research and future work.

MUNICIPIO	PROVINCIA	COMARCA	COD COMARCA	CLASE C3 ÁREA MUN	CLASE C4 ÁREA MUN	Relación C3/C4
Santa Pola	3	El Baix Vinalopó	33	63.30	1.58	40.04
Finestrat	3	la Marina Baixa	31	210.25	8.89	23.65
Benidorm	3	la Marina Baixa	31	109.49	8.58	12.76
El Campello	3	L'Alacanti	32	138.90	13.73	10.11
Teulada	3	la Marina Alta	30	37.42	3.76	9.94
La Vila Joiosa / Villajoyosa	3	la Marina Baixa	31	242.31	25.51	9.50
Guardamar del Segura	3	la Vega Baja (el Baix Segura)	34	209.11	23.28	8.98
Calp	3	la Marina Alta	30	61.05	7.46	8.18
Pilar de la Horadada	3	la Vega Baja (el Baix Segura)	34	292.07	38.61	7.56
Elx / Elche	3	El Baix Vinalopó	33	742.23	150.29	4.94
Alacant / Alicante	3	L'Alacanti	32	516.21	109.51	4.71
El Poble Nou de Benitatx	3	la Marina Alta	30	104.92	24.07	4.36
Orihuela	3	la Vega Baja (el Baix Segura)	34	891.92	260.87	3.42
Torrevieja	3	la Vega Baja (el Baix Segura)	34	348.69	103.76	3.36
L'Alfàs del Pi	3	la Marina Baixa	31	72.52	22.14	3.28
Xàbia / Jávea	3	la Marina Alta	30	124.67	42.11	2.96
Altea	3	la Marina Baixa	31	153.33	55.92	2.74
Els Poblets	3	la Marina Alta	30	12.84	5.06	2.54

*Valor absoluto en ha

MUNICIPIO	PROVINCIA	COMARCA	COD COMARCA	CLASE C3 ÁREA MUN	CLASE C4 ÁREA MUN	Relación C3/C4
Santa Pola	3	El Baix Vinalopo	33	8.08	0.20	40.04
Finestrat	3	la Marina Baixa	31	35.46	1.50	23.65
Benidorm	3	la Marina Baixa	31	19.08	1.49	12.76
El Campello	3	L'Alacanti	32	35.59	3.52	10.11
Teulada	3	la Marina Alta	30	16.74	1.68	9.94
La Vila Joiosa / Villajoyosa	3	la Marina Baixa	31	30.46	3.21	9.50
Guardamar del Segura	3	la Vega Baja (el Baix Segura)	34	32.92	3.67	8.98
Calp	3	la Marina Alta	30	22.04	2.69	8.18
Pilar de la Horadada	3	la Vega Baja (el Baix Segura)	34	41.97	5.55	7.56
Elx / Elche	3	El Baix Vinalopo	33	36.65	7.42	4.94
Alacant / Alicante	3	L'Alacanti	32	36.06	7.65	4.71
El Poble Nou de Benitatx	3	la Marina Alta	30	18.65	4.28	4.36
Orihuela	3	la Vega Baja (el Baix Segura)	34	34.66	10.14	3.42
Torrevieja	3	la Vega Baja (el Baix Segura)	34	36.84	10.96	3.36
L'Alfi s del Pi	3	la Marina Baixa	31	18.06	5.51	3.28
Xàbia / Jávea	3	la Marina Alta	30	8.45	2.86	2.96
Altea	3	la Marina Baixa	31	9.60	3.50	2.74
Els Poblets	3	la Marina Alta	30	16.92	6.67	2.54

*% calculados sobre la superficie de suelo urbanizable del municipio

Table 10: Summary of the relation in percentage and in absolute value of soil classes C3 and C4 of soil municipalities of coastal Alicante

Source: Prepared by the authors, 2019

MUNICIPIO	PROVINCIA	COMARCA	COD COMARCA	CLASE C3 ÁREA MUN	CLASE C4 ÁREA MUN	Relación C3/C4
Cabanes	12	la Plana Alta	5	49.83	7.08	7.033597816
Peníscola / Peñíscola	12	el Baix Maestrat	3	52.21	7.45	7.00824004
Moncofa	12	la Plana Baixa	6	59.38	9.62	6.173415137
Almenara	12	la Plana Baixa	6	28.62	5.81	4.925503673
Benicàssim / Benicásim	12	la Plana Alta	5	12.29	2.58	4.759437169
Vinaròs	12	el Baix Maestrat	3	52.05	12.89	4.03964456
Borriana / Burriana	12	la Plana Baixa	6	63.14	18.63	3.388355004
Xilxes / Chilches	12	la Plana Baixa	6	36.21	12.99	2.788580181
Orpesa / Oropesa del Mar	12	la Plana Alta	5	94.57	34.00	2.781451967
Benicarló	12	el Baix Maestrat	3	74.41	30.86	2.411062722
Nules	12	la Plana Baixa	6	48.94	20.30	2.410913515
Torreblanca	12	la Plana Alta	5	8.05	3.41	2.358483584
Almassora / Almazora	12	la Plana Alta	5	106.62	48.10	2.216738807
Alcalà de Xivert	12	el Baix Maestrat	3	31.09	16.59	1.873340314
La Llosa	12	la Plana Baixa	6	1.31	nulo	

*Valor absoluto en ha

MUNICIPIO	PROVINCIA	COMARCA	COD COMARCA	CLASE C3 ÁREA MUN	CLASE C4 ÁREA MUN	Relación C3/C4
Cabanes	12	la Plana Alta	5	9.25	1.31	7.033597816
Peníscola / Peñíscola	12	el Baix Maestrat	3	1.35	0.19	7.00824004
Moncofa	12	la Plana Baixa	6	20.66	3.35	6.173415137
Almenara	12	la Plana Baixa	6	15.15	3.08	4.925503673
Benicàssim / Benicásim	12	la Plana Alta	5	3.19	0.67	4.759437169
Vinaròs	12	el Baix Maestrat	3	6.36	1.57	4.03964456
Borriana / Burriana	12	la Plana Baixa	6	11.70	3.45	3.388355004
Xilxes / Chilches	12	la Plana Baixa	6	9.89	3.55	2.788580181
Orpesa / Oropesa del Mar	12	la Plana Alta	5	8.61	3.10	2.781451967
Benicarló	12	el Baix Maestrat	3	24.85	10.31	2.411062722
Nules	12	la Plana Baixa	6	13.40	5.56	2.410913515
Torreblanca	12	la Plana Alta	5	2.99	1.27	2.358483584
Almassora / Almazora	12	la Plana Alta	5	17.60	7.94	2.216738807
Alcalà de Xivert	12	el Baix Maestrat	3	6.04	3.23	1.873340314
La Llosa	12	la Plana Baixa	6	5.45	nulo	

*% calculados sobre la superficie de suelo urbanizable del municipio

Table 11: Summary of the relationship in percentage and absolute value of soil classes C3 and C4 of soil municipalities of Castellón litoral

Source: Prepared by the authors, 2019

MUNICIPIO	PROVINCIA	COMARCA	COD COMARCA	CLASE C3 ÁREA MUN	CLASE C4 ÁREA MUN	Relación C3/C4
Albalat dels Sorells	46	L'Hort Nord	13	13.36	0.73	18.40630104
Guardamar de la Safor	46	la Safor	25	3.81	0.26	14.68711763
Puig	46	L'Hort Nord	13	22.54	1.69	13.36125343
Sagunt / Sagunto	46	el Camp de Morvedre	12	300.07	27.18	11.04073155
Piles	46	la Safor	25	12.94	1.35	9.589171184
Massalfassar	46	L'Hort Nord	13	5.40	0.57	9.509733036
Bellreguard	46	la Safor	25	18.39	2.64	6.956778303
Cullera	46	la Ribera Baixa	21	58.94	10.37	5.681846724
Massamagrell	46	L'Hort Nord	13	34.02	6.84	4.970362816
Foios	46	L'Hort Nord	13	0.16	0.04	4.277414399
Daimús	46	la Safor	25	25.26	6.12	4.12461099
Gandia	46	la Safor	25	70.05	17.65	3.968752219
Tavernes de la Valldigna	46	la Safor	25	33.58	8.88	3.783228725
Valencia	46	l'Horta	15	290.08	80.62	3.598145865
Puçol	46	L'Hort Nord	13	43.44	12.81	3.389921371
La Pobla de Farnals	46	L'Hort Nord	13	5.20	1.58	3.291319408
Xeresa	46	la Safor	25	17.09	5.73	2.983073436
Sueca	46	la Ribera Baixa	21	73.08	25.03	2.919236809
Oliva	46	la Safor	25	125.77	43.80	2.871579607
Alboraya	46	L'Hort Nord	13	12.45	4.45	2.797027393
Miramar	46	la Safor	25	23.50	9.06	2.5937367
Xeraco	46	la Safor	25	12.65	6.91	1.830407007
Canet d'En Berenguer	46	el Camp de Morvedre	12	25.01	17.39	1.438654249
Albuixech	46	L'Hort Nord	13	0.90	0.68	1.337085929
Meliana	46	L'Hort Nord	13	4.29	4.41	0.972267603

*Valor absoluto en ha

MUNICIPIO	PROVINCIA	COMARCA	COD COMARCA	CLASE C3 ÁREA MUN	CLASE C4 ÁREA MUN	Relación C3/C4
Albalat dels Sorells	46	L'Hort Nord	13	14.24	0.77	18.40630104
Guardamar de la Safor	46	la Safor	25	24.97	1.70	14.68711763
Puig	46	L'Hort Nord	13	9.28	0.69	13.36125343
Sagunt / Sagunto	46	el Camp de Morvedre	12	18.40	1.67	11.04073155
Piles	46	la Safor	25	30.00	3.13	9.589171184
Massalfassar	46	L'Hort Nord	13	19.76	2.08	9.509733036
Bellreguard	46	la Safor	25	28.83	4.14	6.956778303
Cullera	46	la Ribera Baixa	21	21.83	3.84	5.681846724
Massamagrell	46	L'Hort Nord	13	32.57	6.55	4.970362816
Foios	46	L'Hort Nord	13	3.27	0.77	4.277414399
Daimús	46	la Safor	25	34.68	8.41	4.12461099
Gandia	46	la Safor	25	19.93	5.02	3.968752219
Tavernes de la Valldigna	46	la Safor	25	15.80	4.18	3.783228725
Valencia	46	l'Horta	15	36.72	10.20	3.598145865
Puçol	46	L'Hort Nord	13	39.61	11.68	3.389921371
La Pobla de Farnals	46	L'Hort Nord	13	17.40	5.29	3.291319408
Xeresa	46	la Safor	25	33.88	11.36	2.983073436
Sueca	46	la Ribera Baixa	21	26.13	8.95	2.919236809
Oliva	46	la Safor	25	17.23	6.00	2.871579607
Alboraya	46	L'Hort Nord	13	49.08	17.55	2.797027393
Miramar	46	la Safor	25	33.10	12.76	2.5937367
Xeraco	46	la Safor	25	42.46	23.20	1.830407007
Canet d'En Berenguer	46	el Camp de Morvedre	12	30.00	20.85	1.438654249
Albuixech	46	L'Hort Nord	13	29.10	21.76	1.337085929
Meliana	46	L'Hort Nord	13	40.68	41.84	0.972267603

*% calculados sobre la superficie de suelo urbanizable del municipio

Table 12: Summary of the relation in percentage and in absolute value of soil classes C3 and C4 of soil municipalities of coastal Valencia

Source: Prepared by the authors, 2019

MUNICIPIO	PROVINCIA	COMARCA	COD COMARCA	CLASE C1 ÁREA MUN	CLASE C2 ÁREA MUN	CLASE C1+C2 POR MUN
L'Alfàs del Pi	3	la Marina Baixa	31	295.62	1.124.67	1.420.28
Altea	3	la Marina Baixa	31	548.22	840.28	1.388.50
Xàbia / Jávea	3	la Marina Alta	30	781.90	526.27	1.308.17
Elx / Elche	3	El Baix Vinalopo	33	123.15	1.009.53	1.132.68
Alacant / Alicante	3	L'Alacanti	32	172.56	633.46	806.02
Santa Pola	3	El Baix Vinalopo	33	109.93	608.52	718.45
La Vila Joiosa / Villajoyosa	3	la Marina Baixa	31	77.42	450.19	527.61
Torrevieja	3	la Vega Baja (el Baix Segura)	34	44.74	449.33	494.07
Benidorm	3	la Marina Baixa	31	138.81	317.04	455.86
El Poble Nou de Benitatx	3	la Marina Alta	30	138.31	295.28	433.59
Guardamar del Segura	3	la Vega Baja (el Baix Segura)	34	67.09	335.78	402.87
Finestrat	3	la Marina Baixa	31	114.47	259.39	373.86
Pilar de la Horadada	3	la Vega Baja (el Baix Segura)	34	67.76	297.49	365.25
L'Alfi s del Pi	3	la Marina Baixa	31	104.54	202.42	306.96
El Campello	3	L'Alacanti	32	27.37	210.26	237.62
Calp	3	la Marina Alta	30	75.47	133.06	208.52
Teulada	3	la Marina Alta	30	85.63	96.75	182.38
Els Poblets	3	la Marina Alta	30	13.84	44.17	58.01

*Valor absoluto en has

MUNICIPIO	PROVINCIA	COMARCA	COD COMARCA	CLASE C1 ÁREA MUN	CLASE C2 ÁREA MUN	CLASE C1+C2 POR MUN
Santa Pola	3	El Baix Vinalopo	33	14.03	77.68	91.72
Xàbia / Jávea	3	la Marina Alta	30	53.01	35.68	88.69
Altea	3	la Marina Baixa	31	34.31	52.59	86.90
Teulada	3	la Marina Alta	30	38.30	43.28	81.58
Benidorm	3	la Marina Baixa	31	24.19	55.24	79.43
El Poble Nou de Benitatx	3	la Marina Alta	30	24.58	52.49	77.07
L'Alfàs del Pi	3	la Marina Baixa	31	26.03	50.40	76.43
Els Poblets	3	la Marina Alta	30	18.23	58.18	76.41
Calp	3	la Marina Alta	30	27.24	48.03	75.27
La Vila Joiosa / Villajoyosa	3	la Marina Baixa	31	9.73	56.60	66.33
Guardamar del Segura	3	la Vega Baja (el Baix Segura)	34	10.56	52.86	63.42
Finestrat	3	la Marina Baixa	31	19.30	43.74	63.05
El Campello	3	L'Alacanti	32	7.01	53.88	60.89
Alacant / Alicante	3	L'Alacanti	32	12.05	44.24	56.30
Elx / Elche	3	El Baix Vinalopo	33	6.08	49.85	55.93
Orihuela	3	la Vega Baja (el Baix Segura)	34	11.49	43.71	55.20
Pilar de la Horadada	3	la Vega Baja (el Baix Segura)	34	9.74	42.75	52.48
Torrevieja	3	la Vega Baja (el Baix Segura)	34	4.73	47.47	52.20

*% calculados sobre la superficie de suelo urbanizable del municipio

Table 13: Summary of the relation in percentage and in absolute value of soil classes C1 and C2 of soil municipalities of coastal Alicante

Source: Prepared by the authors, 2019

MUNICIPIO	PROVINCIA	COMARCA	COD COMARCA	CLASE C1 ÁREA MUN	CLASE C2 ÁREA MUN	CLASE C1+C2 POR MUN
Peníscola / Peñíscola	12	el Baix Maestrat	3	2.186.37	1.633.08	3.819.46
Orpesa / Oropesa del Mar	12	la Plana Alta	5	417.01	552.33	969.35
Vinaròs	12	el Baix Maestrat	3	274.52	479.30	753.82
Cabanes	12	la Plana Alta	5	268.13	213.94	482.07
Alcalà de Xivert	12	el Baix Maestrat	3	228.90	237.77	466.67
Borriana / Burriana	12	la Plana Baixa	6	294.92	162.94	457.86
Almassora / Almazora	12	la Plana Alta	5	251.43	199.78	451.21
Benicàssim / Benicásim	12	la Plana Alta	5	138.51	231.42	369.93
Xilxes / Chilches	12	la Plana Baixa	6	153.11	163.70	316.81
Nules	12	la Plana Baixa	6	182.52	113.37	295.89
Torreblanca	12	la Plana Alta	5	191.18	67.00	258.17
Moncofa	12	la Plana Baixa	6	99.22	119.25	218.47
Benicarló	12	el Baix Maestrat	3	47.87	146.33	194.20
Almenara	12	la Plana Baixa	6	87.49	66.94	154.44
La Llosa	12	la Plana Baixa	6	1.39	21.30	22.69

*Valor absoluto en has

MUNICIPIO	PROVINCIA	COMARCA	COD COMARCA	CLASE C1 ÁREA MUN	CLASE C2 ÁREA MUN	CLASE C1+C2 POR MUN
Peníscola / Peñíscola	12	el Baix Maestrat	3	56.36	42.10	98.46
Benicàssim / Benicásim	12	la Plana Alta	5	35.99	60.14	96.13
Torreblanca	12	la Plana Alta	5	70.90	24.85	95.75
La Llosa	12	la Plana Baixa	6	5.78	88.77	94.55
Vinaròs	12	el Baix Maestrat	3	33.53	58.54	92.07
Alcalà de Xivert	12	el Baix Maestrat	3	44.50	46.23	90.73
Cabanes	12	la Plana Alta	5	49.75	39.69	89.44
Orpesa / Oropesa del Mar	12	la Plana Alta	5	37.98	50.31	88.29
Xilxes / Chilches	12	la Plana Baixa	6	41.83	44.73	86.56
Borriana / Burriana	12	la Plana Baixa	6	54.65	30.20	84.85
Almenara	12	la Plana Baixa	6	46.33	35.45	81.77
Nules	12	la Plana Baixa	6	49.99	31.05	81.04
Moncofa	12	la Plana Baixa	6	34.52	41.48	76.00
Almassora / Almazora	12	la Plana Alta	5	41.49	32.97	74.47
Benicarló	12	el Baix Maestrat	3	15.99	48.86	64.85

*% calculados sobre la superficie de suelo urbanizable del municipio

Table 14: Summary of the relationship in percentage and absolute value of soil classes C1 and C2 of soil municipalities of Castellón litoral

Source: Prepared by the authors, 2019

MUNICIPIO	PROVINCIA	COMARCA	COD COMARCA	CLASE C1 ÁREA MUN	CLASE C2 ÁREA MUN	CLASE C1+C2 POR MUN
Sagunt / Sagunto	46	el Camp de Morvedre	12	491.31	811.96	1.303.27
Oliva	46	la Safor	25	347.39	212.85	560.24
Valencia	46	l'Horta	15	136.03	283.31	419.33
Gandia	46	la Safor	25	167.42	96.41	263.83
Puig	46	L'Hort Nord	13	157.33	61.33	218.66
Cullera	46	la Ribera Baixa	21	82.38	118.31	200.69
Sueca	46	la Ribera Baixa	21	99.11	82.49	181.59
Tavernes de la Valldigna	46	la Safor	25	123.91	46.18	170.09
Albalat dels Sorells	46	L'Hort Nord	13	31.10	48.61	79.71
Massamagrell	46	L'Hort Nord	13	15.64	47.96	63.60
Puçol	46	L'Hort Nord	13	13.09	40.33	53.43
Bellreguard	46	la Safor	25	24.53	18.24	42.77
Daimús	46	la Safor	25	19.17	22.29	41.46
Canet d'En Berenguer	46	el Camp de Morvedre	12	3.46	37.52	40.98
Miramar	46	la Safor	25	20.35	18.08	38.43
Piles	46	la Safor	25	12.28	16.56	28.84
Xeresa	46	la Safor	25	16.08	11.55	27.63
La Pobla de Farnals	46	L'Hort Nord	13	14.18	8.90	23.09
Massalfassar	46	L'Hort Nord	13	8.26	13.10	21.36
Guardamar de la Safor	46	la Safor	25	5.54	5.64	11.18
Xeraco	46	la Safor	25	2.64	7.60	10.23
Alboraya	46	L'Hort Nord	13	1.33	7.14	8.46
Foios	46	L'Hort Nord	13	1.23	3.52	4.75
Meliana	46	L'Hort Nord	13	0.62	1.22	1.84
Albuixech	46	L'Hort Nord	13	0.30	1.23	1.52

*Valor absoluto en has

MUNICIPIO	PROVINCIA	COMARCA	COD COMARCA	CLASE C1 ÁREA MUN	CLASE C2 ÁREA MUN	CLASE C1+C2 POR MUN
Foios	46	L'Hort Nord	13	24.94	71.02	95.96
Puig	46	L'Hort Nord	13	64.78	25.25	90.03
Albalat dels Sorells	46	L'Hort Nord	13	33.16	51.82	84.98
Tavernes de la Valldigna	46	la Safor	25	58.29	21.73	80.02
Sagunt / Sagunto	46	el Camp de Morvedre	12	30.13	49.80	79.93
Massalfassar	46	L'Hort Nord	13	30.24	47.93	78.17
La Pobla de Farnals	46	L'Hort Nord	13	47.49	29.81	77.31
Oliva	46	la Safor	25	47.60	29.17	76.77
Gandia	46	la Safor	25	47.63	27.43	75.05
Cullera	46	la Ribera Baixa	21	30.51	43.82	74.33
Guardamar de la Safor	46	la Safor	25	36.33	36.99	73.33
Bellreguard	46	la Safor	25	38.45	28.58	67.03
Piles	46	la Safor	25	28.48	38.39	66.87
Sueca	46	la Ribera Baixa	21	35.43	29.49	64.92
Massamagrell	46	L'Hort Nord	13	14.97	45.91	60.88
Daimús	46	la Safor	25	26.31	30.60	56.92
Xeresa	46	la Safor	25	31.88	22.89	54.77
Miramar	46	la Safor	25	28.67	25.47	54.14
Valencia	46	l'Horta	15	17.22	35.86	53.08
Canet d'En Berenguer	46	el Camp de Morvedre	12	4.15	45.00	49.15
Albuixech	46	L'Hort Nord	13	9.61	39.53	49.13
Puçol	46	L'Hort Nord	13	11.94	36.78	48.71
Xeraco	46	la Safor	25	8.84	25.50	34.34
Alboraya	46	L'Hort Nord	13	5.24	28.13	33.37
Meliana	46	L'Hort Nord	13	5.89	11.58	17.48

*% calculados sobre la superficie de suelo urbanizable del municipio

Table 15: Summary of the relation in percentage and in absolute value of soil classes C1 and C2 of soil municipalities of coastal Valencia

Source: Prepared by the authors, 2019

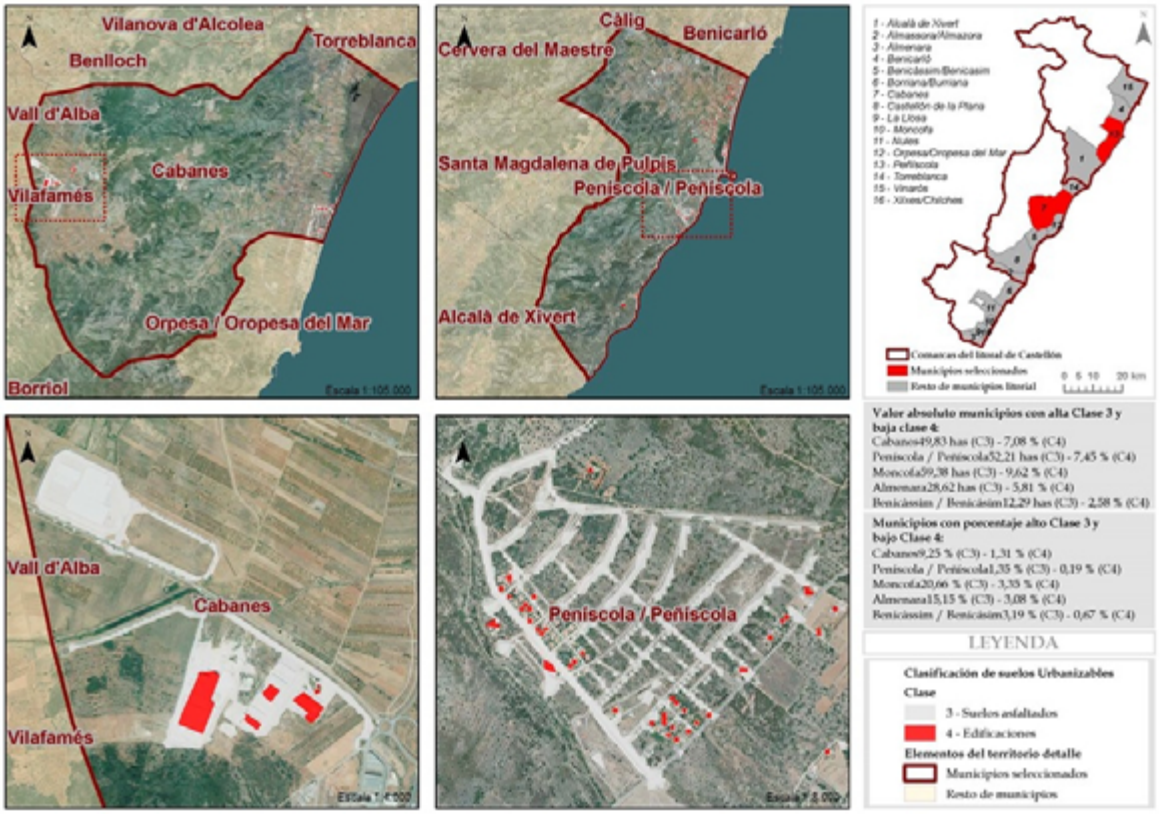


Figure 6: Municipalities on the Castellón coast with the highest proportion of C3 and lowest proportion of C4 simultaneously

Source: Prepared by the authors, 2019

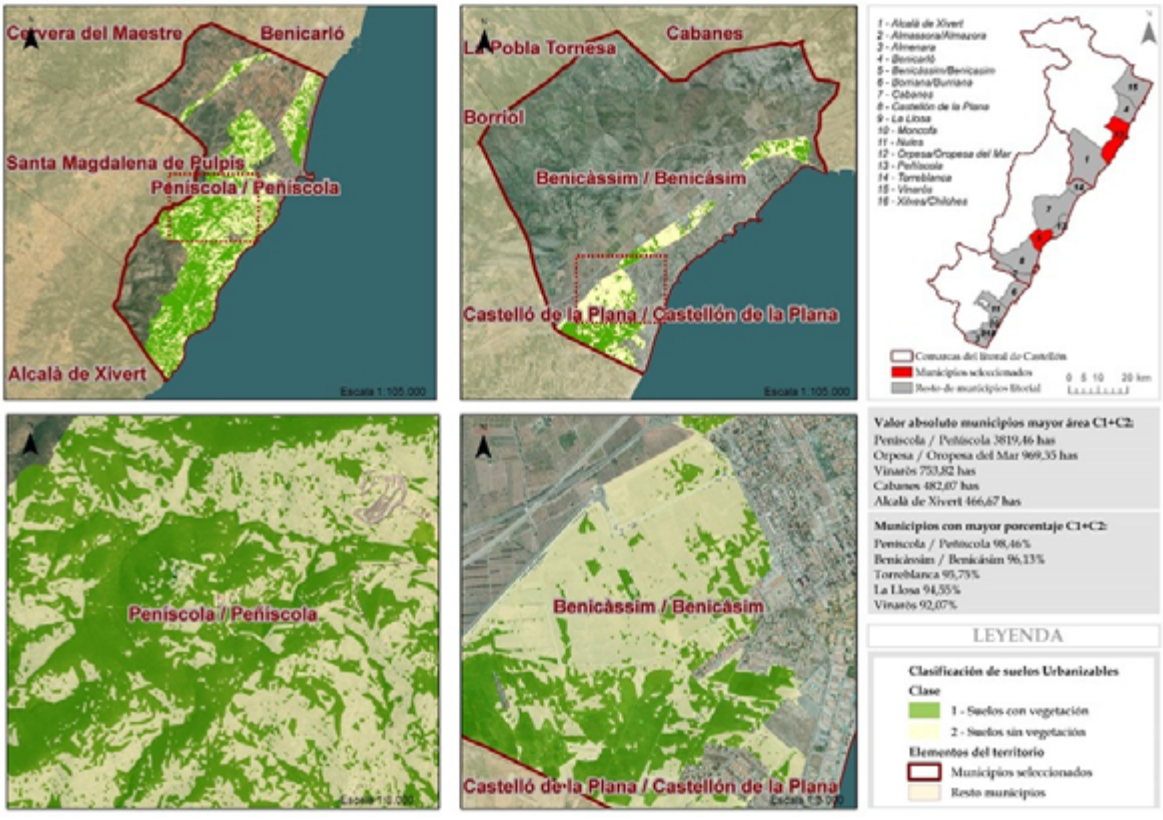


Figure 7: Municipalities on the Castellón coast with the highest proportion of C1 and C2

Source: Prepared by the authors, 2019

5. Conclusions and future line of research

The results obtained allow us to evaluate as positive the proposed method for identifying the nature of land for development in the Comunitat Valenciana. To improve the identification we have to guarantee the temporal coordination of the information of the planning made by the ICV, the information of buildings of the Cadastre and the orthophoto that we use. We have verified that, in occasions, the errors that were manifested have their origin in the difference of date of the support cartographies. On the other hand, we have been able to verify that the dynamics of operation in terms of the use and development of land for development in coastal municipalities is somewhat higher than the average of the rest of the province, justifying this increase to the dynamics itself and greater pressure that characterizes the coastal strip as opposed to intermediate or interior areas. One aspect to highlight is the difference between the performance of the coastal zone and the interior is less than expected. We thought, as a previous hypothesis, that the greater dynamics and coastal pressure were going to show very different behaviours marked by the coastal dynamics, although this did not reflect the calculations obtained.

On the other hand, in view of the results obtained, we are considering several lines of future work. On the one hand, it is necessary to carry out a diachronic analysis, which places us at least at the beginning of the crisis (year 2008), with which to compare the current situation (2018). The evolution and changes in this decade will allow us to identify those urbanizable soils that are paralyzed (very scarce changes in the period 2008-18), or those that have a reasonable rate of transformation within the period of analysis. On the other hand, it is necessary to make an assessment of the probabilities of future transformation. Bags of land for development are in very different situations in relation to the environment that surrounds them and the infrastructures that serve them. We think that bags of land for development closer to land already developed or located in environments with a higher landscape or environmental value, could be more successful in the future development. In the same way, pockets of land that already have nearby infrastructure that gives them access or serves supplies, potentially seem to have more development possibilities. The choice and use of a multi-criteria analysis would allow us to set a likely order of priorities for future soil transformations and an economic valuation of soil maintenance costs while this does not occur.

In view of the inconsistency in the measures taken by the administration to contain growth (Blázquez-Salom *et al*., 2019), it is possible that work along these lines may help to achieve diagnoses that cover large territories and that allow rapid updating over time thanks to the methodology employed. With the data obtained it is possible to obtain an economic approximation of the expenses that produce the immobilized that today is invested in urbanizations partially or totally unused, as well as the expenses that the local administration has to invest for its maintenance, protection and cleaning.

Finally, it can be a useful tool in the line of works such as those developed by Schulz-Dornburg *et al*. (2012), the identification of the unfinished landscapes of Villar, (2012) or the description of processes that have led to precipitated ruins such as those shown by Tudela & Delgado (2018).

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The economic and symbolic value of the territory in spain: an analysis of cases

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Abstract

The territorial issue in Spain is a major topic of debate both at an academic and political level and, above all, at a social and popular level. In any geographical aspect taken as a reference, Spain is a territory with a marked internal diversity. Thus, on this diversity two narratives of great interest have been formulated from which our contribution will start. For Geography, Spain has been and still is a country of contrasts, as stated in numerous books and manuals on the subject. If we go one step further, the Regional Economy and Economic Geography have counterbalanced a rich, urban and industrial Spain with an empty, rural Spain with most of its activities in decline. However, the construction of the idea of a nation in Spain has always been the subject of debate. Faced with a deep-rooted feeling of nation that was built in a unitary way, driven by liberals and conservatives throughout the nineteenth century, the Catalan, Basque and Galician nations, among others, asserted their own stories in a similar historical era. Although we are not interested in the accuracy or inaccuracy of these stories that either defend Spain as a diverse unitary nation-state or as a plurinational reality, we will attempt to conduct a case study on Spain, from its current economic and symbolic importance.

The richness of Spain has always been associated with the coast, where its own and identified bourgeoisie such as the Catalan or Basque, promoted rapid industrialisation. Nowadays, we ask ourselves, has the regional economic geography of development and well-being in Spain been maintained, or has it changed profoundly in recent times? Therefore, does the ability to govern itself or the survival of inter-territorial cooperation funds respond objectively to the classical parameters? Undoubtedly, the many recent studies conducted by Geography and other Social Sciences on these issues illustrate well the current reality. A reality that requires a geographical and symbolic rethinking of the understanding of Spain based on the construction of bridges and higher levels of understanding between the territories, as states the motto of the Istanbul Congress.

Key words: Spain; nation; territorial diversity; regional economy; uneven development

1. Introduction: Spain, diverse territory

In any university book, press release or general information, Spain is presented as one of the most classic European nation-states, with an undeniable historical journey since ancient times. However, if we analyse the name and its use throughout history, there seem to be certain doubts according to contemporary historiographic approaches. *Hispania* was a Roman diocese or, in other words, a large territorial group perfectly defined since the time of the Empire. This *Hispania* was actually the Iberian Peninsula that comprises current Spain and Portugal. The Iberian space as a reference, a mosaic of pre- and proto-historical cultures, of antiquity in the extreme southwestern Europe, constituted a reality not discussed by specialists. Similarly, *Hispania*, with different variations on the name, appeared systematically in both Christian and Islamic cartography throughout the Middle Ages (Martín, 1993; Bosque, Núñez de las Cuevas and Zárate, 1994). In any case, and as stated by F. Farinelli (Farinelli, 2009), the cartographic reason had not yet been developedat that time, and almost no one living in those historical times was aware of belonging to a larger territorial unit, called *Hispania* or *Iberia.*

From this finding, it is necessary to resort to social theory, modern historiography and the approach of cultural studies to find interpretations that explain how Spain (and other *nations* of the peninsular context), has managed to strongly establish itself as a spatial and territorial category in a period of just over 200 years. Thus, the British author B. Anderson provides us with the concept "invention of tradition", which has become very popular in recent decades, and largely explains the ideological foundation of territories, countries and nations in contemporary times (Anderson, 1983), and is always in contrast to *others* (Said, 1978). For the Spanish case, the idea of the current Spanish nation was built in the nineteenth century, first as the result of the liberal and centralised ideology sponsored by the power, and in a second moment backed by religious conservatism, as analysed by Álvarez-Junco (2001). Spain centralised and modernised its power structures since the 1830s, organised in provinces and municipalities governed by similar principles and gradually identified itself as one of the great Catholic nations of the West (Álvarez-Junco, 2001).

The nation-state consolidated with difficulties in the nineteenth century, built a national ideology and reality. However, the outlook was not so simple for two reasons. Firstly, the early creation of other strong national or territorial identities in Catalonia, Euskadi and Galicia (Álvarez Junco, 2001), and secondly, the convulsive Spanish political history from the mid-nineteenth century until the adoption of the Democratic Constitution in 1978. A dynastic war, a monarchical restoration, a monarchical crisis and the proclamation of the Republic, a Civil War and a fierce dictatorship, are not the best examples of a stable State model, and the oscillations between a strong centralism, a regional self-government, and the dependence on Catalan and Basque political forces to stabilise the Madrid executive power have been the norm in this more than a century of historical evolution. Therefore, different territorial representations and continuous debates on the jurisdictional structure of the Spanish State have been added to regional socioeconomic inequalities.

Throughout this text we will try to ask several questions and undertake analysis that helps the foreign reader to understand the complex regional and political geography of Spain. Thus, five epigraphs, the first of theoretical and methodological nature, and a conclusion, have been established. We will ask ourselves how territorial contrasts can be measured in Spain, and formulate three possibilities: the study of the differences between the usually coastal and urbanised Spain, and inland Spain, which has come to be called España vacía(da) (empty(ed) Spain) (Del Molino, 2016; AGE, 2018); the second, focused on the notion of multiple Spain, based on the internal organisation of the country in regions, nationalities or nations, according to the point of view adopted (Farinós and Olcina, 2017), and the third based on the present territorialisation of this complex reality, by means of a map with a double origin, tending towards decentralisation (with the Autonomous Regions) or centralisation (maintaining the provinces) (García-Álvarez, 2002; Burgueño, 2011). The fourth and fifth section will analyse secondary sources to measure the degree of internal diversity of Spain and the recent registered changes. In this way, the concept of rich region and poor region is approached from general socio-economic indicators, which will clarify in part a series of entrenched readings on the wealth or backwardness of certain territories. Then, in a reading based on the representations, we will interpret very different ways of mapping the country, based on geographical readings mediated by concrete ideologies. Finally, in the concluding paragraphs, we will put in order some of the central ideas of a complex, non-linear exhibition, which seeks to understand the importance of Geography to get closer to the current notion of Spain.

2. Geography, political geography and regional analysis. A theoretical and methodological reflection

A reiterated issue in the great treaties that have addressed the history of geographical thought, has been the relationship throughout the nineteenth and early twentieth centuries between the process of institutionalisation of Geography, and its use as one of the main disciplines responsible for transmitting the values of the nation-state in school education (Thrower, 1972; Capel, 1981; Melcón, 1989; Taylor, 1993). Some authors have stressed the conservative nature of the traditional view of Geography, which was happy to describe the existing world, the most relevant data from countries and regions, and the national maps that could easily be fixed in the memory of young people; that is, the Geography that was accessible to a majority, whereas the great theoretical constructions responded to very elaborate discourses (Ortega, 2000; Farinelli, 2003). However, this evidence highlighted by the critical approaches in the history of geographical thought has had a positive impact on the discipline today: it has made Geography responsible for preparing summaries of the nations, regions and localities that make up the map world. These characterisations synthesise a series of attributes of each territory that allow it to be characterised and differentiated from others. Although this method of analysis was used in excess as verified with the criticism to the Vidalian school (Schaeffer, 1953; Chorley and Haggett, 1971) and the emergence of the analytical and quantitative Geography, the search for general laws on space and the territorial organisation has never been able to completely banish from the geographical task the interest in explaining the uniqueness of each place or country, paraphrasing A. Rossi we could say the *geniuslocii*. The political economy has tried to critically approach the wealth and poverty of nations, but this effort has gradually declined until becoming scarcely relevant.

The cartographic reason theorised by F. Farinelli facilitated the proliferation of thematic maps in geographical teaching and research. Maps that often moved the political-administrative divisions of the territory or the interpretations that a particular instance of power had of the territory under its jurisdiction. The early reiteration of these practices in a first stage, between the end of the nineteenth century and the middle of the twentieth century, helped explain political Geography as a branch of the discipline focused on the evolution, relationships and conflicts developed taking the constituted nation-states as the main reference (Taylor, 1993). Therefore, it is not surprising that Europeanness, the productive potential and the strategic role of Spain were exalted, although the manipulation in which Geopolitics fell in Nazi Germany in the 1930s and 1940s caused an acute crisis in this area of knowledge, which did not begin to recover until the 1970s with the rise of the radical paradigm and critical social theory (López-Trigal and Benito, 1999; Nogué and Vicente, 2001). This new period in the evolution of political Geography insisted on analysis at different scales with a growing importance of the local to explain more general processes (Taylor, 1993). It also introduced a postmodern perspective, where differencesbetween territories, the polysemy of the regional or the supra-local, and the adoption of different approaches to explain conflicts and political-administrative processes, granted many new possibilities of study to the geographical analysis applied to a nation as complex, contrasted and dispersed as Spain (Romero, 2005; Farinós and Elorrieta, 2017).

Along with the need for a political Geography of Spain, defended in recent compilations (Gómez-Mendoza, Lois and Nel.lo, 2013), other authors have insisted on building a regional Geography (Rodríguez-Martínez and Plaza, 2001; Farinós and Olcina, 2017). A regional Geography that had to go beyond a simple enumeration of characteristics of the different Autonomous Regions; an analysis that delved into the polysemy of the concept of region (Lois, Rodríguez-González, Santos and Somoza, 2001). The region is an intermediate space, usually between the local and the national (Zoido *et al*t., 2013). It can refer to clear political-administrative realities with abundant powers, but it also includes more generic categories such as coastal regions compared to those in the interior, metropolitan regions as opposed to rural areas or accessible territories compared to those in the peripheries. This diversity of regional meanings allows us to resort to a certain relativism in the use of this word in the next sections. A relativism that fits with post-structuralist interpretations that have become popular in Geography in recent times. In addition, the concept of region has emotional connotations: for those people who reside in territories with a high sense of belonging (as in Catalonia or the Basque Country), the regional is rejected and only the national qualifier is admitted. However, some regions own the term and are defined as *Region of…*, as in the Region of Murcia. These regions, felt or rejected, are combined with the regions of the EU, where Spain is integrated, or the regions with demarcations of certain agricultural products or metropolitan regions, as is the case of Madrid or Barcelona.

In the previous two paragraphs, we have tried to underline that both political geography and regional analysis serve to address the diversity and complexity of national states in the case of Spain. Consequently, we can take another theoretical step on how the geographies of the territory have approached it. It is indisputable that the study of Spain has always been addressed in two ways (Lois and Piñeira, 2017). The first, a centripetal interpretation, with a geographical centre, the *central* Plateau in the physical sense and Madrid in the urban, economic and political sense, that advances towards the peripheries, always coastal, complex, urbanised and with an enormous economic vitality (Catalonia, Valencia, the Andalusian coast, the Basque Country, the Galician and Asturian coast, etc.); in the middle are the flanks of the Plateau, sparsely populated highlands that serve to separate interior realities from regional spaces, quite autonomous, and bathed by the sea. On a more material level, making communications difficult on high-capacity roads (whether highways or high-speed train), conceived in most cases radially from Madrid (Bel, 2010; Lois and Piñeira, 2017). The second reading follows the interpretation that the Catalan historian J. Vicens-Vives made half a century ago (Vicens-Vives, 1970). It is based on an approach of the Iberian Peninsula in a meridian sense, with organised territories from North to South, following the logic of the territorial expansion of the medieval Christian kingdoms (Vicens-Vives, 1970). In this way, Catalonia continued through Valencia and Mallorca, initiating what is nowadays defined as the Mediterranean corridor, Galicia extended to Portugal, and Asturias allowed the birth of León after Castile, to end with the *new Castile* constituted in Andalusia. These two approaches have different consequences as in what refers to transport and communication structuring routes, for example, they justify a radial reading of the territory, or another one that prioritises the corridors, both Mediterranean as well as Atlantic and Cantabrian (Boira, 2013; Lois and Piñeira, 2017). They make it possible to oppose (or complement), the Spain efficiently organised from Madrid or from very dynamic peripheries which must be connected to the political centre through extensive empty(ed) regions.

From the methodological point of view, the proposed analysis presents a dominant theoretical and bibliographic foundation. The unity and diversity of Spain will be interpreted, based on the key concepts and classical readings of Geography, always adopting a critical and distancing perspective with respect to certain myths or simplifications of the reality. Therefore, the historical and political-administrative consideration of the organisation of the Spanish territory and the socio-economic approach, built on unequivocal statistical data, alternates. The polysemic and current interpretation of the geographic discipline is useful to discover different perspectives of a complex reality. With this objective, both quantitative data (synthetic indicators of economic development, structure of the productive sectors, demographic dynamics, etc.) and others of a cultural and symbolic nature that should be studied from a qualitative point of view will be analysed. The territorial investigations of the present reflect certain theoretical and methodological eclecticism, an extremely useful resource approach to the Spanish geographical reality of the beginning of the twenty first century.

3. Spain: a country of territorial contrasts

From the mid-twentieth century until the 1990s, the publication of classic Spanish Geographies was common, which, based on a regional method of renewed French origin, synthesised the main characteristics of the national territory (Terán and Solé-Sabarís, 1978; Bosque and Vilà, 1989-1990; Méndez and Molinero, 1993; Carreras and García-Ballesteros, 1994).In most of them, the regional diversity of the country was studied, with titles such as "Spain, country of contrasts" (Floristan, 1988; Alonso, 1989). The Vidaliano model of regionalisation tested for the first time in the "Tableau de Géographie de France" (Vidal de la Blache, 1903), reached its culmination in the studies of Geography in Spain, which defined a diverse territory. This reading, transmitted to school manuals even in the decades of intense political centralisation of the Franco period, has conditioned the vision that Spanish society has of its own nation-state. For this reason, in the following pages we consider analysing Spain based on its internal contrasts. One of the most obvious, and popularised in the debates of recent years, is among the depopulated, rural and emptied Spain of much of the interior, and the dynamic, urban and populated, extensive coastal regions. As we have already pointed out, throughout the country the denominations of places and territories are not neutral, but intentional. In this way, we will return to the concepts of nation, nationality and region in the Spanish language, applied, not without conflict, to the different parts of Spain, and explain abroad a complex debate which often has not been properly clarified. Finally, Spain has an official political-administrative organisation derived from the precepts of the democratic Constitution of 1978. It is about understanding the result agreed by the political leaders that superimposed two interpretations of the Spanish

map: one of the centralised nineteenth century, which divides the state territory into more or less homogeneous provinces and municipalities; and the decentralising interpretation of the current regime, which institutes the figure of the Autonomous Regions, to integrate both regional realities and so-called *nationalities*, with a certain historical right to self-government.

3.1. The two Spains: the urbanised and dense and the empty(ed)

Any Geography manual referring to Spain states that its territories have been intensely transformed since the mid-twentieth century. On many occasions, the "urbanisation process" formula is used to explain these changes. In fact, throughout the country the industrialisation and economic *modernisation* initiated in the 1950s and 1960s resulted in very rapid growth, first in the main cities and afterwards in their metropolitan areas, leading to a consequent general depopulation of the rural regions (Gil and Gómez-Mendoza, 2001; Nel.lo, 2001). As in other European countries, farming land needed less and less labor due to mechanisation and the progressive insertion of agricultural activity in the market economy. Also, urban factories and services demanded new workers in a way that, for Spain, was much faster than in the surrounding countries. The political instability and the Civil War held back a rural exodus, which broke out between 1950 and 1980, in a context of industrialisation and productive growth policies at all costs, under a dictatorial regime that repressed trade union rights and managed to significantly increase the performance per worker in the Spanish economy.

All the dynamics that we have just mentioned generated a new organisation of space in Spain. The main cities grew enormously, starting with Madrid that benefited from the centralisation of power. This fact resulted in a decline, and an accelerated depopulation process, in its closest interior regions such as Castilla y León, Castilla-La Mancha or Extremadura. Industrialisation, economic diversification and urban and metropolitan boom processes were repeated throughout the coast. This has been clearly observed in the Mediterranean corridor, where the consolidation of the metropolitan region of Barcelona has extended southwards through Tarragona and Reus, and the north of the Valencian coast to the city of Valencia. The Alicante-Murcia coast has also been heavily urbanised with extensions to the farming land and, although there is no continuity to the south, the Málaga-Costa del Sol complex ends an axis of intense growth and densification. Something similar occurs on the Galician coast from Vigo to Coruña-Ferrol, the Oviedo-Gijón-Avilés triangle, and the Basque-Cantabrian coastal strip to the French border. Although the term Atlantic-Cantabrian corridor is used much less, the intensity of urbanisation in the northern and western Spanish regions is not lower. Undoubtedly, the entire coastline appears intensely busy, in contrast to the interior, and this contrast is noticeable simply by observing the recent maps drawn up by the National Geographic Institute (figures 1 and 2).

The first map shows the population distribution in the present (year 2015) based on the number of inhabitants registered by municipality. The second shows the evolution of human capital, expressed in densities, over an extended period of time, from 1900 to 2015. Figure 1 summarises what has been commented on in the previous paragraphs, the coastline shows an intense level of human occupation of the territory, where cities, metropolitan areas, medium and small cities, and more or less wide peri-urban sectors occupied by villas, estates and a group of native towns that have overflowed from an important building growth occur. In the interior, the depopulation trend is somewhat nuanced, first in the great metropolitan region of Madrid, the most important in the country. Then in the urban areas of Zaragoza and Valladolid, and in a series of cities that serve as provincial or economic capitals, standing out for their total population over a majority of municipalities with few inhabitants. From the population distribution data at local level, the strong contrasts in demographic densities are shown. If we move on to its evolution over the last one hundred and fifteen years, the impression that we are facing two Spains, the overpopulated and the emptied, is ratified. Much of the coastline has grown in population, while in the interior only the large urban and metropolitan areas, and some municipalities that include provincial capitals, medium and small cities show a positive balance. A balance that, in any case, responds more to dynamics recorded until the end of the twentieth century than in recent decades, when the entire interior except for very prominent and punctual localities, has tended to decrease.

As a result of these analysed processes, it is possible to differentiate an urban and thriving Spain from a rural and declining one. The first is organised by two large cities, Madrid and Barcelona, a set of metropolitan areas that have between 700,000 and one and a half million inhabitants and centralised by a major capital (Valencia, Seville, Malaga, Bilbao and Zaragoza), other urban areas and growth axes more numerous and distributed throughout the territory, and some central places that still

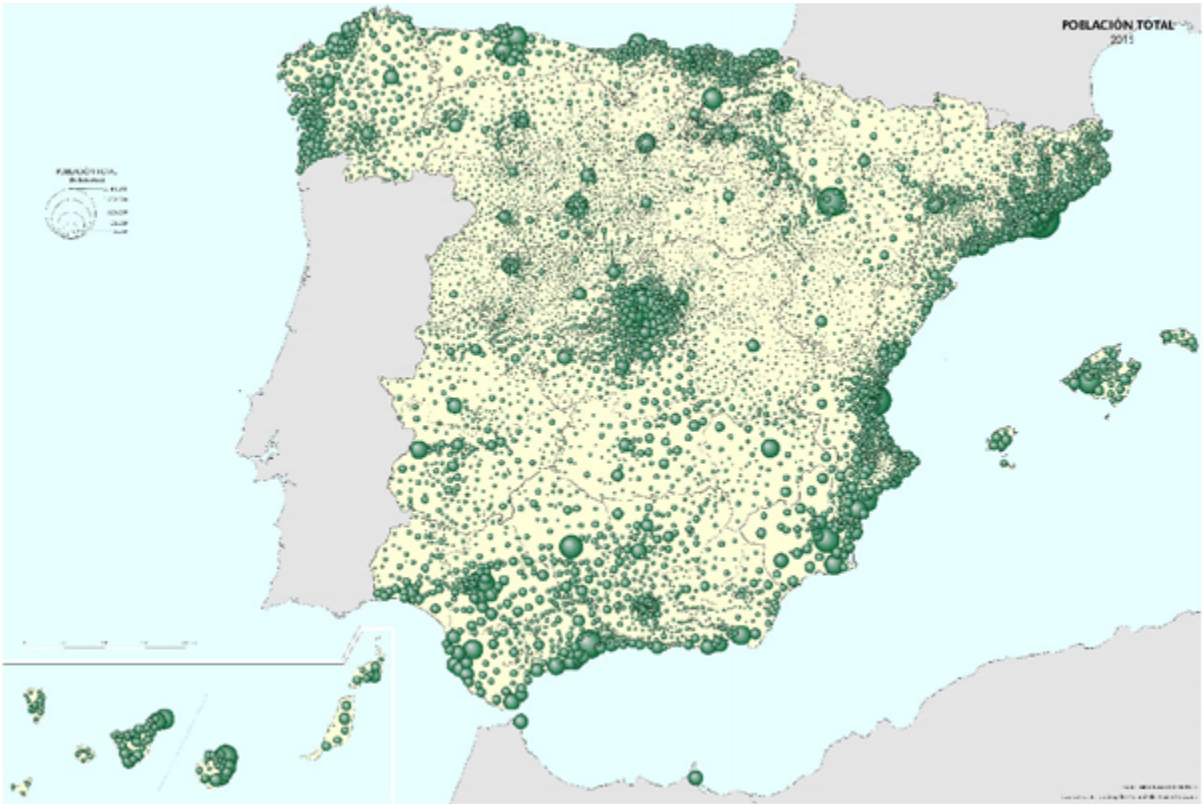

Figure 1. Population distribution in Spain (2015)
Source: National Geographic Institute (2018)

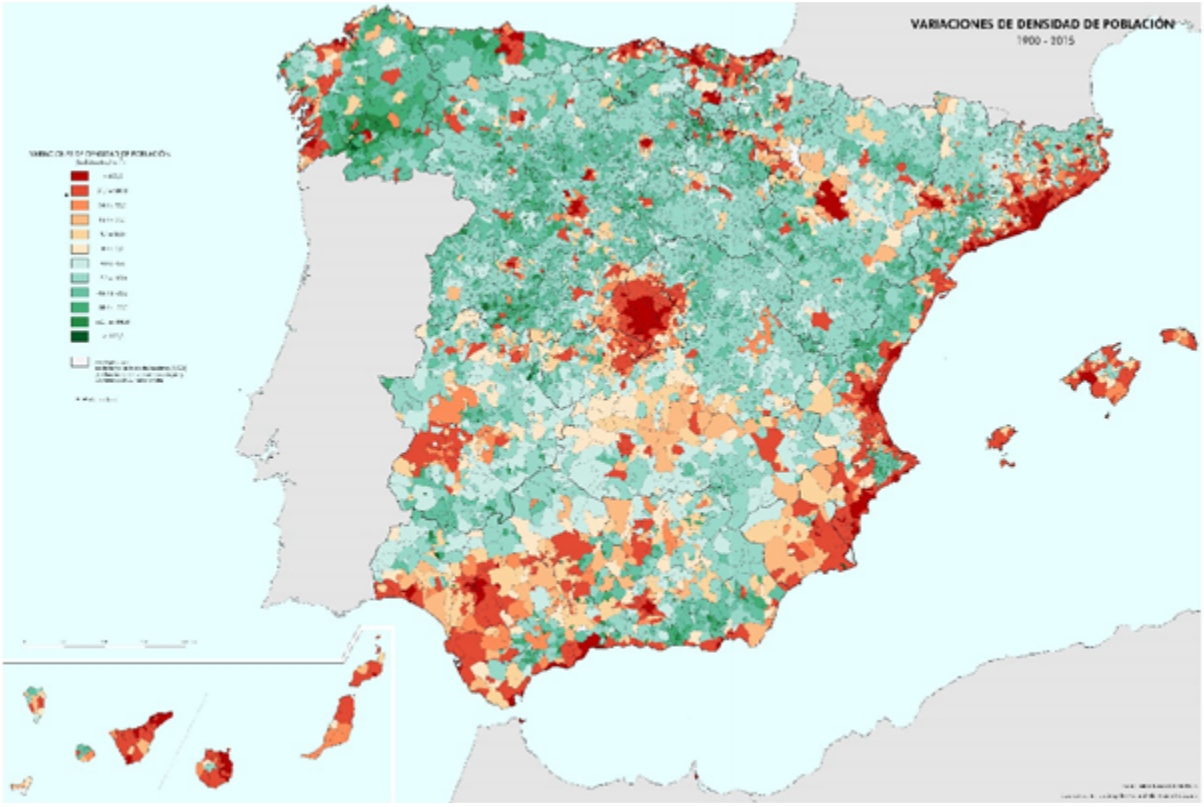

Figure 2. Population density variations (1900-2015)
Source: National Geographic Institute (2018)

maintain some dynamism, generally in coastal sectors or very accessible by structuring communication routes (Lois and Piñeira, 2017). The rest of the country is characterised by an intense depopulation process (AGE, 2018), which spans vast interior rural spaces, afflicted with ageing and an obvious economic agony. This empty(ed) Spain is observed from the interior of Galicia to Aragon in the North, in both Castillas and Extremadura, and along a series of rural regions of northern Andalusia. In this sense it is possible to distinguish three types of rural areas: those close to a city, which can benefit from certain dynamics of urban decongestion; the rural middle, normally specialised in a dominant agricultural activity, which requires little labor and has contributed to simplify the landscape, and the less accessible mountain areas, where the effects of abandonment of the territory are especially intense (Lois and Piñeira, 2017). In short, the contrast between a Spain that counts less than 10 inhabitants per square kilometer and another with more than 300, can occur in small sections of territory between the mountainous interior and the coast.

3.2. The multiple Spains: regions, nationalities and nations in a permanent territorial debate

The inequalities generated by population densities, or a very different level of economic development, have not posed problems to the geographical (regional) characterisation of Spain. All this even considering that our discipline together with the Social Sciences, show their concern about the depopulation or regional wealth asymmetries, making proposals to correct them. However, if we enter the field of territorial representations, problems and debates arise from the beginning. Firstly, and as contemporary historiography has shown, the idea of a Spanish nation (similar to that of the French and other European countries) was asserted during the nineteenth century (Álvarez-Junco, 2001; Moreno and Núñez-Seixas, 2013). A concept of unitary nation-state that was behind the centralisation of power that had accompanied the establishment of a liberal regime since the 1830s (Álvarez-Junco, 2001). In addition, as of the mid-nineteenth century, this first presentation of Spain as a modern state was completed with that of a Catholic nation, keeper of traditions, that various conservative intellectuals successively expressed in their writings (Álvarez-Junco, 2001). Therefore, Spain appeared as a consolidated entity in the contemporary period, due to the conjunction of two very powerful ideological discourses, one liberal and modernising, another Catholic and conservative.

In parallel to this justification of Spain's personality and unity, in a set of peripheral territories that spoke their own languages (Catalonia, Euzkadi and Galicia), national theories were developed following other European models, particularly the Italian *Rissorgimento* (González-Beramendi and Máiz, 1991; González-Beramendi, Máiz and Núñez-Seixas, 1994). It is curious to see how these readings mainly insisted on cultural and ethnic-religious aspects in the Basque case, rather than on objective conditions of economic backwardness or the peripherality, which would have generated significant discourses in Andalusia or the Canary Islands, to name two examples. The elaboration of particular national arguments ran parallel to what happened to the whole of Spain, superimposing, from the beginning, ideas of nation over coincident territories (Carreras, 1992; Romero, 2006), a model that in Europe is similarly represented in the United Kingdom (Castro, 2016). Sometimes, the more moderate representatives of the Catalan, Basque or Galician movements, prefer to use less conflicting expressions to define themselves as Catalan, Basque or Galician, but in all these cases we are faced with the conviction of a national reality or a nation similar to other places in Europe like Scotland, Flanders or Bavaria.

A recurring issue in this *national* and territorial debate in Spain refers to the feeling of belonging, or affection/disaffection towards everything Spanish in the whole country (we could complete it with the position in favour or against Catalan or Basque claims of more self-government). Regarding this issue, there are two simple and direct ways to measure territorial feelings from numerical data: the first, analysing the electoral results and the votes received by constitutionalist, independent or self-determination parties in each territory, a method that we tried in the past with good results (Lois, Escudero and Valcárcel, 2000); a second, analysing the opinion polls that the official sociological study centres perform on the subject (CIS, 1990-2019; Euskobarometro, 1995-2019; CEO, 2005-2019). In these cases, highly nuanced, changing assessments with slightly different conclusions have been recorded, depending on the bias of the question posed. In relation to these data, we will look into the most current, only as a first approach towards a deeper analysis that, in our opinion, Spanish Geography should address.

If we start with the electoral results, the successive elections of April and May 2019 in Spain (first the general elections, then local and European), provide us with very clear evidence. In Catalonia, the strong independence debate that opened a few years ago shows a polarisation between two blocks, with almost identicalsupport for

independence and constitutionalism(unitary), election after election. Thus, in the General Elections the four sovereign or nationalist forces (ERC, Junts, Front Republicà and Convergents) had 39.44 % of the votes, a percentage that rose to 50.06 % in the European Elections of the following month (JEC, 2019). This range of variation is the maximum that can be found, since in the elections to the Madrid Parliament the debate becomes more Spanish and a greater number of people voted, while the European elections coincided with the Local elections, where rulers are closer to citizens, and parties usually transmit their message more efficiently. Away from the immensely intense debate that the possible independence of Catalonia in recent years has generated, in the Basque Country the vote for nationalist or independentist options (PNV, EH Bildu) remained strong in the General Elections, with 47.8 %, and 55.56 % in the European Elections (here we also add the votes of Junts and CPE). A different profile is seen in Galicia (similar to Wales in the British context), where nationalist votes only accounted for 6.99 % (BNG, En Marea y Compromiso) in the General Elections, and 13.5 % in the European.

This implementation of nationalist forces contrasts with the outlook seen on territories identified almost unanimously with the idea of Spain as a nation, where the debate focuses on the scope of autonomy, regionalisation or the need for the recentralisation of power. Thus, for example, in Madrid, Castilla y León or Andalusia, the regional forces never reached 0.2 % of votes in the General elections and 0.35 % in the European, compared to the more aggressively Spanish nationalist options (especially the Vox party), linked to the extreme right that demand a harsh intervention in Catalonia and the adoption of strong anti-immigration measures, that reached percentages in the range of 12-14 % in the General elections, decreasing to 7-10 % in the European elections one month later. These data can be nuanced a little in local and regional elections where local parties can take part obtaining a minority percentage of votes, appealing to formulas of autonomy or greater self-government. In the most recent elections analysed, this was found in Castilla y León, where provincialist and regionalist forces (UPL, XAV, C. Bierzo, etc.) reached 3.28 % and two of the 81 seats of the regional Parliament.

With respect to the feeling of belonging or not belonging to Spain, and the political position favourable to a greater or lesser autonomy, progress towards a federal state, and territorial identity (for example, Catalan and Spanish, more Catalan than Spanish, only Catalan, etc.), several official statistical institutes promote opinion polls, among which the CIS (Center for Sociological Research, dependent on the central administration), the Euskobarometer in the Basque Country (result of an agreement between the Regional Government and the University of the Basque Country) and the CEO of the Generalitat de Cataluña (CIS, 1990-2019; Euskobarometer, 1995-2019; CEO, 2005-2019) are noteworthy. They regularly ask questions about the feeling of belonging and the citizens' opinion on the territorial organisation of the Spanish State. However, the results are varied, as they are conditioned by the methodologies used in each case and by specific events, which exalt or calm the general mood. In general, the three institutes coincide in highlighting major support for the regional organisation of Spain. In the Basque Country and in Catalonia there is a claim of greater self-government, with a significant part of public opinion in independentist positions (tactical or strategic), while in the remaining territories, regionalisation is unevenly supported, with significant segments of those consulted asking for better regional management or a recentralisation of power.

Undoubtedly, the recent territorial debate that has developed in Spain redefines two classic trends in society. The first, deeply rooted in historical nationalities defending a federal structure or greater self-government (and full independence), and another that manifests a progressive establishment of the idea of a unitary Spanish nation, framed in the European context. As was the case with population densities, each of these positions show different support according to the territories, keeping open a permanent debate on the political-administrative organisation of the country (Gómez-Mendoza, Lois and Nel·lo, 2013). Although there has been little research on Spanish Geography to interpret this issue academically, it is certainly desirable that the regional and political components of territorial analysis open new avenues for scientific knowledge of a key issue in the configuration of present-day Spain.

3.3. The territorialisation of a complex reality: the map of Autonomous Regions and provinces

Faced with the current geographical debates in contemporary Spain, the 1978 Democratic Constitution initiated a new and original way of political-administrative organisation of the country (figure 3). Original because the general right to autonomy and self-government of the territories was combined with the maintenance of the unitary map of the nation, defined since 1833 by the new

Figure 3. Autonomous regions and provinces of Spain

Source: www.mapasinteractivos.didactalia.net

consolidated liberal and centralising State (García-Álvarez, 2002; Burgueño, 2011). The practical development of the constitutional requirements resulted in the creation of 17 Autonomous Regions and 2 Autonomous Cities in North Africa (Ceuta and Melilla). Among them, the so-called historical nationalities, who had enjoyed or approved a framework of self-government in the Second Republic (Catalonia, Basque Country and Galicia), were initially established, with Andalusia, and the other territories considered regionssoon afterwards gaining their autonomy through a slower process (García-Álvarez, 2002). However, the areas of these Autonomous Regions were constricted to those of the provinces that comprise them, without the possibility of adding new areas from neighbouring provinces (such as the extremely*Basque* County of Treviño which belongs to Burgos). Thus, the provinces, born in a historical context of consolidation of the modern State and political centralisation (Burgueño, 2011), many of them with somewhat arbitrary limits, ended up defining, individually or by aggregation, Autonomous Regions whose Statutes justify their conformation from well-rooted historical, cultural and singularity reasons. In this way, both the regions and the provinces were divided into municipalities, entities of power or local administration, also born with the liberal state in the 1830s similar to the French *communes*. Although they account for a high total number (around 8,000) and the viability of the smaller municipalities has been questioned many times, the Spanish local map has remained with few variations over the last two hundred years, translating a dual political-administrative reading into the present, between the trend towards standardisation at the beginning and a strong feeling of place, encouraged by exceptionally efficient administrations close to the citizen.

From this peculiar political-administrative organisation, there have been several debates in Geography and the other Social Sciences in Spain. The first refers to the scope of an autonomous system that has been characterised as imperfect federalism (Romero, 2006). The Autonomous Regions arose from a decentralisation process, but they do not comprise basic components of the State, as in Germany, the United States or Switzerland. In addition, their denomination is different, oscillating between nationality and region, and the competencies and attributions that correspond to them in each case. There are no federal institutions, such as another type of Senate or committees of presidents and sectors in areas with full powers (culture, tourism, housing, etc.) and, in general, the coordination mechanisms promoted by the central administration have been weak and ineffective. In fact, the particularity of the system created has resulted in a multiplication of power conflicts and appeals before the Constitutional Court, which has had its original arbitration function overflowed with important issues. Some authors, such as the geographer J. Romero, have drawn up interesting proposals to better order the Spanish political-administrative organisation in a federalising direction (Romero 2006 and 2012), but these ideas have barely left the most documented academic debates.

Another peculiarity, already suggested, of the current political-administrative map is the role of the provinces. These units were born from the attempt at territorial standardisation of the nineteenth century, with symbolic elements of the modern central administration delegated power such as: the Civil Government (now called Sub-delegation of the Government), in charge among other things of managing internal security; the Provincial Court of Justice; the Diputación (Provincial Council), a supramunicipal coordination body, while all of them became the preferred location for public servant positions from this period. The importance of the provinces and the provincial capitals justify their prominent role in the Spanish urban system (Burgueño, 2011), presenting themselves in many rural and inland areas as the only cities in a context of depopulation and economic agony. If the provinces played a fundamental role in the establishment of a unitary State for about one hundred and fifty years, since 1978 they have ratified their significance in the new autonomous context. In the municipal capitals the administrative buildings of the Autonomous Regions delegations are still concentrated, the services both transferred and peripheral to Madrid are maintained, powerful Provincial Councils, now subject to the region's control, continue to operate, and the provincial territory is considered the basic election constituency for most voting processes (despite serious attempts by administrations such as the Generalitat of Catalonia to change this division perceived as imposed). Therefore, the provinces express the original character of the Spanish political-administrative organisation. They continue to represent the old unitary state of the nineteenth century and respond to the new consolidated regional logic of the last forty years, even reaching the paroxysm of this situation in the Basque Country where the provinces are called *historical territories*, with strong powers and considered the legitimate expression of the secular foral rights of the *Basque nation*.

As a conclusive summary of the above, we are interested in noting an idea in our central opinion: there is a complex Spanish space, which we have characterised in a dual key, and a territorial organisation that tries to respond to existing geographical oppositions. In Spain, the urban, dynamic and populated periphery is opposed to the empty(ed) interior with the important exception of Madrid and other capitals. This objective problem of the current configuration of Spain is complicated by differentgeopolitical interpretations of the Spanish Stateaccording to the territories, since the strong particular feelings of Basques and Catalans are far from the unitary or moderately regionalising readings of Madrid inhabitants and Castilians. Based on this *spatial* situation, following the Spanish theorist of Geography J. Ortega Valcárcel (Ortega, 2000), an original and imperfect territoriality has been built (Romero, 2006 and 2012). The political-administrative map responds to two different models that end up juxtaposing, the regional decentraliser and the centralising unitary of the early nineteenth century. Consequently, the daily territorial debate is served and the position of Geography as an analyst of political and regional tensions in the country is fundamental in the understanding of contemporary Spain. Focusing the objectives of our scientific discipline on these issues constitutes a fundamental task to vindicate the role of Geography in the global understanding of the early twenty first century.

4. The concept of rich and poor regions: an approximation of regional economic profiles

In the debates on the territorial organisation of Spain, and as a reinforcement of the comments made in the previous section, a rich Spain and a poor Spain are usually opposed in a constant general characteristic of the country throughout the contemporary era. According to this interpretation,the peripheries have been richer since the early nineteenth century (always taking as reference the early processes of Catalan and Basque industrialisation). It is believed that they still maintain this condition nowadays, with the recent takeoff of Madrid as a result of the attractive effect generated by political power. In a complementary way, the rural interior defines what is considered the poor Spain, especially in the southern regions.

To corroborate or deny these assessments, we have decided to make a generic approach to the economic situation of the country, adopting a regional point of view. Thus, we have analysed the Statistical Yearbooks of Spain, prepared by the INE (INE, 1990 and 2018), and have examined the GDP by Autonomous Region at current value for two key dates: 1985, the year prior to our incorporation into the European institutions (EEC, then EC and today EU) and when the regional delimitation map of the country was finalised (defined between 1978 and 1983), and 2017, to obtain the most up to date data. In addition to this value, the current GDP *per capita* data in the Spanish regions has been provided, as a panoramic approach to rich

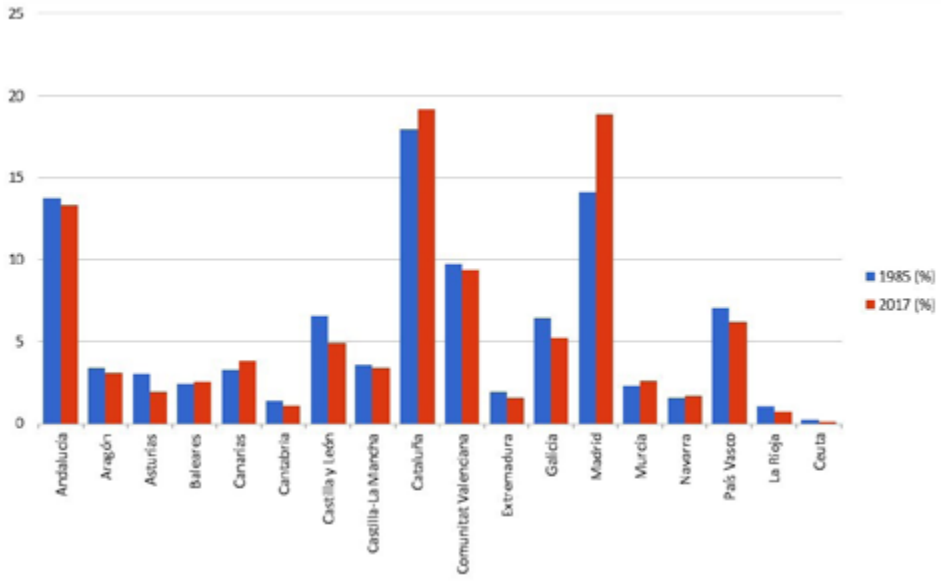

Figure 4. Percentage contribution of each Autonomous Region to the GDP (1985 and 2017)

Source: National Statistics Institute. Statistical yearbook of Spain

Spain and poor Spain. As will be checked through several graphs (figures 4, 5 and 6), the values allow for substantial comments.

Figure 4 shows the contribution of each Autonomous Region to Spanish GDP on the two dates taken as a reference. In this way, it is proven that almost 40 % of the national wealth is generated by Madrid and Catalonia, with a significant contribution (above 7 %) by Andalusia and Comunitat Valenciana (with an important demographic weight) and the Basque Country (due to its greater wealth). A little behind the latter areGalicia and Castilla y León, which lost relative economic importance in the period from 1985-2017. The most striking fact of the graph is the strong increase registered in Madrid's contribution to the Spanish economy, which has been interpreted from different points of view. Firstly, and despite the strength achieved by regional self-governments, it is estimated that as in other European nation-states, the effect of the centraliation of power (and large companies) has contributed to greatly reinforcing the importance of Madrid's GDP. In this case, the similarities with Paris, London or Lisbon and their respective territories are evident. A decentralised political system has not been able to efficiently counteract this process and, consequently, numerous Catalan or Basque leaders insist on advancing their self-government, to build a more polycentric regional economic structure such as the German, Dutch or Italian examples. In this sense, Catalonia has,although modestly, advanced in this direction, due to the role played by Barcelona. The remaining regions, with some exceptions,

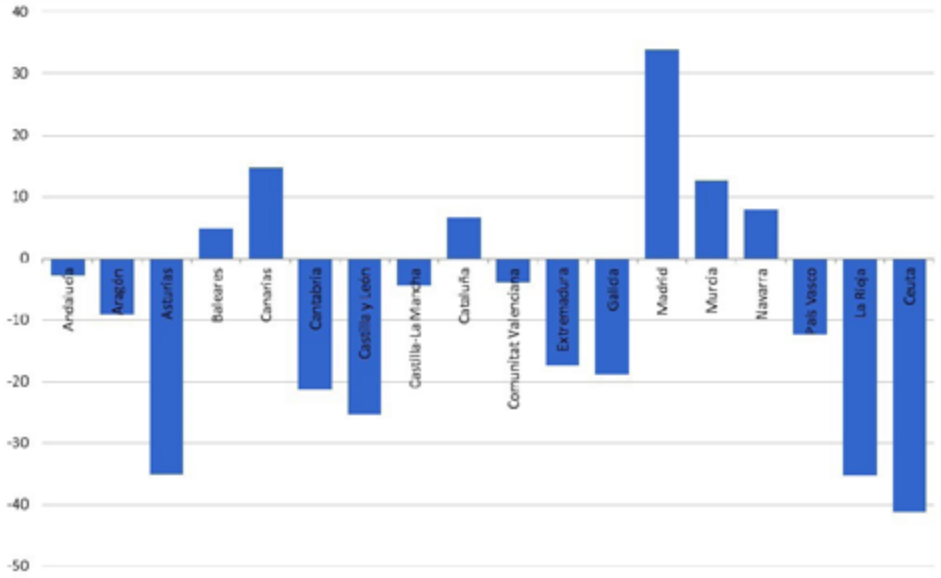

Figure 5. Percentage evolution of GDP by Autonomous Regions to the GDP (1985-2017)

Source: National Statistics Institute. Statistical yearbook of Spain

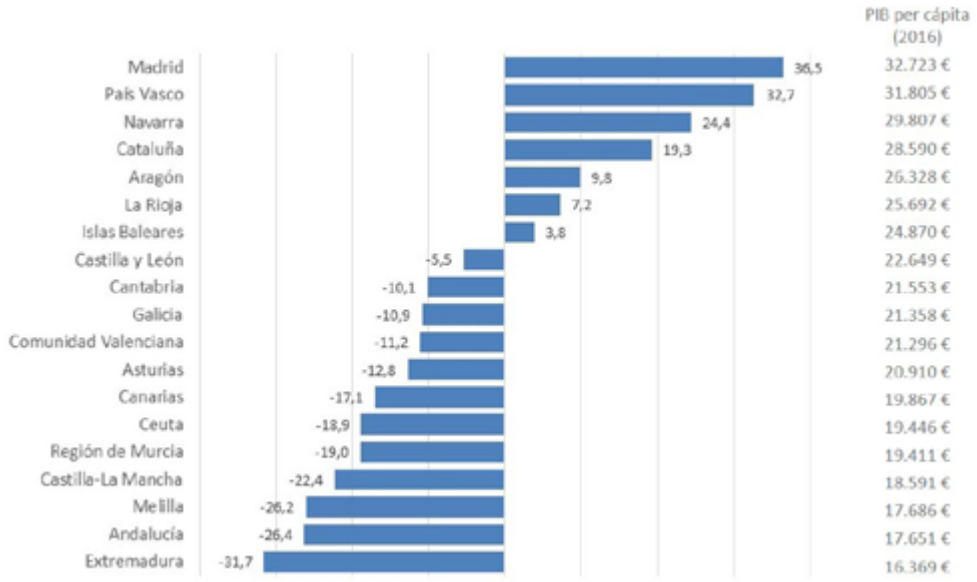

Figure 6. Ratio of regional per capita GDP and national per capita GDP in 2016

Source: National Statistics Institute. Statistical yearbook of Spain

tend to decrease showing what was observed in the distribution of demographic data in terms of GDP, with a tendency to growth in the most dynamic areas and a decline in most of the Spanish space.

The percentage evolution of GDP by Autonomous Regions from 1985 to 2017 can be seen in figure 5. It highlights an increase in the share of Madrid (1985 = 100) by more than 25 %. There are also increases in: the Balearic and Canary Islands, due to the greater weight of tourism in the economic structure; Murcia, which together with tourism development, has managed to build an important agri-food cluster; Navarra, benefiting from the enormous powers of self-government (together with the fact that the Basque Country has its own Tax system) and, to a lesser extent, Catalonia. Small territories, such as the African cities of Ceuta and Melilla, La Rioja or Asturias decreased (affected by the industrial restructuring). The rest of Spain has been losing economic weight in a process linked to demographic stagnation and population ageing in many areas. In short, rich and dynamic Spain no longer responds to the classic parameters of strength in specific peripheral spaces, being led by Madrid (economic centralisation in a period of political decentralisation), more peripheral Autonomous Regions (tourism and agro-industrial centres) and some example of important levels of self-government.

The last graph (figure 6) is intended to synthesise the contrast between rich and poor Spain, according to the most recent GDP per capita data. Again, the pre-eminence of Madrid is clear, followed by the two Autonomous Regions with fiscal autonomy (Basque Country and Navarra), Catalonia, Aragon, La Rioja and the Balearic Islands, drawing a higher income map of Spain that extends throughout the northeast quadrant of the national territory, including the State's capital. The most negative values are no surprise, since traditionally poor regions remain poor, with Extremadura and Andalusia at the top. In the southern half, Castilla-La Mancha, Murcia (despite recent economic strength), the African cities and the Canary Islands have a lower personal income, with 15 % to 26 % less than the average. In any case, it should be noted that the efforts made by the Spanish Inter-territorial Cooperation Fund and, above all, the awarded European Funds, have allowed the gap between the most disadvantaged and richest territories to be maintained (and prevented from widening).

5. The symbolic representations of the territory: maps and territorial identity.

Similarly to the previous section where two perspectives were used to establish internal differences in Spain (one based on population data and another one based on the feelings of belonging expressed by the electoral Geography), now in the face of the incontestable values of National accounting, we focus on the world of representations. There have been numerous periods where the map of the country has been used as a decorative background in elementary schools. The aim was for schoolchildren to memorise the country profiles at an early age and to use the map as the basis for the lectures,

to study rivers, mountain ranges or the location of cities without difficulty (figure 7). The mural map of Spain, with its historical regions, began to be an essential element in the classroom until the end of the Franco period. In fact, as noted, although the authoritarian regime that extended between 1939 and 1975 did not recognise any territorial or identity-based territorial rights (except for the jurisdictions in the provinces of Alava and Navarra, for their support of the rebel generals in 1936), the setting of the name of the traditional regions such as Castilla La Vieja, Castilla La Nueva or Andalucía was so important that it undoubtedly ended up conditioning the configuration of the new autonomous mapafter 1978 (García-Alvarez, 2002).

Figure 7. Image of a Map of Spain in a classroom from the mid-20th century

Source: Museo Pedagóxico Galego (MUPEGA, Xunta de Galicia)

This evidence, together with the rapid recognition of the right to autonomy of Catalonia, the Basque Country or Galicia, encouraged both the writing of Geographies and the preparation of maps that most reliably represented a territorial reality that had been denied for forty years (Carreras, 1983; VV.AA., 1985; Pérez-Alberti, 1986; Souto, 1988). Perhaps the most striking aspect of the process has been the claim of an *original* nation, which groups all the territories where the same language is spoken or apparently similar traits are maintained. In this way, the Catalans have generalised the expression *Països Catalans* throughout the Comunitat Valenciana, the Illes Balears, French Catalonia, the Sardinian Alghero and an eastern strip of Aragon with the same discourse (figure 8). Thus a national irredentism has emerged, many times more symbolic than real, which is repeated in the Basque Country, with the Euskalherria of the 7 provinces (the three of the Autonomous Community, Navarra and the three French-Basque provinces) and in Galicia, extended to the Galician speaking regions of Bierzo, Alta Sanabria and Western Asturias. The intention of these readings is clear: in the face of a country perceived as extensive and as strong as Spain, alternative *national* or cultural realities appear, the better the wider; linguistic identities are also constructed against the mastery of Spanish. In the end, these representations have not gone from being mere cartographic exercises without too many consequences beyond the purely representative. However, the extension of the Basque expression shows an evident perceptual fracture in Navarre society and the designation of *Països Catalans* is not well regarded in Valencia, even among most of the nationalist movements. Regarding the real and positive consequences of these readings, two can be highlighted: the growing demand of a *Mediterranean corridor* that territorially and economically integrates the Spanish Mediterranean facade through fast communication routes (Boira, 2013), and the coordination of the Navarre urban system with the Basque in the Regional Territorial Planning Guidelines.

Figure 8. The Bescós Map of the Catalans Countries of 1962. Regional Division

Source: Creative Commons

Apart from the territories with a singular claim, the construction of other entities is also difficult, in an area of political or regional Geography that has scarcely been addressed so far. In fact, the degree of unity of the Canary Islands, beyond its cartographic and cultural individualisation as an archipelago away from the Iberian Peninsulais not clear. Regarding the Balearic Islands, one of its most distinguished geographers (Rullán, 2019), has insisted on the recent and relatively artificial nature of the denomination, and defends the theory of the predominance of the insular over the unitary perception of the whole, at least between its citizens. Also, there has been little emphasis on the Andalusian double identity, between the valley of the

Guadalquivir centralised by Seville and the eastern space of the Baetic System with Malaga or Granada as reference, which in many historical maps had appeared separated. Finally, the delimitation of the two Castillas has not been easy, with the distorting element of the presence of Madrid (Garcñia-Álvarez, 2002). Guadalajara differs and integrates with difficulties in Castilla-La Mancha and, on the other hand, the affinities between León and Soria, in the confines of Castilla y León, are quite scarce.

In our opinion, the analysis of the political representations of the territories helps to better understand the diversity of Spain and to understand the socio-economic implications of both models. Thus, in the first place the importance of Madrid's growth and the processes of economic centralisation in Spain has not been counteracted by the autonomous State. The application of new territorial planning would be needed to move towards a more polycentric organisation such as the German or Italian one. Second, the claims of important regional economic and political elites are channelled through the autonomous administration. Thus, nationalism and the Catalan bourgeoisie coincide in defending the metropolitan role of Barcelona and in the Basque Country, a generous public finance system has driven numerous innovative projects, with obvious economic results. Third, the dynamics followed in recent decades show obvious losers: the declining areas of the rural interior, and in particular of the territories near Madrid. Finally, it should be stressed that precisely the societies of these areas express a more entrenched Spanish unitary feeling. In fact, it is possible that if there is no in-depth debate about the organization of space, the tendency for inequalities to increase is expected to increase.

5. Conclusion

Throughout the text, an attempt has been made, in the form of an essay rather than an empirical research article, to analyse the real and symbolic value of the territory in Spain from various points of view, to show its main characteristics to an International public. Spain is, without a doubt, an extremely interesting country for geographical studies and the academic Geography of the country is obliged to deepen its regional and political approaches, an option that in many cases has been shunned. Firstly, it is about understanding the different meanings of territory and territorialisation in Spain when postmodern approaches, and the emphasis placed on narratives, are so important in contemporary thinking.

And secondly, it is interesting to deepen the old motto of a country defined by its internal contrasts, not only physical and bioclimatic, but linguistic and cultural, of the degree of development and organisation of space, among many others.

As has been shown, there is objective data that corroborate the notion of diversity within Spain. But there has also been an initial approach to how this diversity overlaps with very different territorial representations and images between some citizens and others, according to their place of residence. The image of Spain is especially different, and numerous official data and surveys corroborate this, from Madrid or from Barcelona. Geography should further investigate this evidence, which establishes a differential element of what is Spanish with respect to what is French, Portuguese, Italian or German. In addition, these different interpretations often conceal a strategy to be better placed, to be more competitive in investments or to receive more public funds. The economic consequences of intense territorial debate are of great interest to the geographical discipline. Thus, Geography should occupy a central space when explaining the complex Spanish reality of the present and the main challenges that the country must address.

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Green and blue plots for sustainability and recovery of urban cultural landscapes

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Abstract

Recent urbanization processes, with high speculative burdens, create sustainability difficulties for today's cities and cause the disappearance or deterioration of cultural landscapes inherited from the past of great heritage value, especially in the cases of the oldest civilization cities. Paradoxically, these damages occur when there is greater social and institutional awareness of the importance of landscape, monumental and archaeological values inherited from the past and present in our urban environments. Through cases in Spain, Madrid, Vitoria-Gasteiz and Toledo, research results are collected to highlight the importance of the implementation of strategies for the recovery and construction of green and blue plots to ensure the sustainability of current urban systems, as well as to facilitate the conservation and recovery of cultural landscapes that are the heritage of the whole society, constitute a source of wealth and employment generation, especially through tourism, and in some circumstances, as in Toledo, the monumental, archaeological and landscape values justify its inclusion in the list of World Heritage Cities of UNESCO and the most recent declaration as City of Exceptional Universal Value.

Keywords: urbanization; speculation; heritage; cultural landscape; recovery; naturalization; green plots; blue plots; sustainability; society

1. Introduction

Today, cultural landscapes have become a matter of general interest and concern for public leaders across all cities. This is largely a result of the growing consideration of the landscape built as a heritage value, thus implicitly recognized by the UNESCO World Cultural and Natural Heritage Convention held in Paris in 1972, and already explicitly, 1992 Paris Convention to implement the criteria and recommendations of the previous one. Precisely in the latter, cultural landscapes are defined as *the result of the combined action of man and the natural environment over a particular space through time.* Shortly thereafter, the development and approval of the 2000 European Convention on the Adoption of Florence gave a definitive impetus to strategies for the protection of the landscape and its value, with the important novelty that these objectives are extended to all kinds of landscapes, not just cultural ones, and are mandatory by the 47 member countries of the Council of Europe, once ratified by their respective governments. Spain did so on November 7, 2007 and came into effect on March 1, 2008, after its publication in the Official Gazette of the State (BOE of February 5, 2008). Thereafter, all land management legislation must be adapted to those criterias (Cortina, 2008).

On the other hand, public sensibility for landscape protection has been increasing around the world since the early 2000s and has proliferated strategies for qualifying cultural *landscapes such as: urban communities,* panoramas and interior settings, certain plazas, streets or neighborhoods as heritage value (Tarroja, 2006). This follows UNESCO's guidelines and the acknowledgements that serve as precedent recognized in the Historical Ensemble of Aranjuez and the Vega del Tajo on December 5th, 2001 and more recently, in June 25th, 2012 for the Río de Janeiro session of the World Heritage Committee held in St. Petersburg. This last candidacy was submitted to UNESCO by the National Historical and Artistic Heritage Institute of Brazil (IPHAN), claiming in its favor the "universal value" of Rio de Janeiro for it's interaction between natural beauty and human intervention, the same as Aranjuez, but at a

larger scale. It is also necessary to take into account the declaration of the XV ICOMOS General Assembly in the historical Chinese city of Xi 'an on the *"Conservation of the environment of structures, sites and heritage areas"*, of October 21, 2005 for the recognition of the heritage importance of urban landscapes. This declaration warned of the importance of the environment surrounding monuments, sites and heritage area. For this reason, planning tools and practices were proposed to properly conserve and manage these areas, mechanisms to monitor changes in the environment in order to prevent their transformation were established and local, interdisciplinary and international communities were outreached to promote social awareness of the conservation and protection of the environment.

The proliferation of declarations in favor of cultural landscapes also responds to a progressive expansion of the concept of *heritage* (Walter, 2007). It goes beyond its previous exclusivity of monuments, unique buildings and artistic vestiges of the past (as was done in the early nineteenth century), to include exceptional natural landscapes with the creation of the first American National Park in Yellowstone in March 1, 1872, between Wyoming and Montana, and in Spain, with Covadonga Mountain National Park, on July 22, 1918, and in recent times, material and immaterial goods associated with the peoples' culture (Convention for the Safeguarding of Intangible Cultural Heritage 2003, París, 17 October 2003).

At the same time, the growing interest in the landscape is also the result of the negative effects caused by excessive demographic pressure on the territory in cities and their environments, with their consequent environmental impacts of all kinds and the deterioration or disappearance of structures inherited from the past (Zárate, 2007). In addition, the territorial, economic and social dynamics of globalization accelerate the perverse effects of urbanization on historical landscapes and cities cease to be composed of continuous building around a primary nucleus to being made up of various areas belonging to several municipalities. The result is always the same, the constant expansion of the peripheries, with neighborhoods increasingly further away from the city center and nearby municipalities that end up functionally integrating into the same urban area, usually the ones with the highest population growth and, for obvious reasons, of younger population. Simultaneously, historic centers often lose residential population and functional variety. For this reason, it wouldn't then be considered unusual for these environments to become theme parks of history because of their, tourism driven, heritage value. Moreover, because of the contrasting process of " of higher environmental quality sectors and the "material deterioration" of others.

It is clear that these changes in the urbanization and society model have had an array of negative effects and impacts on landscapes that have been inherited from past generations. On the one hand, the urban planning tide - either through formal planning mechanisms and land management legislation in developed countries, or through informal mechanisms, the proliferation of neighborhoods of spontaneous growth and self-construction in developing countries - has altered the historic silhouettes of cities. In most cases, it has changed inland urban settings, as well as cultural landscapes in order to accumulate visual and aesthetic values, and for providing support to collective identities/mental images that artists, writers, painters and film, diffuse as genuine and differentiating elements compared to other spaces and places. Another impact of the most recent urbanization is the trivialization and homogenization of landscapes (Muñoz, 2008),so that new residential areas, large commercial surfaces, business centers and transport exchangers from just about anywhere, respond to identical models with the advantages and disadvantages that these represent for the people who use them.

Therefore, faced with this situation of brittleness of inherited landscapes, especially in historic cities —many within the UNESCO list of World Heritage Cities—, international organizations, authorities of different countries and society in general, are aware of the need to update and create specific instruments for their protection; in Spain, to the first "Law 4/2004, of June 30, on Land Management and Landscape Protection", of the Generalitat Valenciana, updated in 2014 (Law 5/July 25, 2014 of the Generalitat, of Land Management, Urbanism and Landscape, of the Valencian Community) and to the "Law 8/2005 of Protection, Landscape Management and Ordination", from the Generalitat de Catalunya, have been followed by similar ones, such as Law 7/2008, of May 23, on the Protection of the Galicia Landscape, or in the form of a Decree, in the Basque Country (Zárate, 2016). However, despite the previously stated norms of Law 16/1985, of June 25, of the Spanish Historical Heritage of autonomous laws for Land Management (LOTAU) and Cultural Heritage, the speculative interests of large land promoters almost always, with the financial support of the city council, outweigh the cultural values and respect for what is common heritage for all rather than the few. Thus, the urban planning tide destroys or jeopardizes the right

to use and enjoy the cultural landscapes that are a major legacy of the past and which policymakers should commit to handing it down in the best possible conditions to future generations by integrating them into sustainable urban development strategies or EDUSI (Bertrand and Lelli, 2009).

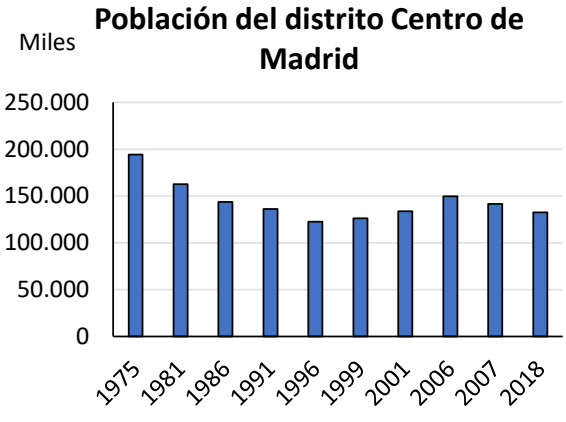
Hence, the need to add to heritage criteria for the defense of cultural landscapes, values of another kind, but substantial to them, such as those related to air and water quality, climate change and biodiversity, which justify the creation of Ministries of Environment and Ecological Transition in most countries that are founded on sustainability centered objectives. The effects of climate change on the life of the planet and its close relationship with the increasingly visible urbanization processes facilitate integration of urban cultural landscape management proposals with those of environmental improvement, supported in turn by sustainability criteria, solidarity and social responsibility. All this is made especially operational through an operational urbanism that prioritizes public spaces, puts heritage values first, provides concrete answers to environmental problems by creating blue and green wefted plots, and by taking advantage of existing structures while creating others (Delbaere, 2010). The 2030 Urban Agenda, issued from the United Nations Conference on Housing and Sustainable Urban Development (Habitat III), held in Quito on 20 October 2016 advances the same line of commitment to the environment and an aspiration to developing more cohesive and habitable cities.

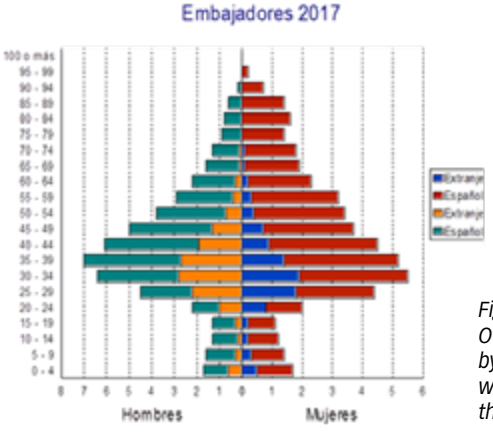
In this contribution, two success stories are shown for urban renewal and the conservation of urban cultural landscapes based on environmental strategies of urban naturalization and the development of blue and green plots: Madrid Rio and Vitoria-Gasteiz, and a third case, that of Toledo, through which hazards that are affecting the conservation of cultural landscapes of exceptional universal are and possible responses to save them are analyzed, beginning with proposals to implement naturalization and environmental improvement strategies that are inspired by the previous two cases.

2. Madrid, green city

Madrid's territorial dynamics are identical to all major agglomerations and historic cities, as seen in figures 1 and 2: a progressive and steady growth on the periphery, including sets created by the 1997 PGOU within its municipality and metropolitan crowns as well as a significant loss of demographic troops and social mix reduction. In Madrid, as in Paris, London or Rome, there is a progressive "gentrification" of its central spaces, very visible in Chueca and Las Letras neighborhoods, and that advances rapidly in others, such as Malasaña and Embajadores.

Like other Spanish cities, Madrid experienced the consequences of a strong population growth between 1960 and 1970. In just 10 years, almost a million, of 2,259,931 in 1960 to 3,146,071 in 1970, inhabitants migrated to the city which made it impossible, amongst other contributors, to build a green belt that could be supported in Manzanares, contemplated in the PGOU of 1946 and 1963, and anticipated in the project of the architects Zuazo and Jansen of 1929. Instead, because of high residential density, housing developments were built along the banks of Manzanares as well as a huge football stadium almost on the riverbed, the "Vicente Calderón", which opened in 1966 for 62,000 spectators. However, because of its huge visual impact on the landscape, the stadium was permanently closed for its demolition and





Figures 1 and 2. Own elaboration by the author with data from the INE

a reordering of the area in 2017. At the same time, the need to facilitate mobility in the 1960s and 1970s justified the layout of the first ring road over the two-sided banks of the river, launched the opening of the M-30's first four sections in 1974. With it came the disappearance of Madrid's emblematic landscape: that of its monumental facade which lied on the cornice of Manzanares, and the San Isidro meadow environment, both of which are present through complimentary means in literary descriptions, engravings and paintings since the sixteenth century. This was done despite the successive laws of urban planning and land management that have always included specific articles for landscape protection (Zárate, 2011).

The Spanish Law of May 12, 1956, on "Land Regime and Urban Planning", contemplated the realization of Special Landscape Protection Plans (Title I of Urban Planning, chapter I, section 2). And different articles of the subsequent reforms of the state laws on Land Regime and Urban Planning (1975, 1992, 1997, 2007 and 2015) are expressed in that same line. The concept of landscape and articles referring to it by it's given name and to their protection and improvement. However, their practical results have been minimal, since these laws have been applied fundamentally to create urban land, which in the first ones was justified by the accumulated deficits of housing after the Civil War and as a response to the demands for industrial land and an expansion, that in the 1960s was characterized by Spain's greatest economic growth, was ahead of all planning, with exceptions, such as Vitoria-Gasteiz (Zárate, 1981).

The Spanish Historical Artistic Heritage Act of 1985 did not contribute much to the protection of Madrid's cultural landscapes, nor did the PGOU of Madrid of 1985, despite it being approved as a symbol of the "austerity of urbanism" compared to its predecessor, that of 1963, called "wasteful urbanism" for betting on the unlimited creation of urban land. Nor did it have much positive effects on the historical landscapes of Madrid. Operation Green Corridor, formulated in the 1980s as an ambitious plan to remodel the south of the city within an area of 163 hectares and which was grounded upon the disappearance and usage of old railway and industrial soils according to other international urban renewal action models : London Docklands, Paris's Défense or Manhattan's West Side (Brandis, D. and Del Rio, I. 1995). On the other hand, the Madrid Rio operation, executed between 2003 and 2007, has been extraordinarily positive due to its environmental, economic and social impact for the inhabitants of the area and the city as a whole. Undoubtedly, it has been one of the most ambitious performances in Europe of urbanism that bets on green and blue plots as a procedure for the regeneration of interior spaces within cities, and consequently, of landscape improvement and recovery of heritage values.

Operation Madrid Rio responded to a model of operational urbanism that bets on the renovation of public and private spaces for sharing (Zepf, 2009). In this case, the action was carried out in a short period of time, between 2003 and 2007, to reduce discomfort to the neighbors, and has basically consisted of the burial of 6 km of M-30 (via two roadways fast on both sides of the Manzanares) and over 1 km. from the exit of the city by the Extremadura road, below the avenue of Portugal, now transformed into a magnificent boulevard with wide green surfaces. This intervention has replaced cement and asphalt with gardens and leisure for all of Madrid with an area of 1, 210, 881 meters of linear park.

The urban development, completed between 2008 and 2013 with a plan for remodeling and improving urban facades to the river, for the most part, social housing of the 1960s, has directly benefited 77,694 inhabitants and has been accompanied by the recovery of the river as a blue and green plot that articulates part of the city in a north-south direction, extending longitudinally in these directions: towards the north, by the regional park of Monte del Pardo, and towards the south, by the regional park of the southeast, until the mouth of the Manzanares River in the Jarama near Arganda. On its banks, thousands of trees have been planted and along the river corridor natural ecosystems and historical landscapes have been recovered, some practically missing and forgotten, such as that of the Huerta de la Partida from the 16th century next to the Palacio de los Vargas. A wet estuary that recovers the also historic Meaques stream, previously piped was built near the cottage, in what was the Crown hunting farm from 1562 until its transfer to the City of Madrid in 1931, with constructions of patrimonial interest of the XVI century during the reign of Felipe II. Currently, it is the largest park in the city and one of the largest in the world, with 1,772.6 hectares, double of what Bois de Boulogne in Paris (846 hectares) is and larger than the Chapultepec forest in Mexico City (686 hectares).

The performance of the Manzanares has also allowed the visual recovery of the monumental cornice with a drop of 30 meters between the riverbed on which the Muslim fortress originated from Madrid in the ninth century which was then the medieval Alcazar and the Palace of Orient

Figure 3. San Antonio de la Florida. Goya`s pictures
Photo: A. Zárate

Figure 4. Dominique Perrault, bridge
Photo: A. Zárate

in the 18th century. Likewise, the Almudena cathedral, the viaduct, the historic Vistillas garden and the imposing mass of the San Francisco church, most likely to which the urban silhouette with which artists and painters have identified the image of Madrid with since the 16th century and have spread it throughout the world. The paintings of Francisco de Goya (1746-1826), Carlos de Haës (1829-1898) and Aureliano de Beruete (1845-1912) are among the artists that best reflect that image. On the other hand, the Madrid Río operation has facilitated the enhancement of monumental bridges of the river: that of Toledo, of Pedro de Ribera, and that of Segovia, of Juan de Herrera, the architect of the Escorial, in addition to highlighting the visually historical hermitages of San Isidro of the 17th century, and of San Antonio de la Florida, with the paintings of Goya, and that of the Virgin of the Port, the last two belonging to the eighteenth century (figure 3). Thereby, the new green and river plots as well as the strip of the river, are configured today, in themselves, as cultural landscapes of enormous heritage value and are shared use for residents, visitors, and tourists among them, since in addition to a recreation area and of sports uses for the city as a whole, this space attracts visitors and is already part of the tourist circuits through the city and recommended by tourist guides like: (https://www.tripadvisor.es/Attraction_Review-g187514-d2239279-Reviews-Parque_Madrid_Rio-Madrid.html).

Amongst other virtues of this action, is interrelating urban spaces that were previously repelled, that had no previous contact with each other, and that were separated by the river and especially by the M-30, which ran, as stated, in opposite directions by its two banks. Before, there was no other communication between the two banks than the historic bridges, 11 in total. Now that number has increased to 23, between bridges and walkways to a total of 23, which makes both banks completely permeable and facilitates their shared use. Among the new bridges is the Arganzuela, avant-garde work of Dominique Perrault, opened in 2011 and that has become an icon of Madrid Rio (figure 4). On the other hand, the operation is complemented by the environmental improvement of the river, its waters and its ecosystems, benefiting from the canalization works carried out throughout the 20th century throughout different projects, and the Comprehensive Sanitation Plan of the 1980s (Royal Decree 2528/1979, of September 7). At present, anyone who walks along the banks of the Manzanares will see the words of Mayor Tierno Galván of 1982 realized: "Soon the Manzanares will be populated with fish and ducks will swim on its waters". Today you can see fishes, the bottom of the river and ducks swimming in its waters. Of course, that Plan required the construction of 8 large sewage treatment plants for the city and the approval, of the Wastewater Sanitation and Purification Plan of the Community of Madrid (1995-2005).

Recently, another step was taken towards the environmental recovery of the river that was partitioned from a project presented to the City Council in 2015 by the "Ecologists in Action" group. The objective was

Figure 5. Proyecto Madrid Río
Source: Ayuntamiento de Madrid

to recover the function of the river as an ecological corridor, reinforcing the landscape and social value of the Manzanares in its urban environment. For that, the floodgates that held the waters in several sections had to be opened, several artificial islands had to be built and riverbank vegetation had to be planted. Thus, a response has also been given to the Water Framework Directive (Directive 2000/60 / EC): "prevent deterioration, improve and restore the state of water bodies and ensure that they are in good chemical and ecological condition" and by Royal Legislative Decree 1/2001, of July 20, approving the consolidated text of the Water Law, "Art. 92 bis. b): "protect, improve and regenerate all surface water bodies in order to achieve good condition."

The success of this way of contributing to the recovery, conservation and enhancement of the landscape, together with its positive effects on the city as a whole and its contribution to a shared use of urban land by all Madrid residents, explain the numerous awards obtained for Madrid Río, among them the first Verónica Rudge Green Prize in 2015, from Harvard University, for its design and social & cultural impact on the transformation of the river, and that of Hispania Nostra in 2016 (figure 5). This action has served as a model for other cities, such as the one that runs in Lima on the banks of the Rimac River, between the edge of its historic center and the hill of San Cristóbal. It is an analogous operation of green and river plots to recover intra-urban spaces and improve their landscape conditions, of course, to value cultural landscapes of high heritage content.

The success of Madrid Río also justifies other remodeling projects of public spaces in this city, such as the winner after popular election for the Plaza de España, with the title "Welcome mother nature, good bye Mr. Ford", designed by the same authors of Madrid Río, the team of Fernando Porras-Isla and Lorenzo Fernández-Ordóñez. This project dedicates 90 % of the area of the square to pedestrians and reduces current traffic by half, burying it; it maintains identical objectives of landscape recovery and naturalization, facilitating the physical link between the Plaza de España and the green areas of the area: the Parque del Oeste, the Sabatini gardens, the Campo del Moro and Madrid Río. It is therefore intended to further prolong the entrance of nature into the city and expand the existing green masses.

On the other hand, this creation of "up-down" green plots, promoted by the city's public leaders, are joined by "bottom-to-top" urban naturalization initiatives, driven by neighborhood associations/groups and more or less educational institutions, including second-education centers and universities, as shown in figure 6. Its way of action is the spontaneous or agreed occupation of free, public or private spaces to install "urban gardens" following guidelines of the global movement known as "Green Guerrilla" or "Community Garden", which is related in turn to self-food utopia (Reynolds , 2009). In 2019, Madrid has a network of community gardens distributed throughout the city and has the recognition and support of several municipalities. One of them, located in the historical park of the Retiro, is managed directly by the City Council for educational purposes and promotion of environmental values.

In any case, the experiences of urban gardens in Madrid, another form of expansion of intra-urban green plots, link the growing interest of society for the environment and with an increasing ecological awareness since the Summits of the Land of Rio of 1992 and of the Sustainable Development of Rio + 20, in 2012, as well as the 2030

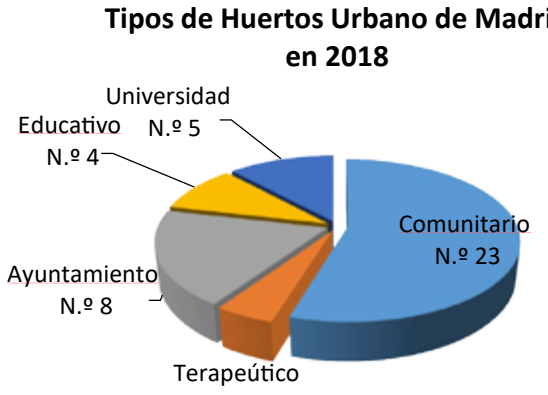


Figure 6. Intra-urban green plots: https://redhuertosurbanosmadrid.wordpress.com

Figure 7. Vertical garden. CaixaForum, Madrid
Photo: A. Zárate

UN Sustainable Development Goals and the New Urban Agenda. Vertical gardens, such as the CaixaForum Cultural Centre on the Paseo del Prado (figure 7), and green roofs are other ways to promote the advancement of biodiversity within the city, such as the larger-scale recovery of Madrid with regards to green corridors and other corridors within the city, which will connect the region's existing urban parks and protected natural areas, with more than 16 % of its area, as proposed by the 2013 General Urban Planning Plan revision. These same objectives include more specificactions, but of great international resonance, such as the bioclimatic or ecological boulevard of the Ensanche de Vallecas, inaugurated in 2007, and the forest park of the Ensanche de Vallecas Valdebebas, of 470 hectares of area, 5 times the extension of the Retiro Park, another of the most ambitious bets of the municipality of Madrid with the horizon of 2020 in favor of sustainability territory and landscape as an element of identity and wealth generation, in line with the European Landscape Convention.

All previous experiences and proposals, together with the existence of a large number of historical gardens - the most important of the Retreat, of 118 hectares of area, belonging to the old Palace of the same name of the seventeenth century -, justify that Madrid is recognized as the second city in the world with highest concentration of trees and green areas, after Tokyo (Zárate, 2014). In turn, the special urban and environmental quality of the Retiro Park and its heritage value, also with the buildings of the old palatial complex: the Casón del Buen Retiro and the Salon del Reino, are arguments used by the City Council to request that the UNESCO recognize and qualify this space and the Prado as cultural landscapes. Since November 18, 2014, this space and its elements are already on the Spanish Indicative List of World Heritage of UNESCO, as a preliminary step for its final declaration.

3. Vitoria-Gasteiz, Green capital

The case of Vitoria-Gasteiz is very different from that of Madrid in terms of evolution and territorial dynamics. It is a medium-sized city with 249,178 inhabitants since 2018, which grew slowly until the mid-twentieth century, but since then it has been one of the Spanish cities with the highest relative population growth, linked in the 1960s and 1970s to intense industrial development from the massive arrival of establishments of this nature from Guipúzcoa. Nonetheless, one of its main characteristics is that its growth has always been planned, which explains its regular blueprint that simply reflects changes in its structure due to the urban models that have happened over time: the medieval, regular and subject to successive extensions; the illustrated city of the late 18th century with the Plaza de España and Los Arquillos, a novel solution to bridge the gap between the foundational nucleus, on top of a hill (547 m), and the Alava plain (520 m), according to design by Olaguíbel Quintana (1752-1818); the nineteenth widening of Dato Street; successive experiences of the garden city model, with the Florida Path and, from the mid-twentieth century, the functional and organic model that inspires the most modern neighborhoods, those that occupy the largest area of the city (Zaramaga, Ariznavarra, Arriaga- Lakua, Salburua, etc.).

Precisely, the character of a city planned over time has led, on the one hand, to the existence of interior green areas of small size, but of heritage value, such as the Florida Park, from the end of the 19th century, and on the other, a proximity to nature and the countryside, given the dimensions of the city and its planned growth model. These circumstances are also those that now - when environmental and landscape strategies are imposed on the planet almost as a mandatory requirement - justify a city project that focuses on quality of life and the environment, which made its international recognition possible in 2012 as a Green Capital, the prestigious title awarded by the European Commission to reward environmental and quality of life policies through naturalization. These same merits have led her to deserve on September 6, 2019 the Global Green City Award, awarded by the Global Forum on Human Settlements, sponsored by the UN. In the case of Vitoria-Gasteiz, the commitment to the landscape and environmental quality is born from the City Council, with the consensus and support of the different social and economic actors of the city, and affects all its urban spaces, although the actions most relevant have taken place at its edges, taking advantage of the opportunities of the natural environment and the abundance of water on the surface and in the subsoil. Thus, one of the most emblematic operations has been the recovery of the important Salburua wetland, disappeared after having been dried up centuries ago to devote its lands to cultivation and in 1934, partially converted into an airfield, precedent of the current one of Foronda that was inaugurated in 1980. Today, Salburua Park, area that occupies 206 hectares and is a humid area formed by several lagoons, whose recovery began in 1994, is included in the list of wetlands of international importance (Ramsar List) and enjoys the category of place of Community Importance (LIC) within the Natura 2000 European Network.

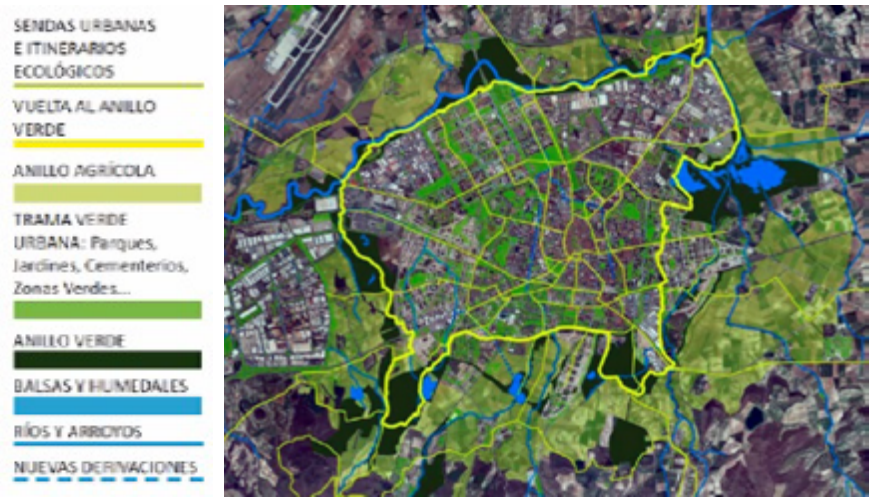


Figure 8. Green frames in Vitoria-Gasteiz

Source: The inner green ring. Towards an Urban Green Infrastructure in Vitoria-Gasteiz. www.vitoria-gasteiz.org/ceac

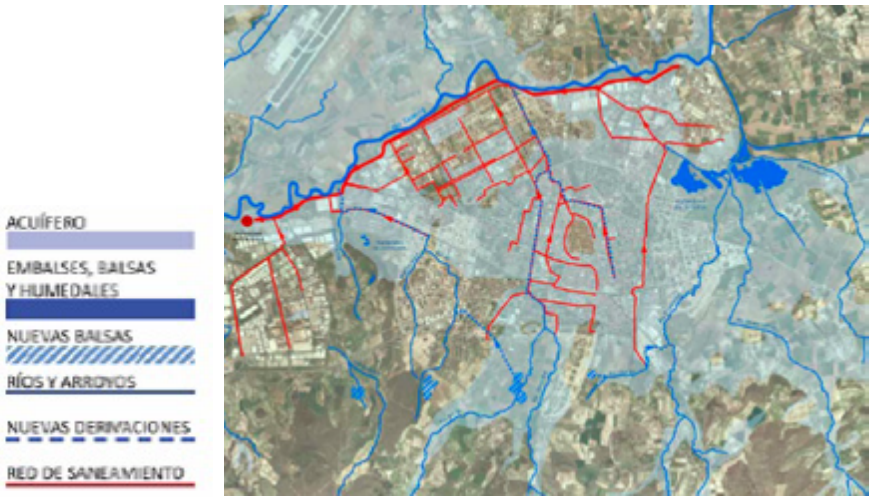


Figure 9. Blue plots

Source: The inner green ring. Towards an Urban Green Infrastructure in Vitoria-Gasteiz. www.vitoria-gasteiz.org/ce

In Vitoria-Gasteiz, the naturalization and landscape improvement strategies had as their first objective the creation of a green ring with a multifunctional structure, since it incorporates natural spaces, urban parks, rural land use and wetlands, all considered essential for quality of life and biodiversity (figures 9 and 10). This ring also includes agricultural soils, aquifers, rivers and streams, rafts, wetlands and the sanitation network; In short, everything that configures an authentic blue plot within the Zadorra river, which crosses the Alava plain, as the main element and landscape reference.

As in other cities, the green plot of Vitoria-Gasteiz is made up of gardens, parks, boulevards, tree-lined promenades and other green surfaces that include interior courtyards, intramural free spaces and cemeteries. All these green areas are distributed evenly throughout the city, so that 100 percent of the population resides less than 300 meters away from a green area, which has facilitated the layout of a network of urban pedestrian paths and for bicycles, which allows a connection with the green ring to be made in which there are also urban gardens, the most numerous to the north, on the banks of the Zadorra river. The latter are periodically taken out by the City Council to be awarded to private citizens for a few years and after the end of the adjudication period they are offer repeats itself. The economic profitability of these orchards is assured through the concerted purchase of their products by prestigious restaurants. In short, these are sustainable strategies that are also related to FAO's recommendations for self-supply in cities (FAO, 2010).

The integration of urban naturalization with landscape strategies of the rehabilitation of buildings committed to energy efficiency, with a program of integral water management and waste treatment, renovation of public space and mobility, with sustainability objectives and environmental improvement, was what made possible the candidacy of Vitoria-Gasteiz for the Green Capital award of the European Commission and its procurment in 2012, being the third city to get it, after failing to do so the first time in Stockholm in 2010, and in Hamburg in

2011. Currently, Vitoria-Gasteiz, with 26.76 m² of parks per inhabitants and 6.61 km² in total, is the city with the most green areas in Spain, a benchmark of quality of life for the rest of the cities of Europe, a model for those who aspire to obtain this prestigious title. Today, its blue and green plots have become an attraction for tourism, as has happened in the capital of Spain with Madrid Rio.

On the other hand, its double medieval enclosure, started with the foundation of the city as a fortress or stronghold on top of a hill in the middle of the Alava plain in 1181, by King Sancho VI el Sabio of Navarra, and developed in the thirteenth century with buildings of great heritage value, such as the churches of Santa María, San Vicente, San Miguel and San Pedro, and a regular framework based on parallel longitudinal streets and transverse cantons and steep slopes, such as Soledad, constitutes in itself a cultural landscape of enormous value. Undoubtedly, Vitoria-Gasteiz is one of the best preserved European medieval cities to date and has contributed decisively to two Special Comprehensive Rehabilitation Plans promoted by the City Council: that of 1985 and 2016. In this context, It has been important to enhance Renaissance palaces, such as Montehermoso, Villasuso, Escoriaza-Esquivel, the partial recovery of the first wall enclosure, leaving open spaces with gardens, and the adequacy of the houses to current conditions of life, although all these actions have not been able to avoid the demographic emptying of this historical part of the city.

4. Naturalization and rio in Toledo, proposal for a sustainable city

In the case of Toledo, the concern of public authorities (CCLM Board and City Council) for the environment and the landscape has evolved in recent times to that of the two previous cases, to the point that some of the views most emblematic of the city's historical complex are threatened, despite being legally protected, the cultural landscapes of las vegas and the cigarrales are in danger and a natural space of environmental quality within the municipality, corresponding to the estate of Zurraquín is occupied by a "Puy du Fou" theme park, over 159 hectares. All this happens after the approval of the 2000 European Landscape Convention and its subsequent ratification by the Spanish government on November 26, 2007 (BOE de 02/05/2008).

4.1. From landscape conservation to destruction risks

However, the uniqueness and variety of the landscapes of Toledo, on the edge of the crystalline base of the Montes de Toledo, and the geomorphological action of the river, together with the monumental values of the historic center and its rich historical past, were decisive for its Inclusion in the list of World Heritage Cities in 1986 and its declaration as UNESCO's City of Outstanding Universal Value in 2013. These same reasons justified Toledo's early qualification in 1940 as a Historic Artistic Site and the preparation of the "Instructions for the General Directorate of Fine Arts "of 1965 (definitively approved in 1968) to define protection zones and visual cones from the access roads. In its interior, construction was prohibited or heights were limited according to the location with respect to the historical complex and the las vegas river, always with the interest that the view of the silhouette of the city from outside could be prevented or hindered.

In 1961, the State created a large mixed polygon in Toledo, with a residential and industrial zone, within the framework

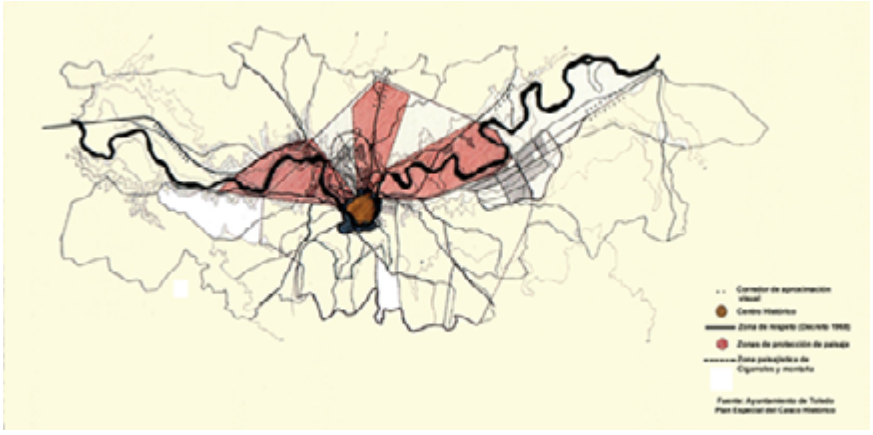


Figure 10. Protection zones and visual cones from the access roads
Source: PECH, 1997

of the Industrial Decongestion Plan of Madrid of 1959, and located it six kilometers east of the city to avoid visual impacts on the Historical Complex and damages due to pollution of the fumes of the industries that were expected to be installed there. In turn, the General Urban Planning Plans of 1968 and 1986, and the Special Plan of the Historic District of 1997 maintained the landscape protection areas defined above (figure 10). The slow growth of the city until 1970, with a very small expansion outside the walls and the existence of military land in the Vega Baja also contributed to the conservation of landscapes and their heritage values, even after the establishment of capital in 1982 Regional of Castilla La Mancha in Toledo will cause a greater increase in population.

On the other hand, the existence of landscape protection zones derived from their qualification as a historical set of installations and soils for military use, as well as the creation of new neighborhoods, responding sometimes to official planning and sometimes to actions outside of it, many based on single-family homes in response to the desire of large sections of the population to live in contact with the countryside, boosted the current urban model diffusor, with physically separated neighborhoods, sometimes more than 4 km from the historic center, categorizing it as an "archipelago city." And to disperse this form even more, the largest relative population increase in recent decades has occurred in the municipalities around it setting up an extensive urban or metropolitan area of 130,446 inhabitants since 2019, in sharp contrast to that of Vitoria-Gasteiz, whose urban form remains very compact, despite its rapid growth since the middle of the last century.

It is evident that the dispersion of neighborhoods in Toledo generate difficulties in connection, imbalances and maintenance costs of the infrastructure and equipment of the city, so that the political groups of the City Council consistently demand the compaction of the gaps between these neighborhoods, but that dispersion, which is perceived as an inconvenience, is also what has allowed the conservation of unique landscapes, both for the originality of the physical environment in which the city sits, the crystalline plinth of Toledo and the river, and for the accumulated footprints from the past. The Historic Center, the cigarrales and las vegas are cultural landscapes with strong aesthetic personalities and complex socio-economic components that complement each other to project an image of Toledo to whose dissemination is attributed to great masters of painting (El Greco, Jenaro Pérez de Villaamil, Aureliano de Beruete, Joaquín Sorolla, Ignacio Zuloaga, Diego Rivera, Benjamín Palencia…) (figures 11 and 12), literary descriptions (Al Edrisi, Andrea Navagero, Garcilaso de la Vega, Cervantes, Tirso de Molina, Benito Pérez Galdos, Blasco Ibañez, Maurice Barrès, Gregorio Marañón) and the cinema (El Buen Amor, of 1963, by Francisco Regueiro, or Tristana de 1970 by Luis Buñuel, among many).

In turn, in that natural and cultural context, the Tajo is the essential element of Toledo's landscapes, hence it is spoken of him as "Padre Río", as the Tiber was for ancient Rome or the Nile for Egypt. The river is the architect of the lathe on which the monumental city is located by fitting tightly in the crystalline socket, about 100 meters deep, in its granites, quartzites and metamorphic rocks, taking advantage of faults and fractures; in turn, the Tagus has

Figure 11. View of Toledo from the Cruz de los Canónigos, Genaro Pérez Villaamil
Bilbao Museum of Fine Arts

Figure 12. View of Toledo with the bridge of San Martín. Ignacio Zuloaga, 1932
Zuloaga Museum, Pedraza Castle, Segovia

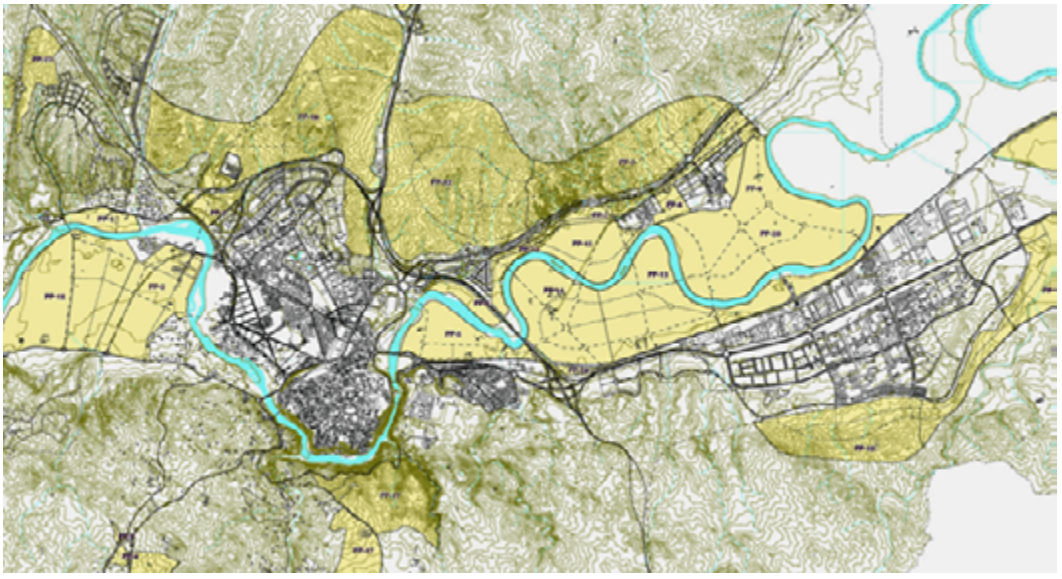


Figure 13 Partial Urbanization Plans provided for by the Municipal Planning Plan of 2007, with the occupation of the river's vegas

Source: Toledo City Council

originated the landscapes of Vega and has led to activity on its banks throughout the ages: orchards, batanes, mills and light factories, with waters that save an unevenness of almost 10 meters from the bridge from Alcantara to San Martín. The history of the city is also not understood without the river: from prehistoric and Bronze Age settlements to Roman times (about 20,000 inhabitants) and next Visigoth stage, as the capital of the first Spanish state. Subsequently, Toledo was the capital of the Middle Frontier, of Taifa Kingdom, and after its conquest by Alfonso VI, in 1085, frequent seat of the Court of Castile and after the Spanish monarchy, especially with Carlos V. Finally, the landscapes created by the river have made possible complementary economies and different livelihoods: forestry and livestock use on the edge of the crystalline base; orchards and leisure activities in Las Vegas, and cereal crops to the north, on the clays and sedimentary marls of the Sagra road.

In the Vega Baja, villas and large buildings were located for shows in Rome (circus, amphitheater and theater), and later, monasteries, churches as well as Christian, Jewish and Muslim cemetaries. It is an intensely occupied space in the past, in it was, among other things, the Basilica of Santa Leocadia and now the church and cemetery of Cristo de la Vega, the Weapons Factory, created by Carlos III in the 18th century, and the working-class town, a city-garden urbanization model, also declared a Site of Cultural Interest (BIC), whose construction with its current configuration was initiated in the late 1940s at the initiative of the Factory's colonel, Mas del Ribero (Campos and Rodríguez, 2008).

4.2. From landscape conservation to the risks of destruction

Nevertheless, all these landscapes, relatively well preserved and legally protected, began to be threatened with the population growth of the city and the intensification of the urbanization process brought by the 80s and, above all, with the 2007 Municipal Management Plan. With it, the landscape protected areas would disappear and the valley floor would be considered as urban land, affected by partial plans and action units that would eliminate the archaeological remains, the views of the historical Las Vegas ensemble and the cultural landscapes along the Tagus Banks (figure 13).

The Municipal Management Plan (POM) of 2007, drawn up during the real estate bubble and within the framework of the urban facilities of the State Land Law of 1997 and the 2004 LOTAU, intended to provide urban land for 144, 000 inhabitants in 2020 , when in 2018, only 84,282 inhabitants had been reached, far off from those forecasts, and when the expectations of real population growth still remain very low, with an even very lower birth & immigration rate, to which is added that population increase since the 1980s is divided between the city of Toledo and the municipalities of its functional area, with abundant land at a much lower price. On the other hand, the 2007 POM actions were justified as a formula to compact the city in order to unite its neighborhoods through an urban continuum. Thus, an urban planning model was proposed that contrasted the economic interests of the great promoters of the land, of the urban agents and of the City

Council, with the conservation of heritage, environmental and landscape values inherited from the past. Moreover, the opposition of cultural institutions, citizen associations and environmentalists in action achieved the stoppage of a large urbanization unit in Vega Baja and its declaration as a BIC and archaeological park materialized by agreement of the JCCLM of 06/10/2008 , and later, successive challenges of the POM of 2007 led to hindering its implementation until its definitive annulment by Order 40/2018, of March 14, of the Ministry of Development of the Junta de Castilla-La Mancha, which has not prevented the construction of two large blocks of five floored residential buildings next to the Roman Circus and the forecast to build 3,698 homes in Vega Baja and 5,500 in Peraleda, both of which are within bounds of archaeological areas, landscape protection and environmental value. All these plans respond to a political vision from the City Council and the Board of Communities identical to that of the POM of 2007: to compact the city and create urban land in the Las Vegas del Rio, for which the City Council has been quick to approve two modifications: 28 and 29, of the PGMOU of 1986, which is the one in force when the 2007 POM was annulled.

In turn, the Board of Communities of Castilla La Mancha and the City Council have facilitated the installation of a theme park "Puy du Fou" southwest of the city, but within its municipality, 4 kilometers from the historic center, with which a new nucleus of urbanization and mobility will emerge, a contradiction with its objectives of compacting the city and the sustainability. The approval of the theme park has been facilitated as a Singular Interest Project (PSI) by the regional government, hoping to obtain great economic benefits for the region and job creation, given that it is expected to attract 4,000 visitors daily at the beginning and then 6,000. However, and regardless of the uncertainties and impacts that a project of this nature can generate on a 159 hectare space, what is difficult to justify is its location in a "non-developable space with special environmental, forest and landscape protection", on the edge of the crystalline base and near the bottom of the Tagus Valley, especially when there are many possible and less environmentally harmful locations within the city, the province and the region.

In any case, Toledo, one of the Spanish cities with the greatest patrimonial and landscape values, is at risk of losing them if a project of a lasting city over time and consensus among all its political, and economic actors is not articulated from the City Council social, beyond a short-term vision that does not solve problems of cohesion and operation of the city as a whole but instead aggravates them, in addition to justifying them on non-real population growth budgets and land needs above current demand and the foreseeable, at least in the near future, and as if that were not enough, without decisively addressing the residential and functional recovery of the Historic District. Therefore, the need to look at what is done in other cities, including Madrid and Vitoria-Gasteiz, which is what they impose in the world, committed to environmental improvement, climate change and ecological transition. The river in Toledo and the gaps between neighborhoods must be considered as opportunities for sustainable urban development, since they offer an alternative city model to the current one, with better quality of life, more efficient, and capable of guaranteeing the conservation of the cultural landscapes that make Toledo one of the world's best cities. And of course, all this must be accompanied by strategies that facilitate the residential recovery of the historic center and its functional revitalization beyond that provided by tourism.

4.3. The essential recovery of the river

The Tagus is the essential element of the cultural landscapes of Toledo and part of any pictorial, literary or tourist representation of the city, as in the View of Toledo del Greco in the Museum dedicated to him, with the allegory of the pitcher of the one that flows the water, or in the Vista of the same author in the Metropolitan of New York. However, the people of Toledo live with their backs to the river after the historical activities of its banks disappeared: batanes, mills, fishing, light factories, orchards…, and since the pollution forced bathing in its waters in 1972. The entry into service of the Trasvase Tajo-Segura in 1979, the intensification of irrigation and the decrease in rainfall have reduced its flow and favored the eutrophication of water, the deterioration of river ecosystems, the loss of biodiversity, bad odors and foams that have worsen the image of the river.

The reduction of the average flow has been important: of the 70.8 m^3 / sg annual average in 1948 or 106.83 in 1972, a rainy year, has been passed to 30.06 m^3 / sg of 2008 or 44 m^3 / sg on average in the last 37 years, hence the general rejection of the Toledo society to the Trasvase and its insistence on the maintenance of its ecological flows according to the Supreme Court Judgment of March 13, 2019. However, even if the if a reduction of annual rainfall (12 % less between 1980-2011 than between 1940 and 1980) cannot be avoided, water quality could still be improved, which is essential for Toledo to return to the

banks of the river and boost their role as a link of union between neighborhoods, which is not difficult, since most of them are articulated along the Tagus, without moving away from its banks.

Figure 14. Evolution of the average annual flow of the Tagus River
Source: Own elaboration with data from the Tajo Hydrographic Confederation

Madrid's Manzanares recovery experience sheds valuable insights and light for Toledo. However, in order to do that, you have to start by improving the control of wastewater that is dumped into the Tagus throughout its basin and especially before entering the city. In Madrid, this started with a treatment plan in 1967 and a comprehensive sanitation plan (PSIM) in December 1977, completed with the Wastewater Treatment and Purification Plan of the Community of Madrid (1995-2005) and other actions later, which has allowed otters to return to the waters of the Manzanares. In Toledo, the current treatment plant of the Industrial Estate is insufficient, with operational problems that affect the increase in the foams of the Tagus and have caused repeated sanctions from the Hydrographic Confederation of the Tagus to the Toledo City Council. The Estivel Wastewater Treatment Plant (WWTP) is located a few kilometers west of the City. It opened on December 29, 2014 and was built by the Ministry of Agriculture, Food and Environment, with an investment of € 43 million, which allows to purify 36 000 m^3 / day of water but is located at the exit of Toledo and not before. The rest of the purification system is made up of two small facilities in the urbanizations of San Bernardo and Montesión. And also, we must remember that Castilla-La Mancha does not plan to complete its Comprehensive Wastewater Treatment Plan until 2027, very late in time.

On the other hand, the regulation of the river regime by the reservoirs of the head and the reduction of flow diminishes the floods and the peaks of autumn and winter, therefore, also the capacity of drag and cleaning of the borders by the waters; sediments and spills accumulate in the bottom and banks of the Tagus from Aranjuez to Toledo, swampy areas emerging with poor oxygen waters and damage to ecosystems. Frequently, dead fish appear and the traditional rupícola vegetation, willows among them, is replaced by reeds and bulrush that impede the flow of water and access to the banks. Under these conditions, despite successive specific actions to improve riverbanks (Campos, 1995) - among them the layout of an "ecological path" -, the Tagus has lost its attractiveness to residents, being reduced, at best, to a sheet of water that is part of the landscape, which is viewed from afar and tourists photograph without approaching its banks. The overcoming of this situation, without forgetting the dirt of its margins, becomes a reason for claim that the authorities should solve, also respecting the Integrated Sustainable Urban Development Strategy (EDUSI) contained in the web pages of the City Council, and the 2030 Urban Agenda, with hardly any compliance in both cases.

5. Green plots for patrimony conservation and the value of the landscape

Given the current situation of the city and the river mentioned above, with the threats to the environment and heritage that Modifications 28 and 29 of the PGMOU of 1986 represent, a new city project is needed that is based on sustainability principles that coincide with the Urban Agenda 2030 and are shared by the whole society, therefore supported by a network of green and blue frames, as it is imposed in the world and as it has been done around the world. To give another concrete example, which is different from the previous ones, we could see what was done in Copenhagen. The Environmental challenges of the millennium, which are both local and global, should also be supported by Toledo's efforts to create green and blue plots that favor biodiversity and reduce greenhouse gas emissions into the atmosphere as these efforts are capable of improving water quality and preventing the loss of cultural landscapes.

5.1. Green solution for the Vega Baja

The proximity of the current constructed spaces of Toledo to nature, less than 300 m away by the existing building gaps between them, and the presence of a large river, promote the development of green plots that would serve to link neighborhoods and weave the city, preventing the disappearance of farm fields in La Peraleda and Huerta

del Rey. To advance this strategy, a first step would be the elaboration of a Special Protection Plan for the Vega Baja and La Peraleda, which will combine green spaces with the archaeological remains of the area, retaking at least some ideas of the Vega Baja Master Plan presented in 2012 and which has never been known again, as the projects of the International Center of Visigoth Culture, Interpretation Center of Vega Baja or Center for Historical Heritage Research, which instead of giving rise to a New building of strong volumetry (Vega Baja Museum in Toledo, 2010), such as the one that was planned after an international competition in 2009, could be housed in vacant buildings of the Weapons Factory itself.

Figur14. Panoramic view of the Vega Baja, on the left the Royal Factory of Arms and in the background, the worker's village, in the middle, the large empty space in which it is intended to build a large number of houses and leave soils for endowment uses

In addition, the naturalization where possible of the huge current empty of the Vega Baja (figure 14), an area equivalent to that of the Historic District, 102 hectares, would reinforce the existing green plot inside the city, the most important: the park of the Three Cultures, inaugurated in 1995 on the grounds of the Central School of Education of the Army assigned to the City Council by the Ministry of Defense. This park, of almost 10 hectares, is the largest in the city, with 70 % of its landscaped land, product of the remodeling of this space by the City Council in 2009.

Some areas of the Vega Baja could be susceptible to use in urban gardens, provided that the archaeological remains allow it, and the conservation of the working village with its current typology and form should also be guaranteed, without modifying its constructions or opening roads as planned in the POM of 2007 or the unfinished footpath promoted in 2019 by the City Council, the Royal Foundation and the University of Castilla La Mancha. The expansion of the Vega Baja archaeological site as a General Interest Property (BIC) in the category of Historic Complex, on July 17, 2008, should facilitate its conservation and enhancement, although it would be necessary to extend that rating to the entire space unit Vega Baja since in more than 90 % of the tastings carried out in different parts of it appear archaeological remains, among them those belonging to what could have been an authentic city or "suburbia" Visigoth. And even better, we should extend the rating enjoyed as a protected space the Historic Center to the two Vegas, the Upper and the Lower, since both have monuments, carry archaeological and landscape values, and are part of the same unit history, everything should be defined with the same historical set category. Finally, it would be necessary to carry out excavation, consolidation and improvement of the Roman Circus to make it visitable and more recognizable of the importance it really had (Artistic Architectural Monument since March 31, 1921), as well as to highlight the Christ of the Vega (Historic Artistic Monument since August 9, 1926) and the Royal Weapons Factory (Cultural Interest Asset by decision of the Governing Council of Castilla-La Mancha, March 2, 2010). Consequently, all these actions would guarantee the permanence of the threatened views of the Historic District from the Vega Baja and would make use of all this space of the city, even capable of generating employment and wealth through tourism.

5.2. Agricultural Park for Peraleda and Huerta del Rey

On the other hand, the rest of Las Vegas, outside the archaeological areas, could recover the agricultural uses that it always had, since the first way to promote biodiversity in cities is to recover soils for agriculture where possible, as has been made in Vitoria-Gasteiz and elsewhere (Zárate, 2015). In Toledo, the orchards and farmland are part of its landscape and history, thus, Andrea Navagero, ambassador of the Republic of Venice in the Court of Carlos V, in his "Journey through Spain" (1524-1526), writes: "Before arriving in Toledo, the river passes through a plain called the Huerta del Rey and is irrigated with ferris wheels, which are hydraulic wheels that take water from the river, so it is all full of trees and many fruits, and everything is carved and made orchards, where the city of vegetables is supplied (…). In this plain there is an old ruined palace called Galiana… the ruins show that the palace was beautiful and in a very peaceful place ", and in 1913 the Mexican Diego Rivera, like so many other painters, offers us an image of agricultural uses in Safont, in the high Vega, which have remained until the 70s of the last century (figures 15 and 16).

Figure 15. Landscape near Toledo, 1913, Huertas de Safont, Diego de Rivera. Col. Private

figure 16. The same landscape painted by Diego Rivera, 104 years later. Safont Area

At present, agriculture is still present in the municipality of Toledo, occupying spaces between neighborhoods: Azucaica, Santa María de Benquerencia, Santa Bárbara and Conjunto Histórico, among others, although with a progressive reduction due to the urbanization tide, as has happened in Safont and part of La Peraleda (figures 30 and 31) due to the change in the rating of rustic to urbanizable or urban land by the POM of 2007. According to data from the Ministry of Agriculture, the current agricultural area of the Toledo municipality is 23-193 hectares and Only between 1980 and 1990, in a decade of great construction activity, the uncultivated area increased from 1,019.1 hectares, 4.4 % of the agricultural area, to 3,038.4 hectares, 13.1 %. Today, most of the crops are cereals, corn and forage plants, while the orchards have almost completely disappeared and unproductive areas increase (figure 17).

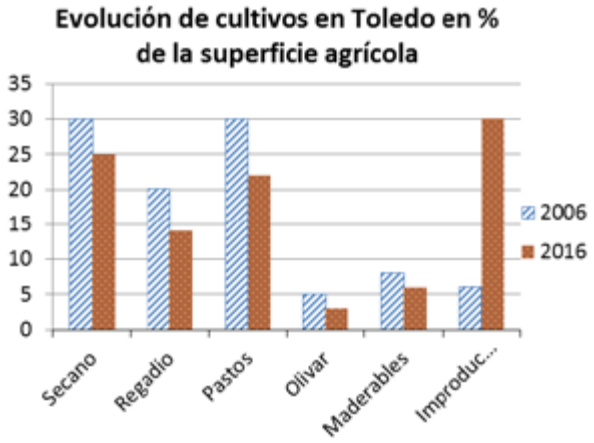


Figure 17. Evolution of the agricultural area
Own elaboration with data Ministry of Agriculture

The recovery of agriculture and the maintenance of the existing one could be carried out with an analogous plan or similar to that of the "Baix Llobregat", next to Barcelona, in the immediate vicinity of its free zone, in a highly industrialized area and neighboring the airport of the Prat In the face of urban and industry pressure that threatened there the continuity of crops in the 70s, farmers partnered to create an agricultural park. For this, a Consortium was established, and a Management and Development Plan and a Special Plan were created to define and establish the rules applicable to the park. It all started in 1974 with a social movement under the slogan "Salvem el Pla" to safeguard the economic interests of farmers, the environmental values of natural ecosystems and preserve the agricultural landscape (figure 18). In 1996, the promoters took part in a LIFE program of the European Union and in 2002 they developed the Management and Development Plan referred to. In 2004, the Special Plan for the protection and improvement of the Agrarian Park of Baix Llobregat was launched, which has allowed its operation so far.

Figure 18. View of the Agrarian Park of Baix Llobregat
Photo: A. Zárate

In Toledo, with an urban pressure incomparably less than that of the surroundings of Barcelona, there would be no inconvenience for such an action, which could by itself prevent the disappearance of the endangered cultural and landscape elements of La Peraleda, Vega Baja and La Huerta del Rey, also recalling that they are within the

landscape protection zones delimited by the 1968 Fine Arts Instructions and the Buffer Zone of Toledo's declaration as Outstanding Universal Value of 2013. In both areas, uses survive agricultural next to land converted to urban fallows, awaiting recovery of the real estate market and a population upturn that make viable the urban development actions provided for in Modifications 28 and 29 of the PGMOU of 1986.

6. Conclusion: local solutions for global problems through green and blue plots

Landscape and river, green and blue frames, are different sides of the same coin that make the sustainable development of any city possible and guarantee the recovery of its cultural landscapes, its conservation and enhancement, as demonstrated through Madrid and Vitoria -Gasteiz, as will happen in Lima between its historic center and the hill of San Cristóbal, on the other side of the Rimac River, and as expected to happen in Toledo, where the Tagus is supportive of its landscapes and should be enhanced as the axis of structuring of the city and the union of its different neighborhoods, which, on the other hand, from the point of view of the urban form, is not difficult, since they all articulate from east to west along the river, forming an 18 km long corridor, from its eastern end in Santa María de Benquerencia, to the hill of the Legua and Valparaiso at its western end.

As stated before, it is necessary that the proposals of green and blue frames are integrated into a global city project, without leaving for a separate treatment the historical centers, as has happened in Toledo and in the rest of the Spanish cities, when elaborated in its Special Plans in accordance with the provisions of the Spanish Artistic Historical Heritage Act of 1985. Similarly, it is absolutely necessary to facilitate participation in these projects of all local, social, political and economic agents based on sustainability criteria and shared responsibility, which also stimulates and contemplates the New Urban Agenda 2030, emanating from the "United Nations Conference on Housing and Sustainable Development", Habitat III, from October 17 to 20, 2016 in Quito. It encourages those responsible for cities to promote people-friendly, safe, sustainable and resilient environments, not only in the face of natural threats but in the face of intrusive social and economic dynamics threats as well.

Likewise, green and blue strategies are influenced by the recommendations of the 1994 Aalborg conference, which opened the way to environmentally sustainable urban policies, increasingly concerned with the management of urban waste, the purification of wastewater, intelligent water and energy management, and even, ideally, food self-sufficiency through urban agriculture, linking, in turn, with the concern for people's quality of life, the value of Landscape and climate change. The success of the experiences of Madrid and Vitoria-Gasteiz, but which are already numerous in Europe and other continents, should serve as an example to deepen in all city's management dynamics aimed at improving the quality of life of its inhabitants and limiting the effects of climate change.

Nor can we forget that the green and blue frames are generating tourist uses from sustainability criteria, by turning into a visiting element spaces that were not attractive before and by favoring the enhancement of the landscape in general and urban cultural landscapes in special, as has happened in the cases cited. Thus, the "green" and the "blue" acquire economic potential through their ability to generate employment and tourism (Zárate, 2016), although the social values they awaken to facilitate meeting relationships, activities of leisure, feelings of collective identity, respect and tolerance towards others (Martínez, 2007). Nor should its effects on international cooperation be ignored, since apart from what has been said above, by acting from the local to the global scale, green areas, including agriculture, function as CO_2 sinks that contribute to the air quality of the planet and in any case they are integrated within the concrete orientations of the European Territorial Strategy (ETE), of the Territorial Agenda of the European Union 2020 and of the different mandates of sustainable development of the UN.

In short, the application of urban strategies to improve green and blue patterns demonstrates its effectiveness for the sustainability of the cultural landscapes of our cities and for responding to environmental problems that are manifested locally but are indeed a global issue as well.

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Bohemian, hipster, alternative, ethnic, all trendy: neighbourhoods of Madrid and Barcelona and their contribution to recent urban dynamics.

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Summary

Spanish cities, especially those that are the most demographically and economically prominent, have undergone a major overall restructuring of production processes, where new intangible activities are consolidated as the driving forces of current regional development (leisure, consumption, tourism, cultural and creative and innovation services, among others). Many of these transformations occur in clusters or are concentrated in different neighbourhoods, which in some cases were previously run down. Therefore, since the beginning of the 21st century, and with the process becoming even more acute since the economic crisis of 2008, major transformations have taken place that some authors have characterised as themed processes, although they are linked to specific characteristics of the regions.

In this context, neighbourhoods from cities around the world have been identified where these processes are taking place, to then subsequently focus on the cases of Madrid and Barcelona. Signs of the transformation will be analysed and compared by looking at the l'Eixample district and the Sant Antoni, Gràcia, Poblenou and Sants neighbourhoods in Barcelona, as well as the Chueca, Malasaña and Lavapiés neighbourhoods in Madrid. They will be characterised based on some of the activities that are conducted there. Methodologically, quantitative indicators and qualitative information will be used. In this latter aspect, the image of the neighbourhood projected by the different public and private promotion efforts is interesting and will be studied by analysing their contents.

Keywords: *cool* neighbourhood; Madrid; Barcelona; globalisation; theming; urban consumption

1. Introduction, objectives and methodology

The following work aims to explore the role played in recent urban dynamics by emblematic neighbourhoods of Spain's the two largest cities, Madrid and Barcelona. In this sense, the main questions to be resolved are related

to the different characteristics that they acquire due to the development, or the continuance, of leisure, consumer and other related activities, such as the production of cultural, creative and innovation services. The specific combination of all of these things results in very characteristic urban landscapes that are being investigated not only for being attractions for consumers, but also because the aesthetic or morphological aspects that are defined by some authors as "the cultural scene" (Navarro *et al.*, 2012) or "the scenic landscape" (Córdoba *et al.*, 2018) and which, in itself, is a consumer product for residents and tourists. All of this starts from the central role that cities develop in the cultural economy, within an economic and productive paradigm defined as "cognitive cultural capitalism" (Scott, 2006), where aesthetic and morphological attributes acquire a fundamental role as engines that trigger the grouping (clustering) of certain production activities (design, fashion, editing, among others).

It is necessary to emphasise the role that cities acquire in globalisation and the power they have to attract economic activity. Although the most important have been defined in scientific literature under the name of "world cities" (Friedmann, 1986) and/or "global cities" (Sassen, 1991), transformations, that might not be as intense, are observed in a large part of urban centres. It is especially interesting for this analysis to define how urban centres have developed enormous potential to influence trends and fashions by proposing consumption space models (Zukin, 1995; Hanningan, 2005) and creating a whole narrative for residents and tourists, which emphasises city consumption (Mansvelt, 2008). In this respect, it is a topic that is addressed in international scientific literature, but less studied as far as Spain is concerned, especially recent processes related to the boom that some neighbourhoods have undergone as attractions, not only for leisure and use by residents, but also for tourism.

This also has to do with the proliferation of proposals for cities "to be consumed", which have been prepared by the global press specialised in leisure, consumption and tourism and other entities (travel agencies and global distribution systems -GDS-). These texts highlight different neighbourhoods or districts that have developed or have the attributes and activities that make your visit desirable. In this reflection, we should also consider the media such as the *Time Out* group[1], which annually announces a list of the "50 coolest neighbourhoods in the world[2]", and also appears in numerous international newspapers. Among the neighbourhoods cited in 2018, two belong to Madrid and Barcelona, more specifically Embajadores-Lavapiés, considered at that time the coolest neighbourhood in the world, and Sant Antoni (22nd place). In 2019, this media outlet also reviews of the two locations in both cities, with Embajadores-Lavapiés occupying the 9th position and proposing for Barcelona the Poblenou neighbourhood, in 20th place.

Taking into account the importance of these types of proposals, the analysis aims to investigate several aspects: What neighbourhoods in these two cities are being globally valued as "scenes or landscapes" for consumption? What characterises these neighbourhoods? What are the processes that develop in them? And to what extent do these processes have a global nature or are they particular to each of them?

For this purpose, the work is organised as follows: the next section is dedicated to presenting the interpretative framework of the processes regarding the value of neighbourhoods and locations as elements of urban revitalisation and consumer objects, for which the scientific literature provides of an important theoretical body. Next, we will elaborate on the case in a global scenario, assessing the location of these regions in different cities of the world and identifying the most relevant cases for Spanish cities. Subsequently, we will elaborate on the attributes or characteristics that make them important from both a qualitative and quantitative point of view, exploring some of their dynamics. Finally, we will present the main conclusions reached with the analysis.

The methodological proposal for the research is based on the premise that it is necessary to combine quantitative and qualitative techniques when identifying the fashionable neighbourhoods, the processes that take place in them and, especially, the projected image that makes them consumer objects. We therefore initially chose to analyse texts and the content of promotional websites or information on these locations, identifying the neighbourhoods, what is said about them and the projected image. We consulted official websites of city promotion agencies as well as information from leading communication media and information agencies, many

1 A global communication company dedicated to leisure, consumption and tourism in cities. *Time Out* magazine is consulted every month by 7.4 million readers worldwide, with 300,000 pages available online.

2 *Time Out: The 50 coolest neighbourhoods in the world*. On line: https://www.timeout.com/coolest-neighbourhoods-in-the-world. 19th/09/2018. Consulted: 20th/03/2019.

of them used by millions of consumers[3]. The use of these sources and methods is justified by the significant role that autonomous or intermediate agents (advertising and marketing companies, mass media, audio-visual producers and multimedia material, among others) acquire by producing films, television programmes, educational materials, the news, advertising or other narratives, influencing the expectations of consumers –residents, visitors, tourists– (Pike, 2002; Tasci and Gartnet, 2007) along with the adaptation of the lands (business, activities, morphologies) to the latter.

In this respect, certain studies have proven that the image projected on the locations (brand image) is an intermediate element between the images of consumers (cognitive, affective, individualised) and their future behaviours, based on the expectations generated (Qu *et al.*, 2010). This type of methodology is mainly used to assess the tourist image of the destinations. We consider, however, that it can be extended to the leisure and consumption locations of the cities, since they act as mini destinations for the local population. It is therefore worth mentioning some theories that indicate the convergence of behaviours between tourists and residents at the consumer locations (Urry, 1996; Domínguez and Russo, 2010).

In order to identify these locations, in the first place, a map has been compiled showing the different neighbourhoods on the global scale as they have been proposed by leading mass media, either those of the leisure and tourism sector, or others with important sections on this topic in their publications. In addition to *Time Out, Forbes, Lonely Planet, The Guardian, Condé Nast Traveler, Businessinsider, Travel and Leisure*, among others, have been consulted. The official websites of different destinations have also been examined, especially with regard to the enhancement of specific features of the neighbourhoods, such as being LGBTQ places, or the presence of an important creative activity[4]. Next, the aforementioned text produced by Time Out has been studied to determine the characteristics that are valued on the global scale, where the "50 coolest neighbourhoods in the world in 2018" are presented and analysed. To this end, the characteristics outlined in the 50 neighbourhoods have been extracted by analysing the contents, in order to answer the following questions: What urban typology do these neighbourhoods have? What environment is described? In this environment, what specific type of activities take place, beyond bars, restaurants or shows? And finally, what types of residents or visitors use them?

For the interpretation of the results, we have chosen to use proposals related to the analysis of destination image because, as noted, the neighbourhoods analysed constitute destinations for residents of other areas of the city as well as for tourists. One of the most common interpretations is that proposed by Echtner and Ritchie (1991; 1993), who point out that destination image consists of a group of functional components (very specific, that give the characteristics), to which they add a series of attributes or adjectives of a psychological or perceptual nature (which qualify the specific aspects). All this creates a global image (holistic) of a unique or individual nature that would serve to characterise the area and make it stand out with respect to others. However, in no case is this information static, as concrete elements heighten psychological impressions and, both one and the other have a high influence on the global vision of the area (Baloglu and McCleary, 1999).

A quantitative analysis has also been used to elaborate on the processes of the neighbourhoods of Madrid and Barcelona. A neighbourhood database has therefore been developed[5] that includes different indicators. Among them, information on the price of second-hand housing and its variation rate (2014-2018) stands out for its relevance for

3 The analysis of the texts on the study neighbourhoods of Madrid and Barcelona has been published in the following media, in addition to *Time Out* (see note 1):

Lonely Planet on Line in Spanish and English: belonging to the Lonely Planet Global Ltd. group, dedicated to the development of travel guides. It currently has a social network community of more than 10 million and a mobile application (app) that covers 100 cities and that had already been downloaded since 2017 on more than one million occasions. Source: https://www.lonelyplanet.com/about/story

Travel and Leisure: American travel magazine published by the Meredith publishing group. It has about five million readers a month. It also publishes for Australia, China, India, Mexico, Russia, Turkey and Southeast Asia. It promotes the "The World's Best Awards" on the theme of travel. Source: https://www.travelandleisure.com

Condé Nast Traveler: main competitor of the previous publication, is part of one of the most important multimedia publishing groups in the world. According to its website, it has 2.2 M Impacts/month (2018 3rd Ac EGM, Google Analytics and Social Networks January 2019).

4 The specific references to the sources appear in the corresponding maps: figures 1 to 3.

5 In some cases, the denominations identified do not match the administrative boundaries. The correspondence is as follows: Malasaña= Universidad; Lavapiés= Embajadores; Chueca= Justicia; l'Eixample is a district of Barcelona containing several neighbourhoods, among which is Sant Antoni.

the interpretation of the processes)[6]; likewise, to determine the level of presence of leisure-consumption and tourism activities, those most related have been selected: catering, hospitality and those of an artistic and creative nature[7], extracted from the Censuses of Premises and Activities of both cities. A Sargent-Florence location ratio has been developed for all of them[8]. The level of implementation and growth rates of tourist apartments have also been calculated, in order to assess the extent to which cool activities are related to the rapid development of this type of accommodation.

The fundamental sources were the open data banks of both cities, owned by the municipal governments. Data from the Continuous Register and Census of premises at street level, classified by economic activities (CNAE -National Classification of Economic Activities-) has been specifically used. The latter has been a very valuable source of information since conclusions can be drawn about the concentration of establishments and the specialisation of the locations, which undoubtedly helps to create a certain cultural scenario. Finally, data on tourist apartments from the Inside Airbnb[9] source is considered. It is clear that tourist apartments currently constitute part of the supply and demand for accommodation, which in many cases is not complementary but an alternative to hotels (Navarro and Berrozpe, 2015). Finally, for an adequate interpretation of the data, we decided to represent some of the main results of the analysis in different scatter plots (figures 5 to 7). This required the inclusion of the results of the neighbourhoods involved, as well as others with different behaviours, which allows us to assess the magnitude of the processes more accurately.

2. Neighbourhoods as territories of innovation and creativity for consumption

The crisis of the Fordist industrial model, accompanied by a fundamental change in the productive paradigm, means that the centre of the economy now resides in knowledge-intensive sectors, on the one hand, and in cultural and creative industries, on the other, which, in both cases, have a significant presence in the cities. This process is also linked to the capacity that some cities have to attract these activities and human capital (creative classes) responsible for their development, generating a spiral of creative energy capable of generating growth. For certain authors, headed by Florida (2002), this capacity is closely related to the existence of what he has called "bohemian enclaves", very present in global cities such as New York, Los Angeles, London, Berlin or Paris. In fact, after studying the case of American cities, this author insists on close connections between innovative and high-tech industries and the Bohemian Index, made up of the number of people that can be considered bohemian, in an economic sense of the term[10].

At the same time, globalisation helps to consolidate cities as fundamental economic and social scenarios, where these groups and others with similar traits develop their recreational and leisure activities. Some urban subcultures assume a more important role. Many of these are characterised by their alternative, dissident or peculiar way of life compared to the lifestyles of the bourgeois classes in the twentieth century (Young, 1971; Graña, 1964 and 1990) and they have their own forms of consumption, which acquire important nuances. It should also be stated that along with the bohemians there are other similar denominations or typologies such as cool, hipster or indie people, among others. These groups are characterised for their advanced and specialised forms of knowledge about goods and consumption, and can be considered an attitude and a form of cultural capital that is essentially not yet available to the majority of the population (Nancarrow *et al.,* 2002).

6 The sale price of second-hand housing has been considered as an indicator of the value of the price of land and its evolution. Although this indicator does not cover all types of establishments (commercial premises, equipment, newly built housing, etc.), we believe that it can be used as a source for the interpretation of the processes, given that no comparable and equivalent information is available for both cities in relation to the other types.

7 Museums, art galleries, exhibitions, concert halls, theatres and other performing arts exhibition media.

8 Sargent-Florence ratio. CL = (Lij / Li) / (Lj / Lt). Lij: Premises in sector i (sector 1, 2, 3) in the selected neighbourhood; Lj: Total premises in the neighbourhood; Li: Premises of sector i in the city as a whole; Lt: Total premises of the city.

9 Inside Airbnb. On line: http://insideairbnb.com/get-the-data.html

Dates: Barcelona, April, 2015 and May, 2019; Madrid, July, 2015 and May, 2019.

10 The groups of professional people considered "bohemian" in the Florida study (2002) are: authors (writers and scriptwriters, among others), designers, musicians and composers, actors and directors, artisans, plastic artists (painters, sculptors and engravers), photographers, dancers and other people employed in jobs related to these.

They also tend to use this cultural capital to identify themselves as a group, as opposed to other people with lower access capacities, a form of social differentiation that not only lies in economic capacity but also in what is done and how it is done (Bourdieu, 1986; Mizruchi, 1990). Therefore, shared cultural capital acquires an important semiotic value, as a countercultural reaction to capitalism, in an open relationship with what is considered authentic (vintage clothing, ethnic and ecological food and goods, DIY —do it yourself—, eclecticism, second-hand stores, custom-made or customised goods). This is combined with values considered alternative at some time, such as anti-authoritarian attitudes, sexual permissiveness, freedom of artistic and personal expression (McKay, 1998; Nancarrow and Nancarrow, 2017).

Paradoxically, some authors understand these behaviours as part of consumer capitalism, where variety and transgression are demanded, as a form of hedonism, much more than homogeneous consumption (Frank, 1998). This means that at least the appropriation of essential messages by a majority of consumers must be related to the emergence of the leisure-consumption and entertainment societies (predicted by Debord, in the 60s), as a way of life, but also as part of the capitalist mode of production (Scott 2006). Therefore, social groups remain in the paradox between their incorporation into dominant forms and the enhancement of new practices and ideologies (Frank, 1998). This contributes to the dialectic of consumer societies, where access to goods and services must be sufficiently generalised to obtain benefits and, at the same time, users want to have unique experiences, since these are precisely the stimulus that generates consumption, which is particularly linked to what happens in urban settings (Harvey, 2012).

There are close relationships between these practices and the places and regions that support them, generating an active and culturally and socially attractive urban life, while contributing to economic development. Consequently, these are processes where not only the economic component is important, but also the way in which the available cultural capital intermingles with economic activities, resulting in regional renewal.

Some of the morphological characteristics of creative and innovative places have been determined in the case of Canada (Spencer, 2015). This author points out two types of creative neighbourhoods, whose urban forms are related to the needs of established economic activities: those destined for technological and information industries (scientific neighbourhoods) and those for the artistic and creative industries and activities (creative neighbourhoods). The first are located in peripheral areas, with a very open urban network and low road density, although the roads are wide and facilitate traffic, while housing is mainly for industrial and commercial uses, and there is a relatively low presence of catering and leisure services. The second group is located more centrally, in a dense urban area, with mixed residential, commercial, administrative, leisure-consumption and creation and innovation uses. This second group is the basis of small creative firms where proximity and centrality have considerable locational advantages and where the presence of headquarters of important cultural institutions (universities, colleges specialising in arts and design, museums, galleries, theatres) act as attractions (technically known as "soft conditions"). The importance of these locations should be highlighted as the socialisation framework (professional and personal) of the groups that carry out their activities there (Munster and Murie, 2010; Oliveira and Vázquez, 2012), producing a collective appropriation of the space, which they associate with their identity (Short, 1996; Gust, 1999; Escalona, 2000).

The process described turns these locations into centres of social life, and are also considered coveted consumer objects (Mansvelt, 2008). As the scenario and the environment of the neighbourhood is being created, it can also be used by the authorities and the planners, as well as by the different local actors, as another element of the economy, since it is susceptible to significant commercialisation and privatisation (Harvey, 1989). To this end, the policies emphasise the discourse of competitiveness (Theodore *et al.*, 2009) and highlight the innovative and creative capital established. Therefore, they tend to undergo important remodelling processes, including theme-setting, and are in constant re-invention and re-evaluation in order to attract "customers, investments, visitors, tourists and new activities" (Murphy and Boyle, 2006). The "show" created must also be considered a fundamental expression of the neoliberal city and a way of generating economic activity in a highly competitive environment between cities and regions (Miles, 2012).

The whole process also involves intense publicity, so that, directly (by the competent political and administrative bodies) or indirectly (consultants and specialised media), references to neighbourhoods can be found in the numerous promotional channels, such as institutional websites, magazines or sections in the press specialising

in travel and tourism and in reports issued by the main international consultants. These are benchmarking activities worldwide that, in many cases, can be attributed propaganda intentions of all kinds, which go beyond "selling the city", since at the same time the capacity to analyse and obtain information from the standard-setter is being valued (Gago, *et al.,* 2017). This spreads an image of the area, in most cases positive, which is again a vehicle for attracting economic and investment activities, residents and visitors (locals or tourists), among others.

3. *Cool* neighbourhoods on the international scale: location and characteristics

The attached maps (figures 1 to 3) show a wide "range" of creative, innovative, cool, modern neighbourhoods, etc., belonging to well-known cities of the world, which are systematically collected by powerful and leading international media outlets, which is part of the game in

Fig. 1. Selection of neighbourhoods described as "cool" in world's cities.

Source: Compilation based on information from *Time Out, Forbes* and *Lonely Planet*

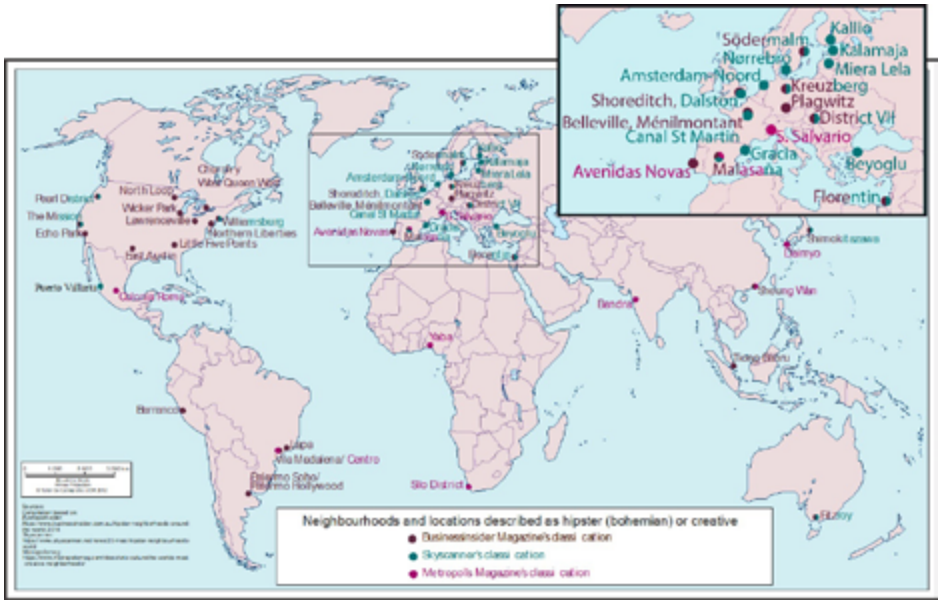


Fig. 2. Selection of neighbourhoods described as "hipster" or similar in world`s cities.

Source: Compilation based on information from *Businessinsider, Skyscanner* and *Metropolis*

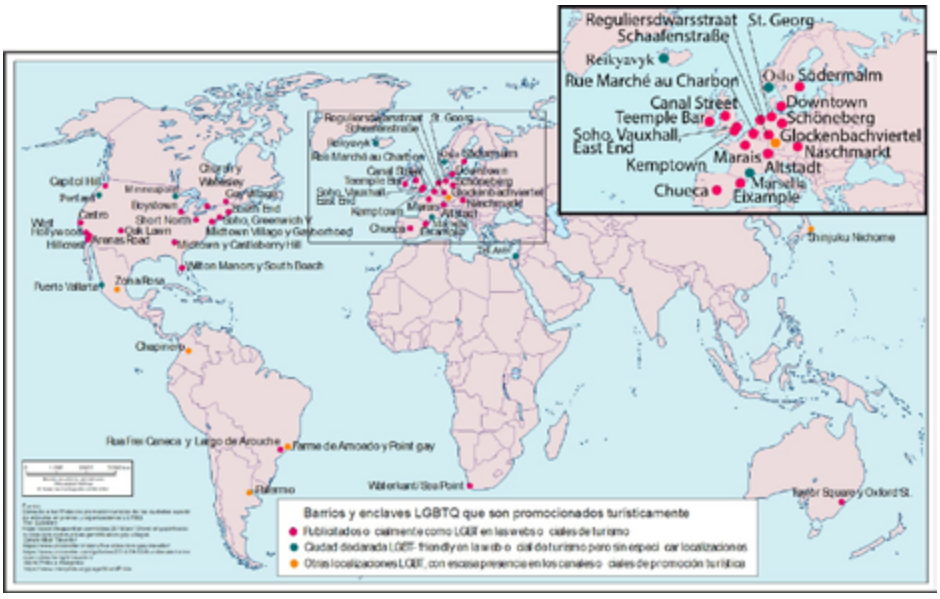


Fig. 3. Selection of neighbourhoods described AS LGBTQ in world's cities

Source: Compilation based on information from official Websites of tourism promotion of the cities, plus press coverage and LGBTQ organizations: *The Guardian, Conde Nast Traveller (among others) and World Pride-Interpride*

the context of high competition between cities (op. cit. 2017). Several types of adjectives about locations stand out in these media, that is, cool, associated on many occasions with the bohemian, the hipster, the creative and the gay-friendly (locations with marked dedication to LGBTQ collectives). This refers to the main attributes used as an attraction, according to the forms of the consumption space currently proposed. It should be noted that these are lists that are usually renewed every year, so the presence of some locations may vary in time and form.

Nevertheless, these maps show how the great cities of the world, such as New York, have boundaries that refer to different characteristics: in terms of the cool and bohemian, West Village and Sunset Park stand out, the hipster, Williamsburg, the creative, also Williamsburg, or the LGBTQ environment, the neighbourhoods of Soho and Greenwich Village. Numerous references to its neighbourhoods, in relation to consumption and cultural scenarios created, have also been observed in many cities, such as London (eight neighbourhoods), Paris (five), Madrid (five, of which three refer to Malasaña-Universidad), Tokyo (four, with the Shimokitazawa neighbourhood with two references), Barcelona (four), San Francisco (four) and Amsterdam, Lisbon and Stockholm (three), among others.

The most outstanding characteristics of these and other neighbourhoods are summarised in figure 4. Four urban morphologies have been found on which these enclaves mainly develop: old historical areas, followed by those spaces where water is the protagonist (riverbanks, promenades or old ports). It is also important to mention the conversion of old industrial areas, now occupied by leisure-consumption and artistic-creative activities. Finally, the location can also be characterised by occupying spaces created from scratch, linked to contemporary and avant-garde architectures, in some cases side by side with traditional ones.

Numerous qualifications of the environment offered in these neighbourhoods are given along with the characteristics of their locations: "Full of life and activity", "fashionable" (understood as spaces for the consumption of the latest artistic trends or social and leisure-consumption), "decadent or abandoned", "isolated", "quiet", "out of the beaten track". These descriptions also show important contrasts, highlighting two types of neighbourhoods: those that are very popular and full of bustle and activity, compared to others in which it is still possible to get away from the masses and enjoy a quieter space, sometimes similar to exclusive environments. Another aspect mentioned in the descriptions is the regional or local identity evoked, often hybrid or mixed, typical of the places in which globalisation is evident. Some neighbourhoods are attractive because of their environments that are cosmopolitan (since they house a population of various origins) or international (the activities or goods that are consumed have a scope or come from distant locations). However, the opposite is also true and, therefore, one of the most remarkable characteristics is to preserve their essence, based on history, local artistic or handmade products or on the morphology of buildings and the urban fabric.

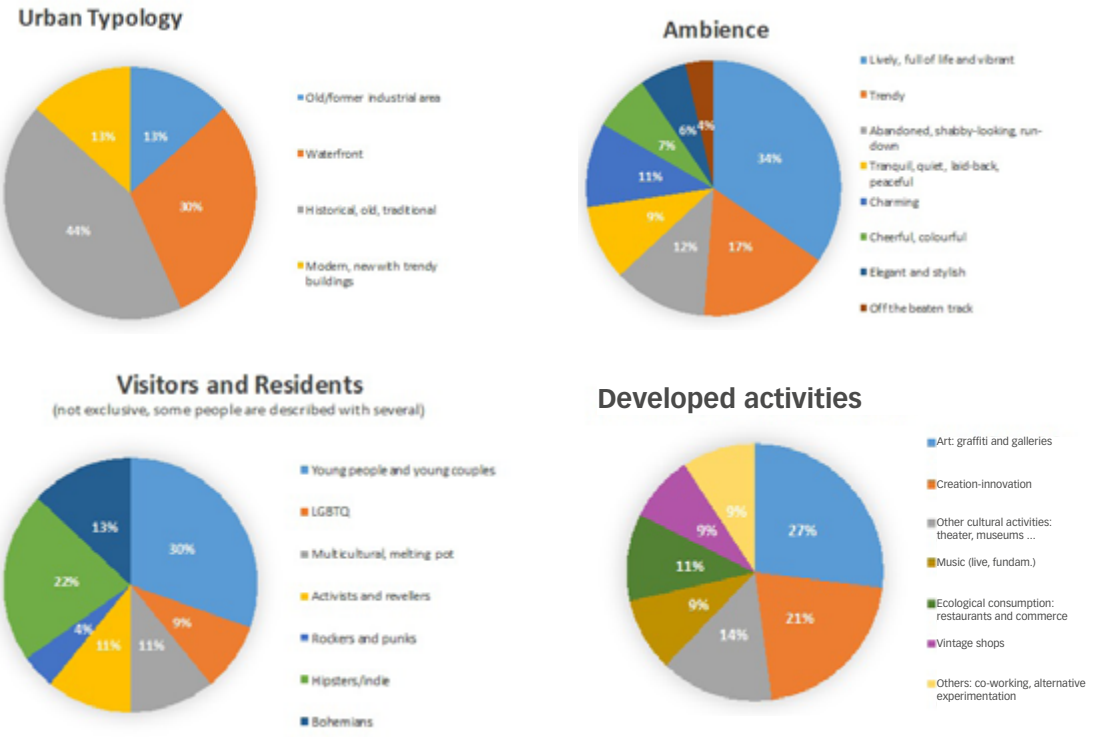


Fig 4. Cool neighbourhoods: main characteristics

Source: Own research based on the amount of the neighbourhoods' attributes as described in the publication "The 50 coolest neighbourhoods in the world" (*Time Out, 2018. See note 2*). Each graph answers one of the four questions under analysis, explained in section 1

Two types of attributes end up configuring neighbourhoods; one is the characterisation of residents and visitors, which also confers local/regional identity. These are occupied by young people, either couples or individual creative or professional people. Many of these stand out for being part of very recognisable urban subcultures: hipster/indie, bohemian, rock, punk, activist and alternative people. Some of the neighbourhoods stand out as the meeting place and social venue for LGBTQ groups. Finally, it is interesting to analyse the activities that take place. Cool neighbourhoods are therefore characterised by hosting countless artistic and creative activities: live music, digital design and publishing, performing arts, museums. It is also important to mention the plastic arts, especially the decoration of walls and doors with graffiti and the proliferation of art galleries and that attract visitors and tourists. As regards leisure/consumption options —apart from bars, restaurants and nightclubs, mentioned in all the descriptions—, organic establishments and vintage stores are also major attractions.

A large part of the attributes identified in the analysis, combined with each other, enable the holistic characterisation of these locations as places with very specific functions, linked to the artistic and creative services and activities they host, which always includes restaurants and accommodation (functional attributes).

Added to this are the attributes or adjectives of a psychological or perceptual nature when describing the environment ("decadent", "thrilling", "charming", "cheerful", "elegant"). However, the most important thing, in our opinion, is the formation of a specific expectation about an urban scenario, which is globally replicated in regions and locations and where the local and the global interact in a very powerful way, so much so that we would dare to say that the *neighbourhood no longer belongs to the residents or the city, but to the whole world*.

These narratives, however, do not explain some internal processes that undoubtedly do not have a positive effect. Many of these neighbourhoods undergo gentrification processes, simultaneously or later on, which is understood as the expulsion of residents and previous economic activities (less productive) and the attraction of new residents (of higher income) and activities of greater economic value. In fact, many authors point out that the cultural capital, the artistic and cultural manifestations taking place and the ways of life of residents and visitors are highly gentrifying (Smith, 1979; Zukin, 1991; Miles, 1997; Checa- Artasu, 2011), attracting both groups of creative professionals and young people. One of the charts elaborated on the types of residents and visitors in figure 4 makes reference to all of them.

It must be emphasised that neighbourhoods and their popularity can go out of fashion, and the activity will move to other locations in the city that are more attractive at another time.

The consequences of this are not negligible as regards the loss of economic activities (business) and the social and associative fabric. This fact has been studied, for example, in New York, with the cases of Soho (seventies), East Village (eighties) and Williamsburg (nineties onwards), since the new and the old put endless pressure on each other (Greenwald, 2012). We must remember that cities change very quickly and that their emblematic areas are often subject to trends, or rather "life cycles" (op. cit., 2012), which specialised media usually record effectively. In this respect, there is a certain gap in the scientific literature regarding the in-depth analysis of life cycles of neighbourhoods whose destination is leisure, consumption and tourism. Perhaps for these specific locations, objects of desire, it would be possible to apply interpretive models similar to those proposed for tourist destinations (Butler, 1980) or for consumer goods (Levitt, 1965; Klepper, 1996). This may also be related to theories that explain different urbanisation and counter-urbanization processes in metropolitan and regional contexts (Geyer and Kontuli, 1993).

4. Bohemian, hipster, alternative, ethnic and LGBTQ neighbourhoods in Barcelona and Madrid

Seven neighbourhoods in Madrid and Barcelona appear in the consulted listings. It must be stated that the objective is not to identify all of them but to provide the analysis of outstanding examples that serve as a case study, and look at their dynamics. These are "Poblenou- 22@, Sant Antoni, l'Eixample, Sants and Gràcia (Vila de Gràcia) in Barcelona and Chueca (Justicia), Lavapiés (Embajadores) and Malasaña (Universidad) in Madrid. It is important to note that this selection also reflects the concentration of activities and employment in the creative sectors in both cities. This is a trend shown in numerous studies (Méndez *et al.,* 2012, for example). Since the end of the previous decade (2009), the urban area of Madrid provided 29.3 % of the country's creative jobs, and 71.5 % were in the city itself, followed by Barcelona (17.9 %) (Prada, 2015).

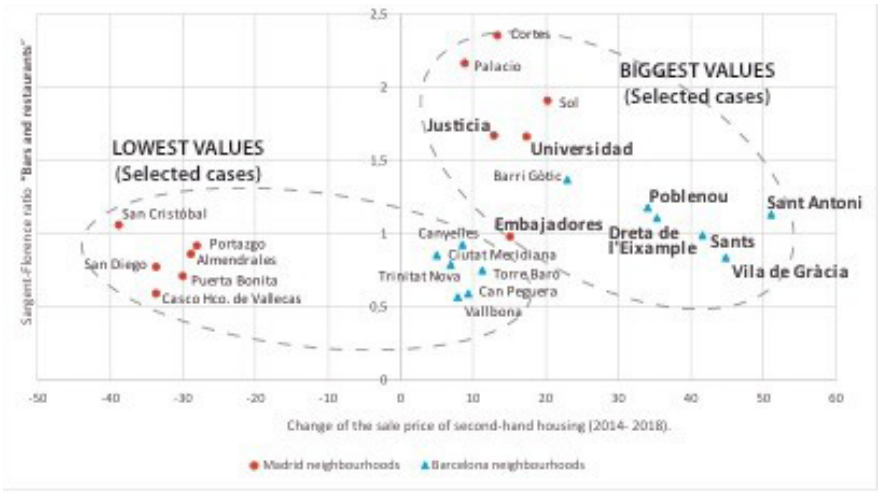
A summary of the results related to the selected neighbourhoods can be found in figures 5 to 7 and in tables 1 and 2. Multiple circumstances are responsible for this and, in some cases, their interpretation would require individual explanations and a deeper look at the dynamics of the cities and, more specifically, the locations themselves. In general, the charts show that all the selected neighbourhoods have an important relationship between the concentration of creative activities and leisure and consumption (measured through location ratios) and high rates of increase in the price of land.

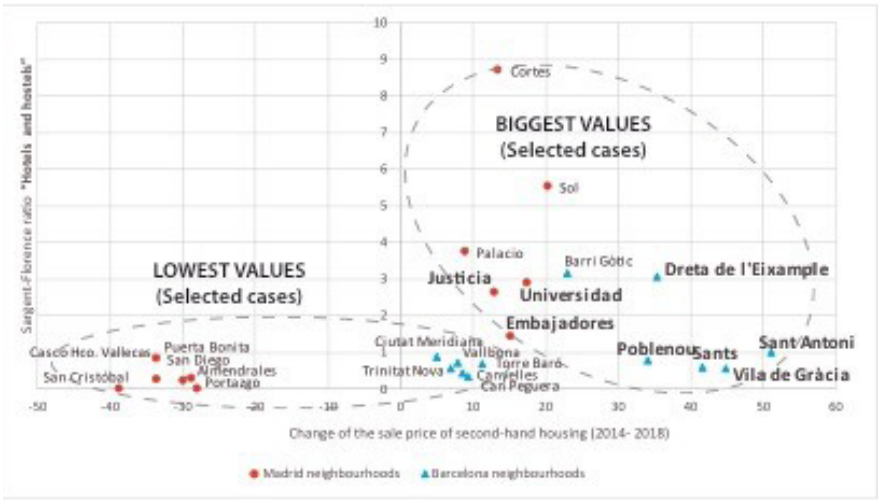
Two initial observations should be made. First, there are more neighbourhoods than those selected with similar behaviours. In the case of Madrid, it would be all of those belonging to the Centro district and for Barcelona, the Barri Gòtic. On the other hand, that data shows dissimilar urban dynamics between both cities, especially in the evolution of land prices and in the differential concentration of artistic and cultural services (not so much in the location of catering services). This is very clear in the case of the Centro district of Madrid, where all the selected activities have location ratios that mark a high degree of specialisation (figures 5 to 7).

In the neighbourhoods selected for Barcelona, location ratios are much lower than in Madrid in all cases analysed. They emphasise the restoration activities of Barri Gòtic, the Dreta del Eixample in the case of the hospitality industry and Vila de Gràcia in cultural and recreational equipment, with a specialisation ratio of around 2.

It is also evident that the price of housing in the Catalan capital has evolved positively throughout the period, even in the most popular neighbourhoods, such as Ciutat Meridiana, Trinitat Nova or Can Peguera, although the differences between them and those registering higher increases are very significant. Sant Antoni, Vila de Gràcia and Sants, the three with a growth rate above 40 % in the five years considered, are the most notable. This is the most significant data point, since the evolution of the price of the land is the only indicator that can justify establishing a certain casuistic relationship with the dynamics of high creative activity attributed to them by the consulted sources.

In the case of Madrid, the increases in the price of land are not so high, although they also register an increase in the neighbourhoods studied. However, at the same time as Lavapiés-Embajadores, Malasaña-Universidad and Chueca-Justicia, the other three neighbourhoods of the Centro district also stand out, namely Sol, Palacio and, above all, Cortes. The latter, also known as the Barrio de las Letras, plays an important role in the city's tourist circuits,





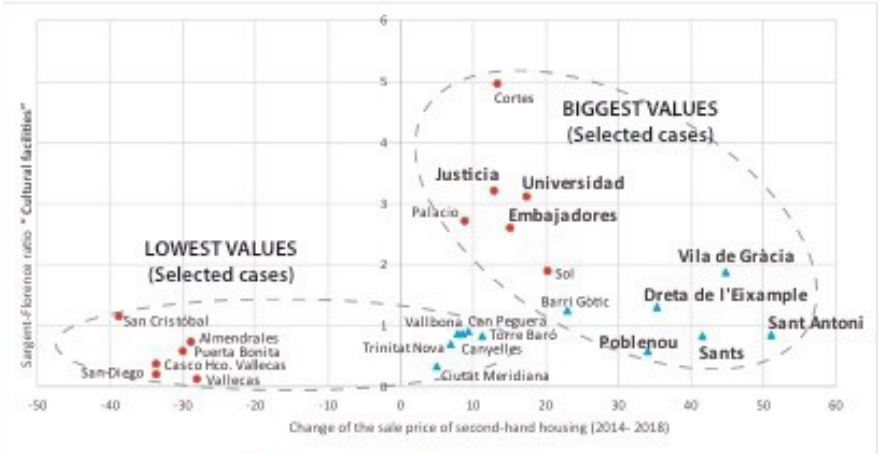


Fig. 5 to 7. Scatter plots. Change of the sale price of second hand housing and Sargent- Florence ratio (Bars and restaurants, hotels and hostels and cultural facilities)

Source: Own research based on data of Barcelona and Madrid City Councils (Census of premises and data on housing prices)

especially in terms of the hotel and restaurant business, which are mainly located in the axis of Calle Huertas, despite the fact that this is not specified in the international sources consulted.

We do not believe that it is possible to take the comparison between both cities and their neighbourhoods beyond this, because the cities behave differently in both, the evolution of the price of land, which is positive in all case studies,

		Nº apt. (April 2015	Nº apt. (May 2019	% (2019)	Total change Nº apt. (2019-2015	Change % (2015-2019)	% change of total of city's change
Barcelona	La Dreta de l'Eixample	673	1350	17.85	677	100.59	37.59
	La Sagrada Familia	429	619	8.19	190	44.29	10.55
	El Raval	670	592	7.83	-78	-11.64	-4.33
	L'Antiga Esquerra de l'Eixample	422	552	7.30	130	30.81	7.22
	La Vila de Gràcia	518	551	7.29	33	6.37	1.83
	El Poble Sec	428	525	6.94	97	22.66	5.39
	Sant Pere, Santa Caterina i la Ribera	569	518	6.85	-51	-8.96	-2.83
	El Barri Gotic	501	511	6.76	10	2.00	0.56
	Sant Antoni	375	440	5.82	65	17.33	3.61
	La Nova Esquerra de l'Eixample	252	299	3.95	47	18.65	2.61
	La Barceloneta	183	242	3.20	59	32.24	3.28
	El Poblenou	190	229	3.03	39	20.53	2.17
	El Fort Pienc	215	222	2.94	7	3.26	0.39
	Camp de l'Arpa del C.	88	214	2.83	126	143.18	7.00
	Sants	103	177	2.34	74	71.84	4.11
	Barcelona	6,438	7,562	100.00	1,801	159.85	100
Madrid	Lavapiés/Embajadores	731	1,890	16.04	1.159	158.55	15.99
	Malasaña/ Universidad	643	1,401	11.89	758	117.88	10.46
	Palacio	491	1,097	9.31	606	123.42	8.36
	Sol	381	1,012	8.59	631	165.62	8.71
	Chueca/ Justicia	343	811	6.88	468	136.44	6.46
	Cortes	338	750	6.37	412	121.89	5.68
	Trafalgar	117	224	1.90	107	91.45	1.48
	Palos de Moguer	62	210	1.78	148	238.71	2.04
	Recoletos	66	208	1.77	142	215.15	1.96
	Goya	72	208	1.77	136	188.89	1.88
	Argüelles	87	192	1.63	105	120.69	1.45
	Puerta del Ángel	37	137	1.16	100	270.27	1.38
	Guindalera	44	133	1.13	89	202.27	1.23
	Castellana	27	130	1.10	103	381.48	1.42
	Almagro	69	119	1.01	50	72.46	0.69
	Madrid	4,534	11,782	100,00	7,248	17.45	100

Table 1. Change in the number of tourist apartments from Airbnb (2015-2019) in selected neighbourhoods of Madrid and Barcelona

Source: own elaboration based on Inside Airbnb. With colour: studied cases

Note: Only entire apartments.

	"@ 22"/ Poblenou	Sant Antoni/ Eixample	Sants	Gràcia	Chueca (Justicia)	Lavapiés (Embajad.)	Malasaña (Universidad)
Ambience							
Lively, full of life and vibrant							
Trendy							
Abandoned, shabby-looking, run down							
Tranquil, quiet, laid-back, peaceful							
Charming							
Cheerful, colourful							
Elegant, stylish							
Off the beaten track							
Local vs cosmopolitan							
Authentic, historical or antique atmosphere, real spirit of the city							
Cosmopolitan, international							
Urban Typology							
Old/former industrial area							
Waterfront							
Historical, old, traditional							
Modern, new with trendy buildings							
Visitors and Residents							
Young people and young couples							
LGBTQ							
Multicultural, melting pot							
Activists and revellers							
Rockers and punks							
Hipster/indie							
Bohemians							
Activities							
(always related to a bustling cultural life)							
Art: street murals and galleries							
Creation-innovation: design, edition, creative gastronomy							
Other cultural activities: theatres, museums, exhibitions, concert halls, other performing arts							
Music (mainly live-music)							
Eco and organic commerce							
Vintage and second-hand shops							
Others activities: co-working, experimentalism and anti-establishment							

Table 2. Main characteristics and activities of the studied neighbourhoods

Source: Compilation based on the analysis of the texts about the neighbourhoods of Madrid and Barcelona, published in the following media: *Time Out, Lonely Planet, Conde Nast, Travel and Leisure*; Plus, analysis of the contents of the official tourism webs of Barcelona and Madrid. For further information, see note 3

although more pronounced in Barcelona, and in the degree of presence of the activities considered here. It is obvious that the different size of the municipal districts, which in the case of Madrid is much larger, must be a factor. Therefore, perhaps the analysis in subsequent research should be extended to the entire metropolitan area to include the peripheral municipalities.

Thus, the search for the causes of the success of these neighbourhoods must be extended. In this respect, we believe that the analysis of the evolution of the number of tourist apartments could be indicative of the significance that the selected neighbourhoods have acquired in urban dynamics (table 1). However, it should also be noted that the regulatory standard in both cities is very different.

Since January 2017, Barcelona has the Special Urban Plan for Tourist Accommodation (PEUAT)[11]. Now owners must meet a series of requirements to register their homes for tourist use. In addition, some of the study neighbourhoods such as part of Sant Antoni, part of those of Vila de Gràcia, l'Eixample and Poblenou, are subject to restrictions, since at the time of the enactment of the law there was a very high tourist housing rate (ZE1). The neighbourhood of Sants also receives specific treatment, more specifically, the historic centre. As for Madrid, the regulations that prevailed in the city were quite liberal until the approval, under the progressive government of Mayor Carmena, of the Special Plan for the regulation of the use of tertiary services for accommodation[12] (March 2019). This plan considerably limits tourist apartments, as a separate entrance is required from that of regular residents. However, its effects cannot be seen in the data considered and, as of today, there are serious doubts about its continuity given the political change in the municipality.

This difference in the rules governing the activity can be seen in the spectacular growth of this type of accommodation in Madrid. In any case, the areas in the study in both cities show positive increases and concentrate an important amount of these increases compared to the entire city. This is evident in different neighbourhoods of l'Eixample, but especially in Embajadores-Lavapiés and Universidad-Malasaña.

However, all the above only provides us with an inaccurate idea of the magnitude of the process and does not explain the reason for the broad international media coverage that these neighbourhoods receive, which is the starting point of our reflection. It almost seems that the opposite was true. Advertising on these places favours the location of certain activities, such as tourist apartments. In addition, the growth rates of the artistic, creative and leisure-consumption activities analysed, as well as visitor and tourist attractions, should be included in the analysis, but there is no comparable data between both cities (incompatible dates and classifications of comparable activities).

As we well know, for people dedicated to geography, regional processes sometimes have a qualitative dimension that can not only be explained with numbers or indicators. This once again leads to the consideration of contemporary consumption practices where some of the following processes are combined: the increase in aesthetic and semiotic characteristics of goods and services to make them attractive (Baudrillard, 1974; Lash & Urry, 1994; Molotch, 1996), the use of experiences (Gilmore and Pine, 2002), the sophistication of consumption as an element of social identification (Bourdieu, 1986), the use of urban scenarios as an important part of daily consumption practices (Mansvelt, 2008) and the competitiveness that occurs within cities and between cities, especially global ones.

We use all of the above for further analysis of the characteristics of neighbourhoods in different advertising and communication media (table 2), to try and describe what the seven that are included for the case studies are like. To facilitate the search, the characterisation of the 50 cool neighbourhoods (figures 1 to 4) shown in the previous section has been used.

We see how the characteristics described for all neighbourhoods in the world (figure 4) are replicated in a large part of the seven studied neighbourhoods and they show quite homogeneous scenarios, very similar to those in the previous section. With all this, the threat of homogenisation or standardisation (urbanisation, Muñoz, 2008) of the neighbourhoods should be considered a real danger, and it is necessary to take measures to prevent reaching a point of no return. The seven are described as neighbourhoods that are full of life and activity, with a trendy atmosphere and locations for artistic, cultural and creative activities. However, all of them have some peculiarities and paradoxes, such as the coexistence of native and cosmopolitan elements. The former, considered authentic, gives neighbourhoods an identity while showing the increase in consumer preferences for everyday scenarios (Maitland, 2008). Cosmopolitan or international elements are mainly present in gastronomy, the morphology of the establishments, sometimes in the presence of immigrants (Lavapiés-Embajadores) and in the tourists and visitors who frequent them (Malasaña or Sants).

Beyond all this, the experimental and alternative role of Poblenou stands out, the presence of LGBTQ groups in Chueca-Justicia and l'Eixample, the role that graffiti plays as aesthetic and artistic elements in Lavapiés and Sant Antoni, multiculturalism that some neighbourhoods

11 On Line: https://ajuntament.barcelona.cat/ecologiaurbana/sites/default/files/ManualOperatiu_PEUAT_ES.pdf

12 On Line: https://www.bocm.es/boletin/CM_Orden_BOCM/2019/04/23/BOCM-20190423-38.PDF

present, either due to the presence of immigrants, many of them illegal, as in Lavapiés, or to the role played by students and tourists. You can also distinguish in them groups belonging to urban subcultures, such as Hipsters in Malasaña and Gràcia, which are difficult to differentiate from the Bohemians of Poblenou.

So far the process described above shows lights and shadows. No reference has been made to the appropriation of cultural capital by economic and political agents. For example, the neighbourhoods of Malasaña (Universidad) and Lavapiés (Embajadores) were actively included in the Strategic Tourism Plan 2012-2015 (Madrid City Council, 2012), as they are considered areas of potential expansion, beyond traditional circuits (Madrid plays off).

Other negative effects that must be considered, in addition to the significant increase in land prices in the study locations and the exorbitant increase in tourist accommodation (although not with the same intensity in both cities), are the disappearance of traditional businesses and invasion and overcrowding of locations by both local residents and tourists. This is being denounced by neighbourhood associations that have with greater awareness of the problem. Without delving into the process, as it is not included in the scope of this work, it is worth mentioning neighbourhood movements such as "Somos Malasaña", "Lavapiés, ¿dónde vas?", "Fem Sant Antoni: Quin barri volem?"[13] or some demands made by the "Associació Veïnal Vila de Gràcia".

5. Conclusions.

The above illustrates the high significance of cities today in terms of recent leisure-consumption practices, being also privileged enclaves for socialisation. The creative economy, as an essential part of the paradigm of "cognitive cultural capitalism" is a great ally when it comes to promoting urban regeneration. However, the whole process must be understood as a network of relationships where the identity of the locations (the neighbourhood or the district), the concentration of activities (not only artistic and creative, but also consumption), the life of the city and the adaptation to tastes or fashions by businesses come together. This reflects a neighbourhood narrative for consumption, which is still based or rooted in the practices of daily life, but adapts to international tastes, describing hybrid or mestizo spaces that are typical of globalisation. These spaces are fundamental for the socialisation and development of the collective identities of some groups.

In this respect, the role of certain autonomous agents, such as the global media, must be noted, since they generate an image, opinion and expectations about the locations. Some of these areas were unremarkable residential neighbourhoods a few years ago, some even showing signs of high marginality. They now suffer from high media exposure, which is much appreciated by economic and planning agents due to the business possibilities involved.

In the cities of Barcelona and Madrid, which are an integral part of the phenomenon of global urban tourism, the processes described are very visible, housing neighbourhoods or districts with major transformations that vary the dynamics of the city as a whole. This includes, in particular, free time and leisure, as well as the housing market and movements of tourists in their travels: Chueca, Gràcia, Lavapiés, Malasaña, Sant Antoni and Poblenou are good examples of this. Artistic and creative activities play a significant role in these neighbourhoods and in both cities, but other works deal with that topic. This work focuses on the high capacity they have to transform some areas and convert them into "Coveted consumer items".

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13 "Somos Malasaña": We are Malasaña; "Lavapiés, ¿dónde vas?": Lavapiés, Where are you going?; "Fem Sant Antoni: Quin barri volem?": Let's make Sant Antoni: What neighborhood do we want?

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The regional heritage of the enarenado farming method in the canary islands

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Abstract

The agricultural space is a social construction, the result of the action on a given geographical area by humans who transform it to cultivate plants or raise animals for their benefit. It is, therefore, a space created from nature, an artificial ecosystem that harnesses environmental conditions to produce food or raw materials. For this reason, the agricultural space reflects the main conditioning factors of the natural environment —soil, topography and climate— and it also reveals the technological development and cultural traits of the society that has created it. In the case of the Canary Islands, the regional heritage that agricultural traditions have imprinted on the islands has been mediated by the volcanic origin of the archipelago, the mountainous terrain, the scarcity of arable soil, the fight against aridity and the search for water in the subsoil. All these factors have given rise to a unique agricultural landscape, with features, such as *gavias*, *nateros* and *enarenados*, that only partly survive in an economy that has undergone significant deagriculturalisation, but that have had a remarkable impact on the landscape that may still be seen today.

Keywords: natural constraints; agricultural space; social construction; *enarenado*; tephra mulch; sand mulch; regional heritage

The Canary Islands are located at the southern limit of the temperate zone, off the northwest coast of Africa, in the cold waters of the Canary Current; overall rainfall is scarce —no more than 325 mm on average— and is very unevenly distributed. For this reason, water shortages have shaped the economic development of the islands since Spanish colonisation at the end of the 15th century, and have given rise to the creation of original agricultural systems to harness the scarce rainfall and keep the crops from drying out, such as *enarenados*, which use sea sand or fine fragments of tephra, or pyroclasts, as a mulch to cover the agricultural soil.

Owing to their capacity to retain moisture, the organic or volcanic materials used to make the *enarenados* have been an important ally for farmers on the islands in their fight against aridity in areas of scarce rainfall. This farming system has been used to grow various crops — from grapevine to vegetables, cereals and a few fruit trees that are well-adapted to arid conditions— that have contributed to the local population's self-sufficiency and even to agricultural exports. Historical examples include onions from Lanzarote and extra-early potatoes from the south of Tenerife, although there are also examples of natural *enarenados* on young soils cultivated by farmers on the islands of Gran Canaria, La Palma and El Hierro. In addition, the *enarenados* have created landscapes with a distinctive visual identity; made of yellow, off-white or black materials, depending on their composition, they have become an integral part of the local heritage and a major draw for tourists. Most of them are no longer cultivated today because of their low or non-existent economic viability. However, a reappraisal of the landscape and the environment of the *enarenados* has led certain social

groups to promote their rehabilitation and some island councils to include them in land-use and urban planning to promote their conservation, as tangible elements of an agricultural heritage that may be appreciated from a historical perspective (Castillo Ruiz and Martínez Yáñez, 2014, p. 111).

The primary objective of this study is to unravel the various causal relationships between the volcanic and subtropical conditions of the Canary Islands and the material culture imported by the Spanish and European colonisers in the configuration of the traditional agricultural space of the archipelago. The space was, moreover, influenced by constraints that would test the limits of any productive system: aridity, a lack of arable land, fragmentation of landholdings, and limited surface area. The legacy left behind by those farmers who laboured the land for more than five centuries is most evident in the different agricultural systems that were adapted to the environmental demands of geography and the socioeconomic developments of different periods in history. These systems are the aforementioned *gavias*, *nateros* and *enarenados*, alongside the spectacular terrace farming systems built on the steepest slopes, all of which have shaped a regional heritage with unique agronomic, ethnographic and landscape value that still survives today despite the significant agrarian decline of recent decades, and have left an indelible trace on the rural environment. In the words of other authors, "the historical context acquires a central role insofar as it deciphers those economic and social factors that have played a transcendental part in the construction of the regional space, melting pot of contradictions and arena of conflict" (Morales Matos and Santana Santana, 2005, p. 154).

To explain the genesis and the function of these systems in their spatial and temporal context, this study uses an analytical methodology to examine the chosen configurations, and to describe the processes that they have followed since their origin. The aim is to understand and interpret the originality and utility of the different systems created by the farmers of the islands through observation and experimentation. Many sources were used in the preparation of this study, from written and bibliographical sources to statistics and cartography – in particular, the *Crop Maps of the Canary Islands*, which in their successive editions have gathered meaningful historical data on the main features and the functioning of these farming systems, using a visual tracking technique to identify the vestiges of abandoned agricultural spaces. In addition to these valuable tools, which have enabled us to reconstruct the main features of the agricultural heritage of the past, we have also used land-use planning documents, such as those that led to the creation of protected natural spaces in emblematic places such as La Geria, in Lanzarote. The bibliographical sources that were consulted on the construction and use of *enarenados* were highly useful, and included the works of Rodríguez Brito (*La agricultura de exportación en Canarias (1940-1980)*, 1986), García Rodríguez (*Los paisajes de la aridez en Canarias,* 2013; *Los paisajes agrarios de Canarias*, 2013), Santamarta Cerezal and Suárez Moreno (*El aprovechamiento del agua en los agrosistemas tradicionales canarios. Comparación con otros territorios*, 2012), Sardá Ferrán and Zamora Cabrera (*Aproximación a los paisajes culturales del regadío. La Geria de Lanzarote,* 2014) and Sabaté Bel (*El país del pargo salado*, 2011), among many others that are quoted throughout the text and listed in the References section at the end of this paper.

1. The material construction of the island agricultural space

Volcanic soil is classified by soil scientists among the most fertile in the world, since the materials from which it is made —such as tephra and lava flows— contain minerals that, when weathered by the elements, provide plants with rich nutrients (Fernández Caldas, Tejedor Salguero and Rodríguez Rodríguez, 1978). But in volcanic regions with little rainfall, such as the Canary Islands, of which 42.6 per cent of the surface area is arid (Tejedor *et al.*, 2013), water availability is a factor that limits the development of agriculture. For this reason, farmers on the islands have, in the past, devised strategies for a more efficient use of the scarce water available for growing crops. In addition to the direct use of rain for dryland or rainfed crops, agricultural strategies have, in some cases, harnessed runoff water flowing down slopes and ravines during heavy rainfall, channelling it onto farmed plots, as in the *gavia* systems on the island of Fuerteventura (García Rodríguez, 2013). In other cases, the approach has focused on conserving precious soil moisture, through the construction of *enarenados* that are covered with a mulch of porous volcanic materials, such as tephra or sea sand, which condenses moisture from the air when the temperature drops at night.

The *enarenados* of the Canary Islands, called *arenados* by Lanzarote farmers, is an original system of cultivation that,

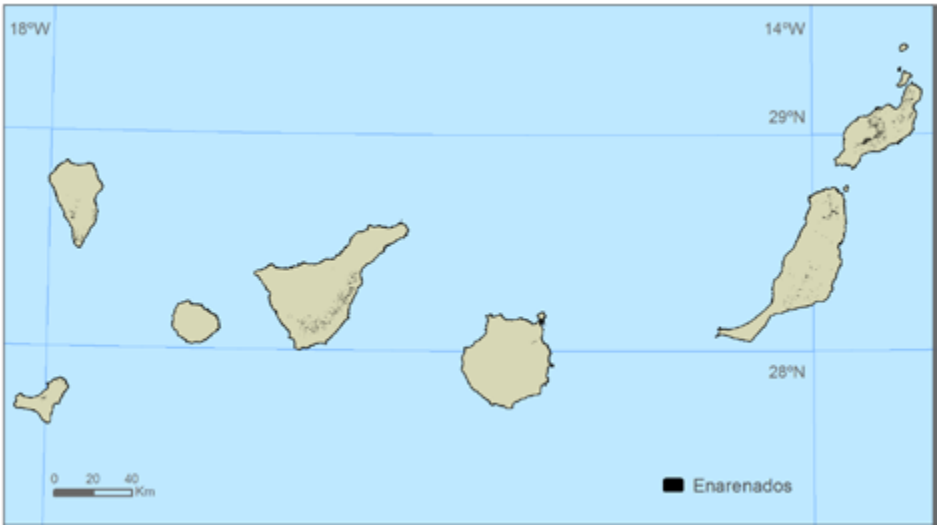

Figure 1. General location of crops grown using the enarenado system in the Canary Islands

Source: *Crop Map of the Canary Islands*, 2001 (Tenerife), 2008 (La Palma), 2013 (Gran Canaria), 2014 (Lanzarote and Fuerteventura) and 2015 (El Hierro). Department of Agriculture, Livestock, Fisheries and Water of the Government of the Canary Islands

in some cases, uses a layer of calcareous sand of marine origin, and in others, light, porous volcanic material, to cover the fertile soil and conserve or supply the moisture needed to grow crops in areas of low rainfall on the coastal strip (97.3 mm at the airport of Lanzarote, at an altitude of 20 m). They are also found in places with more rainfall, such as the leeward *medianías* (mid-elevation vegetation belt) on the more mountainous islands, especially on Tenerife (197.5 mm in Valle San Lorenzo, Arona, at an altitude of 435 m).

In the first case —*enarenados* formed naturally by the wind— organogenic sand from the beach is spread on pre-existing farmland. The local name given to this system is *jable* and it is characteristic of the central strip of the island of Lanzarote, also named Jable, and is most extensive in the municipalities of Teguise and San Bartolomé (Rodríguez Brito, 1986, p. 26). This strip has traditionally been the main area for cultivating sweet potato, a tuber from the tropics that in the past supplanted the potato —difficult to grow due to the arid climate— in the island diet. In the second case, the genesis of *enarenados* may be natural or artificial —man imitating nature— and the material typically used is tephra: fine basic pyroclasts (*picón negro*), found on much of the island of Lanzarote and in specific areas of the other islands, except on La Gomera, or acidic pyroclastic material (*picón blanco*), also known as *jable*, in the south of Tenerife.

The tephra used to make *enarenados* is classified according to its size and composition. Basaltic pyroclasts are generally black or reddish and the smallest particles are called *ash* (smaller than 2 mm in diameter); intermediate fragments are known as *lapilli* (between 2 mm and 64 mm in diameter); and the larger fragments are known as *scoria* (larger than 64 mm in diameter). The latter are not used to make artificial *enarenados* due to their unwieldy dimensions, but they may be found in situ under vineyards or fig trees, once they have undergone a certain degree of weathering. Acidic, trachytic or phonolitic clasts, according to their geological nature, are lighter, less dark and more porous and form pumice deposits on the southern slopes of the island of Tenerife, ejected by explosive volcanic eruptions. In some cases these materials have been directly used to grow crops, when they are more weathered, or have been used to cover agricultural soil that occurs naturally or that has been brought from other places to make *enarenados* (Santamarta Cerezal and Suárez Moreno, 2012, p. 367).

These three types of *enarenado* may be distinguished by the colour of the fields, which are yellow, black or whitish, depending on the mulching materials that cover them, and also by the plants that have traditionally thrived on them —sweet potatoes, grapevines, onions, and potatoes, inter alia— and which have left visible signs on the built agricultural landscape. Nevertheless, in our classification of the agricultural landscapes of the Canary Islands we have chosen to establish a single unit to encompass all types: "the agricultural landscapes of *enarenados*", also called "the landscapes of agriculture on sand and tephra" (García Rodríguez, 2013, p. 125). These materials, which occur naturally in the environment, are used to retain moisture in the soil, using the same system: the *enarenado*.

This system maintains the moisture of the soil for several months after scarce rainfall (barely 100 mm of precipitation) and, in some cases, generates agricultural yields similar to irrigation systems, as demonstrated by certain authors (Rodríguez Brito, 1986, p. 28-29). In the case of lapilli or *picón negro*, this property is due to the fact

that this porous material swiftly absorbs solar radiation, but its thermal conductivity is low – only 0.15 calories per cm3 and degree Celsius. When night falls the *picón* cools quickly, and as it does so in an environment of high relative humidity (between 90 and 95 per cent), caused by the proximity of the sea and the moist air of the trade winds, water condenses which may then be used by the plants (Santamarta Cerezal and Suárez Moreno, 2012, p. 364). Moreover, *enarenados* also save on manpower in agricultural tasks, since grasses rarely take root on their surface (Rodríguez Brito, 1986: 28).

These agricultural techniques, which are practised in arid areas or areas with limited rainfall, have led to the creation of farming systems of remarkable originality that harness local materials from the islands. As in other arid regions of the world, they serve a dual function: first, to make optimal use of scarce water resources and, second, to conserve soil, especially on sloping terrain. To these functions, we might well add another, of equal importance: the creation of a unique island landscape of terraces and *enarenados* (Santamarta Cerezal and Suárez Moreno, 2012, p. 354), which are of immense agronomic, environmental, ethnographic and cultural interest for islands that now largely depend on tourism, as is the case of Lanzarote. On this island, which bears the marks of historical eruptions, the artist César Manrique recreated a unique aesthetic blend of volcanic landscapes and the main elements of local architecture, which has become the hallmark of Lanzarote's tourist identity (Díaz Hernández, Domínguez Mujica and Parreño Castellano, 2016).

In short, the archipelago's remarkable diversity of microclimates has led farmers to develop various strategies and crop systems in relation to the soil and water available at each location. In the case of the driest areas on the least steep terrains, with sufficient arable soil, *gavias* have been built to soak up rainwater; in minor ravines and gullies *nateros* have been built, banking up the intermittent watercourse with successive walls to retain the fertile silt carried by runoff water and thereby create plots; and finally, they have used in-situ or artificially deposited porous pyroclastic materials from volcanoes or sea sand (*jable*) scattered by the wind over the arable land to retain and capture environmental moisture through the creation of *enarenados*. Similar agricultural systems exist in arid regions of North Africa, Southern Europe and the Americas (Perdomo Molina, 2002; Perdomo and Palerm, 2008).

But, in reality, this set of cultivated lands contains different types of agricultural landscapes, dryland and irrigated: dryland cereals and vegetables on the natural and artificial *enarenados* of Lanzarote, which in many cases may be irrigated; dryland cereals, maize and potatoes planted in the *nateros* and *gavias* of Fuerteventura, which in practice have almost disappeared today; dryland grapevines on scoria and natural volcanic *enarenados* of El Hierro, La Palma and Gran Canaria, and irrigated potatoes grown on artificial *enarenados* of white tephra on the south of Tenerife.

Except for Fuerteventura's landscapes of *gavias* and *nateros*, explored in previous articles on "landscapes of aridity" (García Rodríguez, 2013), what really unites all of these landscapes is an agricultural system, the *enarenado*: natural, with sea sand in El Jable, on Lanzarote; also natural, but of volcanic origin in the vineyards of the south of La Palma, the north of El Hierro and the east of Gran Canaria, and also formed by recent volcanic eruptions in the striking winegrowing landscape of La Geria and other areas of Lanzarote; and artificial in some enclaves of Fuerteventura and on most of Lanzarote, where vineyards and some vegetables are currently grown in fields with the use of techniques akin to gardening, progressively acquiring localised irrigation systems in the case of Lanzarote to improve yields; also artificial in the fields covered with *jable* or white tephra in the south of Tenerife, mainly given over to the cultivation of irrigated potatoes for export until the late 1970s and, later, also to other vegetables and grapevines for the island market.

But in the Canary Islands the term *jable* is used to refer to different materials, depending on the island in question, although on all of them it has a common agronomic purpose. On the two easternmost islands of the archipelago, *jable* refers to clear organogenic sand, consisting mainly of the remains of shells of marine invertebrates and calcareous algae, and which, in the case of Lanzarote, farmers learnt to use from the middle of the 19th century. The farmers of El Hierro, on the other hand, use this word to designate basaltic tephra, weathered to a greater or lesser extent, and which is found in abundance on the geologically youngest island of the archipelago. They grow grapevines directly on these materials or use them as mulch for the same purpose. In the south of Tenerife, the *jable* is also tephra, but of the pumice variety, the light-coloured ejecta of explosive volcanic eruptions in the geological past (Sabaté Bel, 2011a, p. 408). These have been used in the construction of *enarenados* since the end of the 19th century, and even, in more humid places, to directly cultivate vegetables, although in both cases irrigation has been used since the middle of the 20th century.

Despite the relatively recent expansion of the aforementioned cultivation systems across the arid environments of the islands, some local authors consider the *gavias*, *nateros* and *enarenados* to be pre-Hispanic water-harnessing strategies, consolidated with the arrival of Europeans from the 16th century onwards (Cabrera Pérez, Perera Betancor and Tejera Gaspar, 1999, p. 143). At present, most of the lands cultivated with these agricultural systems have been abandoned, "in spite of the fact that they are outstanding elements of the agricultural heritage that are in need of rehabilitation and conservation, because in addition to their unquestionable landscape, environmental and cultural value, they are agrosystems that favour sustainable development" (Santamarta Cerezal and Suárez Moreno, 2012, p. 360). In a similar vein, Sardà Ferrán and Zamora Cabrera (2014) contended that "the island is capable of producing crops in a sustainable manner with the scarce rainfall alone, thanks to the *enarenado* technique and other variants such as those found in the Jable area".

However, from the point of view of productivity, their yields in most cases are low, and often non-existent due to the total loss of crops in frequent periods of extreme drought. But the originality of these systems that exploit arid lands, and the intricate relationship that they have woven between man and nature, have been recognised by international organisations such as UNESCO, which has declared the two easternmost islands of the archipelago —Fuerteventura and Lanzarote— biosphere reserves; on these islands, these systems remain fundamental elements of the landscape. But the visual appreciation of these arid landscapes has also changed with the passage of time, from rejection in the past to their subsequent aesthetic re-evaluation. Islands such as Lanzarote and Fuerteventura, with arid landscapes that in no way resembled the tourism clichés of the early 20th century, began to gain recognition after 1930, when writers and artists such as Miguel de Unamuno or Agustín de Espinosa extolled their virtues (Sardà Ferrán and Zamora Cabrera, 2014, p. 847). Since then, the aesthetic virtues of Lanzarote have been firmly established, according to the poet Lázaro Santana (1997), beyond the traditional canons of beauty, product of the visible and invisible strata that make up its landscape and of anthropogenic action on an austere environment.

2. The sea sand and tephra enarenados of Lanzarote

In Lanzarote, the word *jable* refers to organogenic sand that, after being deposited on the northern beach of Famara, is swept inland by the trade winds, giving rise to extensive natural *enarenados* across the municipalities of Teguise, Tinajo and San Bartolomé. They were first used in the 19th century, when farmers discovered "their ability to conserve and condense environmental moisture", which enabled dryland cultivation of plants typically grown on irrigated land and in humid tropical climes, such as sweet potatoes, tomatoes, melons, watermelons and other vegetables (Martín Martín, 2000).

The agricultural landscape of the *enarenados de jable* reached its maximum extent in the 1960s. They were enclosed by rows of rye or rye straw, or other materials,

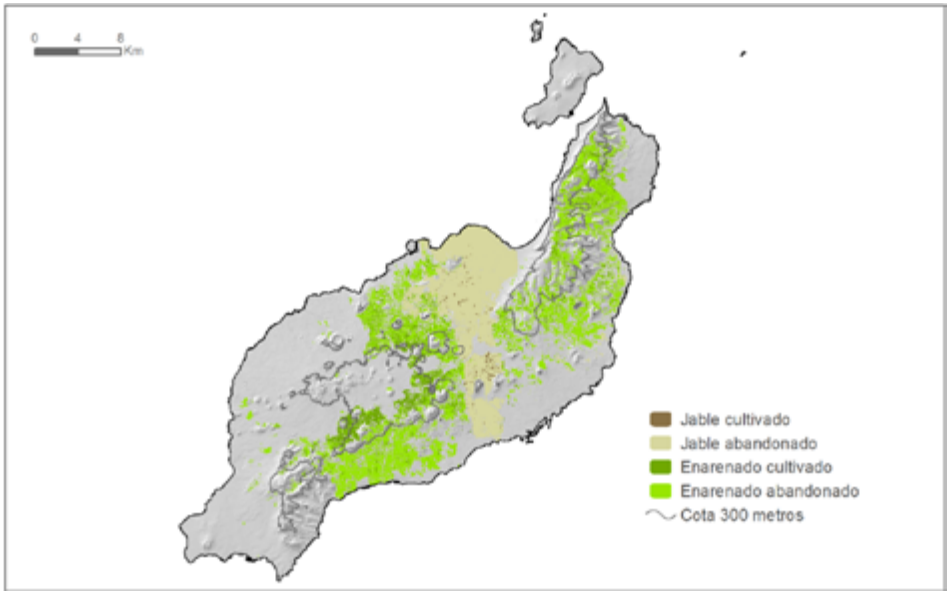

Figure 2. Location of the different types of enarenado –cultivated and abandoned– on Lanzarote

Source: 2014 *Lanzarote Crop Map*, Department of Agriculture, Livestock, Fisheries and Water of the Government of the Canary Islands

arranged perpendicular to the direction of the prevailing wind, and individual stones were placed around the cultivated plants in small mounds to lift them from the ground. The purpose of these systems is the same: to retain the sands driven by the wind and to prevent the plants from being buffeted or buried and, in the process, to use the sand that accumulates under the rows of rye by spreading it over the crops, thus constantly renewing the *enarenados* (Rodríguez Brito, 1986, p. 27).

The *enarenado de jable* has certain advantages for growing crops, according to Rodríguez Brito (1986), because organic calcareous sand conserves and condenses moisture and favours plant development by acting as a thermal insulator. It is therefore possible to grow vegetable crops using this agricultural system, especially sweet potatoes and, to a lesser extent, pumpkins, cabbages, tomatoes, watermelons and other food crops. When the crop is harvested, the rows of rye are removed and the wind spreads the accumulated sand, renewing the surface layer of the *jable* sand mulch, as the previous layer will have mixed with the soil and been partially altered. For this reason, the crops in this area are arranged in such a way that they do not impede sand from reaching producing plots. Traditionally, a three-field rotation system was used: sweet potatoes, tomatoes and fallow; or two-crop: sweet potatoes and fallow. But later, due to the crisis and the almost complete disappearance of tomato crops, the two-field system predominated (Rodríguez Brito, 1986: 27).

The *enarenados de jable* (organogenic sand mulch) have been most affected by agricultural abandonment in recent decades, as their maintenance requires a considerable effort and yields are generally low. Until the 1960s, almost the entire *jable* surface area, subsequently calculated at about 7,400 hectares, was cultivated (Rodríguez Brito,

Agricultural use	Area 2004	Area 2014	Agricultural use	Area 2004	Area 2014
Fallow plot jable	1,274.03	326.50	Cultivated picón	3,002.06	2,982.41
Fallow plot picón	3,604.03	724.89	Abandoned picón	8,910.89	8,132.19
Total fallow	4,878.06	1,051.39	Total picón	11,912.95	11,114.60
Cultivated jable	167.24	168.70	Total cultivated jable+picón	3,169.30	3,151.11
Abandoned jable	5,089.28	6,904.54	Total abandoned picón+jable	14,000.17	15,036.73
Total jable	6,530.55	7,399.74	Total picón+jable	23,321.56	19,565.73

Table 1. Area cultivated and abandoned in 2004 and 2014 in jable and picón enarenados on Lanzarote in hectares
Source: 2004 and 2014 *Lanzarote Crop Maps*. Department of Agriculture, Livestock, Fisheries and Water of the Government of the Canary Islands

Agricultural use	Area	Agricultural use	Area	Agricultural use	Area
Grapevine	1,638.19	Leguminous crops	45.44	Ornamentals	0.96
Vegetables	546.02	Temperate fruit trees	18.52	Grapevine-prickly pear	23.18
Maize	206.52	Aloe vera	11.67	Grapevine-temperate fruit	3.29
Sweet potato	211.18	Olive trees	6.90	Family vegetable garden	60.14
Onion	107.89	Subtropical fruit trees	2.84	Other crops	16.46
Potato	103.99	Fig trees	3.23	Fallow plots	1,051.39
Prickly pear	93.51	Watermelon-melon	7.46	Cultivated area	3,151.11
Cereals	48.21	Tomato	7.11	Abandoned area	15,036.73

Table 2. Land use in jable and picón enarenados on Lanzarote in hectares in 2014
Source: 2004 and 2014 *Lanzarote Crop Maps*. Department of Agriculture, Livestock, Fisheries and Water of the Government of the Canary Islands

1986, p. 27). However, according to the 2014 *Lanzarote Crop Map* (table 1), the area of cultivated *jable* is only 168.70 hectares. The abandoned *jable* amounts to about 6,900 hectares, to which, if we add the 326.50 hectares of *jable* considered by technicians as "fallow plots" or plots containing no crops but ready for cultivation (although in reality this figure has not subsequently been verified), the total area of land abandoned in this category of *enarenado* amounts to more than 7,200 hectares, or 97.7 per cent of the agricultural area that may have been used for this agricultural system in the past. In this context, and bearing in mind that the Agricultural Machinery Service of the Lanzarote Island Council (*Cabildo Insular*) continuously carries out conservation and maintenance work on the *enarenados* at low cost for landowners for landscape and environmental reasons, a significant part of the plots that were uncultivated during the mapping campaign and that were catalogued in the fieldwork as "fallow plots" could be the visible results of these tasks and not plots set aside to be sowed at a later date.

The introduction of *enarenados de picón* (tephra mulch) as a farming method on the island of Lanzarote was the work both of the hand of nature and of farmers' renowned observational powers. The Timanfaya historical eruptions from 1730 to 1735 and the subsequent eruptions of 1824 buried entire villages and wide swathes of farmland (León Hernández, 2006). After the disaster, however, the farmers must have noticed how the plants that had been half-buried by the *picón* had both survived and grown more vigorously than those left untouched by it. This was when the "natural *enarenado*" was first created, and it must have been the inspiration behind the idea of digging through the layers of volcanic ash that had settled on the former farmlands to the fertile soil buried underneath and planting vineyards or fig trees. It was this task that led to the creation of the spectacular landscape of La Geria, to which the semicircular walls of stone were probably added soon after to protect the plants from the wind; it is a paradigmatic example of the human struggle against an adverse physical environment to obtain the fruits of the earth (Martín Martín, 2000, p. 102).

The natural *enarenados de picón* are located in areas close to recent volcanoes, where lapilli have covered pre-existing topsoil. They are limited to the periphery of these loci of recent ejecta, in areas where the tephra has not yet been altered by weathering. The main area of natural *enarenados* is located leeward of the Timanfaya volcanic field, in La Geria, between the towns of Uga and Mozaga. But the thickness of the layer of lapilli often makes it difficult to farm these natural *enarenados*. This thickness is highly variable, but the requirement for crops to prosper oscillates between 20 cm and 2 m. The task of preparing the *enarenados* consists of excavating hollows (*socos* or *gerias*), 1 m to 2.5 m deep, down to the buried palaeosol. As a result of this task, 2 m^3 to 6 m^3 of volcanic ash or lapilli are extracted from these small depressions in the form of inverted cones. At the bottom of the hollow a vine or fruit tree is planted. The density of these planted hollows is between 250 and 350 per hectare, depending on the thickness of the mulch layer, which is a wide spacing of plantings. In addition, these *enarenados* are limited in terms of the type of crops that may be planted, as they must have a deep root system that penetrates through the layer of lapilli to reach the palaeosol. For this reason, the predominant crop is grapevine, and to a lesser extent, fig trees and other fruit trees (Rodríguez Brito, 1986, pp. 27-28).

For decades, however, crops grown in natural *enarenados* have been difficult to maintain, as it is a markedly artisanal farming method with low yields, especially in the case of grapevine. This problem is compounded by frequent harvest losses caused by blasts of hot air from the Sahara Desert. The air temperature soars and the black lapilli absorb heat, and because of the way that the crops —mainly grapevine— grow at the bottom of the *gerias*, they are scorched and wither in the heat, especially when the plants are still tender (Rodríguez Brito, 1986, p. 28).

The agricultural "discovery" of the *enarenado* system transformed an arid and unproductive area of Lanzarote, affected by recent volcanic eruptions, into an extraordinary landscape of thousands of funnel-shaped hollows. The natural *enarenado*, formed in the surroundings of Timanfaya, subsequently spread to other areas of the island. The *picón* was transported from the mountains and unproductive areas to other parts of the island, where artificial *enarenados* were created, which ended up covering most of Lanzarote's farmland with a layer of 15 cm to 20 cm of the material, on which various varieties of vegetables and other crops were planted to supply the population and make the island self-sufficient. In some cases, certain products have also been grown for export, such as sweet potatoes and onions in the 1960s and 1970s.

The initial construction of the *enarenados de picón* was an arduous task, as the lapilli, or *rofe*, had to be transported by camel from the *roferos* (volcanic cones where the material was collected) to the farmlands. In some cases, "loan soil" also had to be provided when it was scarce

or non-existent. The process became much easier with the introduction of trucks and mechanical shovels, and with loans and subsidies from the National Institute for Colonisation and the Institute for Agrarian Reform and Development (IRYDA), which contributed to increasing the island's *enarenado* surface area. It cost more than one million pesetas at the beginning of the 1980s to prepare one hectare of *enarenados*, according to Rodríguez Brito (1986); of this budget, the IRYDA covered some 880,000 pesetas with its subsidies and loans. This aid scheme enabled many small landowners to earn a decent wage and introduce improvements to their land, in times of widespread unemployment on the island. Support for dryland farming in Lanzarote was the only exception to the post-Civil War agricultural policy, as almost all the aid for the Canary Islands promoted irrigated agriculture, mainly banana plantations (Rodríguez Brito, 1986, p. 29).

This laborious farming technique, akin to gardening and requiring abundant manpower on the smallholdings, made considerable agricultural productivity possible in traditional self-subsistence crops. This held true even in the case of water-intensive crops, like maize or sweet potato, despite dwindling and irregular rainfall on the island. These crops, along with fishing on the nearby Canary-Saharan bank, sustained the moderate population growth of Lanzarote for much of the 20th century, as its population doubled in the first 60 years of the last century, before the more recent development of tourism. By contrast, the population of the equally arid island of Fuerteventura only multiplied by 1.57 between 1900 and 1960, while that of the entire archipelago multiplied by 2.65 and that of Gran Canaria by 3.15 in the same period of time. This contrast in the demographic patterns of the two easternmost islands has been considered by some authors a clear example of geographical possibilism, as opposed to the environmental determinism represented by the harshness of the desert climate (García Rodríguez, 1992, p. 39).

The *enarenados* constructed with tephra, or *rofe*, by the farmers of Lanzarote revalued, from a productive point of view, the most arid strip of land of the "Island of the Volcanoes", according to Rodríguez Brito (1986), located in the triangle between Tinajo-Mozaga-Yaiza. However, this agricultural system presents a range of agronomic constraints, such as its limited average lifecycle, between 15 and 20 years, after which time the *picón* mixes with the soil and loses its protective function, and therefore needs renewing; and the places where supplies of this material are sourced —where farming is in competition with its use in gardening for the tourist sector— have been reduced to a minimum due to environmental protection and landscape conservation rules introduced in land-use and urban planning from 1991 onwards. In addition to this circumstance there is also the complexity of working the land, including the use of fertiliser, which must be applied superficially so as not to accelerate deterioration of the *enarenados* by mixing the *picón* with the agricultural soil. There are also difficulties in treating soil pests, such as nematodes (Rodríguez Brito, 1986, p. 30). As a consequence of all the aspects described above, the 2014 *Lanzarote Crop Map* recorded 8,132.19 hectares of abandoned *enarenados de picón*, not counting the 724.89 hectares of the controversially labelled "fallow plots"; and only 2,982.41 hectares are still cultivated, notably to grow vineyards, in widely spaced planting patterns, especially in the area of La Geria, with 1,638.19 hectares – 54.9 % of the surface area of the *enarenados de picón*.

However, the 2004 *Lanzarote Crop Map* recorded more than 23,300 hectares of natural and artificial *enarenados* of *jable* and *picón*, used to produce food at some moment prior to the date that said map was drawn up, and which had left behind a still visible trace on the former farmlands that the fieldworkers were able to identify. Of this considerable surface area, which covers 27.6 % of the island, more than 15,000 hectares have ceased to be cultivated in the last three or four decades, according to the record of abandoned cropland in the 2014 *Lanzarote Crop Map*, and this without taking into account the category of "fallow plot", which totals more than 1,000 hectares. This means that the decline in cultivated area is more than two thirds of the probable agricultural land used in Lanzarote at the end of the 1960s (table 1).

The net agricultural abandonment recorded for the *enarenados* of *jable* and *picón* between the 2004 and 2014 *Lanzarote Crop Maps* was just over 1,000 hectares and the cultivated areas in both cases are almost identical —just under 3,200 hectares— which is surprising, considering the drought suffered by the island in recent times and the dwindling numbers of the older generation of long-suffering farmers who continued to cultivate many plots, probably more as a cultural practice and a hobby in their retirement than as a productive task. However, the agricultural area of the *enarenados* recorded by the first of these maps was 23,321.56 hectares; the area recorded by the second was 19,565.73 hectares. This means that there is a difference between the two maps of more than 3,750 hectares in the area covered by this farming method. Moreover, this difference is almost identical to the disparity between the area of fallow plots recorded by the maps.

But it may well be that these discrepancies have more to do with modifications to the criteria for drawing up the two crop maps than with the changes to the agricultural area of Lanzarote at the beginning of the 21st century. In this regard, we may point out the moderate difference between the total agricultural area recorded in the 2004 and 2014 *Lanzarote Crop Maps*, barely more than 2,400 hectares, where the theoretical UAA of the first was 25,137.67 hectares, which would include the area cultivated at that date and the agricultural area that was cultivated in the past but has ceased to be so. Therefore, the "mass" abandonment of the cultivated area of the *enarenados* of *jable* and *picón* of Lanzarote occurred in the last decades of the 20th century, and not in more recent years, owing to their low yields and the indisputable "attractiveness" of the tourist sector, sustained by construction and services, which ushered in a notable improvement in the standard of living of the island population.

According to the 2014 *Lanzarote Crop Map*, grapevine is the leading crop grown in *enarenados* of *jable* and *picón* (table 2), although its surface area of more than 1,600 hectares is somewhat misleading due to the wide spacing that vines require to survive in this agricultural system. This area of cultivation has remained steady over the last decade, according to the data of the 2004 *Crop Map*, although it did record more than 230 hectares of vineyard in different phases of abandonment in *enarenados*, and about 320 hectares for which this system was not used. This would suggest that the decline in agricultural activity has also affected the most emblematic crop of La Geria in recent years, despite the fact that in some areas methods have been modernised with the introduction of drip irrigation systems.

After grapevines, the remaining *enarenado* crops are the most typical garden vegetables of the "Island of the Volcanoes" (table 2), grown for subsistence purposes, including maize, with more than 200 hectares, onions and potatoes, with more than 100 hectares in both cases, which together with sweet potatoes, with more than 200 hectares, have also benefited on many plots from the introduction of drip irrigation with desalinated water from the public supply network, or with reclaimed water from the treatment plants. A certain importance, at least from the landscape and land-use point of view, has also been given to crops of prickly pear, with almost 100 hectares, which was formerly used to breed cochineal, a dye-producing insect that played an integral part in the agricultural economy of the islands in the last third of the 19th century, but was overtaken by more competitive production in certain countries of Latin America, such as Mexico and Peru, and especially by the discovery of aniline and synthetic dyes that were manufactured in Europe (Pérez Sandi and Becerra, 2001, p. 5).

3. The *enarenado de jable* of the south of Tenerife

The second type of agricultural landscape is the *enarenado de jable* in the south of Tenerife, which spread in the 1940s as a consequence of British demand for early and extra-early potatoes, once the problem of the water supply in the south had been solved with the building of channels from galleries excavated in areas of the island with higher rainfall. The success of these crops led to the construction of a major extension of terraces with local or "loan" soil. Walls were built to level the plots and to facilitate conservation of the *jable*, the agricultural tasks and irrigation. These unique artificial terraces, made up of thousands of small plots, are located between 300 metres and 1,000 metres above sea level, although in some places they reach even higher, as in the case of the municipality of Vilaflor.

Therefore, the *jable* farming system in the south of Tenerife not only managed to acclimatise to potato-growing, by emulating the conditions of the island's windward *medianías* (mid-elevation vegetation belt), where potatoes had been grown since their introduction in the 16th century, but also, for many years, sold them abroad. According to Sabaté Bel (2011), the factors behind the establishment of this export industry in the last quarter of the 19th century were, on the one hand, the interest of the British in introducing new seed varieties and stimulating early crop production on the island to cover the period in which, because of their climate, they could not cover domestic demand with their own harvested potatoes; and, on the other hand, for the islands this was the only viable trading option for areas that could not produce bananas or tomatoes, especially for the farming communities that were hit hard by the free port system and growing imports of cheaper foreign cereals (Macías Hernández, 1989, p. 5).

Between 1900 and 1930, the potato-growing area in the Canary Islands increased by 25 per cent, exports to England doubled and, after the introduction of chemical fertilisers, average yields doubled, reaching 12,000 kg per hectare (Macías Hernández, 1989, p. 6). Throughout this overall process, the contribution of the south of Tenerife was

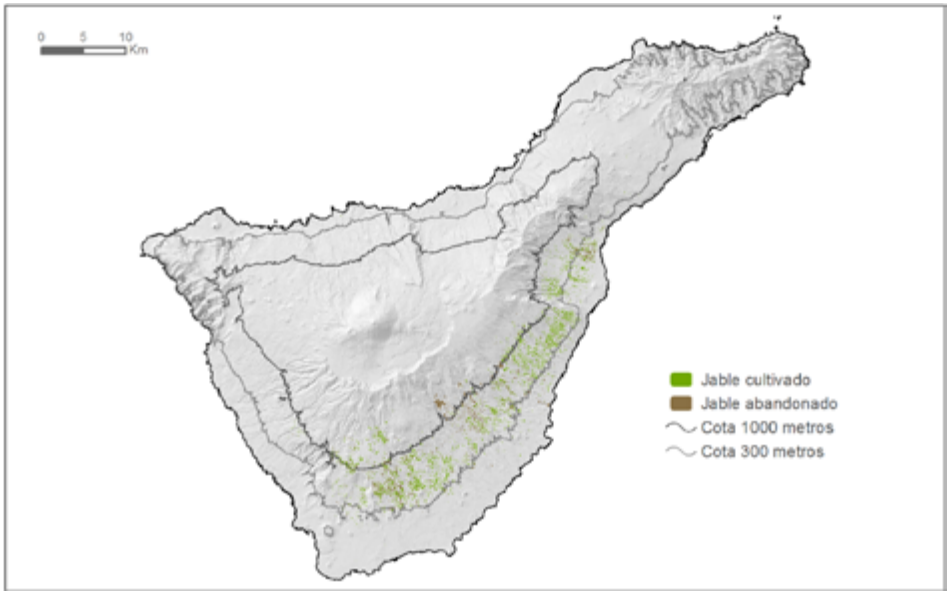

Figure 3. Location of cultivated and abandoned enarenados de jable in Tenerife

Source: 2008 *Tenerife Crop Map*. Department of Agriculture, Livestock, Fisheries and Water of the Government of the Canary Islands

hugely significant, with the spread of a new system that made optimal use of pumice mulch, using it to cover plots where it had not originally been deposited naturally, but which contained fertile soil (Sabaté Bel, 2011, pp. 445-446).

The origins of this farming technique using *jable* in the south of Tenerife are still relatively unknown, but, little by little, we have gathered oral and written references that are beginning to shed light on the matter. What seems evident, according to Sabaté Bel, is the link between this "new" production system and the rise of a particularly entrepreneurial agrarian bourgeoisie, who set their sights on trading agricultural products. The most reliable references are found in the last third of the 19th century. All oral records, and the few written records available to date, agree that *jable* was already being used as an artificial mulch for soil at that time (Sabaté Bel, 2011, p. 446).

But the end of potato exports to the United Kingdom in the late 1970s curtailed the expansion of *jable* farming and ushered in the beginning of its decline, and hence the decline of the agricultural landscape built by local farmers to produce the potatoes. At the same time, while thousands of plots were gradually abandoned, potato-growing became more specialised, particularly in the municipality of Vilaflor. A certain agricultural diversification also began in the surviving farms, with the introduction of vegetables and some temperate or subtropical fruit trees, such as oranges, avocado trees and peach trees, which since then have supplied the local island market. A significant per centage of plots were given over to viticulture, which until then had been located almost exclusively on the margins of the plots and beyond the reach of irrigation systems. The spread of irrigated espaliered grapevines grown on abandoned or newly

Crop	Area	Crop	Area
Potato	1,999.11	Temperate fruit trees	20.18
Vegetables	185.36	Subtropical fruit trees	15.25
Grapevine-potato	111.21	Ornamentals-aromatics	11.14
Grapevine	100.81	Cereal-fodder-legume	1.02
Grapevine-vegetables	56.64	Cultivated area	2,679.12
Citrus fruits	52.49	Abandoned area	1,218.13
Family vegetable garden	125.41	Area enarenados	3,896.75

Table 3. Area of enarenados de jable in the south of Tenerife in 2001 in hectares

Source: 2001 *Tenerife Crop Map*. Department of Agriculture, Livestock, Fisheries and Water

	Western Canary Islands		Eastern Canary Islands		Canary Islands	
Land use	**Km²**	**%**	**Km²**	**%**	**Km²**	**%**
Cultivated area	296.2	8.8	177.2	4.3	473.5	6.3
Agricultural abandonment	414.5	12.3	516.4	12.7	930.8	12.5
Built area	168.3	5.0	249.1	6.1	417.4	5.6
Road infrastructure	36.2	1.1	38.1	0.9	74.3	1.0
Shrubland and sparse vegetation	1,069.9	31.7	2,173.7	53.5	3,243.6	43.5
Protected Natural Spaces	1,518.3	44.9	1,495.6	36.8	3,013.9	40.5
Area Canary Islands	3,379.4	100	4,065.8	100	7,446.9	100

Table 4. Distribution of main land uses in the Canary Islands between 2003 and 2008

Source: Data adapted from García Cruz, J.I. (2013): *El impacto territorial del tercer boom turístico de Canarias*. Publications service of the University of La Laguna, 882 pp. and *Crop Maps of the Canary Islands* (2003-2008)

created pumice *enarenados* on the sunny southern slopes of the island was bolstered by the establishment of the Abona and Ycoden Daute Isora designations of origin in the 1990s and by the well-earned reputation of the white wines of southern Tenerife. In spite of this, the 2001 *Tenerife Crop Map*, the last to have information on *jable* croplands, recorded more than 1,200 hectares of abandoned *enarenados*, which represents more than 38 per cent of the agricultural area at the height of this original agricultural system.

4. The environmental function of enarenados and agricultural abandonment

As is well-known, arid and semiarid regions are fragile environments (Pizarro Tapia, 1999, p. 1) and human activity can easily destroy their natural vegetation if it oversteps certain thresholds. When this happens, erosion rapidly impoverishes the soil and the process of *desertification* begins. According to some geomorphological studies, an area of over 3,200 km² in the Canary Islands is affected by severe erosion, which represents 43 per cent of the total area, producing a loss of over 12 tonnes of topsoil per hectare per year (Rodríguez Rodríguez, 2001).

The layer of tephra mulch on the *enarenados* substantially improves water conservation in the soil because of its influence on two main processes —infiltration and evaporation— thus optimising scarce rainwater. According to experiments conducted by researchers from the Department of Soil Science at the University of La Laguna, the moisture content of soil covered by tephra is three times higher than that of soil that is bare on the upper layers. Statistical tests show significant differences of 99 per cent during all months of the year and at all depths, with the greatest differences observed in summer and the smallest in winter (Tejedor *et al.*, 2013, p. 81). In addition, this tephra mulch performs a protective function for the surface of the soil, intercepting raindrops and dissipating their energy. This leads to a higher rate of water infiltration, and therefore reduced runoff and sediment loss. Similarly, the greater surface roughness of the *picón* also reduces the speed of runoff water (Tejedor *et al.*, 2013, p. 86).

However, despite the undoubted environmental benefits of traditional farming systems, the *Strategy to combat desertification in the Canary Islands* (Tejedor *et al.*, 2013) notes that almost 82 per cent of the surface area of the archipelago is currently at risk of desertification. This threat does not, however, affect all islands equally: it is at its highest on Lanzarote and Fuerteventura, but only partially affects La Palma (31 per cent of the island). To address this problem, which is not only environmental but also social and affects development models, this document considers essential the joint involvement of various fields of knowledge and decision-making – inter alia, environment, agriculture, regional planning, education and the economy. It concludes that the fight against desertification in the Canary Islands must undergo a major effort of coordination and integration.

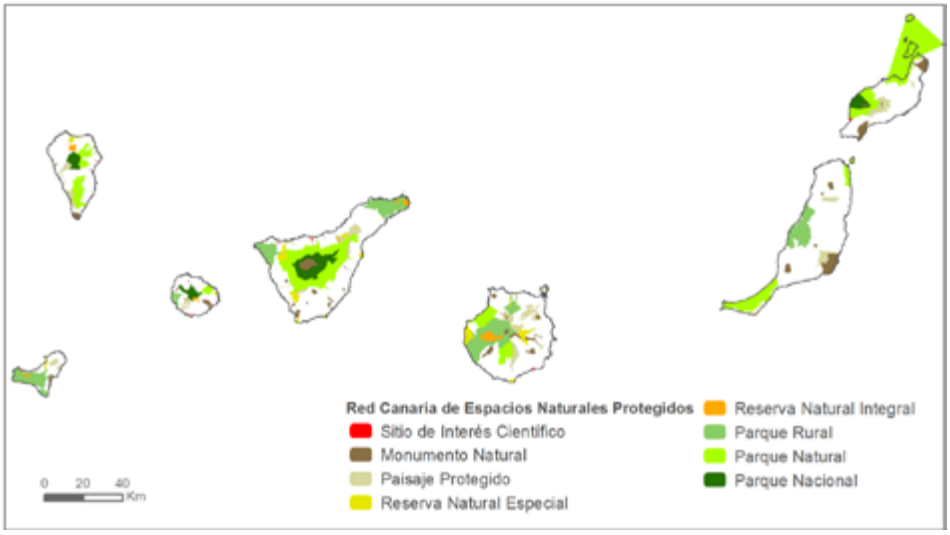

Figure 4. Distribution of the Protected Natural Spaces of the Canary Islands

Figure 4. Distribution of the Protected Natural Spaces of the Canary Islands

However, most of the arable land occupied by the traditional farming systems, which are valued in terms of landscape and environmental benefits, is no longer cultivated. This is confirmed in the *Crop Maps of the Canary Islands* of the first years of the 21st century (2003-2008), which recorded an area of abandoned land of more than 93,000 hectares. This decline in agriculture, particularly in traditional crops, in a period of significant economic and demographic growth after the 1960s, represents a loss of at least 12.5 per cent of the agricultural space of the archipelago, although the regional government's department of agriculture has tried to sugar the pill by considering this for many years in its statistics extensive and old fallow land, doubling the area of land cultivated in the first decade of the 21st century, which is 47,348.2 hectares, according to the aforementioned maps.

The consideration of abandoned arable land as fallow land set aside for prolonged periods while waiting for an improvement in prospects would raise the utilised agricultural area (UAA) in the Canary Islands in the first years of the 21st century to 140,430.2 hectares, which would represent almost a fifth of the entire surface area of the region. In reality, the reduction in the cultivated area from its former proportion to 6.3 per cent of the area of the archipelago has left a significant visible imprint on the rural space, which is why it has been described as a "landscape of agricultural abandonment" (García Rodríguez, 2013; González Morales and Ramón Ojeda, 2017) in the most recently proposed classifications of the agricultural landscapes. In addition, this space has been used, in part, for self-build properties and residential urbanisation, which have grown uncontrollably and, in many places, outside official urban planning, especially in the vicinity of the island capitals and on the northern side of the islands of Tenerife and Gran Canaria. This process has given rise to a disproportionate and chaotic urban development model that does not sit well with the small size of the islands (García Rodríguez, 2015, p. 17).

5. Conservation of the enarenados landscape

The Preamble to Law 12/1987, of 19 June, on the Declaration of Natural Spaces in the Canary Islands, based the existence of unique ecosystems on the unique geographical features of the archipelago; the flora is notable for the high number of endemic species and even contains surviving plants from the Tertiary, now extinct in most parts of the world, which make up the unique laurisilva forest of the Garajonay National Park, declared a World Heritage Site by UNESCO. The fact of their survival may be explained by the isolation of the islands and their morphological and topographical features, rising to 3,718 m in the case of Tenerife. These features have also led to a vertical layering of vegetation in altitudinal belts in which different plant communities have developed, forming more or less homogeneous belts which nevertheless possess extraordinary floristic variety and diversity of genera and species (Santana Santana and Naranjo Cigala, 1993). In these unique ecosystems various species of fauna are also present (birds, reptiles, insects, etc.), many of them endemic, increasing the value and diversity of the natural environment of the islands. Furthermore, as the Canary Islands are an active volcanic region, they play host to a wide range of volcanic phenomena, which together with other elements make up a great variety of geomorphological structures and volcanic landscapes. This

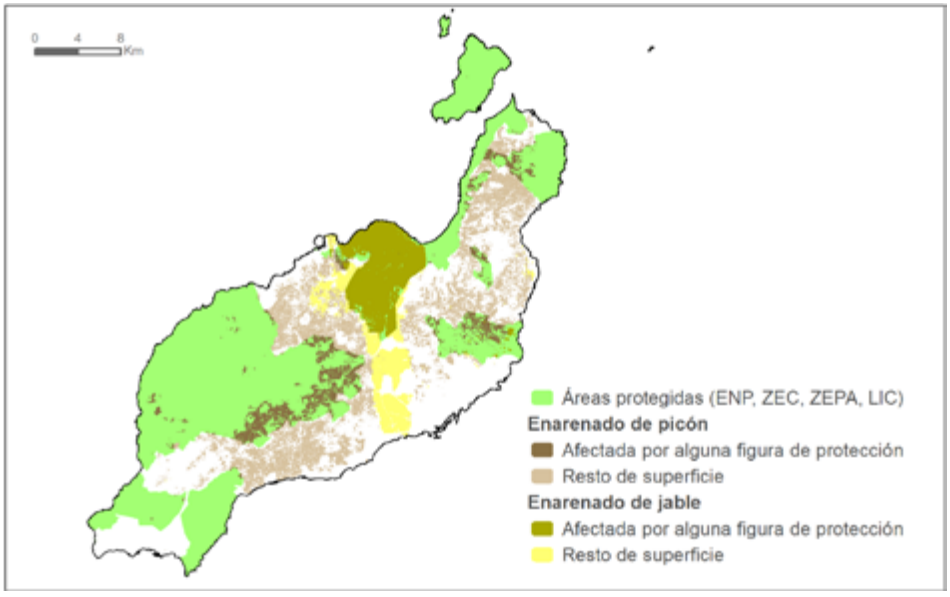

Figure 5. Types of protection given to enarenados of jable and tephra on Lanzarote

Source: Land Occupation Map, Cartography of the Canary Islands and Canary Islands Network of Protected Natural Spaces. Prepared by the authors

natural setting has also been acted upon by humans, who have shaped the primal landscape and added features of unquestionable cultural and heritage value, which have given rise to new forms of landscape, enriched by these elements of regional identity.

The aforementioned Law 12/1987, on the Declaration of Natural Spaces in the Canary Islands, justifies the need to protect this important natural legacy with specific legal instruments that actively safeguard and guarantee its conservation for two contrasting reasons. First, with the aim of preserving part of the world's scientific heritage contained in this wide range of ecosystems due to their abundant genetic wealth, and which are also an important resource for regional development. Second, with the aim of safeguarding these "fragile" island ecosystems from population pressure and the constant increase in tourist flows into the islands.

As a result of this two-pronged argument, the text of the Preamble concludes that "the pressure that all this entails for the natural environment, among many other elements and factors, makes it advisable to preserve those natural spaces that, due to their specific features and values, require it". This conclusion is justified by social demand, which "is calling for the establishment of a chain of protected natural spaces that contain the most valuable elements of our natural and cultural heritage and this from both the conservationist perspective and the prism of certainty in the identification and delimitation of the spaces that must be preserved so as not to unjustifiably restrict public and private activities".

The specific delimitation of the natural spaces of the islands was set in motion by Law 12/1994, of 19 December, on Natural Spaces of the Canary Islands, which argued as a starting point on the need for these spaces that "territorial

	Island area km²	% / Canary Islands	Number of PNS	Area of PNS km²	% / Islands
El Hierro	268.71	3.61	7	156.04	58.07
Fuerteventura	1,659.74	22.29	13	477.27	28.76
Gran Canaria	1,560.10	20.95	33	667.08	42.76
La Gomera	369.76	4.97	17	123.15	33.31
Lanzarote	845.94	11.36	13	350.29	41.41
La Palma	708.32	9.51	20	250.05	35.30
Tenerife	2,034.38	27.32	43	989.10	48.62
Canary Islands	7,446.95	100	146	3,013.96	40.47

Table 5. Area of the Protected Natural Spaces (PNS) of the Canary Islands

Source: Department of the Environment and Land-Use Planning of the Government of the Canary Islands

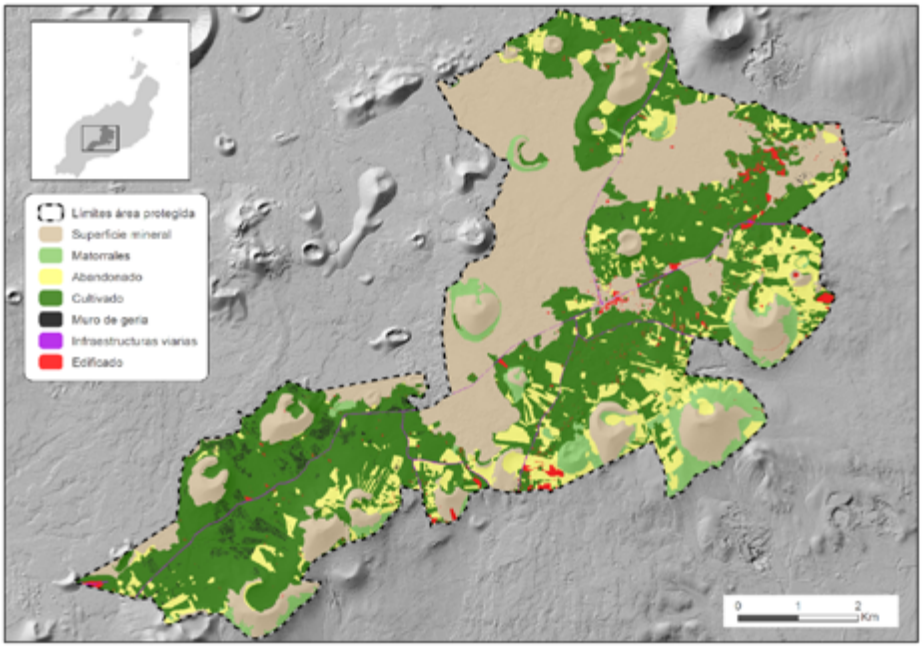

Figure 6. Distribution of land uses in the Protected Landscape of La Geria, Lanzarote

Source: Grafcan, 2019. Prepared by the authors

fragmentation, population density and the almost exclusive dependence of the economy on the service sector have generated a development model impossible to maintain, insofar as it involves surpassing the capacity of our natural resources to recover". For this reason, the preamble points out that "this situation requires remedial measures and among them, the establishment of a general legal framework for the Natural Spaces of the Canary Islands that makes the rational use of resources possible, as a guarantee of sustainable development and in accordance with the principle of solidarity". The new regulation, based on national Law 4/1989, of 27 March, on the Conservation of Natural Areas and Wild Flora and Fauna, reclassified the types of natural areas established by the previous law, integrating them into 8 groups, ranging from national parks, over which the Autonomous Community had no authority at the time, to sites of scientific interest.

This legal instrument facilitated the consolidation of 146 protected natural spaces under the 8 groups, totalling more than 3,000 km^2 of protected territory, that is, 40.47 % of the region; it is the second most widespread land occupation in the Canary Islands after areas of scrubland and sparse vegetation (table 4). However, this major step to safeguard threatened ecosystems, which has removed two-fifths of the rural space of the archipelago from the conventional system of production, would not have been socially possible without large-scale food imports and the crisis of the traditional farming sector, which began in the 1950s.

The current model of protection for the most emblematic natural landscapes of the archipelago, which was initially set up through the aforementioned Law 12/1994, of 19 December, on Natural Spaces in the Canary Islands, and which has subsequently been confirmed by Legislative Decree 1/2000, of 8 May, approving the Consolidated Text of the Laws on Land-Use Planning and Natural Spaces of the Canary Islands and, more recently, by Law 4/2017, of 13 July, on Land and Protected Natural Spaces of the Canary Islands, also plays an important role in the preservation of numerous cultural landscapes, such as the aforementioned agricultural landscapes of the *enarenados* of Lanzarote and Tenerife. These spaces have, in part, been declared protected landscapes, as in the case of the Protected Landscape of La Geria, on Lanzarote, and the Protected Landscape of Ifonche, on Fuerteventura. This means that these spaces have special action plans to meet the conservation goals that led to their creation. The rest of the agricultural landscapes of the *enarenados* have specific protection status in the land-use plans of their respective islands, which contain clear guidelines for municipal planning that share the same aims. Therefore, the main obstacle to maintaining these original agricultural landscapes is not the lack of rules to guide the actions of the various stakeholders, but agricultural abandonment.

One of the management instruments is the Special Plan for the Protected Landscape of La Geria, approved in 2013 by Resolution of the Commission for Land-Use and Environmental Planning of the Canary Islands, and which affects the municipalities of Tinajo, Tías, Teguise, San Bartolomé and Yaiza, in which this landscape is found. According to Jiménez Jaén (2013), this is one of the few management instruments for protected natural spaces

to have been approved in recent years. However, this case may give us an idea of the special nature of these instruments in the Autonomous Community of the Canary Islands. Indeed, "the land-use planning instruments for protected natural spaces in the Canary Islands not only regulate aspects relating to the management of natural resources, establishing the zoning and systems of use, but also establish all the urban planning of the territory included in these spaces. That is, they include the classification and categorisation of land as if they were general land management plans. In addition, although they do not take the form of a decree of the Government of the Canary Islands, they form part of a true regulatory standard which includes the master plan for the use and management of a protected natural space" (Jiménez Jaén, 2013, p. 2).

In Law 9/1999, of 13 May, on Land Use of the Canary Islands, and later on in the Consolidated Text, the management instruments for protected natural spaces not only include provisions for the management of natural resources, but also urban provisions for the space itself. That is to say, they provide for overall land-use planning of the protected natural space, including, alongside the environmental provisions, those that relate to urban planning, which is why the urban plans of the respective municipalities cannot contain provisions on these spaces. Specifically, the spatial plans for protected landscapes, according to the Consolidated Text of the Laws on Land-Use Planning and Natural Spaces of the Canary Islands, establish the class and category of land, and the latter is also a subdivision of the class that determines the legal status of land (Jiménez Jaén, 2013, p. 6).

According to the same author, one of the novelties included in this planning instrument is the creation of an "Area of Integrated Management", in accordance with the provisions of Articles 140 and 141 of the Consolidated Text of the Laws on Land-Use Planning and Natural Spaces of the Canary Islands. The regulations of the Plan indicate the existence in the Protected Landscape of "population and activities ascribed to five of the seven municipalities of Lanzarote", as well as the existence of "activities that shape the landscape under protection, which requires the adoption of a global strategy", justifying the fact that "management of this Natural Space is carried out by a single body that brings together all the competing authorities in the area". In this way, the administrative organisation of the Area of Integrated Management takes the form of a consortium, and may also be organised as an autonomous management body if the requirements of Article 142.3 of the aforementioned Consolidated Text are met, that is, in the event that, after the period stipulated in the Law has transpired, the consortium has not been created (Jiménez Jaén, 2013, pp. 7-8).

Following this criterion, and in view of the evident danger of abandoning agricultural activity in this geographical area, the Lanzarote Island Council, together with the town councils of the area, have formed a consortium to launch a major wine tourism project in the Protected Landscape of La Geria. This project aims to coordinate the actions of local institutions to protect the agricultural landscape, to preserve traditional winegrowing and winemaking activity, and to promote tourism under environmental and sustainability criteria that help farmers earn an income with which they can pay for the upkeep of this unique agricultural landscape of low yields and numerous visitors.

The spectacular nature of this original landscape is due in large part to the fact that "the constant trade winds that sweep across the island have made it necessary to build small semicircular windbreaks of basalt stone, transversal to the direction of the wind, which crown the top of the inverted cone. The multitude of hollows, or *socos*, excavated in the La Geria valley, which even ascend the slopes of the volcanoes that delimit it" give rise to a unique combination of shapes and colours that make the agricultural landscape of La Geria one of the great tourist attractions of Lanzarote (Martín Martín, 2000, p. 102). For this reason, it was designated a natural park by Law 12/1987, of 19 June, on the Declaration of the Natural Spaces of the Canary Islands, and subsequently reclassified as a protected landscape by Law 12/1994, of 19 December, on the Natural Spaces of the Canary Islands.

6. Conclusions

Water shortages have shaped the economic development of the Canary Islands since Spanish colonisation, and have given rise to the creation of original agricultural systems to harness the scarce rainfall and keep the crops from drying out, such as *enarenados*, which use sea sand or fine fragments of tephra, or pyroclasts, as a mulch to cover the agricultural soil.

The *enarenados* are an original system of cultivation that, in some cases, uses a layer of calcareous sand of marine origin, and in others, light, porous volcanic material —tephra— to cover the fertile soil to conserve or supply the moisture needed to grow crops in areas of low rainfall.

Owing to their capacity for to retain moisture, the organic or volcanic materials used to make the *enarenados* have been an important ally for farmers on the islands in their fight against aridity in areas of scarce rainfall.

This farming system has been used to grow various crops —from grapevine to vegetables, cereals and a few fruit trees that are well-adapted to arid conditions— that have contributed to local population's self-sufficiency and even to agricultural exports. Historical examples include onions from Lanzarote and extra-early potatoes from the south of Tenerife, although there are also examples of natural *enarenados* on young soils cultivated by farmers on the islands of Gran Canaria, La Palma and El Hierro.

In addition, the *enarenados* have created landscapes with a distinctive visual identity; made of yellow, off-white or black materials, depending on their composition, they have become an integral part of their local agrarian heritage and a major draw for tourists. Most of them are no longer cultivated today because of their low or non-existent economic viability.

A reappraisal of the landscape and the environment of the *enarenados* has led certain social groups to promote their rehabilitation and some island councils to include them in land-use and urban planning to promote their conservation, as tangible elements of an agricultural heritage that may be appreciated from a historical perspective.

In the case of Lanzarote, an island that bears the marks of historical eruptions, the artist César Manrique recreated a unique aesthetic blend of volcanic landscapes, *enarenados* and the main elements of local architecture, which has become the hallmark of the island's tourist identity.

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Territorial heritage and production models in wine designations of origin: the case of the Ebro Valley (Spain)

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Abstract

Protected Designations of Origin (PDOs) for wine are legal entities linked to a territory with a heritage comprising several factors. The production models adopted by PDOs differ and they can be categorised by the *worlds of production* theory, which has arisen from the *economics of conventions*. The hypothesis is that there are significant relationships between ways to value and manage heritage elements and PDO production models. A method based on synthetic indices was designed to test this hypothesis using data from several sources. These indices enable us to identify each PDO's world of production and the valuation and management ways of its territorial heritage elements. After testing this method in the PDOs of the Ebro Valley (north-eastern Spain), evidence was found of territorial heritage valuation and management ways varying across production models.

Keywords: Protected Designation of Origin; territorial heritage; world of production; wine; Ebro Valley

1. Introduction

The concepts of landscape, territory and heritage are closely related in geography. The European Landscape Convention (Article 1.a) defines landscape as 'an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors' (Council of Europe, 2000). It is an apt definition for a long geographical tradition. Territory is 'a geographical space attributed to a human community that occupies, demarcates and manages it and also obtains from it its main material resource and experiences it by conferring upon it multiple attributes' (Zoido, 2010: 89). Heritage refers to elements to which society attributes material or symbolic value (Silva and Fernández, 2017), that have been often inherited from previous generations (Juaristi, 2012) and always deemed worth preserving and passed on to descendants. The link between landscape and heritage has been accepted by UNESCO, which recognised cultural landscapes as part of World Heritage in 1992. Territory 'can be considered inherited natural and cultural heritage, built by people over centuries' (Capel, 2014: 16).

The concept of a cultural landscape can be based on a morphological definition as 'the result of a social group's action on an original natural landscape, through an agent, culture' (Mateu, 2014: 255). Culture, as an agent impacting on and modifying the landscape, is a feature of social groups that have occupied and managed the territory throughout history; therefore, the evolution of the landscape can be analysed from a historicist standpoint (Sabaté, 2008). How a landscape is managed in each period moulds and shapes it, thereby giving it a symbolism and identity of its own. Given that landscape elements are perceived by individuals in the community, viewing them

as a collective right is justified and is in keeping with the Council of Europe's definition of landscape as it includes how people perceive it.

In postmodern times, some landscapes are deemed to have attractive features that can help develop the territory, in other words, insofar as landscape is heritage, it can generate income. These attractive features are related to tourist potential, but also to the idealisation of certain spaces, from the idyllic representations of rural areas to the power that such representations wield in urban markets (Amilien *et al.*, 2007). This implies that landscape management is not neutral: its capacity to produce income can be increased or limited by how it is managed.

In some sectors, such as the wine industry, regional brands play an essential role. Protected Designations of Origin (PDOs) directly link the product to its geographical production area. The first point in Article 5 of European Union Regulation 1151/2012 on quality schemes for agricultural products and foodstuffs states that a "designation of origin" is a name which identifies a product: (a) originating in a specific place, region or, in exceptional cases, a country; (b) whose quality or characteristics are essentially or exclusively due to a particular geographical environment with its inherent natural and human factors; and (c) the production steps of which all take place in the defined geographical area' (European Commission, 2012). This definition highlights that the PDO concept is highly dependent on the notion of territory.

In wine PDOs, winemaking is a landscape layer comprising several components. Although these include vineyards and wineries, there are other heritage elements involved, such as the soil where the vine grows (*terroir*), the grape varieties grown and used to make the wine, the wine's name and the link between the activity and the territory. As these elements form a vine-growing region's heritage, we can study how they are valued and managed in each PDO.

Climent and Esteban (2018) demonstrated that PDOs use a variety of valuation and management ways for their heritage elements. Some PDOs have even made substantial changes to them and thus diluted their own identity. Meanwhile, other designations remain attached to tradition and use heritage elements to make them stand out in the market.

There are 90 active wine PDOs in Spain that follow different production models (Esteban and Climent, 2017). Some supply markets comprising a high number of consumers, while others predominantly target more restricted and elitist markets. Large cooperative wineries that are supplied by an extensive network of vine growers predominate in some of them, while others prefer the Vinos de Pago model, in which the winery is supplied by its own vineyard. There are also differences in estate size and in production practices, such as irrigation tolerance.

The aim of this research is to identify valuation and management ways of PDO heritage elements and also PDO production models to establish whether there are significant relationships between the two. The seven PDOs in the Ebro Valley (north-eastern Spain) were chosen as the case study.

The theoretical framework is described in the following section. Our information sources and classification procedures can be found in the method section. Our findings are outlined under the results heading and we present our conclusions in the last section.

2. Theoretical framework

This section contains the theoretical-conceptual foundations of the production models and heritage elements of wine PDOs. For the former we have used the *worlds of production* theory, widely applied to industrial production in general and to the agri-food sector specifically (Ávila and Sánchez, 2019). In the latter, the conceptual framework relating territory, landscape and heritage has been applied to PDOs.

2.1. PDO production models

The worlds of production theory (Salais and Storper, 1992), arising from the 'economics of conventions', makes it possible to define a product's production model based on two of its main dimensions: the type of technology used to produce it and the type of market it targets.

This theoretical framework differentiates between specialised and standardised technology. Production in specialised settings is restricted to a small group of experts, while in standardised settings the knowledge required to produce it is generalised. Consequently, in standardised settings, there is a tendency towards automation to reduce costs, while in specialised settings competition tends to focus on differentiation. The former

tend towards economies of scale and the latter towards economies of scope.

The trend towards standardisation in the vine-growing sector can be seen in the shift towards mechanisation, used, above all, on larger estates, and in the expansion of trellis training. We have also observed the proliferation of specialised practices, such as night harvesting or harvesting old vines again as their fruit is highly appreciated in the sector. Some wineries are currently run by large cooperatives with their grapes supplied by many vine growers and they generally tend to standardise the product, while others are supplied by their own vineyards or they directly control themselves. The former's large size enables them to obtain economies of scale (Salazar and Galve, 2011) and to supply large national and international markets. The latter focus more on producing wines with a differentiated quality that are marketed in high-price segments or market niches.

In accordance with the worlds of production theory, the market type can be generic or dedicated. Generic markets generally comprise a large number of anonymous buyers, whereas dedicated markets lean towards product differentiation and personalisation. In other words, the latter target specific market niches, while the former target large undifferentiated markets or mass markets. The wine sector has a variety of marketing channels: on the one hand, there are specialised channels, such as restaurants and specialist wine retailers; and on the other, wine is sold in supermarkets, usually at moderate prices. In the latter case, wineries use homogeneous and large series to supply large chains. In dedicated settings, however, the series are shorter as they are targeted at a low number of customers.

Salais and Storper (1992) identify four production models or 'worlds of production' based on the crossover of these dimensions. The first is the interpersonal world (specialised and dedicated product), in which high-quality wines are marketed in short series. Competition in this type of product essentially revolves around differentiation and quality.

This world is opposed to the industrial one (standardised and generic product), which refers to wines for large markets comprising anonymous consumers and produced in an automated fashion. This world of production is linked to large-scale wine production to supply large markets at very competitive prices.

The third is the market world (standardised and dedicated product). In this case, the wines are produced using standardised technologies and targeted at specific market niches in relatively short series. The market world is linked to large wineries that make a considerable effort to differentiate their products and target specific market niches, competing on differentiation and also on price.

The fourth is the innovation world (specialised and generic product) in which articles produced using specialised technologies are targeted at markets comprising a large number of consumers. In the wine sector, it is linked to PDOs and prestigious wineries that target large anonymous markets where consumers seek high-quality products.

This theoretical model has been applied to the wine sector in Spain before (Sánchez *et al.*, 2010; Climent and Sánchez, 2015; Esteban and Climent, 2017). The results obtained highlight the variety of PDO models and the importance of PDOs in the industrial and interpersonal worlds. Although there are PDOs in other worlds of production, these are the two models currently polarising the sector.

2.2. PDO heritage elements

PDOs fall in the category of food and drink and typical products from specific geographical areas. Their roots and ties to their territory not only enable them to benefit from its existing heritage, but also contribute to creating, preserving and increasing it. The vineyard and wineries are the essential material elements supporting the winemaking activity. In addition, there are also immaterial or intangible elements, such as the name identifying the product. Each of these elements is outlined below.

Vineyards, as a result of their surface area, determine the morphology of the PDOs landscapes. As with other landscape elements, the vineyard layer has been transformed over time. The shift towards trellis vineyards, which have replaced traditional bush-trained vines, has significantly changed wine landscapes, a change fostered by the possibilities of mechanising this type of planting (Ruiz, 2013). The fragmentation of the traditional vineyard landscape contrasts with the trend towards vine monoculture on large regular estates, which can currently be observed in some regions (Molinero, 2011).

Wineries are the other vital part of the winemaking activity. Over time, their location and morphology have changed from traditional family wineries in houses or on hillsides to the large industrial and functional wineries found on main transport routes. But change has not ended there; today, as

part of the new wine culture (Bujan, 2003), more wineries are being established within the vineyards themselves, when they are large enough. Along similar lines, other wineries have opted for hill tops and other prime locations in the landscape. Given that these wineries are not merely functional, since they encompass high architectural values, they usually become a tourist attraction.

Terroir as a physical space where the vine grows, characterised by the presence of a particular soil and microclimate, is another of a PDO's heritage elements. Although defining and analysing terroir is not a common practice in Spain (as opposed to France), in some PDOs it has led to studies that link the wine's organoleptic characteristics to the physical and chemical properties of a specific physical and material place where the vine grows. This hugely valuable heritage element is not only linked to the concept of protection, which identifies wine qualities with the region of origin, but also to the plot where the vine grows. Consequently, knowledge and valorisation of terroir are extremely important.

The vine variety grown is a heritage element that is strongly linked to the territory, since varieties considered traditional from each place became individualised there long ago as a result of genetic evolution partly fostered by the growing techniques used. Nevertheless, grape varieties have been taken from one place to another and have acclimatised to different settings where they also form part of the heritage, although to a lesser extent than the traditional varieties.

As an intangible PDO element, the PDO name plays a dominant role for two main reasons: firstly, because the PDO is a legal entity that protects the use of that name; and, secondly, because it identifies the product and, as a result of the product being identified with a regional brand, it also indirectly ends up identifying the area, thereby consolidating both. As well as the PDO name, the wine brands marketed there can also be considered, since they often have the same name as or a name closely related to the area's toponyms, historic characters or events or certain local characteristics and cultural expressions.

The PDO is integrated in a specific territory to which it is connected through the collective of vine growers and wine producers, which maintains more or less strong links with the other members in the organised community. Besides winemaking, heritage is diverse and other activities take place in this territory, mutually enhanced by the existence of the PDO. The new wine culture has led to the development of wine tourism, which is increasingly intertwined with other facets of cultural tourism, in the broad sense of the term.

3. Method

As the case study for this paper we chose the seven PDOs in the Ebro Valley, which are in five different autonomous communities. These are Campo de Borja, Calatayud, Cariñena, Somontano (the four in Aragon), Costers del Segre (in Catalonia) Navarra and Rioja, in the autonomous communities of the same name, although the Rioja PDO also covers the southern part of the Basque Country and Navarre. Our research consisted of identifying each one's production model and valuing their heritage elements. Subsequently, we analysed the relationship between production models and how to value heritage elements. The procedures and sources we used are detailed next.

3.1. Identification of production models

Identifying the production model in accordance with the worlds of production theory is based on characterising each PDO's technology type and the type of market predominantly targeted by its products. Esteban and Climent (2017) have shown the usefulness of using simple statistical indicators to identify production technology and market types.

Regarding technology, the average size of the agricultural estate (ratio of crop area to number of vine growers) gives an indication of mechanisation possibilities and, consequently, how agricultural activities could be standardised. This leads to the possibility of obtaining economies of scale in the vine-growing sector. The ratio of the number of vine growers to the number of wineries contrasts two antagonistic models: on the one hand, the model of large cooperative wineries, which are supplied by a high number of vine growers and are linked to the emergence of economies of scale and standardised wines; on the other, the Vinos de Pago model, where each winery is linked to a single estate and to economies of scope and the search for differentiated quality. Multiplying both ratios, since high values of both indicate standardisation and low values specialisation), results in a simple indicator: surface area per winery. Low indicator values are associated with wineries that are supplied by a small vine-growing area, which leads us to assume they tend to use specialised

technologies, whereas high values are associated with wineries that are supplied by large vineyard areas, in other words, they tend to use standardised technologies.

An indicator that also combines two indices was used for the market type. Firstly, the average number of wine brands produced by each winery, as an indicator of production differentiation (Climent and Sánchez, 2015). Secondly, the total volume of wine marketed by each winery. Dividing the latter by the former gives the average size indicator of the wine brand. This links large brands with generic markets and small brands with dedicated markets.

The proposed indicators have been calculated on the basis of *El País wine directory* and the *Datos de las denominaciones de origen protegidas de vinos* directory (*Data on Protected Designations of Origin for Wines* produced by the Ministry of Agriculture, Fisheries and Food, several years). This last source provided the surface area recorded for each growing season and the number of wineries, which enabled us to directly calculate the technology indicator. Concerning the market type indicator, both data sources have been combined: firstly, the volume marketed per winery in each PDO was calculated using the Ministry's publication; secondly, the average number of brands per winery was calculated with the information contained in *El País wine directory*; finally, they were used to estimate average brand size in each PDO.

The above-described calculations were made for the last ten vine-growing seasons, from 2006–2007 to 2015–2016. Subsequently, each PDO's average in the study period was calculated to identify its production model.

3.2. Identification of heritage elements

The indicator-based method proposed by Climent and Esteban (2018) was adopted to value the heritage elements and it is summarised in the points below.

Morphological characteristics of the vineyard landscape:

- The traditional vine-training method in the study area is bush style. Modern trellis training has changed the vineyard's traditional morphology. The indicator considered in this point is the percentage of the trellis-trained surface area. The information sources were the Vine-Growing Registers of Aragon, Catalonia and Navarre. There is no information on this indicator for Rioja.
- SIGPAC (2018) was used to calculate the average size of the *tesela*,[1] as an indicator of the fragmentation of the vine-growing landscape.

Morphological characteristics of the wineries:

- The presence or absence of monumental wineries has been considered on the basis of fieldwork and image analysis.
- Concerning whether the *château* model is widespread or not, given that it is impossible to precisely determine the number of wineries that are supplied by their own vineyards, we calculated the number of vine growers per winery as a proxy indicator, a figure estimated in the aforementioned publication of the Ministry of Agriculture, Fisheries and Food.

Terroir: the PDOs specifications were analysed and the autonomous community government responsible for the matter was contacted to determine whether there is a demarcation of subareas within the PDO.

Vine variety: the grape varieties grown and used to produce wine were classified into two main groups: autochthonous or originating from the PDO (or from the region) and those that are allochthonous or originating from other regions. Varieties considered autochthonous are not only individualised varieties in the area, but also those that have become acclimatised and grown there for a long period of time (at least a century). Using the documented and encyclopaedic work by Robinson *et al.* (2012) as an information source, the following autochthonous varieties were considered: tempranillo *(ull de llebre* in Catalonia), garnacha, macabeo (*viura* in Rioja), mazuelo (also known as cariñena), graciano and parellada. Two indicators were calculated using this information:

Percentage of surface area where autochthonous varieties are grown. The information was obtained from the Vine-Growing Registers of Aragon, Navarre and Catalonia and from the Regulatory Board of the Qualified Designation of Origin Rioja (2016).

Percentage of wine brands produced using autochthonous varieties. The information was taken from the *Guía Peñín directory* (2016).

1 Set of contiguous vineyard plots that form a continuous vineyard; each *tesela* is like an island-like vineyard surrounded by other crops

Local place names in wine brands: an estimate was made of the percentage of brands that refer to places in the PDO. This statistic resulted from the combined analysis of the wine brands in the *Guía Peñín directory* (2016) and the place-name database of the Basic Geographical Nomenclature of Spain, of the National Geographical Institute (IGN).

Wine tourism and cooperation in promotional activities for the territory: we investigated whether there is a wine route in the PDO and whether other area elements outside the wine sector are promoted as part of the route. This information was taken from the websites of the analysed PDOs.

4. Results

The results obtained are presented in three steps. Firstly, the PDO production models of the Ebro Valley are identified within the framework of the worlds of production theory, based on indicators described in the method section. Next, their heritage elements are measured and characterised by the associated indicators. We then check the parallels between production models and heritage elements, and the existence of possible causal links between them.

4.1. Production models

All the analysed PDOs were classified into two production models: the industrial world and the interpersonal world. Campo de Borja and Cariñena are in the former, Somontano, Costers del Segre, Navarra and Rioja are classified in the latter. Calatayud is a unique case, because although it is closer to the industrial world, its values are quite different from those of the other two PDOs. Rioja has a smaller average surface area per winery than the others and the average brand size is smaller in Costers del Segre than in the others; however, in these two cases, their figures are quite close to the other PDOs in the interpersonal world. Despite the clarifications, this classification presents two homogeneous groups, which are clearly separated by the threshold of around 250 ha in the area supplying the wineries and 1,000 hl. in the brand size (table 1). Calatayud is a unique case, since both the surface area per winery and the average size of the wine brand give values close to the average thresholds, which are approximately equidistant from those for the other two groups (figure 1).

PDO	Surface area per winery (ha.)	Average brand size (hl.)	World of production
Campo de Borja	410.65	1,788.48	Industrial
Cariñena	383.02	1,506.82	
Calatayud	247.55	1,016.28	-
Somontano	139.76	526.30	Interpersonal
Costers del Segre	118.50	361.28	
Navarra	115.72	786.39	
Rioja	68.66	617.01	

Table 1. PDO Production Models in the Ebro Valley

Source: Ministry of Agriculture, Fisheries and Food and *El País directory*; Average values of the 2006–2007 to 2015–2016 growing seasons

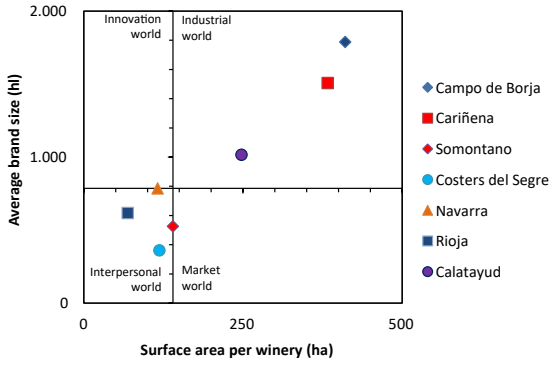

Figure 1. PDO Production Models in the Ebro Valley

Source: Ministry of Agriculture, Fisheries and Food and *El País directory*; Average values of the 2006–2007 to 2015–2016 growing seasons

4.2. Heritage elements

Rioja and Cariñena are the PDOs with the largest average *tesela*; in contrast, the vineyard landscape in Calatayud is far more fragmented (table 2). The other PDOs adopt intermediate values of between 2 ha and 4 ha. Calatayud, the PDO with the most fragmented vineyards, is also the PDO that has preserved traditional planting systems the most since trellis vineyards occupy only 31.8 %. In all the others, the presence of trellis vineyards is around 70 % or above and the proportion is especially high in Somontano and Navarra.

The winery layer shows that the trend towards the *château* model is less developed in Campo de Borja, Cariñena and Calatayud than in the other analysed PDOs. The model of large wineries run by vine growers' cooperatives plays a crucial role in the above-mentioned PDOs. A greater approximation towards the *château* model and the existence of monumental wineries seem to be directly related: the relevant presence of monumental wineries is greater in PDOs where the average number of vine growers per winery is lower.

PDO	Vineyard landscape		Winery		Terroir	Grape varieties		Name	Ties to the territory	
	Average tesela size (ha.)[1]	Trellis vineyard surface area (%))[2]	Vine growers per winery[3]	Importance of monumental wineries[4]	Sub-areas defined in specifications (SP) or *terroir* units (CT))[5]	Area growing local varieties (%)[6]	Wine brands coinciding with local place names (%)[7]	Marcas de vino que coinciden con topónimos locales (%)[8]	There is a wine route[9]	The route combines visits to wineries and other elements[10]
Campo de Borja	4.2	70.8	64	NO	CT	71.1	68.3	1.2	YES	YES
Cariñena	11.5	70.4	47	NO	CT (beginning)	73.7	60.3	3.3	YES	YES
Calatayud	1.8	31.8	53	NO	NO	92.6	78.9	12.7	YES	YES
Somontano	3.5	82.8	14	YES	NO	33.3	21.5	13.4	YES	YES
Costers del Segre	2.8	68.5	12	YES	SP	55.0	23.1	11.0	YES	YES
Navarra	4.3	91.3	23	YES	SP	64.3	48.6	6.7	YES	YES
Rioja	8.7	n.d	20	YES	SP	99.5	98.0	15.3	YES	YES

Table 2. PDO heritage elements in the Ebro Valley

Sources: 1. Own based on SIGPAC data (2018); 2. Vine-Growing Registers of Aragon, Catalonia and Navarre (2017); 3. Own based on data from the Ministry of Agriculture, Fisheries and Food (2018); 4. Fieldwork and analysis of winery images (2019); 5. PDO specifications and contact with the autonomous community government (2019); 6. Vine-Growing Registers of Aragon, Catalonia and Navarre (2017), Regulatory Board of the Qualified Designation of Origin Rioja (2016); 7. *Guía Peñín directory* (2016); 8. Own based on *Guía Peñín directory* (2016) and Basic Geographical Nomenclature of Spain (2017); 9. and 10. Websites of the PDOs analysed (2019)

Differentiated units within the PDO are defined in the specifications and they are effectively established in three of the PDOs in the Ebro Valley (Rioja, Navarra and Costers del Segre). An exhaustive zoning study was completed in Campo de Borja on *terroir* and a map was produced (Lorente, 2017). The other three do not have this type of zoning, although the process has begun in Cariñena.

Local grape varieties are virtually the only ones grown in Rioja. Almost all the vineyards in this PDO have been planted with autochthonous vines, with the tempranillo variety being by far the most common. The situation is similar in Calatayud, where varieties originating from the region cover more than 90% of the surface area, with garnacha being clearly the most common. Campo de Borja, Cariñena and Navarre are in an intermediate situation, as the autochthonous varieties occupy around 70% of the vineyard. Some French varieties have recently been introduced in these three PDOs, mostly the red grape cabernet-sauvignon and the white grape chardonnay. However, allochthonous varieties are most important in Costers del Segre where they cover almost the same area as the autochthonous varieties and, above all, in Somontano where they cover two thirds of the vineyards.

These vine-growing area percentages are transferred mimetically to the composition of the wine brands marketed in each PDO. PDOs with a larger area of local varieties have a higher proportion of brands made exclusively from them. Brand percentages are systematically lower than surface area percentages and the reason for this is that there are wine brands made with a combination or *coupage* of autochthonous and allochthonous varieties and the table only shows brands made exclusively with autochthonous varieties.

The link between the brands and local place names is clearly lower in Campo de Borja and Cariñena than in the other PDOs. The frequency is especially high in Rioja. However, in the latter, brands with references to local places amount to 15 % of the total, a figure that seems too low to speak of a strong link. Nevertheless, as the calculation method consisted of crosschecking brand names with place names using an automatic process, some coincidences may not have been detected due to slight spelling variations. Some wine brands show that the wine producers' intention is to link them to the area by adopting names of historical or other figures and not just place names.

Finally, all the analysed PDOs have wine routes and all of them include visits to PDO sites that are not directly related to the sector in addition to the winery visits.

4.3. Production models and heritage elements

The PDOs of the industrial and interpersonal worlds of production present a vineyard landscape with similar characteristics, although in one of each (Cariñena and Rioja, respectively) the vineyard is considerably more compact than in the others. There is a significant presence of trellis vineyards in all of them.[2] However, Calatayud, which is not clearly in any of the worlds of production, is also a unique case in this respect: its indicators show the highest vineyard fragmentation, with the lowest average *tesela* size of all the PDOs and the least modernisation or, if preferred, the greatest attachment to tradition, with the lowest percentage of trellis training.

A shift towards the *château* model is greater in the interpersonal world than in the industrial world, where the model of large cooperatives clearly predominates. Monumental wineries are also more relevant in the PDOs in the interpersonal world. Calatayud is similar to Cariñena and Campo de Borja in this respect, in other words, it is like PDOs in the industrial world.

Internal zoning included in the specifications occurs in PDOs in the interpersonal world, with the sole exception of Somontano. Concerning the industrial world, a zoning study has been conducted using *terroir* criteria in Campo de Borja and a similar study has begun in Cariñena. Neither case has any practical consequences, since they are merely studies that may later be included in their respective specifications. There is no such initiative in Calatayud.

The importance of the local grape varieties is lower in the interpersonal world, except in Rioja. These highly modernised PDOs with elements such as trellis training have adopted allochthonous varieties —with a preference for grapes of French origin— and have marketed a large number of brands made with them. The case of Rioja within this world of production is totally different, since almost all the surface area and brands in this PDO are dominated by autochthonous varieties. Local grape varieties in industrial PDOs are considerably more important than in interpersonal ones. Calatayud mostly follows the same pattern, with very high percentages of surface areas where autochthonous varieties are grown and wine brands made from them.

Regarding the link between wine brands and local place names, this occurs most often in interpersonal PDOs. Campo de Borja and Cariñena do not use the names of places in the local geographical area in their wine brands to the same extent. In this aspect, Calatayud identifies with the PDOs in the interpersonal world.

The indicators for ties to the area concerning wine routes do not provide any differentiation elements, given that all the PDOs analysed have similar resources; however, the extent of their development differs in some cases.

The above observations are summarised in table 3. Considerable parallels can be seen between PDO production models and heritage elements, although these are not mechanical coincidences, since Rioja is significantly different from the other PDOs in the interpersonal world. It is also clear that Calatayud is in a unique situation.

2 As stated in the method section, no data are available on trellis or bush training in Rioja.

Heritage elements	Industrial world C. de Borja, Cariñena	Calatayud	Interpersonal world Somontano, Navarra, C. Segre / Rioja	
Vineyard	Trellis	Bush	Trellis	n.d.
Wineries	Large Functional		Small Some monumental	
Zoning	Terroir map	No	In specifications *	
Grape varieties	Autochthonous Presence of allochthonous varieties	Autochthonous	Allochthonous Presence of autochthonous varieties	Autochthonous
Place name	Few brands	Many brands		
Wine routes	Yes			

* Except Somontano

Table 3. Heritage elements and production models in Ebro Valley PDOs

Source: Own

5. Conclusions

The results show that the initial hypothesis was plausible and reasonable, since, in the cases under study, parallels have been found between the production models, defined on the basis of the worlds of production theory, and the characteristics of PDO heritage elements.

As can be seen, PDOs identified with the industrial world of production fully coincide with each other on valuing *terroir* (although this is still in the early stages), the use of autochthonous and allochthonous varieties (with a preference for the former), the scant interest in associating place names with wine brands, and a certain reluctance to add artistic values to winery architecture, which generally conforms to functional designs. The PDOs identified with the interpersonal world of production also coincide with each other on the same elements: the existence of officially differentiated areas, as a shift towards the notion of terroir; a combination of autochthonous and allochthonous grape varieties, with a preference for the latter; an interest in linking wine brands to place names to emphasise the idea of attachment to the territory; and investment in monumental wineries, with the aim of becoming real icons of territorial heritage in some cases. Although there are some coincidences between the PDOs in these worlds of production, such as the predominance of trellis training and existence of wine routes, there are more differences.

However, the PDOs of each production model differ in the way they combine their heritage elements. Rioja is, of course, the most important PDO in the Ebro Valley in almost every way. It is clearly different from the others in the interpersonal world to which it belongs in one crucial aspect, namely its attachment to autochthonous grape varieties, which are virtually the only ones grown. Somontano is the only PDO in the interpersonal world that does not include internal zoning in its specifications and, so far, no previous studies have been planned for that purpose. Calatayud, however, is a unique case that cannot be clearly included in either of the two worlds, nor in any of the other two that the worlds of production theory identifies. Given that it shares heritage elements with the PDOs of both worlds, it could be deemed a case that consolidates the plausibility of the initial hypothesis.

These parallels between worlds of production and heritage element characteristics encourage us to seek a causal mechanism between the two, but this issue should not be addressed now for two reasons. The first is that this study uses a very small sample of only seven PDOs, and they all belong to the same geographical area out of a total of 90 throughout Spain. Nevertheless, the results obtained invite us to extend the study to all PDOs or, at least, to a much larger and more geographically diverse sample. The second reason is that research on this causal mechanism would require a specific methodological design.

The task is better left for another occasion, therefore, although some reflections can be made to help improve the hypothesis. Concerning the industrial world, the predominance of the cooperative winery model has helped more modest and less modernised farms survive than in the interpersonal world. No doubt this has contributed to a more substantial presence of autochthonous varieties, although they have not managed to avoid the attractiveness of French varieties altogether. The results also enable us to confirm that these PDOs have developed in a way that is partially detached from their own heritage elements. They essentially aim to supply mass markets of anonymous consumers with large volume series for Spain and for export. In this context, it is understandable that brands barely refer to local aspects in their names as they would not mean anything to these generic customers. Similarly, they are not much interested in building monumental wineries, as this type of customer is not expected to go to the area for tourism.

Nevertheless, some changes have been observed, such as studies focusing on *terroir* zoning, the establishment of small wineries targeting reduced market niches or the considerable effort some large cooperatives are making to launch special brands onto the market for select customers in short series. The above can improve these PDOs' competitive position in some market niches, even though they have a highly efficient model based on supplying large markets.

Interpersonal PDOs, which produce wines for differentiated customers using specialised technologies, are more open to new wine culture. A high number of modestly-sized private wineries, compared with large cooperatives, means they are more likely to build winery using new styles and designs to attract their potential customers to the area, although only the most successful can afford to erect real architectural icons. The search for a close relationship between the product and the territory can be interpreted along the same lines when place names are used for their wine brands. The interpersonal world seeks to consolidate the differentiated quality of its wines by linking them to their place of origin using elements

such as brand names and by building monumental wineries for tourists to visit.

Here lies a contradiction between this desire for roots and the fact that autochthonous vine varieties have been relegated to a minority position and gradually replaced by French varieties, in terms of vineyard area and especially their presence in wine types. Most of these PDOs have experienced a thorough modernisation process, which led to new wineries and new techniques and the abandonment of some aspects of local tradition.

There is a possible explanation for this process, which could also explain the Rioja exception. Traditional wines from the central and eastern part of the Ebro Valley, where summers are very warm and dry, have always had a high alcohol content, possibly due to the strong concentration of sugar that accumulates in the grape variety best adapted to these climate conditions, the garnacha, which originally came from this region. In the final decades of last century, when the old wine culture —which regarded wine as a food supplement (Sanz, 2009)— gave way to the new culture —which considers it as a consumer product for experiencing pleasant sensations— strongly alcoholic and traditionally made wines, which do not excite some palates, ceased to be attractive. Therefore, new winemakers in the area investigate new ways of making wine, where applicable, and they not only bring the techniques with them but also the grape varieties. The process in Rioja differed and took place much earlier as a result of the phylloxera pest at the end of the 19th century. Bordeaux wine merchants took advantage of the possibilities of the tempranillo grape and helped local winemakers improve their techniques. From that moment, Rioja became one of the most prestigious vine-growing areas in Spain and the first to be recognised as a PDO, based on traditional grape varieties and the new techniques they had been taught, which they subsequently perfected.

The unique case of Calatayud has a possible explanation, which should be properly explained. This is an area where vineyards went into decline as a result of phylloxera, and increasingly more hectares were being lost to other crops. In the last decades of the 20th century, some of the remaining vine growers decided to relaunch winemaking and they achieved recognition as a PDO. Given that the number of vineyards was low and the estates were fragmented, modernisation towards the industrial and interpersonal worlds was difficult, resulting in them preserving old traits, such as the bush-training system and the traditional grape variety, garnacha. This delay in the modernisation process has benefited them, because they now find themselves with an important traditional vineyard of old vines growing a variety, garnacha, that is becoming more appreciated worldwide and that has opened the door to international markets. We could term this a post-productivist modernisation, without the changes that occurred during the modernisation of other areas that involved grubbing vineyards and replacing local varieties.

Finally, despite this study's limitations, we have consolidated the hypothesis that PDO production models exert a direct influence or are correlated with their heritage elements. Continuing with this line of research could prove to be of considerable interest for better understanding of the wine sector in Spain.

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Attempts and projects of neoendogenous development for rural areas in the South of Spain

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Abstract

The rural areas have several hindrances in order to propose initiatives for their socioeconomic progress. Territorial development actions implemented thanks to the LEADER approach have collided with constraints, which have derived in many of the occasions that the proposed projects could not be carried out. For the municipalities of the rural areas of Andalucía and Extremadura, the executed and proposed but finally not made LEADER approach projects have been studied in the 2007-2013 programming period. What causes are behind their non-implementation? Are the geographic obstacles determining this? In most of the cases analyzed, the geographic component is not the main factor in the non-development of each of these initiatives. Other reasons, relatively easy to correct, are behind that desire and cannot.

Keywords: Neoendogenous rural development; LEADER approach; failed projects; rural areas; deep rural areas

1. Introduction

The situation of the rural territories of the European Union cannot currently be understood without considering the overall impact of the practice of neo-endogenous rural development, in short, of the LEADER approach. This approach has its origin in the Reform of the Structural Funds of the late 1980s, coinciding in time with the appearance of the document "The future of the rural world" in 1988. Thus, the LEADER Approach has been applied over 30 years in European rural areas. In this study, we focus on the 2007-2013 programming period in which the LEADER approach is applied through Regional Rural Development Programs supported by the European Agricultural and Rural Development Fund (EAFRD). Taking into account the rural territories in which LEADER is employed, we propose a series of research questions: What happens to the deep rural territories? That is to say, to the mountain and sparsely populated areas where the rural exodus continues. What success rates are there in these territories? Who were the promoters of the LEADER projects? What were the reasons why some projects were not carried out? In this way, an analysis of the actions carried out and the ones proposed but not finally executed is necessary.

Thus, the aim of this study is to analyze the LEADER projects executed and the ones didn't carried out, their relationship with their promoters and with the greater and lesser rurality of the territories, for the southern Spanish regions of Extremadura and Andalusia during the 2007-2013 programming period. In addition, it is intended to analyze whether there are territorial implications in the causes of withdrawal of failed projects, that is, if the geographical component has conditioned the reasons for not being carried out.

There is an extensive literature on the practice of LEADER as an approach to neo-endogenous rural development in rural areas. As main factor to explain the success or fail of an initiative inside of this approach, some authors have noted the bureaucracy and the increased influence of regional and local government (Navarro *et al.*, 2016), having as main affected those marginal areas and collectives.

For the specific case of Andalusia and Extremadura, the analysis of the projects carried out with the LEADER approach has shown great territorial inequalities in the distribution of its funds (Cañete *et al.*, 2017; Nieto and Cárdenas, 2015, 2018; Leco *et al.*, 2017). The appearance of "spaces with projects" and "spaces without projects" has been favored, since the presence of solvent entrepreneurs and investment capacity is not similar in each of the territories (Cuadrado, 2012). In this way, the deep rural territories have been largely excluded from these neo-endogenous local development initiatives, favoring territorial exclusion rather than correcting it. Therefore, "the diversity of rural areas by public policies that impact in rural territories have not been sufficiently incorporated in their objectives and measures" (Sánchez *et al.*, 2014, 23). Thus, LEADER approach didn´t establish concrete measures for sparsely populated areas. Yet it has long been established that community of place are far from homogenous and include many "communities of interest" with highly unequal capacities to act" (Shucksmith, 2000, 208). In this way, its particular features (bottom-up approach, innovation, creation of local public-private partnerships, participation in local decision making, interterritorial cooperation, multisectoral integration, networking and area-based approach) (European Commission, 2006), don't fit with the weaknesses and special particularities of rural areas with hard problematics on ageing and depopulation. Another aspect concerns innovation, its fostering especially in social sense (Labianca *et al.*, 2016; Lacquement, 2016), producing demonstrative effect or generate participation in local decision making in rural areas without entrepreneurs or a right critical mass. The experimental nature of LEADER projects and its participatory nature (High and Nemes, 2007) hardly can be carried out in these kind of territories. There has also been an unequal participation of social actors as promoters (Cejudo *et al.*, 2017). However, a common feature in these studies is that they are based on the analysis of executed projects. Those projects that were presented but ultimately not carried out (at least with LEADER funding) and referred to as "failed" projects in this paper have traditionally been excluded from these analyzes. The causes of withdrawal of these projects or if they are related to geographical implications have not been sufficiently studied. These types of projects, the "failed", have been studied indirectly and implicitly, but not directly. Thus, the presence of a "project class" stands out (Dargan and Schucksmith, 2008: 285), which include the members of the Local Action Groups (LAGs), mainly town councils and consolidated entrepreneurs. These entrepreneurs have high financing capacity, knowledge and ability to innovate and they are well informed of LEADER's investments, so that public institutions and administrations lose their monopoly over public action (Romero y Farinós, 2006). On the contrary, other socially and territorially disadvantaged groups are distant and have great obstacles to access this type of aid. Viladomiu *et al.* (2010: 281) ensure that "the compensation established for women has had a small impact as a means of encouraging greater participation of this social group". For their part, Vaillant and Lafuente (2007) make a general observation about the causes that lead to the closure of companies in rural territories, related to the waiting for short-term benefits, lack of business culture or social rejection of failure business. Ariga *et al.* (2009) study the issue from a gender perspective, noting that rural women are less likely to be entrepreneurs than men are and this is despite the fact that women generally seem less fearful of business failure. Finally, there are brief studies on the "failed" projects for the previous programming period (2000-2006) in which the prevalence of the private entrepreneur over the public one and of young and new entrepreneurs over those who are not are manifested (Cañete *et al.*, 2018; Navarro *et al.*, 2018).

2. Methodology and study area

As main source of information, the list of projects in the Axis of the LEADER approach has been used, both executed and not executed, during the period 2007-2013 for Extremadura and Andalusia. The regional governments of both regions have provided the list.

The study has focused on the 2007-2013 programming period for two reasons: it is the most recent period and it is the only one for which detailed information is available. In the case of Extremadura, the projects executed were 4,264 and there were 2,978 "failed" projects (41.1 %). In the Andalusian case, there were 6,225 executed projects and 6,630 "failed" (51.6 %).

The scale of analysis of this work is the LAG, since in the case of Extremadura there is no information available

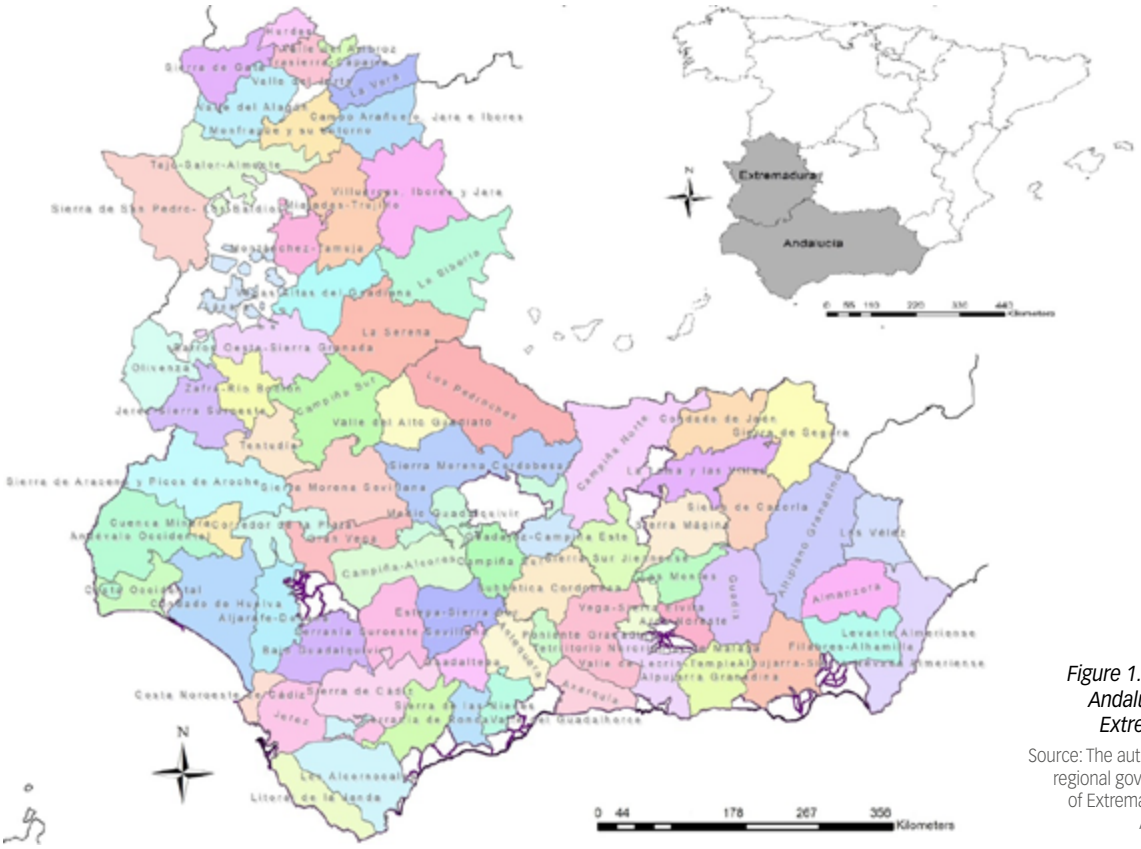

Figure 1. LAGs in Andalucia and Extremadura

Source: The authors from regional governments of Extremadura and Andalucía

at the municipal or project level. Both types of projects (executed projects and "failed" projects) by LAG will be related to clarify whether geographical conditions influence a high or low success rate. In addition, within the "failed" projects, "denied projects" (those that did not have the subsidy approved) and "approved or awarded projects" (those whose subsidy was approved by their LAG and a contract was signed but finally they were not carried out) are identified. Furthermore, trying to obtain a qualitative and detailed analysis, searching for the exclusion causes closer to "reality" and deepening in these reasons, considering firstly the official causes noted by the LAGs, have been shown the final reasons of failing in these LEADER projects.

At this point, it is important to make it clear that the achievement of a LEADER project can take more than two years, since very extensive documentation is required and numerous phases must be completed. Therefore, it is not surprising that many projects remain in the way. Some of the projects that we have studied were withdrawn before the contract was approved by the LAG. Some of the projects were rejected because they did not meet some of the following conditions: executing the project in accordance with the obligations agreed in the contract; beginning the investment within a period of more than 3 months and complete it within a period of more than 18 months from the signing of the contract; not submitting the documents that justified the complete execution of the subsidized business; not maintaining the business for at least five years; not keeping balance sheets of all financial transactions related to the subsidized investment; and / or not informing the public that the investment is subsidized by the Junta de Andalucía and the EU.

The study areas are the Spanish regions of Andalucía and Extremadura, which group 1,158 municipalities and one-quarter of the national area, 25.2 % (129,232 km^2). Both regions, in 2015, had a population of 9.4 million inhabitants, being located in a peripheral position within the European Union, also within the Spanish state, with respect to political and economic decision centers. In addition, compared to the EU and Spanish average, both regions have low per capita income and low population densities in most of their municipalities, not exceeding the average of 27 inhabitants/km^2 in Extremadura and 96 inhabitants/km^2 in Andalucía. Municipalities with less than 5,000 inhabitants predominate in the Andalusian case. In Extremadura, the rural territory is poorly articulated, but in Andalucía, there are municipalities called "agrocities" or county towns (most of them with more than 20,000 inhabitants) that structure the local territory. Agricultural activity is very important

in both regions from the economic, social and territorial points of view. Thus, the primary sector represents, in 2015, 7 % of the GDP in Extremadura and 4.2 % in Andalucía, while in Spain and in the EU the percentages are 2.3 % and 1.3 % respectively. On the surface, more than 50 % of the area of Extremadura is dedicated to agricultural purposes and 63 % in Andalucía. In addition, agricultural employees represent 9.3 % of the total in Andalucía and 12 % in Extremadura, which are higher values than the one in Spain in 2015 (4.3 %). For these reasons, both regions receive a large amount of subsidies related to the first pillar of the Common Agricultural Policy (CAP) and the Agricultural Unemployment Subsidy for temporary agricultural workers. These subsidies play an important role in the social, economic and even territorial stability of rural areas. Finally, unemployment rates are very high in both regions, particularly in the agricultural sector and in rural areas, exceeding two and even three times the national and European average.

LAGs protects most of the territory of the two study areas, with 24 in Extremadura and 52 in Andalucía (figure 1). In Extremadura, LAGs act on 99 % of the regional area and in Andalucía on 90 %. Regarding the number of inhabitants, the municipalities that form the LAGs of Extremadura have the 69 % of the region and in Andalucía 45 %.

Within these LAGs, special mention is made of areas of lower population density, which some authors call *deep rural*. Thus, in this study the definition established by Molinero (2017) is used. This author considers that the municipalities with a population density of less than 5 inhabitants/km² form the deep rural territory and those with values between 5-10 inhabitants/km² to the stagnated rural territory. Specifically, Molinero considers that the deep rural territory is a «marginal rural space, as well as poorly accessible, sparsely populated, aged, regressive, clearly dominated by agricultural activity and in which not only population is not gained, but also lost» (Molinero, 2017: 34). Although this delimitation is very restricted in Andalusia and not so much for the Extremadura case (because its rural scope does not present, in general, the problems of depopulation of other areas of the Spanish interior), it helps to establish a categorization of the analyzed territory and study what is being done in the area of local development.

Statistically, the classification defined by Molinero (2017) is adjusted taking into account only the population density, however, at the same time the low values of this variable imply more demographic characteristics (negative population growth caused by vegetative and negative migratory balances) that cause the low population density of deep rural spaces, which are also recognized by the OECD (OECD, 2002). Specifically, the OECD establishes a rural territorial limit based on population density and the number of inhabitants of the largest population centers. This limit is developed in three phases (OECD, 1994): 1) Rural is that local community with a population density of less than 150 inhabitants / km²; 2) A rural community, depending on its percentage of population, is classified as predominantly rural region (when it has more than 50 % of the population), intermediate region (between 15 % and 50 %) or predominantly urban region (less than 15 %); 3) Depending on the population of the most populated urban center, a province may go from being predominantly rural to intermediate region (when the urban center has more than 200,000 inhabitants and 25 % of the total population) and from intermediate to predominantly urban region (when the urban center has more than 500,000 inhabitants and 25 % of the total population). Given these limits, both Extremadura and Andalucía are predominantly rural regions.

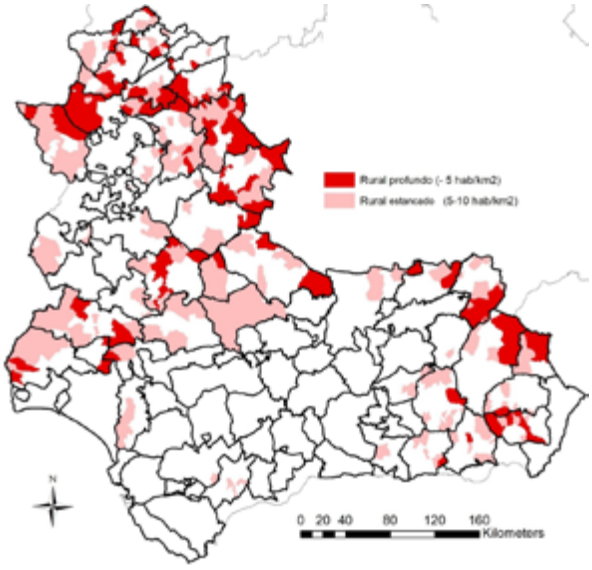

Figure 2. Deep rural areas for the regions of Extremadura and Andalusia (Spain) (2015)

Source: National Statistics Institute. The authors

The year chosen to study population density is 2015, the year in which a large part of the LEADER project aid contracts for the 2007-2013 period in the Extremadura and Andalusian LAGs were closed. In the case of Extremadura (figure 2), the average population density is 28.5 inhabitants / km², so it can be determined that most of its territory is immersed within the *deep rural*. Analyzing this variable by GAL and its municipalities, there are different categories of rurality. Thus, in Extremadura, three strips with

municipalities with a population density of less than 10 inhabitants/km^2 are identified: in the area of the peneplain of the province of Cáceres bordering the Portuguese limit (LAGs of Monfragüe, Tajo-Salor-Almonte and Valle del Alagón); in the dryland areas of the province of Badajoz (to the south) bordering the regions of Castilla-La Mancha and Andalucía (LAGs of La Siberia, fundamentally, and La Serena and Campiña Sur) and in two mountain areas of the north of Cáceres (Villuercas-Ibores-Jara and Las Hurdes). In the case of Andalucía, municipalities of the deep rural are in the peripheral and mountainous areas of Sierra Morena and Sistemas Béticos in the provinces of Almería (7), Huelva (7), Granada (4), Jaén (3), Córdoba (3) and Sevilla (1), with 25 municipalities.

3. Results

According to the relationship of projects executed with the "failed" ones, there is a high variety of results if it is studied at the level of each region (Extremadura or Andalusia) and each LAG territory. The average for both regions was 1.1 initiatives executed for each failed one, with a higher success rate for the Extremadura case. Thus in the case of this concrete region, it has been noted an average value of 2.02; 2 projects executed for every 1 "failed", with an average of 35 % projects that have not been executed with respect to the total projects funded thanks to LEADER approach. Two typologies of LAGs could be pointed. On the one hand, LAGs with a number of 1.5 or higher, meaning less than 40 % of "failed" projects with respect to the total. These ones are located in mountain and border areas with Portugal in the North of the province of Cáceres and in LAGs of the province of Badajoz on its border with the Andalusian region, adding two LAGs located around the urban centers of the cities of Cáceres and Badajoz. These territories rejected few projects so the success rate can be considered high. The strategies of these LAGs have been more adapted to the particular conditions of their territories, although this does not determine other indicators of success, such as those that have lower population densities, do not deal with greater investments, private participation or more potential private beneficiaries. These LAGs also present a huge number of projects whose beneficiaries have been public entities (municipalities) and social associations, with higher funded percentages and advantages. On the other hand, the numbers below the average, this is watched in those LAGs where the number of failed projects was closed to the number of executed with rates below of 1.5, more than 40 % of the applications received in the LAGs (in some cases it has reached almost 60 %) have not been carried out. This fact is due to two main reasons. First, there are LAGs that have traditionally managed a large amount of funds and projects, being proactive revitalizing their population (located in irrigated areas, productive drylands and the surrounding areas of the urban municipalities), receiving these ones numerous applications for projects that are rejected for not being able to face the economic criteria. Secondly, there are others LAGs in more marginal territories, such as those placed closed to provincial borders or in mountain area where projects haven´t been signed caused to a high number of inconveniences in their managament or that subsequently have failed due to the effects of the economic crisis of this period (table 1).

In the case of Andalusia, it is noted a lower success rate, even less than 1, 0.9 projects carried out for each 1 "failed. The average of projects failed by LAG in this region is 100-150, with an equal distribution for all the rural areas. Usually, as it will shown below, there is the high participation in this region of private iniciative and the lower involvement of public initiative (municipalities) and associations (mainly LAGs) would explain these results, at the same time. Thus, in red tones, with values below 1, even below 0.5, executed projects for each 1 failed, there were LAGs where the leadership in the development of initiatives was carried out by the private sector, small companies and self-employed, mainly. This is representative for the LAGs of Costa Noroeste de Cádiz (0.1), Serranía de Ronda (0.2) o los Vélez (0.3). On the opposite side, with blue tones, there were territories where the municipalities, mainly, and the LAGs, in second place, were the main actors in the development of initiatives, compared to a lower involvement of private entrepreneurs; contributing this to higher and better project achievement rates. As more representative cases, we could mention Levante Almeriense (2.4 projects executed for each failed project), Condado de Jaén (2.2) and Alfanevada (2.1). The very limited importance of social capital (Tellman 2012, Esparcia et al 2015, Fonronda, 2015) explains the higher implication of municipalities, and, in addition, the low or even the null existence of new private entrepreneurs, increased this by the economic crisis, implied a huge involvement of LAGs.

Detailing the explanation, for the index that relates the executed projects witho those not approved by the LAGs, an average number of 1.6 projects is approved for each project not approved, although that we found high differences between both regions and between

LAGs	Municipalities	Municipalities <5inhab/ km² %	Inhabitants	Investment (millions of €)	Private investment %	Executed/ Failed	Self-employed %	Companies %	Associations %	Public entities %	Cooperatives %
ADECOM LÁCARA	21	0.0	57,397	15.5	60.4	5.3	20.2	19.1	39.3	20.2	1.2
ADEME	14	57.1	9,504	5.8	34.7	2.2	21.1	21.1	21.1	36.8	0.0
ADERCO	11	0.0	32,406	10.3	50.8	1.8	28.5	14.6	48.9	7.3	0.7
ADERSUR	10	0.0	31,126	9.2	48.7	4.5	11.8	14.7	29.4	44.1	0.0
ADESVAL	27	18.5	37,439	9.2	40.3	2.9	27.5	16.3	29.1	24.4	2.7
ADEVAG	17	0.0	88,410	9.7	44.6	1.2	16.4	9.1	35.2	39.4	0.0
ADIC HURDES	6	16.7	6,338	7.0	36.9	2.4	12.9	3.0	77.3	6.1	0.8
ADICOMT	19	10.5	32,134	10.3	47.4	1.3	44.5	26.9	15.1	12.6	0.8
ADICOVER	19	10.5	24,886	9.5	41.1	0.9	43.4	26.6	9.7	16.8	3.5
ADISGATA	20	15.0	21,070	8.1	37.3	3.0	19.7	13.1	27.0	38.0	2.2
ADISMONTA	22	4.6	18,481	6.8	28.7	2.3	43.1	10.3	3.5	36.2	6.9
APRODERVI	19	36.8	13,719	4.9	28.4	0.8	20.5	6.8	44.3	24.4	4.0
ARJABOR	17	11.8	37,194	8.5	47.5	0.9	31.4	19.2	33.7	15.7	0.0
CAMPIÑA SUR	21	28.6	31,186	9.2	42.4	1.3	12.9	11.2	39.4	35.7	0.8
CÁPARRA	15	20.0	9,115	7.8	41.1	1.8	18.0	21.7	42.2	11.8	6.2
CEDECO TENTUDÍA	9	0.0	20,833	9.2	44.5	1.3	44.6	19.6	16.1	17.9	1.8
CEDER ZAFRA RÍO BODIÓN	15	0.0	47,108	7.2	37.8	1.2	39.4	34.9	1.5	22.7	1.5
DIVA	8	0.0	7,967	7.9	46.1	3.0	21.1	1.8	54.2	18.7	4.2
FEDESIBA	19	0.0	84,773	16.7	60.6	0.8	27.7	19.4	31.6	17.0	4.4
LA SERENA	19	10.5	41,069	12.5	48.5	0.7	18.9	17.3	25.1	36.7	2.1
LA SIBERIA	18	38.9	25,196	9.4	45.8	1.4	17.4	8.4	44.9	23.4	6.0
SIERRA SAN PEDRO	12	33.3	24,604	9.5	44.1	1.1	13.3	14.9	23.1	48.7	0.0
SOPRODEVAJE	11	0.0	11,181	7.8	32.6	4.5	51.4	15.3	2.8	16.7	13.9
TAGUS	15	33.3	27,327	12.5	53.0	2.9	54.8	26.9	2.9	14.4	1.0
ALMANZORA	26	3.9	53,770	8.1	46.9	0.7	16.3	20.9	7.0	47.7	3.5
ALPUJARRA-SIERRA NEVADA ALMERIENSE	31	3.2	41,128	8.4	52.3	0.8	34.5	16.0	14.3	28.6	6.7
FILABRES-ALHAMILLA	15	26.7	12,542	5.4	49.2	1.8	7.8	8.8	19.6	61.8	2.0
LEVANTE ALMERIENSE	13	0.0	118,492	11.5	57.8	2.4	11.3	32.3	12.9	38.7	3.2
LOS VÉLEZ	4	25.0	11,691	8.7	65.0	0.3	11.1	25.9	40.7	18.5	0.0
LOS ALCORNOCALES	10	0.0	218,364	9.6	55.9	1.2	10.3	50.0	20.5	19.2	0.0
JEREZ	3	0.0	342,720	11.4	58.7	0.9	44.0	24.8	12.1	3.2	9.6
COSTA NOROESTE DE CÁDIZ	4	0.0	122,690	1.7	22.4	0.1	42.9	33.3	9.5	4.8	4.8
LITORAL DE LA JANDA	5	0.0	158,544	11.9	55.4	1.9	42.7	19.3	12.3	14.6	9.9
SIERRA DE CÁDIZ	19	0.0	118,015	8.9	50.9	0.4	20.2	26.3	12.1	28.3	13.1
CAMPIÑA SUR	11	0.0	105,699	6.8	53.3	0.5	21.7	35.0	10.0	21.7	5.0
GUADAJOZ-CAMPIÑA ESTE	5	0.0	37,928	10.0	60.9	1.0	24.6	22.7	22.7	25.5	4.5
MEDIO GUADALQUIVIR	13	0.0	96,210	10.0	67.3	1.8	13.9	41.6	13.9	22.8	4.0
LOS PEDROCHES	17	11.8	54,448	13.7	60.1	1.2	17.2	13.4	12.7	47.0	7.5
SIERRA MORENA CORDOBESA	8	0.0	28,376	14.6	66.4	1.2	18.8	28.2	6.0	39.3	6.0
SUBBÉTICA CORDOBESA	14	0.0	124,711	14.2	70.2	1.0	19.1	15.7	6.1	50.4	7.0
VALLE DEL ALTO GUADIATO	6	16.7	20,877	11.8	56.6	1.2	31.8	21.0	14.2	23.0	1.4
ALPUJARRA GRANADINA	32	3.1	39,201	9.3	51.3	0.8	15.9	18.2	23.9	36.4	3.4
ALTIPLANO GRANADINO	14	14.3	55,473	12.5	57.9	1.0	15.3	28.8	21.6	22.5	6.3
ALFANEVADA	12	0.0	21,180	7.4	40.8	2.1	14.8	12.2	27.0	40.0	6.1
GUADIX	32	3.1	46,153	11.5	44.3	1.4	22.8	18.9	19.7	34.7	1.6
LOS MONTES	10	0.0	19,331	16.2	76.6	1.0	35.3	26.5	2.9	6.9	27.5
PONIENTE GRANADINO	16	0.0	75,143	14.3	63.7	1.8	26.4	22.9	10.4	29.2	10.4
VALLE DE LECRÍN-TEMPLE	22	0.0	107,286	14.5	65.1	1.0	26.2	23.1	10.0	38.5	1.5
VEGA-SIERRA ELVIRA	12	0.0	123,106	9.9	57.7	1.4	22.1	22.1	21.1	23.2	10.5
ANDÉVALO OCCIDENTAL	16	12.5	41,835	9.9	50.8	1.5	20.0	24.8	6.2	46.2	0.7
CONDADO DE HUELVA	19	0.0	140,871	12.3	61.6	0.9	22.4	31.3	13.4	20.9	9.7
COSTA OCCIDENTAL	7	0.0	136,250	7.6	60.4	1.2	44.6	32.5	6.4	9.6	3.2
CUENCA MINERA	7	28.6	16,099	10.3	50.8	0.9	43.0	26.7	5.9	20.7	0.0
SIERRA ARACENA-PICOS AROCHE	29	13.8	38,644	12.0	60.8	1.1	24.9	20.7	15.5	37.3	0.5
CAMPIÑA NORTE	25	4.0	144,307	11.5	59.4	1.1	18.7	12.4	13.4	51.7	0.5
CONDADO DE JAÉN	8	12.5	23,465	10.4	54.7	2.2	16.9	10.4	25.3	35.7	7.1
LA LOMA Y LAS VILLAS	14	0.0	103,111	16.2	67.3	0.8	16.6	24.5	18.5	29.1	7.9
SIERRA DE CAZORLA	9	0.0	32,329	9.5	47.0	1.0	25.8	16.8	29.0	20.7	3.2
SIERRA DE SEGURA	13	7.7	25,131	11.4	56.7	1.9	22.2	12.4	32.0	21.6	6.5
SIERRA MÁGINA	16	0.0	56,444	11.5	56.0	1.0	31.5	15.3	18.6	21.0	8.1
SIERRA SUR JIENNENSE	10	0.0	94,251	10.8	60.8	0.7	17.9	27.8	30.9	15.4	1.2
ANTEQUERA	7	0.0	128,332	10.6	54.7	0.8	37.4	26.3	14.0	15.2	3.5
AXARQUÍA	31	0.0	205,219	11.3	59.7	1.0	30.2	29.3	9.5	25.0	4.3
GUADALTEBA	8	0.0	24,659	11.7	63.4	1.6	19.2	46.2	18.0	14.1	2.6
SERRANÍA DE RONDA	21	0.0	53,415	1.8	27.8	0.2	17.5	22.5	17.5	27.5	10.0
SIERRA DE LAS NIEVES	9	0.0	20,962	8.5	55.6	1.1	22.2	18.1	8.1	40.9	10.7
TERRITORIO NE MÁLAGA	7	0.0	28,440	13.0	64.0	1.9	35.9	25.8	14.5	12.6	10.1
VALLE DEL GUADALHORCE	7	0.0	99,083	9.4	48.6	1.2	37.2	25.7	13.3	16.8	6.2
ALJARAFE-DOÑANA	16	0.0	110,391	13.3	59.9	0.6	20.1	34.7	15.3	20.1	4.9
BAJO GUADALQUIVIR	7	0.0	151,785	13.0	67.3	0.9	33.8	32.5	8.8	13.8	10.0
CAMPIÑA-ALCORES	8	0.0	152,904	15.2	67.9	1.2	27.9	32.7	12.9	18.4	6.1
CORREDOR DE LA PLATA	7	14.3	22,509	10.9	64.0	0.6	20.7	25.3	12.6	35.6	4.6
ESTEPA-SIERRA SUR	18	0.0	85,978	9.4	55.0	0.5	7.1	19.1	17.9	23.8	21.4
GRAN VEGA	13	0.0	157,502	11.4	59.2	0.9	30.8	37.7	10.0	17.7	3.1
SERRANÍA SUROESTE SEVILLANA	8	0.0	97,059	12.3	57.9	1.0	23.7	29.0	9.9	21.4	6.9
SIERRA MORENA SEVILLANA	10	0.0	26,284	14.0	68.0	0.4	23.8	24.8	2.9	40.0	7.6

Table 1. Summary of failed and successful projects for the LAGs of the regions of Andalusia and Extremadura

Source: Regional governments of Extremadura and Andalusia. The authors

LAGs (figure 3). In fact, in the case of Extremadura it is calculated an average number of 4.3, compared to 1.1 in the andalusian case. With this indicator, the LAGs which had a high number of requests to the LEADER approach, and in the first period of execution, can be located, the approval or signing of the agreement by the respective LAG being rejected. In Extremadura, we can differentiate two types of LAGs. On the one hand, LAGs with a cero number, being those that approved all the applications of projects. They are mostly located in mountain and border areas with Portugal in the North of the province of Cáceres and two LAGs of the province of Badajoz on the edge of the andalusian region (Jérez-Sierra Suroeste and Zafra-Río Bodión). In the case of Cáceres, matching with rural areas that had the highest number of municipalities with the lowest population density. These LAGs have small municipalities and, in addition, aged population, and not productive economy, and therefore, have not received a significant number of projects that could be rejected. In these municipalities, the highest percentage of beneficiaries has been from public administrations, municipalities that have carried out non-productive projects, and in this way, not to have to return LEADER funding to the EU, and to obtain the highest financed percentage. At the same time, within these LAGs, it is noted other municipalities with higher number of inhabitants, where the LAG´s social and technical headquarters are located, also close to the main cities of Extremadura, and where was managed a higher number of projects with private entrepreneurs and, therefore, private participation.

Oppositely, there were LAGs having a large number of applications, rejecting a high part of them, more than 150, and an index between 1 and 2, and therefore, between 30 % and 40 % of the total projects were withdrawn before signing the agreement with the LAG. The rejection was due to two main causes; on the one hand, in some LAGs with significant number of companies, not all the applications received could be approved because they did not have enough funding for the high number of projects LAGs received. In the case of areas with lower population densities, the projects were not signed with the LAG due to difficulties in obtaining complementary financing (from banks), in the processing of applications and/or the effects of the economic crisis of 2007-2010, which in small entrepreneurs was more decisive in deciding not to take risks in search of new business opportunities.

Usually, in territories with an index higher than 2, rejecting between 5 % and 20 % of the projects received, the two mentioned reasons affected too, but less decisive for having a lower rejection number. In more dynamic LAGs linked to economic sectors such as agribusiness, irrigation, or very productive wineyards or olives trees, also located in the areas of influence of urban centers, LAGs rejected some projects because the promoters haven´t got enough economic resources for the application, and in the case of marginal areas, promoters found problems related to bureaucratic procedures and bank loans.

In the andalusian case, on the other hand, it is again the typology of the entrepreneur, which explains to a greater extent the differences between some LAGs and others. The almost correspondence between failed projects and non approved projects, 6,630 and 5,443, respectively, is another explanatory reason. Thus, in LAGs with a greater importance of small companies and self-employed is where the ratios of executed are lower, and on the contrary, in LAGs with a higher importance of public entities –municipalities- and the LAGs, there were higher success rates. In addition, female business people encountered more difficulties than their male counterparts.

Therefore, as the main reasons for failure noted by the managers and technicians of the LAGs interviewed were the poor draft and preparation of the projects, the lack of funding and the complex requirements of the application procedure affecting in a higher way to small entrepreneurs and self-employed. Thus, as main cause to fail, would be the lack of financing, a factor that was particularly important in this period (2008-2015) caused by the serious economic crisis. Subsidies were only granted by the LAGs once the investment was completed. Many entrepreneurs did not have enough funds to cover the investment costs before receiving the subsidy, or they could not convince the banks to obtain a loan to cover this period of time, which forced them to withdraw their applications. In some cases, to face this problem, LAGs gave a “provisional approval” in which they “previously approved” the grant. With this document, it was easier for the entrepreneur to obtain the bank´s financing, which allowed them to avoid the vicious circle. Another important problem was the poor preparation and draft of the project, many of which contained a large number of technical and legal deficiencies; for example, the lack of a local license to open the business or the impossibility of obtaining it (perhaps because the project did not comply with local urban planning rules). The complex requirements of the LEADER approach proved to be another important obstacle. Projects were more likely to be accepted if they met the criteria established by the LAGs according to the particular strategic sectors in which to invest: technical,

economic and innovation issues (good practices, job creation, use of local resources, demonstration effects, social innovation …), legal issues, etc. Projects that did not meet these criteria were unlikely to receive the positive technical-economic report from the LAG. In this case, the main explicit causes mentioned by the LAGs were "the elegibility report is negative", "not fitting into the LAG strategy" and "negative evaluation in the technical-economic report". Other reasons included a "low level of innovation" or the fact that "projects did not use local assets". Even, some of these projects were contrary to the strategy of local rural development, incorporating external assets and resources that competed with local products. LAGs offered a huge amount of information explaining how to prepare initiatives fitting them to local strategies and evaluation criteria. In some cases, despite of entrepreneurs knew that their projects were not eligible, decided to apply. In an exceptional and serious case, after receiving the subsidy, the entrepreneur decided to use the money for other purposes, giving place that the LAG demanded the back of the funds. Another predominant reason for failure was the complex bureaucratic and procedural requirements and the low financing capacity of LEADER approach. In these cases, the managers mentioned "complexity in the procedure", "did not present the correct documentation", "did not meet the deadline in the execution of the project" or "lack of funding". In some cases, LAGs were able to support project promoters to overcome these kinds of problems. In other cases, the projects failed because the promoters bought used machinery, which was not eligible for funds and in others, they could not execute the investment before the deadline. At the end of the programmation period, some projects had to be rejected because the LAG hadn´t funds in that particular sector or measure. Another important point was the obligation not to initiate the investment until the application was approved. A final reason for the rejection was that the projects had received grants or financing from other funds. Therefore, if the reasons noted for failure in each specific initiative are analyzed in detail, for the Alfanevada and Altiplano de Granada LAGs, it is found that most of them are related with the poor preparation of the projects, the lack of finance and the complex requirements of the application procedure. In fact, one of the main reasons pointed was the "withdrawal of the entrepreneurs" (30.1 % of the cases), due mainly to a lack of finance; and the second casuistics was related with bureaucratic and programation problems: "does not fit into the LAG strategy, not sufficiently innovative, negative assessment in the technical-economic report" (23.9 %) or "correct documentation not submitted" (8.0 %) (table 2).

General phase	Nº Proj.	% Projects	Specific phase	Nº Proj.	% Projects	Specific reason	Nº Proj.	% Projects
Rejection of the grant application	127	77.9	Initial application to the LAG	40	24.5	Withdrawal of the promoter	33	20.2
						Complexity in the procedure	5	3.1
						Receipt of other grants	1	0.6
						No reason given	1	0.6
			Certificate of non-initiation of the investment. Compliance of project with legal conditions. Technical and economic report	87	53.4	The investment had started before the application	3	1.8
						Eligibility report is negative, legal reasons, applicant ineligible for grants	11	6.7
						Does not fit into the LAG strategy, not sufficiently innovative, negative assessment in the technical-economic report	39	23.9
						Funding not provided	8	4.9
						Technically/ financially inviable	7	4.3
						Correct documentation not submitted	13	8.0
						LAG had insufficient funds	5	3.1
						Did not meet the deadline	1	0.6
Award of the grant	36	22,1	Although grant is awarded, the promoter withdraws before signing the contract	3	1.8	Withdrawal of the promoter	3	1.8
			After signing the contract for the grant	33	20.2	Withdrawal of the promoter; did not request payment of grant	13	8.0
						Failure to meet deadline	9	5.5
						Did not provide funding	4	2.5
						Complexity in the procedure	4	2.5
						Breaches the object and purpose	1	0.6
						Finance obtained from another fund	1	0.6
						No reason given	1	0.6
Total	**163**	**100.0**	**Total**	**163**	**100.0**	**Total**	**163**	**100.0**

Table 2. Stages at which projects failed (Altiplano de Granada and Alfanevada LAGs 2008-2015)

Source: Regional Government of Andalusia. Prepared by the authors

Thus, in more intense reds colours (figure 3), with values close to 0.0, territories with a higher amount of private entrepreneurs appear again, and where the leadership applying for projects was led by these ones, micro and small businesses, especially, as happened in Costa Noroeste de Cádiz (0.1), Serranía de Ronda (0.2) and Los Vélez (0.4). In this one, the very low entrepreneurial initiative and business dynamism led to a very few number of projects executed, and a large number of those rejected, in a relative way, and where the deadlines, not adapting to the strategy or the unfeasibility were the main causes.

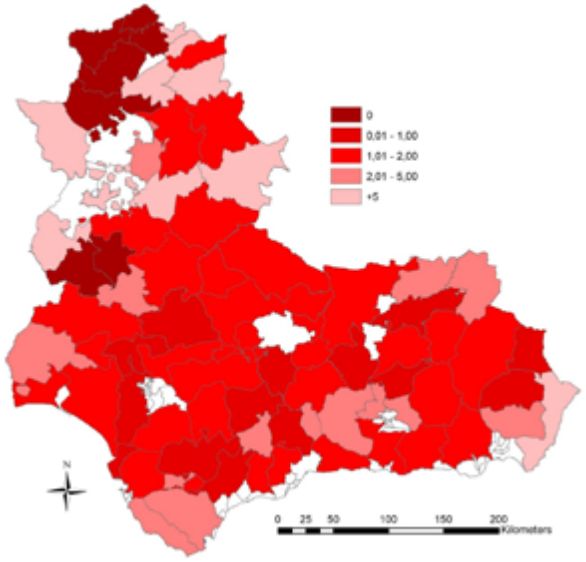

Figure 3. List of projects executed and not approved/denied within the LEADER approach for LAGs in the regions of Extremadura and Andalusia in the 2007-2013 programming period

Source: Regional Governments of Extremadura and Andalusia. Prepared by the authors

In the opposite way, in the LAGs of Levante Almeriense (5.2), Filabres-Alhamilla (3.6) and Condado de Jaén (3.0), were municipalities and associacions (LAGs mainly). Specifically in the case of Levante Almeriense, entrepreneurs and public entities that led the process were consolidated. In the case of Filabres-Alhamilla, mainly public entities (municipalities) stand out and, in a lesser way, associacions. Then, in the case of Condado de Jaén, public entities and associations too.

It is necessary, therefore, to influence the type of promoter that predominates in the executed projects, to understand, on the one hand, the greater or lesser sucess rate in the projects, and on the other hand, to understand the different leadership in each LAG of some collectives or others (figure 4). In the case of Extremadura, of the total projects executed, the highest percentage (42 %) has been focused on small companies (self-employed, small entrepreneurs and companies), followed by associations, with 33 %, and public entities (25 %). In the andalusian case, the predominance of companies is even higher, 52 %, which partly explains that lower success rate in the achievement of projects, followed by public entities (mainly municipalities, 27 %), LAGs (10 %) and associations (4 %).

Specifically, for Extremadura, with more than 70 % of its projects executed dedicated to private entrepreneurs, we found LAGs placed in irrigated areas closed to urban centers, such as the LAGs of Miajadas-Trujillo, Zafra-Río Bodión, La Vera, Valle del Jerte and Tajo-Salor-Almonte, highlighting in them, services activities. These ones were territories that presented a higher rate of rejected projects because they couldn´t finance initiatives and intermediate success values regarding the number of projects failed during the LEADER´s management (the effects of the crisis affected to concrete entrepreneurs not being able to carry the LEADER projects). In the opposite way, the lowest values regarding the typology of entrepreneurs, with less than 25 %, were in the LAGs of Campiña Sur and Hurdes, located in very depressed and bordering areas. For the associations, the highest number of projects in Hurdes LAG has been executed, in contrast to the previous case, with more than 70 %. With less than 20 %, the LAGs of Tentudia, Miajadas-Trujillo, La Vera, Montánchez-Tamuja, Tajo-Salor-Almonte, Valle del Jerte and Zafra-Bodión, having these last three ones less than 3 %, because as it has been noted before, more than 70 % of its projects have been focused in private entrepreneurs. Finally, regarding to the territorial distribution of the projects lead by public entities, the highest values (around 45 %) were in the LAGs of Sierra de San Pedro-Los Baldíos and Jerez-Sierra Suroeste, which were also those LAGs that didn´t reject projects, as opposed to Olivenza and Hurdes, with less than 7 %, focused on their civic and social associacions.

Finally, according to Andalusia, the predominance of the private sector, small companies and self-employed, and to a lesser extent, cooperatives, explained that in almost all LAGs thesse types of entrepreneurs were the highest executors of projects, with few exceptions. They have an almost absolute predominance in the LAGs of the western provinces (Huelva, Seville, Cádiz and Málaga), highlighting with more than 75 % participation in projects in the LAGs of Costa Noroeste de Cádiz, Costa Occidental de Huelva, Jerez and Bajo Guadalquivir. On the other hand, public entities, mainly municipalities, had the leadership in other LAGs, where the economic dynamism was reduced, such as Filabres-Alhamilla; where the importance and size of

the municipalities allowed these ones to control and lead the strategy of each LAGs (Campiña Norte de Jaén or Subbética Cordobesa), having in them a percentage higher than 50 %. Finally, the associations, and within these, the respective LAGs as promoters, had the higher participation in the leadership of projects in those areas of the eastern provinces, with less economic dynamism, and higher number of municipalities with small size and importance, relative importance of civic associations, and where LAGs wanted to consolidate as an local asset and promoter of rural development; as it happened in the following LAGs where the percentage for this type of promoters excedes 25 %: Los Vélez, Sierra de Segura, Sierra Sur Jiennense, Sierra de Cazorla, Alfanevada and Condado de Jaén.

Figure 4. Leading role in projects executed with LEADER approach for LAGs in the regions of Extremaadura and Andalusia in the 2007-2013 programming period

Source: Regional Governments of Extremadura and Andalusia. Prepared by the authors

Ending with this analysis, although in the Extremadura case there is not information at municipal level of the investment made and the type of promoter in them, it is important to face our hypothesis, at least, for the andalusian case, where this type of data is available. Thus, the investment of the public sector in the case of the municipalities of andalusian region of less than 5 inhab/km², 43 %, representing for the total of andalusian LAGs only 19 %, and for private entrepreneurs, in this type of municipalities more marginal, 38 %, being for the total andalusian LAGs 63 %. These percentages point the prominence of municipalities in the more marginal and rural municipalities where private initiative and economic dynamism is minor; and also explaining the differences in success rates, of 1.2 in these municipalities of lower density, and 0.9 for all LAGs in this region.

4. Conclusions

There are several final conclusions to be noted from the previous analysis. Firstly, the different role and leadership played by each type of promoter, attending to each LAG, and to the greater or lesser condition of perificity and economic development of each territory. If in marginal rural areas the leadership in LEADER approach has been developed by the public sector —municipalities mainly— and LAGs —in a second position—, in the rest of LAGs has been searched the leadership and control of the private sector (small and medium business and self-employed). This explains the higher success rates in the deep rural areas compared to the rest of territories. Public promoters and LAGs had a lower level of risk to the extent that the European Fund for Agriculture and Rural Development represents a higher percentage of the investment in their projects. In addition, local public entities and LAG have staff and technicians focused on the draft and elaboration of projects. As another explanatory and additional factor, it has to be noted the importance that the economic crisis has had in the implementation of the LEADER approach, especially to obtain private financing; thus, private promoters with a low capacity and access to credit have been those who have had very few possibilities to execute projects.

In addition, low population densities and perificity produce a series of particular local factors that often lead the municipalities of these LAGs to opt for projects that improve equipment. In addition, the creation of new attractions related to the promotion of natural and cultural heritage is chosen. On the contrary, the proximity to urban and metropolitan areas tends to push LAGs towards initiatives that contribute to the development of a residential type of rural economy, structured around small service companies for new residents. A third type is those areas that are focused on the valorization of agrarian production, destined for international markets through cooperatives, agricultural transformation companies and small agri-food processing companies.

Therefore, the role of territorial structures is a factor of differentiation/specialization in development strategies, but does not entirely determine the success or failure

of the LEADER approach. The profile of the benefited entrepreneurs, and mainly, if they are public or private ones, explains the different achievements of every LAG. The withdrawal of private promoters was due to finance problems, ill-prepared projects, the presence of a huge number of "opportunistic projects" ("let´s apply and see what happens"), the tough conditions and criteria imposed by the LEADER approach, and the complexity of the application procedure, were the main conditions to face by them. Thus, the low presence of consumers of deep rural areas and another obstacles as accessibility and low abundance of communication infrastructures played a second role. In these kind of marginal rural areas was very difficult to obtain small entrepreneurs to be funded with LEADER approach, even more, that these ones set up a new business.

The local actors, being coordinated within the LAGs, have created different projects, capital and social innovation, activating local resources and integrating each of the territorial economies into the global economy. It is necessary that different actors know the rules of action to improve the ability to plan the draft of strategies and projects. Higher variety of project actors within LAGs will create a more suitable local governance situation to promote local assets and enroll territories into the global system. Therefore, local actors and social capital are decisive components of territorial capital.

However, the data also shows the necessity of more planning to encourage and generate, entrepreneurs and projects, correspondingly, in marginal rural areas. This would possible if the technical staff of the LAGs could spend more time to generate animation in these territories. Therefore, more involvement work and funds are needed to encourage projects and potential private entrepreneurs in remote and marginal rural areas.

In conclusion, it is necessary to strengthen the implementation of neo-endogenous rural development, improving their strenghts and correcting their weaknesses (top-down control, domination of local economic elites, high levels of individualism in projects, geographical inequalities…), always taking into account the specificities of LEADER approach and the fundamental features on which it is based. Higher priority should be given to the creation of new business opportunities and even the promotion of cooperatives, as a low atention to the existing companies. It is also essential to assess and plan these actions more effectively, avoiding opportunistic project applications and making bureaucratic processes more flexible.

Finally, in future research on this topic, it would be appropriate to explore in greater depth the types of entrepreneurs, the territorial inequalities and the reasons of abandonment and failure of these projects. However, this requires the availability of similar and comparable information sources for all the study areas.

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Hispanic Visions of Stanbul

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Abstract

This article aims to convey the perception that Spanish travellers had of the historic city of Constantinople in the past. Both in its period known as Byzantium as well as the period starting in 1453, when it was given the current name of Istanbul. Travellers, spies, diplomats, seafarers, scientists and other Spanish personalities visited this geographical space and left us their testimonies, either literary or iconographic.

Keywords: Byzantium; Istanbul; Spanish Travellers; geographical perception

1. Introduction

Our intention in this investigation is to convey the images, that various Spanish travellers who have visited the city of Istanbul since the 12th century, have brought back to us. We are including the period in which the city was known as Byzantium and was the Eastern capital of the Roman Empire. In this way we intend to present the geographic perceptions of the authors, their descriptions, impressions and stories, sometimes more imagined than real. In this way it is possible to obtain their view on the spatial distribution of the different powers, that in each era controlled this urban territory.

We will carry out the aforementioned using their own literary productions, in the form of travel books, chronicles or reports, written by themselves or using examples from other authorities and institutions.

The layout of the text, after this introductory block, will consist of two large thematic blocks of diachronic analysis. The first up to the year 1453, in which the city was taken by the Ottomans and converted into the current Istanbul. The second deals with what was called the Turkish Sultanate, in existence until 1922, as well as the period which starts with the proclamation by Kemal Ataturk of the Turkish Republic, the regime still in existence today.

From the Byzantine era we have chosen texts from Benjamin de Tudela (12th century), Ramón Montaner (14th century), Ruy González de Clavijo and Pero Tafur (both from the 15th century). Under Turkish rule we have opted for the works of Cristóbal de Villalón (16th century), Jacobo Cansino and Pedro Cubero Sebastián (17th century), Gabriel de Aristizábal (1784), Federico Gravina (1788), Juan de Dios de la Rada y Delgado (1871), Carlos Alonso del Real and Agustín de Foxá (both from the 20th century). An index of sources used and bibliography will complete the study.

The city of Istanbul, formerly Byzantium, has a mythical ideological belief value which conveys axiological, esthetical and emotional reverberations that irradiate an irreducible polysemy. It´s most revealing and fertile semes are not precisely the realistic and objective ones, but the poetic ones, that is to say syntagms, icons, images, symbols and tropes that in reality produce them. All this leads to the creation of an intersubjective and mutual representation in its visitors. (Lisón Tolosana,1992:27).

With this in mind, we should also take into consideration, in view of the metropolis that we are studying, known in the middle ages as the "Empress of Cities", that it was the capital of two great political empires.So relations between the capital and the subjugated territories should lead us to understand the confusion between geographic space and political space, given that they constitute in historical epochs, a single reality. (Gil Pujol, 1991: 119).

Within the perception of the landscapes that the authors we are studying transmit to us, we also observe geographic and cultural ingredients that imply these perceptions and representations of the travellers.Therefore we must take into account the fact that there is not a pure description, but one that is forcibly selective (subjective). Any geographical method should take into account the previous considerations that influence perceptions, in our case of this city. (Gómez Mendoza-Ortega Cantero, 1988: 153).

To achieve the legitimacy of the city and therefore the mapping of Istanbul, we have to take into account a series of elements that constitute the image of the city, these being (Lynch, 1974: 47):

a) Borders; like walls, hills, limits, water courses…

b) Paths or pipelines; streets, trails, roads, canals…

c) Milestones and cairns, usually physical objects: buildings, isolated towers, columns, gilded domes, gardens, hills…

d) Hubs or strategic points: crossroads, enclosed squares, road junctions…

e) Areas or sections of the city, that form a whole due to topographical, ethnic, social or economic characteristics, types of building, layout of streets…

We will take into account some, if not all, of these aspects when we come to choose texts and to obtain the urban semiotics, the basic elements to be able to achieve a perception of the city.

We should acknowledge that the name of Constantinople, whose origin dates from the refoundation of Byzantium by the Emperor Constantine in the year 330, has remained throughout history. Not only during the time of the Byzantine Empire, but also throughout the Turkish conquest in the 15th century. However, in this second period the name only appears in historiography and in western diplomacy.

2. Under the Byzantine Empire

In this period, which for our study begins in the 12th century and concludes in 1453, we have four Hispanic authors that have left their literary mark after having visited the city. The four form a group around what we can call travel literature, chronicles or diplomatic reports.

2.1. Travel book written by Benjamin de Tudela

Born in Tudela in the kingdom of Navarre in 1130, he started his journey in 1166 during the reign of Sancho VI the Wise. It is estimated he returned in 1170, and five years later he died in the place of his birth. He was of the Jewish faith and in his narrativehe was interested in the conditions in the Jewish quarters of the different cities he visited. The first edition of his book was printed in Istanbul in 1543, in Hebrew. The first print run in Latin was carried out in 1575 by Arias Montano, in Antwerp. It wasn't until 1918 that it was translated into Spanish, in Madrid, by Ignacio Agustín González Llubera.

On his travels to the great metropolises of his time, Tudela provides a range of information according to his preferences and interests. He analyses the number of days it would take to walk from one Jewish community to another, the local civic government, the natural resources, the principal commercial and mercantile activities, security of the roads and maritime routes, and the Orography and, on occasion, oral legends and traditions. (Rica Amram, 2013: D. B. R. A. H. XLVIII, 492).

On his journey he stays in Constantinople, and he provides us with a vivid description, of great importance, of the conditions and situation of the inhabitants of the metropolis. We shall now discuss some of his reflections: (Tudela B. de, 2002: 26-29).

"There is the throne of King Manuel I the Emperor. under his dominion he has twelve princes (high dignitaries), each one of whom possesses their own palace in Constantinople… The perimeter of the city is 18 miles, half of it over the sea and half over the continent. It covers two straits of the sea, one which comes from the sea of Russia, and the other from the sea of Spain… It is a bustling city; people come to it with merchandise from all continental and maritime nations. There is no other place like it, except Baghdad, the great city of the Ismailis".

"There is the church of Saint Sophia, just like the Pope of the Greeks, seeing as they don't follow the religion of the

Pope in Rome… Such wealth cannot be found in any other church in the world. In its interior there are columns of gold and silver and innumerable lamps of gold and silver".

"There is a place dedicated to the enjoyment of the king, attached to the wall of the palace, called the hippodrome… in this place all kinds of human beings from all over the world, with all sorts of enchantment, or none, display themselves before the king and queen; and they bring lions, panthers, bears and zebras to fight each other…"

"King Manuel built a great palace on the seashore, besides those that his ancestors built, and he called it Blachernae. He covered the columns and walls with pure gold and silver…there is a throne of gold and noble stone, and he hung a great golden crown on a gold chain above the throne…In the crown there are innumerable precious stones…and there are buildings there that cannot be enumerated ".

"Every year from all parts of Greece taxes are brought, filling fortresses to the brim with silk fabrics and Tyrian purple, and Gold…It is said that the taxes in the Capital rise annually to 20.000 pieces of gold from the shop and market rents, as well as taxes from maritime and continental merchandise. The Greeks in the country are very rich in gold and precious stones, they wear gowns of silk with golden lace woven and embroidered on their vestments, they resemble princes bestride their horses. The country is very bountiful in every kind of clothing, as well as having wine and meat in abundance…"

"There they are very knowledgeable of the literature of the Greeks, they recruit mercenaries called barbarians from all the gentile people, to make war against the Sultan, king of the Turkmen, because they themselves lack a combative spirit. They are therefore considered rather effeminate, that they lack the strength to resist…"

Lastly he speaks about the Jewish community, that he says they are deported to the other part of the strait of the sea, called Pera. He indicates that there are about 2000 Rabbinate Jews and 500 Karaite Jews. Amongst them there were silk craftsmen, merchants and many tycoons. " There the Jews are not allowed to ride horses, except for R. Selomoh the Egyptian, who is the Kings' doctor… The Greeks detest the Jews, whether they are good or bad, making their injustice towards them even worse. The Jews are rich and kind, charitable and trustworthy to fulfil their obligations, they accept the iniquity of their oppression with resignation".

2.2. The Chronicle of Ramón Montaner

This author (Perelada 1265-Ibiza1336) took part in the almogavars' expedition to the Orient. He wrote his chronicle between 1325 and 1332, and in it he narrates the history of the Crown of Aragon from Jaime I until the coronation of Alfonso IV. Being a member of that expedition he was able to visit the city of Byzantium.

In chapter V he tells us that they arrived in Constantinople in the month of September 1303, where the Emperor Andronicus II and his son met them with a warm welcome, along with all the other peoples of the Empire. On the other hand, the Genoese of Pera could not hide their displeasure. In section VI he tells us that the Greeks are guilty of two notable sins; the first is that they are the proudest people in the world, they see no value in others,only in themselves, even though they are worthless; and the second is that there is not a people in the world that is less charitable to their neighbours. In the following chapter he informs us that they held a great festival in honour of the expedition leader, Roger de Flor, receiving from the Emperor four months' pay for the requirements of the company of the almogavars. Their war cry was Via fora! (To the street!).

In chapter XV he specifically tells us: " The Emperor, in the presence of all, made Roger sit before him, gave him the staff, the cap, the flag and the stamp of the empire, he had him dressed in the clothes corresponding to his office and he made him Cesar of the Empire, whose office is distinguished by allowing the holder to sit in a chair close to the Emperor, not much different except for being half a hand lower, he can also do in the Empire as much as the Emperor, so that he can make perpetual donations, borrow from the treasury, impose taxes and order hangings and drawings…" (Montaner, 1860: 400).

As we can gather from the previous paragraphs Montaner does not describe Constantinople to us. He confines himself to describing what its inhabitants were like, political power and the people in general, including the Italian colony of Pera. It is therefore a narration of an epic nature, he is only interested in the military theme in so far as it relates to the period that we are studying.

We could however obtain an impression of the entrance of Roger de Flor into Constantinople if we contemplate the canvas that, with that title, José Moreno Carbonero painted in 1888 commissioned by the Senate. It's a masterpiece of the genre of the historical painting of the XIX century. A

description of the painting could be the following: " In the background of the painting one can observe the port of Boukoleon. It acquired the name from a bronze statue that represented the fight between a bull and a lion placed on top of a tall pedestal overlooking the sea. The port formed a part of the imperial enclosure and the emperors used it to receive their guests…on disembarking the almogavars pass in front of the pedestal where, on a portable golden throne, sit the old Andronicus II and his son Michael. They are surrounded by eunuchs, the guard and other high dignitaries of the Court…In the background Hagia Sophia and the Hippodrome, connected so that the Emperor could reach them from his palace without having to go out into the city". (Aviles, 1903: 29-31).

The novel *Tirant Lo Blanc* by the Valencian Joanot Martorell (1410- 1465) was also influenced by the chronicle of Montaner. As far as we know, Martorell travelled all over the kingdom of Aragon but never set foot in Byzantium. However, he relates to us in the central part of his work, how Tirant receives the call from the Byzantine Emperor in the times of Roger and he goes to Constantinople where, like a good knight, he falls in love with a Greek woman and saves the city from the Turkish siege. The aforementioned novel, cited by Cervantes in Don Quixote, was written in the middle of the XV century and it was first published in Valencia in 1490.

2.3. The Tamerlane Embassy of Ruy González de Clavijo

This Castilian Diplomat (Madrid, middle of the XIV century-Madrid 1412) is the Author of the Chronicle of the journey that, between 1403 and 1406, he undertook as Ambassador of King Henry III of Castile to the far-off Court of Tamerlane, inheritor of the Empire of Genghis Khan. The expedition was made up of 14 people.

The work is organized around two main issues: how they passed their time on the journey and the emphasis on the geographical area covered with relation to the variety of its inhabitants. He describes Constantinople in chapter III. They arrived in Pera on the 24th of October 1403 and found accommodation there. On the 28th the Emperor Manuel II received them in his palace and later they went to visit the city. (González de Clavijo, 1999: 41 onwards).

On this first urban excursion they visit different churches and monasteries, that they describe in detail, among them the famous Monastery of Saint John at Stoudios. Next they visit the Hippodrome where they say of the Egyptian obelisk: " It was a great marvel to see such a large stone, so pointed and so thin, how it got there, what ingenuity or what strength of man could place it there, how tall it is, that column of very great stone that from the sea appears first before the Capital". He then goes on to describe the other elements of the Hippodrome.

They next went to see the basilica of Saint Sophia. " It is the best, the most honourable and privileged that there is in the city. In front there is a great square with a marvellous very high stone column and on top was a great flat flagstone with a copper horse above. (The column of the Emperor Justinian).

" In this city there are underground passages and cisterns and houses below, in which there are other marvels to see. There was a very large underground cistern that had a lot of water, and it was so big that they said there could fit a hundred galleys in it ". After describing the beauties of Saint Sophia and Saint George they continue to the walls by the Kynegos gate and returned, now tired, to Pera. On Thursday 1st of November they go again to Constantinople with the guide that the Emperor had offered to them and arrived on horseback at the church of Theotokos and other monasteries and cisterns in the Golden Horn zone. And further on he says:

"The city of Constantinople is well surrounded by a high strong wall with big strong towers, that has three corners, and from corner to corner there are six miles. Thus the perimeter of the whole city is 18 miles which is 6 leagues. And two parts of the wall are close to the sea, and the other land. And on a cape, at the corner that is not near the sea, up high, are the palaces of the Emperor" (Blachernae). "And however much it appears to be a great city with such a large enclosure, it is not so well populated, for in the middle of it there are many knolls in which there is work going on making bread and wine and many orchards, and with the orchards are houses like in the provinces, except they are in the middle of the city. The most populated area is at the bottom, down by the wall that is next to the sea, and the busiest route is from the city to the gates that lead to the sea, notably to the gates that lead straight to the city of Pera".

"Another thing is that although there are great buildings of houses and churches and monasteries in this city, most of them are in ruins. And one has the impression that in former times, when the city was in its element, it was one of the noble cities of the world. And they say

that there are 3000 churches, large and small, in the city today. And within it there are wells full of fresh water. And in some parts outside the city, between the wall and the sea, heading towards Pera from the city, there are many houses where they sell things and stores where they keep the merchandise that they bring to sell overseas… so Constantinople is like Seville and the city of Pera like Triana, with the port and the ships in middle".

He later moves on to describe the port of the Golden Horn and the city of Pera, which the Greeks called Galata. They stayed here until the 13th of November when they continued their journey up the Bosphorus. But the bad weather forced them to return and spend the winter in Pera, from where they set sail for Trabzon on the 22nd of March 1404.

2.4. Adventures and travels of a Spanish gentleman by Pero Tafur

This author (Seville 1410-Cordoba 1480) was a typical rich traveller of the beginning of the Renaissance who took this route for mere pleasure. He wrote his book after the journey that he commenced in the autumn of 1436 and finished in 1439. It is narrated in the first person, a formula that reinforces the truthfulness and authenticity of what is said. In the book, says Miguel Ángel Pérez Priego (D.B.R.A.H.XLVII, 532), it is self-evident the chivalrous orientation and flavour that prevails, as well as the constant presumption of the status of a knight on the part of the author.

The visit to Byzantium took place on the second journey of his adventures, which lasted from the 9th of May 1437 until the 22nd of May of the following year. He was in our city twice, once in November 1437 (he doesn´t describe it) and the second time in February-March 1438. In total he would stay in the city of the Bosphorus for about three months. In Constantinople he visited the Basileus John VIII with the objective of finding out the origin of his surname and to ascertain that he was related to the Emperor, who proposed that he stay there and get married. The following are some citations from our authors text: (Tafur, 1995; 95 onwards).

"We went to the church of Saint Sophia and listened to mass, and afterwards we were shown all of it, which is so big that they say that when Constantinople was prosperous, there were 6000 clergy…It has many high altars (vaults) all covered with lead, and inside mosaic work including a lance on the floor, and the mosaic is so fine that even a paintbrush wouldn't be able to do better…" He continues to describe the basilica and the relics they were shown.

He points out that on leaving he found a column with edge carvings and on top a big horse and knight made of gilded brass that claims erroneously to be Constantine, but is in fact Justinian. Next he speaks of the existence of great squares and houses where they sell bread, wine, fish and seafood, given that the Greeks are much given to eating these products.

" In Constantinople there is a very large square made by hand, and all the way around it are inbuilt arches and below there are vaults, where the people watched the games in the old days, when they put on festivals, and in the middle of it there are two gilded brass snakes one intertwined with the other. In the middle of the square there is a statue of a man also of brass…Halfway across that square was a stone needle, made in the style of Rome…".

" The city of Constantinople takes the form of a triangle, two parts in the sea and one on land, and very notably enclosed by a great wall…The house of the Emperor shows signs of having been magnificent, but that is no longer the case, for the house and the city show the signs of the ravages of time." He indicates that under the palace in a marble building there is a great library, " in which there are many books and ancient writings and histories".

" The city is very poorly populated and made up of quarters, but the sea coast makes for better living; the people not very well dressed, sadder and poorer, showing their bad nature, for they are full of vices and sins…a stones' throw from the city is the shipyard, next to the sea, showing signs of having been a magnificent thing, and still to this day it is a good enough haven for ships. Opposite Pera there is a handmade pier, to which the ships are tied…this port for one reason or another is always full with ships, because of the great loading and unloading that is done there…".

The city of Pera has up to 2000 inhabitants, nicely walled and well dug and sturdy, good monasteries and churches, a nice well-built market house, city of high excesses in the style of Genoa; the ordinary people are Greek but the people who govern and who have trades are Genoese… This Pera was formerly called Galata". Throughout these descriptions he inserts legends or rumours of the places visited that mostly had no credibility.

In the four stories cited the descriptive character of the texts stands out. The quoting and enumeration of public

monuments dominates, both civil and religious, many of which we have excluded so as not to be too repetitive. There is also a configuration of the city, that it has the shape of a triangle and is walled, two maritime sides and one towards land. The perimeter of the historic city, Tudela and Clavijo both calculate to be 18 miles. Outstanding landmarks in all of them are Saint Sophia, the obelisks of the Hippodrome and the commemorative columns, especially that of Justinian.

The rich and ostentatious character of the city in Tudela becomes decadent and depopulated in the cases of Clavijo or Tafur. The Italians have taken control of Pera and the Turks appear powerful and threatening.Thus one can see a decline in the rhythm and life of the city, that in the late middle ages was known as the Empress of Cities. All of the authors speak of the many defects and vices of the Byzantines, of their inclination for ostentation and luxury. In the case of the two authors of the XV century they underline the degradation wrought by Genoese and Venetians, which they contrast with the nobility of the Turks. Perhaps they are announcing the fall of the city into the hands of Mehmet II in 1453.

There are also references to the morphology of the city, with its distribution of space according to professions or geographic origin of the inhabitants. We could speak of three areas of power: political, located in the Sacred Palace and the Hippodrome, also in Blachernae; religious located in Saint Sophia and the multiple churches and monasteries; and economic in Pera and the Golden Horn. This incipient layout of urban cartography, merely literary, could bring to mind Charles Booth's plan for London at the end of the XIX century. But only as wishful thinking.

3. Under Turkish Rule

We distinguish between two periods in this section: One starting in the XV century and extending until 1922 and the other which begins with the reforms of K. Ataturk, who transfers the Capital of the State from Istanbul to Ankara.

3.1. Under the Ottoman Sultanate

In this period we will emphasise the following authors and works:

3.1.1. The Turkish journey of Cristóbal de Villalón

Born in 1500 and passed away in 1558, our author was a student in Salamanca and a notable humanist teacher. His most outstanding work was The Scholastic, a paradigm of the behaviour of the perfect scholar and at the same time a university utopia. Given its Erasmist content it wasn't published while the author was alive. The work that we will examine here is also attributed to Villalón, written in 1557, shortly before he died.

It is a meticulous chronicle of the life that prisoners led in Constantinople in the XVI century. The author is a "warned" man, who took full advantage of his misfortune to inform Philip II of the power, the finances and weaknesses of the Turks. The journey is literally configured like a dialogued novel, with two interlocutors Juan de Voto a Dios and Mátalas Callando. (Villalón, 1919: Volume II, 5 and onwards).

He inserts the specific references to Istanbul in Volume II. Here there are several sections about life in Turkey: religion, pilgrimage to Mecca, weddings, justice, the Sultan, the army, citizens customs, women, weapons, clothes, etc. There are another two, one dedicated to Saint Sophia, discussing the materials that it is made of and that inside 17.000 souls could fit. The other is a description of the city.

"On the shore of the Hellespont is the city of Constantinople and it can be quite isolated, because the channel becomes a sound, which is the port of the city and it goes on for two whole leagues. And in it you can fit all the ships, galleys and boats that there are today in the world…" Later he describes the excellent features of the Golden Horn, it's people and dwellers on Galata its inhabitants and activities.

"Mosques and stoves, that they call baths, there are more than a few all over the city, and Greek churches. The baths have their source inside, of which Constantinople and Galata are very well provided… Constantinople, which was called Byzantium before, is in the best place for a city so that the sun heats it from east to west.The city is right on the Bosphorus Channel. There must be 40.000 houses for the Christians alone and about a thousand for the Jews, probably 60.000 for the Turks. We can put it at 100.000, I'm not including the suburbs with more than 10.000…"

Constantinople has an area of 5 leagues, all inhabited, more in some parts, less in others. The city is made in the shape of a triangle…Very few houses or buildings are good, apart from the four principal mosques and the

palaces and some houses at the bottom. The best building and house that one most has to see is the bazistan, which is a cloister built underground, in which there are all the jewellers that there are in the city and where all the delicate goods are made, such as silks, embroidery, gold, silver and precious stones…"

"The greatest splendour of Constantinople is that after having seen everything there is more to see underneath. They are vaults with columns of marble and stone and brick inside. No Turk knows what the main streets are…it is more important to know where the four principle mosques are. If you want to buy or sell, the streets are ordered according to the product that is marketed".

"The first thing that we ran into on our way to Constantinople is called Yedikule, the Seven Towers, where there are seven strong and well-made towers together, it is said that they used to be full of money. Look at the magnificence of the city: one column is very tall and thick, depicting roman history, in an area called AbratBazar. You can go up by a spiral staircase. In comparison, other cities are not so tightly packed and lumped together as Constantinople".

3.1.2. Istanbul in the XVII century

In this century we can cite three authors whose works allude to this city.

The first is Jacobo Cansino (Oran 1590-1666), a Jew in the service of the Spanish Crown. In 1638 he translated and adapted from Hebrew to Spanish the work of the rabbi Moses Almosnino titled: Extremesand greatness of Constantinople, written in the XVI century. He dedicated it to the Count-Duke of Olivares for whom he was a confidant. It consists of three books: The first is a physical, humane and economic description of the city at the end of the XVI century, it is the most interesting in terms of geography. In the second and third he tells us of the successes, personality and death of the great Sultan Suleiman the Magnificent. (Cansino, 1638: 5 onwards).

Book 1 is interesting for how much he talks about the weather and the influence of the winds on the city, the rain and its effect in the streets and the cleanliness. He then alludes to the supplies, the characteristics of the Turks and their social stratification, pastimes, etc. Like a good believer he comments on Judaism in Istanbul, and the way of life of this religious community. At the end of the book he tells us: "Most years there is plague in Constantinople and it starts with such force that where it enters, there being tender creatures, it doesn't leave before sweeping away as many as there are" (Cansino, 1638: 32). Although the original work was written in 1567 the facts can very well be taken as true in this century of the Baroque.

Francisco Moncada y Moncada (Valencia 1586-Goch, Germany 1635), third Marquis of Aytona, was a distinguished Spanish diplomat. His work Expedition of Catalans and Aragoneses against Turks and Greeks was printed in 1623. He used the medieval chronicle of Montaner, but also other sources. He narrates the exploits that the subjects of the Crown of Aragon undertook in the Orient in the Middle ages. Apart from Montaner he uses the texts of Gregoras, Paquimeres, D. Colcocondilis and the History of Cantacuzeno, and of course the Annals of J. Zurita.

Through Moncada we know that in the times of the Almagovars, the Emperor Andronicus II ordered that the Spanish Company "lodge within the city, in the quarter they called Blachernae" (Moncada y Moncada, 1777: 42). This was where the new imperial palace was situated, built in the XII century by the Comnena dynasty. After the death of Isabella Clara Eugenia in 1633 Moncada was interim Governor of the Spanish Netherlands until the arrival of the Cardinal-Infante Ferdinand.

Neither Cansino nor Moncada were ever personally in Istanbul but in their works they speak of the city. A man who was there was Pedro Cubero Sebastián (Zaragoza 1645-1700) a religious man and Spanish writer. From 1670 and for nine long years of hardship he travelled to the major cities of Europe, Asia and America. He tells us of his experiences in Istanbul in chapter XVI of his: Brief account of the pilgrimage that I made to most parts of the world… Madrid 1680: 144-150.

"I wasn't in Istanbul for very long and I couldn't see it all. This lovely city, Capital of Thrace, is situated on a triangular tip of land and in front is ancient Chalcedon, at the end of the land of Europe, closing the Thracian Bosphorus. The city occupies 12 miles with its walls and towers, made in the old way very similar to those of Rome, they are surrounded by sea…To the north the sea comes in land, five miles, which makes it so big that a thousand vessels can comfortably fit inside…It divides the city of Constantinople from what was formerly known as Galata, which is also like a small city, it was a colony of the Genoese…"

"As you can see the rooftops and windows of the houses painted different colours, from afar it gives a lovely

perspective, and because of how white the buildings of the houses are and so many cypresses there are, then the darkness of the lead covers of the domes of all the mosques, all together it makes for such a lovely view, that in my opinion, having seen the best cities in the world, none of them lives up to the beauty and agreeable view of Constantinople, seen from outside that is, because internally it is disgusting and gross and of cheap materials, because most of the houses are made of wood. The mosques are strong buildings and five in particular, which are distinguished for being the imperial ones. Their model was Saint Sophia". Later he describes this and other mosques and palaces.Lastly he indicates that the plague was in the city, and so he quickly left.

3.1.3. Istanbul in the XVIII century

The Spanish Bourbons of this century tried to extend political and commercial relations with the Eastern Mediterranean. With this end in mind they entered into negotiations with the Turkish Empire, especially in the time of Charles III. The mission of the agent from Alicante Juan Bouligny, initiated in 1778, concluded with the Treaty of peace, commerce and friendship between Spain and the Ottoman Porte, signed in Constantinople on the 14th of September 1782 (Cantillo y Jovellanos, 1843: 568 onwards). Through this agreement Spanish consulates were authorized to be installed in the Turkish commercial squares, as well as the opening of commerce in the East to the Spanish bourgeoisie.

Bouligny opened the Spanish legation in Istanbul and he was our first permanent diplomatic representative. In turn Sultan Abdul Hamid I sent the diplomat and historian Vasif Efendi to Charles III, who arrived in the port of Barcelona in 1787. He was received in San Ildefonso by the elderly king and he travelled for several months around Spain to get to know the main cities.

By Royal Decree don Tomás López in 1783 produced a topographic map of Constantinople and the adjacent settlements, in accordance with the state the city had been reduced to after the three fires of 1782. The original can be found in the Royal Palace Library, catalogue number MAP/392(36). It is a reduced scale map but with great expressive vigour, the first that was published in our country about that city. The layout of the map is contemporary with the negotiations and has a key inserted at the foot, where numbers relate to the mosques, residences of the foreign ministers, buildings and places of note.

In relation to all the aforementioned we have to place the journey of Gabriel de Aristizábal to Constantinople in 1784. The original and handwritten versions of his report are found in the Royal Palace Library with the catalogue number II/1051. The text and the drawings of the manuscript have been reproduced in his book by González Castrillo in 1997. Aristizábal (Madrid 1743-San Fernando 1805) was sent in charge of the ships "Triunfante" and "San Pascual" the frigate "Santa Clotilde" and the brigantine "Infante". He left a 45 page account of his experiences with abundant information about that city, including 47 finely drawn exceptionally good drawings. The report consists of two parts:

The first (pages 1-16) contains the object of the expedition, to take to Constantinople the first Spanish Embassy, plus a summary of the journal of the voyage.The second (pages 17-44v) contains miscellaneous information about the city: location. topography, climate, monuments, customs, social, economic, religious, political and military organization of the Ottoman Empire. The description of the Byzantine monuments is very scarce and is centred on Saint Sophia, of which he drew a map, the Hippodrome, Saints Sergius and Bacchus Church, the Columns of Constantine, Theodosius, Arcadius and Marcian. And also the cisterns and aqueducts.

The drawings are in the majority cartographic, outlines of coasts, fortifications and armaments. Those dedicated to monuments are: The panoramic view of the Byzantine wall from the 7 towers to Seraglio Point, the uprising in Constantinople in 1422, two exterior views, one interior and the floor plan of Saint Sophia, the obelisks and Serpentine Column of the Hippodrome, together with a floor plan of the Church of the Holy Apostles, plus the reconstruction of 4 historic columns.

The visit of the expedition to Constantinople lasted for 53 days. The journey had commenced in Cartagena on the 24th of April arriving in Istanbul on the 1st of September 1784. On the 24th of October they left the Turkish Capital to return again to the aforementioned Murcian city on the 31st of May 1785.

On the location of Istanbul he says the following; "The delightfulness of its land has no comparison. Great distances unfold in which, on one side the horizon is made by the sea, and on the other, there are extensive pastures and plains, interrupted by occasional mountains that present a delightful view.The most agreeable that you can imagine is that which the Bosphorus offers, it's shores inhabited with houses (some very nice), trees and gardens. Truly it's

situation could not be improved. And if art were to combine with nature, constructing the buildings according to the rules of good architecture, in which the Turks are extremely ignorant and slovenly, it would be totally admirable". (González Castrillo, 2005: 715 onwards). Further on he insists: "The lack of taste when it comes to architecture deprives this city of noble buildings that would beautify it, because neither the public buildings nor the houses of the powerful, although big, maintain proportion or show taste. The streets in general are neither wide nor straight".

A few years later Federico Gravina y Nápoli (Palermo 1756-Cadiz 1806), departed from this city for Istanbul in April 1788. His mission was to bring back the Ambassador of the Sultan,Vasif Efendi. He did it in charge of the frigate "Santa Rosa" arriving at his destination on the 12th of May. They stayed there for 31 days, visiting mosques, bazaars, squares, streets and various public works. The testimony of it all was collected in his Description of Constantinople, whose manuscript is found in the Royal Library in Madrid, catalogue number II/1938. An extract of the Captains' diary handwritten by Gravina himself is in the Naval Museum in Madrid. In 2001 an edition of the book was published by José Mª Sanchez Molledo and the publisher Miraguano.

The manuscript consists of 162 pages of quarter size paper. It is structured in six chapters. In the first he describes the city and its monuments, the second is dedicated to Seraglio and the customs of the Ottoman Court. In the third he concentrates on the administration of the Empire: army, navy and finances. The fourth is dedicated to the customs of the Turks and the life of Mohammed. The fifth is about the practices of the Turks in their houses, their food, with the women, etc. In the last chapter he alludes to the rest of the inhabitants of Constantinople: Franks and Rayahs (non-believers): Armenians, Greeks, Jews and Aleppines. It is the vision of a learned man of an Ottoman Empire in decline.

From the first chapter the following text stands out: "The angle of land that begins in Eyüp and finishes at the 7 towers is the straightest and largest of the three sides, being 8 miles long. There are 5 gates in it. It has double walls with a distance of 20 to 25 feet between them and stands of a moat with a width of 25 feet. The exterior wall is 4 yards high with 250 towers. The interior wall is a little more than 20 feet high with 250 towers that correspond with the others and are much higher than the wall. All the walls that surround Constantinople are in a very bad state, as since the time of the Greeks they have only been repaired in a superficial manner. There is no artillery in them or anything that could serve to defend them" (Gravina, 2001: 57 onwards). Further on he says: "From the tower called Leandro is the most beautiful eye-catching view that Constantinople presents. The two areas of Pera and Galata and the view of Seraglio makes for an amphitheatre of beautiful perspective…The circumference of the city is 21 miles, plus that of the suburbs of Galata, Pera, Tophane and others that are 12 miles gives us a total circumference of 33 miles. It is not easy to quantify the population of this Capital, but a general estimate is one million inhabitants, a number that we shouldn't doubt. It is sometimes afflicted by strong earthquakes, for which reason it is almost all built of wood, by an annual plague and continuous fires".

In chapter 5 he underlines that " Whether due to their natural haughtiness, or because of their despotic government, the Turks apply themselves little to commerce, to study or to other activities, they generally have a sedentary life, they pass most of their time in the harem and visiting one and other".

Then under Charles IV the Count of Floridablanca, who continued to be the Minister of State, commissioned Don José Moreno, Secretary of the Royal Academy of Fine Arts of San Fernando, to produce a book with the reports of Aristizábal and Gravina. This commission led to the work Journey to Constantinople, edited by the Royal Press in Madrid in 1790. Apart from the accounts referred to, Moreno used other contemporary works about the Turkish Empire. Additionally it contains engravings made by artists from the Royal Calcography.

On the cover of the book Spain is represented showing the seas of the Levant and encouraging its people with the caption "Spaniard return to where you belong". The text that we are discussing is therefore a compilation, systematization and enlargement of many sources of information, amongst which was the documentation of the Secretary of State. Therefore it is a very meticulous official text, on full size good quality paper. An excellent example of Spanish publishing at the end of the Enlightenment.

Although Moreno hadn't been to Istanbul his book is very well researched and even better illustrated. It is articulated in three parts. The first, pages 1-52, are dedicated to the details of the expedition of 1784. In the second, pages 53-333, he discusses in 13 chapters the political, military, religious, administrative and fiscal system of the Empire, as well as its social organization, habits and customs, including in chapter 7 (pages 169-188), the description and commentaries about the antiques of Constantinople.

In the third part, pages 345-360,he describes the return of the squadron to Cartagena and its port of call in Malta. It includes two appendices; one with the courses of the journey of Aristizábal and the other a summary of a journey to Cyprus and the coasts of Syria, undertaken in 1788 by Felipe López de Carrizosa from Constantinople.

As an official book it highlights the commercial interest that Turkey has for the Spanish. Moreno opts for Roman classical art to the detriment of Byzantine art. He allowed himself to be captured by the dazzle that Istanbul produces as seen from the sea and he says textually "How different Constantinople is, how admirable, for a seafarer who arrives by the sea of Marmaris! What a grandiose mass is its centre, from where innumerable needles stick out and interrupt the sky! The two continents of Asia and Europe, only three quarters of a league apart; What a perspective they present, what a delightful composition! Here, the Capital and it's districts of Galata, Pera and Tophane with its freshwater canal in the middle; and there the port, arsenal and foundries. Over there, it's lush fields, Chalcedon, Scutari, populous city opposite the port; and in front of it the tower of Leandro, from where Constantinople looks like a picturesque amphitheatre". In this description we can clearly observe the influences of the two accounts that were ordered by Charles III to be made by his mariners (Moreno, 1790: 159 and onwards).

3.1.4. The Voyage to the Orient of the frigate "Arapiles" by Juan de Dios de la Rada y Delgado

As precedents to this journey, we should cite the one that the marine guard Manuel Esquivel y Castañeda commenced in 1802, in the frigate "Soledad", under the command of Alcalá Galiano. His objective was to create the map number 3 of the Mediterranean which includes the Bosphorus. Esquivel wrote a diary with some brief annotations about Istanbul. The traveller and spy from Barcelona Domingo Badía (Ali Bey) also left us several pages dedicated to Constantinople in his famous travel book, first published in Paris in 1814.

During the brief reign of Amadeo de Saboya a commission was set up that, under the leadership of J. de D. de la Rada y Delgado (Almeria 1827-Madrid 1901), archaeologist and antiquarian, transferred to the Eastern Mediterranean. It had as a mission the search for antiques for the recently created National Archaeology Museum. Rada was accompanied by the Hellenist Zammit Romero and the prestigious illustrator Ricardo Velázquez Bosco.

Práxedes M. Sagasta, then Minister for Development, sponsored the frigate "Arapiles". She undertook a voyage that started in Cartagena in June 1871 and concluded on the 22nd of September of the same year. It was a journey of 86 days which would yield the acquisition of 22 crates with 329 artistic objects for said museum. Above all Greek and Cypriot vases, sculptures, coins, relief casts of the Acropolis, etc.

Rada, who would become Director of the cited Madrid Museum from 1891 until his retirement in 1900, wrote a memoir of the expedition, published in Barcelona between 1876 and 1882 by Emilio Olivier and company. It consists of three volumes. The first one deals with the preparation for the journey and of the frigate, from his departure from Madrid, via Cartagena, until Naples, Messina and Athens. It consists of 767 pages and 29 illustrations. In the second they visit Piraeus, Troy and Canakkale, and then carry on to Istanbul. This is covered in 727 pages and 20 illustrations. In the third they tour around Beirut, Damascus and Jerusalem later moving on to Alexandria and by way of Malta they returned once again to Cartagena. This last volume consists of 233 pages and 15 illustrations.

To their stay in Constantinople, where they were entertained by the Spanish Embassy, Rada dedicates 400 pages of volume II. He has a first impression entitled: "Istanbul Turkish city par excellence" (Rada y Delgado, 1876-1882: II 64); pausing his gaze on the profile of its mosques, minarets, domes, cypresses and cemeteries, that contrast with the habits and traditions of its inhabitants in its dirty alleyways. He also reports on the system of Government, Education, the arsenal of the Navy, the gastronomy and so on. They see the city differently to the European concept of one, with a spatial organisation according to the types of population: Latins in Pera and Galata, Greeks in Fener and Jews in Balat. The Muslims would populate the old Byzantium. The Armenians also have their quarter.

They lament the scarcity and ruination of the Roman and Greek antiques. Rada makes special mention of the Turkish bath: "A warning to the unsuspecting, who hearing tales from travellers, wish to suffer that veritable torment, to which Europeans are not accustomed" (Rada y Delgado, 1876-1882: II 291 and onwards). On the visit to the Great Bazaar he says that "it is a festival, a great market of wealth and splendour, which makes one lose one's calm, one's head and one's pocket". With regards to the Palace of the Sultan: " The Seraglio is not a great artistic monument like the Alhambra; the Court of the Lions of this

Arab palace, is worth more than all the kiosks and all the towers of the Turkish palace". Regarding the harem he comments that "It was a vast monastery that had for a religion pleasure and for its god the Sultan". They left the Turkish city on the 9th of august 1871 heading for Mytilene.

Four years before the Basque Diplomat Adolfo Mentabarry del Pozo left us a romantic image of Istanbul and the Bosphorus in his book Journey to the Orient from Madrid to Constantinople. This was published in Madrid in 1873 with a foreword by Antonio Cánovas del Castillo. In it he was able to perceive with a certain anticipation the existing contradiction between the idyllic image of the city on arriving by boat and that which is perceived on walking through its streets, disordered and somewhat chaotic.

Nine of the aforementioned authors in this block visited Istanbul. One observes from those of the XVIII and XIX centuries an evident decline of the Ottoman Empire, which contrasts with the splendour that the city and the Turks had in the XVI century, under Suleiman the Magnificent. This was compatible with an expansion of the city and its population that in the last centuries had flooded the streets of old Byzantium and Pera. What they all confirm is its commercial and mercantile character, compatible with the sedentary idiosyncrasies that they assign to the Turk. Which explains the important numbers of the minority Rayahs (non-believers) that populate its most active quarters.The platitudes about the baths, the harem and the riches of the great souk are expressed as much in Aristizábal as in Gravina, and more so in Rada y Delgado.

The urban morphology is expressed more precisely in the Modern Age than by the travellers of the Middle Ages. The stratifications by professions, wealth and origin is evident in it. Muslims in old Byzantium and the non-believers on the outskirts, occupying not only Pera and Galata, but now also areas of the Bosphorus and the Golden Horn. Their commercial activity has extended in the last centuries to Scutari and Asian Chalcedon, today integrated into Great Istanbul. Political power is maintained, very much in consonance with religious power, dominating the centrality of the areas in Topkapi and the large mosques.

Another particularity of the travellers of the XVIII and XIX centuries is the incorporation into their memoirs of maps, blueprints, sketches, floorplans, graphics and in general illustrations that complete their reports. With these not only do we get vicarious information of an iconic nature, but they also serve to better express to us the direction and orientation of the voyage that gave rise to these accounts.

3.2. Istanbul in the XX century

The city lost its status as the capital of Turkey in 1923, after the coup of Kemal Ataturk and the proclamation of the present Republic. The city did not however cease to be a vibrant and dynamic centre as has been demonstrated to us by Orhan Pamuk, Nobel prize for Literature, as well as Ara Güler, the best photographer of Modern Istanbul. This attraction has seduced many Spaniards, especially tourists in the second half of this century.

With regard to important writers we should mention Julio Camba, Correspondent for the Madrid daily La Correspondencia de España in the years 1908-1909. For Antonio Gala, Istanbul was the setting in which his 1993 novel The Turkish Passion plays out.

But the person who best penetrates in this century into the soul of the great city of the Bosphorus is Agustín de Foxá (Madrid 1906-1959). In 1938 and for the Diario Vasco of San Sebastian he wrote an article in which he says: "We entered Istanbul. The round domes were visible now, like balloons prisoners of the kitchens of old Seraglio, the balconies with the Arabic lattice of the confessionaries or nuns cloister of the old harems and the pointed minarets with a dawn rose on the tip of the mosque of the Sultan Ahmet" (Foxá 1971: II 700 onwards).

In the article "Byzantium defeats Istanbul" for the Madrid newspaper ABC in 1950 he describes the different parts of the old city today visible and writes: "Constantinople is defeating Istanbul, as I have been able to verify on my second journey to the Golden Horn. While the secular Republic defeats Mohammedan Turkey, the refined and mysterious Byzantium emerges". When he enters Hagia Sofia he praises the denomination of this temple to something so difficult and abstract as Holy Wisdom and continues: " The terrifying symbol of our century without faith is this substitution of two temples dedicated to prayer by a museum. Because the museum is the temple of atheism, like the secular minute of silence for a deceased person is the Lords' Prayer of nothing".

Also for the newspaper ABC in the same year he sent another article titled: Ait-Meidan, in which he recalls the remains that are left of the former Hippodrome of Constantinople. "Where the heartbeat of Byzantium really is, is in the marvellous Ait-Meidan or Horse square. Here was the Hippodrome, the sporting, religious and political heart of the city. It was a jumbled world of coachmen, dancers and heresiarchs…there is an orange dusk over Saint Sophia,

over the great church, intact, after a millennium and a half of Byzantine and Turkish life. Now the twilight has that difficult colour, violet purple, discovered by the Byzantines, and that only their Emperors can use, those refined despots, a mixture of paganism and theology, lascivious and penitent, capable of emptying with splinters the eyes of their rivals on the island of Prinkipo and to pour, afterwards, repentant, those tears, that according to the very fine metaphor of Theophylactus, are like the blood of the veins of the soul".

In the summer of 1933 the dean of the faculty of Philosophy and Arts at the Central University of Madrid, Manuel García Morente, organized a Mediterranean cruise for university students. He was supported by Marañón, Ortega and other intellectuals, as well as by the Minister for Public Education, Fernando de los Ríos, who ordered the chartering of the motor-vessel "Ciudad de Cádiz". The boat was nothing more than a classroom, and the aim was to put into practice the knowledge acquired in the classes of that course. About 200 students and teachers embarked for 50 days in July and August on an itinerary that took in all the countries of the Mare Nostrum. At night on the 6th of July they arrived in Istanbul and they stayed there until the 11th of the same month.

After the voyage a competition was established for articles written by students who attended the course. They were not looking for erudition but impressions that a young person may have perceived throughout the journey. First prize was for the work "Diary of a student traveller" written by Carlos Alonso Del Real Ramos (Madrid 1914-1993). At the time he was 19 years old and later he was to become professor of Prehistory at the Complutense University and a good Classical Philologist. Here he describes to us in his article how he sees the city of Istanbul. It was included in a volume published in 1934 and titled "Youth in the old world. A cruise of the Mediterranean". (Alonso del Real-Marias-Granell, 1934: 90 onwards).

" Slender majesty of minarets and Byzantine solemnity of domes. Constantinople is inexplicable. Looking from some point from where you can overlook the whole city, or at least, some of its quarters and it seems, and is-why not?-very beautiful. But when we go inside it is of a vulgarity that makes us want to flee". After visiting several monuments and places in the city he climbs the tower of the University and from there he says: " There is a view unsurpassed by any that I have known until now. It is very beautiful this city, in that there are so many mosques, so many small cemeteries, some old quarters with wooden houses-from there the fires-to keep a watch over they built this tower and its sisters in Galata, Pera and Scutari. The Bosphorus is very beautiful and the Golden Horn as well. It's a great shame that such beauty is not real!"

"Constantinople, apart from a few things, is no more than a formidable hoax. Knowing how to skilfully combine the water and the mosques. With that and some old quarters, two squares with a certain grandeur-relatively speaking-, some palaces and a park with museums, they make you believe that Constantinople is something…The view from the Bosphorus impressed me, because I wasn't yet aware of the hoax…It doesn't lack merit having known how to organize so formidably this touristic trickery…"

" Yesterday afternoon (11th of July) we left Constantinople. The mosques of Istanbul, the false treasures, the pseudo classical palaces, the museums, Eyúp, the Byzantine churches, the gardens of Seraglio. All that is there; perhaps we won't see it again. We are left with Saint Sophia, the museums, the Chora church, Saint John of Stoudios, the square of the Hippodrome, the Golden Horn, the remains of the walls and the general view of the city. We are left with these things of beauty, of splendour or grace.
We are left as a matter of curiosity with Seraglio, the cemeteries, a few mosques. As a disappointment and weariness the streets of Istanbul today and all that is Galata and Pera. As a vulgar memory Scutari, the gardens and the palaces. As an unkempt galling ugliness the statue of Kemal. The mosques, apart from three, are worth nothing more than elements of the landscape. In isolation it would be better to forget about them".

Opposite the descriptions of the authors of the previous centuries the literary images of this century are more complex and subjective, Both Foxá and Alonso Del Real know how to imprint into their comments a specific personality that transcends objectivity. They are assessments, of the urban whole and its variety as well as of the political changes that the secular Republic has imprinted on the city. It has lost its status as the political capital but they haven't been able to seize it's economic and cultural power, which it maintains today in the Turkey of the XXI century.

Throughout the majority of the texts that we have presented, as much under Byzantine rule as Turkish, we cannot say that a hegemony of the natural elements exists over the social elements in the descriptions of the city. Both coexist, although conceived in a choreographic form and therefore without scientific structuring. On the other hand it is logical if we take into account the training and the objectives of the

travellers and their stories. We could say the same about their concept of geography without doubt consistent with what in those centuries was thought and done.

If there is a common denominator in almost all the travellers that accessed Istanbul by sea it is the high degree of admiration they experience. They are fascinated by that so complex amphitheatre full of: borders (walls of Theodosius or the Golden Horn), pathways (The Mese or the Valens Aqueduct), landmarks (Galata Tower, columns of Emperors, obelisks or mosques), hubs (Hippodrome, arenas or Augusteon) and neighbourhoods (Blachernae, Pera, Galata or Scutari), which they observe from a distance. It is an experience that many visitors have enjoyed and to tell the truth it is the best letter of introduction for this city, bridge between continents and of course between cultures.

4. Supporting Documentation

4.1. Sources

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New data for a new representation of the city: some contributions*

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* This paper presents some of the work carried out by the tGIS Research Group (Transport, Infrastructure and Territory) of the Complutense University of Madrid

Abstract

This contribution presents the opportunities offered by new data sources associated with big data and their animated cartographic representation in urban geography research. A description is initially made of the characteristics of new data sources, the opportunities they offer and also their limitations. Later, some of the work carried out in this line by the tGIS Research Group of the Complutense University of Madrid is shown. We present the results of several animated maps which have enabled us to examine the changing distribution of the population throughout the day and cycling mobility in the city of Madrid, the emergence of the phenomenon of shared Airbnb accommodation in Barcelona and the consequences of daily traffic congestion for accessibility in the city of London.

1. Introduction

The explosion of geolocated data and improvements in geographic information technologies experienced in the last decade facilitate a new cartographic representation of the city and its dynamics. A representation in many cases of themes that are either new or have been scarcely addressed up until now due to lack of data. A representation and analysis of the city that is also highly detailed in terms of space and time scales, based on the development of maps and animated cartography, and reflects more accurately the dynamism of the city.

For a number of years now, we have been immersed in a time that has become known as the data revolution. The concept of big data, a term used to describe large volumes of data, has become widespread. Data that, on the one hand, comes from a multitude of sensors and devices that record human activity and the functioning of our cities today. Smartphone GPS devices, phone call records, browsers, transport smart cards, credit card payments, mobility service applications, traffic cameras, loop antennas, etc., all monitor us (Goodchild, 2017) and contribute to and enhance the development of smart cities. On the other hand we have data generated through the activity of users on the Internet, which is recorded and stored in the cloud. This occurs through the use of a multitude of services, such as the Google search engine, and social media, such as Facebook, Twitter, Instagram, Flickr, etc. A large amount of the data generated is geolocated geographic information (Gutiérrez, J., 2018).

When we talk about 'new' data, it is appropriate to use quotation marks for the adjective new. Although it is clear that the development of big data is still a recent phenomenon, the truth is that the first works carried out with some of these sources took place some years ago.

Geolocated data used in mobile telephony, for example, dates back to the early years of this century (see for example Ratti *et al.,* 2006). In any case, most of these sources are still in their adolescence. Twitter, one of the most used sources in social sciences, turns 14 in March 2020 (its founder Jack Dorsey sent the first tweet on 21 March 2006). But we had to wait a little longer for tweets to include geolocation information, so most works that have used this data from a geographic perspective are from the mid-2010s.

The data revolution has also been accompanied, as is logical, by the emergence of new software and tools that allow us to deal with the characteristics of new sources and the challenges they represent. The emergence of proprietary tools for managing large databases is increasingly common in working with geolocated data. Either through new platforms or the incorporation of big data tools into the most common geographic information system (GIS) programs. Thus, systems for the administration of large databases, such as PostgreSQL, have incorporated modules for working with geographic objects (PostGIS). The usual GIS platforms, such as ESRI's ArcGIS or free QGIS software, have also begun to incorporate modules and applications for working with massive data. These are tools that enable the storage and processing of data, analysis and final visualisation of this data and its results, in some cases in real time. Spatial analysis modules have also appeared in some recent data analysis packages. One of the most well-known is R or RStudio, in which packages such as *sf*, *raster*, *gstat*, *RGeostats* and others enable users to work with geolocated data. Software has also been created specifically taking into account new data. Among these stands out the Spanish Carto platform, which was created as a display to facilitate the cartographic visualisation of new sources, but increasingly incorporates tools for spatial analysis.

Among the great novelties offered and facilitated by new data and new tools is the incorporation of a highly detailed time variable into both the analysis and visualisation of the daily dynamics of the city. Almost 50 years ago, the geographer Torsten Hägerstrand (1970) published his famous paper "What about People in Regional Science?", in which he highlighted the need to incorporate time into geography studies. To do so, he proposed new ways of representation in the form of space-time prisms. Two major limitations were encountered, however, when working with them: lack of data (he tried with personal journals, but the difficulty in obtaining large samples was evident) and, at the same time, lack of computer tools. These two limitations are no longer a problem; the challenge now is to analyse and represent large volumes of data with high space and time resolution (Shaw *et al.,* 2008). Advances in computing and GIS tools now allow the mapping of these processes. The challenge now is to propose and address new or classic topics from the perspective and taking advantage of the possibilities that new data provides. It is not surprising that the opportunities these technologies offer have spawned neologisms such as neogeography (Bosque, 2015).

One of these opportunities is the study of urban dynamics throughout the day, a field into which very few urban geography works to date have ventured. The functioning of a city throughout the day is structured around the need of individuals to perform different activities which require them to be in certain locations at specific times (Miller, 2005). These activities carried out at specific times explain what some have called 'the pulse of the city' (Batty, 2010). At present, we can collect samples of daily activity data on a massive scale, with precise space-time detail and (sometimes) at a reduced cost (Chen *et al.,* 2011; Huang & Wong, 2015). The aim of this text is to show some examples of this carried out by the tGIS Research Group of the Complutense University of Madrid. In these works, we present different urban themes and different time scales, ranging from the changing distribution of the population throughout the day to the development of the Airbnb phenomenon in Barcelona in recent years, and we do so through the maps and animated visualisations that have helped us in our work. Before presenting these examples, a brief description of the characteristics of new data sources is carried out based on two previous works (Gutiérrez *et al.,* 2016, and Gutiérrez, 2018), which should help to better understand the processes of analysis and the results shown later.

2. The characteristics of new data sources

The famous Vs have been used frequently to characterise data originating from big data (Kitchin, 2013; Gutiérrez, 2018). The most used Vs are those associated with volume, velocity and variety. Volume refers to the large amounts or massive nature of the data generated. These large amounts of data are generated at an unprecedented velocity and are also becoming available to users more quickly, in many cases in real time. The data also comes from a wide variety

of sources and has a wide variety of formats. Compared to traditional sources that provide structured data in a single format, new data is produced in many different forms (text, photographs, videos, GPS tracks, etc.) and without a clearly defined structure. In addition to these three Vs there are others than can be added, such as those related to the value of the data ('data is the new oil'), veracity (the advantage of massive samples and also because data from numerous sources reflects what people actually do and not what they say they do), and visualisation (alluding precisely to the need to represent data in an understandable format once processed).

In relation to visualisation, there is, of course, the representation and analysis of data spatially. In this regard, one of the characteristics that provides these new sources with special value for geography is that a large amount of the data has recorded locations. It is space and time referenced. This is the famous fingerprint that we all leave behind, whether we like it or not, when we do activities or move around a city, in the form of geographical coordinates (x, y) and moments in time (dates and times). These space and time references have different degrees of accuracy, so it is necessary to refer to the space resolution and time granularity of the data (Gutiérrez, 2018). Spatial resolution refers to geolocation accuracy. Time granularity refers to the frequency with which data is recorded. Spatial resolution and time granularity are different depending on the sources and should be considered.

Mobile phone data is one of the most used sources, despite difficulties in getting access to it. Its use opens up great possibilities, for example, in studies of presence and daily mobility of the population of a city. The space and time resolution of telephone data is, however, variable. Mobile phone data can be georeferenced at the xy coordinate level through trilateration techniques, but in reality work is rarely carried out with that level of detail. Typically, the activity of the mobile phone is georeferenced from the telephone antenna to which it is connected and the location of the individual is taken as being that of the Voronoi polygon of that tower (Ricciato *et al.,* 2015). The extent of these Voronoi polygons can range from 1 km^2 in dense urban areas to more than 4 km^2 in peripheral or peri-urban areas. The smallest cells are obviously at high population density points, both outdoors and indoors: shopping centres, train stations, airports, etc., but, as we move away from these spaces, the density of towers reduces and the size of the polygons to which the data is georeferenced increases. Therefore, what is known is that the mobile phone is near the tower that transmits the call or, more specifically, within the corresponding Voronoi polygon, but its location is not known exactly and that uncertainty is also variable spatially. The time granularity of mobile phone data is also variable depending on data types and also users. In the first works with mobile phone data, call data and SMS messages (known as CDRs) were used. The average values between two consecutive events fluctuated around 2 hours. Today, most studies also work with information from data sessions (xDR, such as mobile connections for example to use networks like WhatsApp), and this has significantly reduced the time granularity of this data. More and more companies though are starting to save information from what is known as passive data, which includes any mobile connections to the network.

Compared to mobile phone data, data from social media (for example, Twitter or photo-sharing sites) has high spatial resolution by working with the xy coordinates of the place where images have been uploaded by users, but its time granularity is much lower, since user activity is usually low. Other data, such as that recorded from GPS, has high space and time resolutions. In these cases, there is high spatial resolution (x y coordinate), usually with a very small error, and also with a very high time resolution (most devices log a record every 2 seconds). This high resolution and GPS granularity, however, represents a major challenge for capturing and storing the large amount of data generated, so in many cases it is decided not to collect data as often and store tracks with points taken every minute or every two minutes.

2.1. All that glisters is not gold

Sources associated with geolocated big data provide enormous opportunities for city analysis, enabling us to delve deeper into the usual study topics from different perspectives or open new lines of research. There are, however, challenges and certain issues that we need to consider when working with them.

To begin with, even in sources with geolocation, not all data is geolocated or not all is good. In some sources, the proportion of geolocated data is very small. On Twitter, for example, a very low percentage of tweets have coordinates, and this reduces the amount of available data and makes it necessary to resort to periods of more extensive data collection to have enough data to do the case study. In addition, geolocation is not always correct. In some cases because the device's GPS has not been saved correctly or in others because the user has not uploaded

the georeferencing correctly (for example, when uploading a geolocated photo to a photo-sharing site such as Flickr or Instagram). In mobile telephony, the tower to which the mobile phone is connected is often not the closest or bounces appear between antennas, which can simulate spurious movements of users.

Secondly, not all of the big data is valid. The tasks of cleaning and pre-processing data are fundamental when using this type of source and require a large amount of time and, often, a large part of the research budget. As we have seen previously, it is necessary to disregard non- or badly geolocated data. But in addition, depending on the sources, a selection of valid users for the analyses must be made. On many social media sites, such as Instagram and Twitter, many of the very active users are actually bots, which need to be disregarded in our work. On others, for example in the case of mobility work with CDRs, it is necessary to obtain a sample of users with sufficient activity to be able to know their locations and movements at different moments in time.

Data availability is another fundamental aspect. Not all big data is easily accessible. The opportunities offered by new sources of data are enormous, but access to these opportunities is sometimes limited. To access mobile phone or bank card usage data, for example, we depend on the companies themselves, which increasingly use their own data and do not make it available to third parties, even commercially. In other cases, the cost of data is high, often excessively so for projects that are carried out by public research centres.

Limitations generated by aspects related to user privacy also play an important role in the availability of data. Data privacy laws, which on the one hand protect us as users, limit its use and our ability to perform analyses. The need to add data in space or time to maintain anonymity limits some of the studies on cities that we can undertake. There are also restrictions on certain information about user characteristics. For example, if we work with credit card data belonging to bank customers, it is difficult to obtain information on user characteristics such as their place of residence.

Finally, although samples are large, certain biases may sometimes appear in them. This is particularly the case with social media. These types of platforms are mostly used by young people and groups with higher levels of purchasing power and education. On Twitter, for example, more than 50 % of users are between 25 and 44 years old.

These aspects should not, however, inhibit the social researcher in the use of this new data; it is simply necessary to be cautious, consider the problems and look for imaginative solutions to overcome them in the best possible way. The opportunities for studying and representing the dynamics of a city are enormous. Let us see some examples.

3. New animated maps, new applications

Several recent works carried out by the geography departments at Spanish universities have taken advantage of the space and time resolution of these new data sources to provide animated examples of the dynamics of Spanish cities. Due to proximity, I will focus on four examples carried out by our tGIS research group at the Complutense University of Madrid.

3.1. Population distribution throughout the day

Thanks to data from geolocated tweets, in García-Palomares *et al.,* (2018), we built an animated map that allows us to visualise the distribution of Twitter users in the metropolitan area of Madrid throughout a typical day. This distribution is a good proxy for the use of Twitter by the population of the city and its changing densities throughout the day.

The data used to perform this mapping was downloaded from the Twitter Streaming API from January 2012 to December 2013. Tweets geolocated in the Community of Madrid were downloaded. Together with the coordinates, for each tweet, information was obtained from the user ID, date and time the tweet was sent. The initial database contained more than 6.8 million tweets. From this, tweets that were sent on standard working days (Tuesday, Wednesday and Thursday) were selected.

From this dataset, a pre-processing and cleaning of the data was performed in a GIS, creating a layer of points with the xy coordinates of the position from which each of the tweets was sent. To eliminate bots (machines that send numerous tweets from the same location) or tweets sent from the same location and at the same time (users who tweet compulsively) and thus avoid overvaluing the presence of such users, it was necessary to work with the number of unique users instead of the number of tweets.

To do so, the tweets were grouped by space and time (every quarter of an hour) according to the user's ID, so what was obtained in each spatial unit was the presence of unique active users and not the number of tweets sent.

The spatial zoning of the Madrid Transport Authority was used in the spatial aggregation of the Twitter data. This zoning has the advantage of using homogeneous spatial units from the point of view of land use and building typology. The zones are also large enough to record a significant number of tweets. Once each tweet was associated with the zone from which it was sent, through database management operations, the number of users in each zone and at each time was obtained in 15 minute slots.

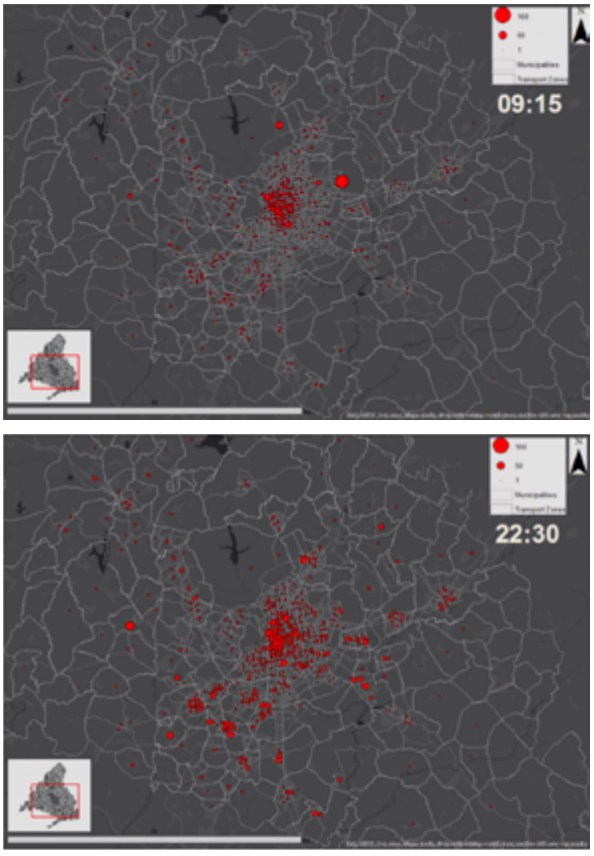

Figure 1a - 1b: Distribution of the number of tweeters in Madrid. The figure shows the times of 9:15 and 22: 30 as frames of an animated map that reflects variations in the number of tweeters in Madrid during a typical working day and every 15 minutes. Published in Cities

In short, this work enabled the creation of a dynamic map[1] composed of 96 frames, showing the time sequence obtained from the presence of unique active users in each transport zone and for every quarter of an hour (figure 1a). The map very accurately reflects the concentration of the population in the activity spaces (from the centre and north of the city of Madrid) in the morning hours and a greater dispersion to the residential areas of the metropolitan area during the evening/night (figure 1b).

3.2. Public bicycle journeys in the city

Among data sources with high space and time resolution, records obtained through GPS are very useful for monitoring the behaviour of the population in relation to their mobility. This data enables detailed analysis of recent urban phenomena, such as the rise of cycling mobility or models of shared mobility. This was done in the work of Romanillos *et al.,* (2018), where GPS record data was used to visualise and analyse shared bicycle mobility in Madrid throughout the day.

Madrid's public bicycle system (BiciMAD) has experienced strong growth in recent years, exceeding 17,000 daily journeys in October 2019[2]. The system uses bicycles that are all electric motor assisted. They also all have a GPS device which enables their positions to be monitored at all times.

In order to identify the routes used by users, information was requested from the Municipal Transport Company (EMT), the current service operator, which provided data corresponding to the 253,556 tracks registered by the system during the month of April 2017. As in the case of Twitter, a process of cleaning and selection of valid data was necessary. For example, tracks originating from the redistribution of bicycles carried out by the company itself were eliminated. The final sample was reduced to about 230,000 journeys. For each track, information on origin and destination stations, duration of journeys in seconds, start times, types of user (frequent, occasional or unknown) and age range was available. The data provided refers to a collection of GPS tracking points recorded at an average interval of 75 seconds. This time resolution is lower than usual in mobile phone applications or GPS devices, so it was necessary to estimate the routes on the street map from the shortest path between the tracking

1 https://www.sciencedirect.com/science/article/abs/pii/S0264275117306303

2 https://elpais.com/ccaa/2019/10/13/madrid/1570998467_632903.html

points provided. For this, we used a highly detailed street map (from the company TomTom), which was updated with various cycling infrastructures included in the Madrid Cycling Mobility Master Plan.

Cycling journeys throughout a day were represented on an animated map, which combined all of the tracks obtained in the week of 17-23 April. On the map, the routes were drawn throughout the day in a different colour depending on whether it was a route made on a working day or at the weekend. The map was completed with an animated chart that shows the number of routes being taken at the same time throughout the city. In addition to the routes, the map also shows the activity at each of the bicycle docks, with the number of check-ins and check-outs at any given time. This animation consists of more than 6,450 frames. As an example, we include two moments in that time sequence (figure 2), which show the situation at 9:00 and 12:00. In the first one, weekday routes —journeys made mainly for work or study (in pink)— dominate and are concentrated in the streets of the city centre. Meanwhile, at 13:00, weekend and leisure journeys predominate (in yellow) and they are much more concentrated in tourist spaces and green or leisure areas.

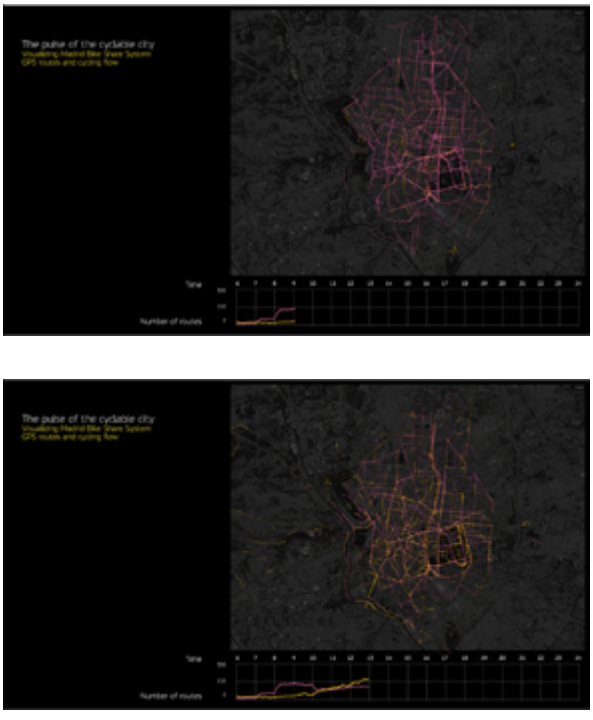

Figure 2: Journeys of BiciMAD users in Madrid. The figure shows two moments in time at 9:00 and 12:00 from an animation published in the Journal of Maps

3.3. The explosion of the Airbnb phenomenon

A new phenomenon in cities is what is known as collaborative consumption and peer-to-peer (P2P) platforms. In the field of urban tourism, the case of Airbnb stands out. A web platform that puts travellers and hosts in contact for the rental of accommodation and is having a great impact on the property dynamics of the historical centres of many cities. The concentration of this phenomenon in certain heritage neighbourhoods of cities has caused serious tensions with local residents as a result of increases in rental prices and the associated gentrification processes. To analyse this phenomenon, in Gutiérrez *et al.,* (2017), we studied the special distribution patterns of Airbnb accommodations offered in Barcelona and compared them with the hotels and places most visited by tourists. The analysis was accompanied by an animated map showing the appearance of Airbnb vacancies in the city since the first one appeared in October 2008. The animation reflects the tsunami effect of the phenomenon on the city centre.

The data used on the Airbnb listings came from the Inside Airbnb project (http://insideairbnb.com/). This is an independent project which collects information from more than 40 cities in the world. The data compiled for Barcelona refers to October 2015. Two files with numerous information about each listing were downloaded, in relation to Room Type (entire homes/apartments; private vs shared rooms; number of bedrooms and beds), Activity (estimated nights/year; reviews/listing/month; reviews; estimated occupancy; price/night; estimated income/month), Availability, Listings per Host, etc. With the xy coordinates stored in each record, a point map layer was created in a geodatabase in ArcGIS with the location and characteristics of each accommodation. This cloud of points was animated from the date on which the property was first published. The sequence shows how the offers are distributed and accumulated from the publication of the first one (in 2008) until November 2015. The initial base map shows, in addition to an orthophoto, the location of the hotels in the city in blue. The animation shows how the first vacancies were located in the central spaces of the city, either in the most touristic areas or in some of the most traditional residential neighbourhoods in the centre. This is the situation, for example, in the frame showing the situation in 2010. Over time, the number of vacancies skyrockets, filling up the previous spaces and extending to other more peripheral residential areas, but always within the area of the city centre (see figure 3).

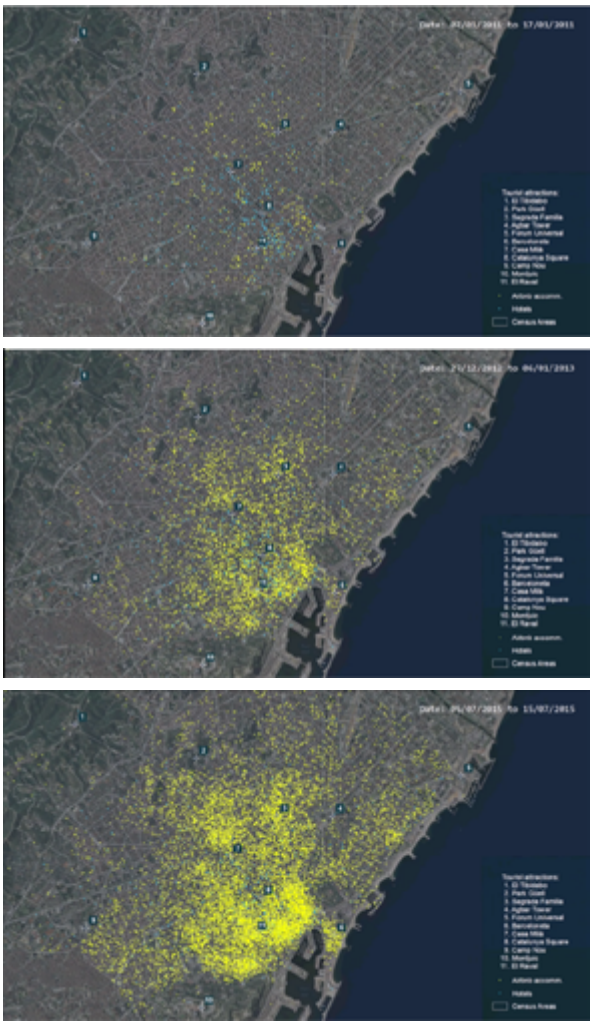

Figure 3: Evolution of the location of the offer of Airbnb accommodation in Barcelona coloured in yellow. The situations in January 2011, January 2013 and July 2015 are shown, as part of an animation published in Tourism Management

3.4. Changes in daily accessibility as a result of congestion.

Accessibility refers to the ease of reaching the desired destinations from a specific location and by means of a specific transport system. Its measurement is important both from the economic perspective (it facilitates companies' access to markets) and from the social perspective (it contributes to the well-being of the population by facilitating their access to workplaces, educational establishments and other amenities).

Accessibility is an essentially dynamic concept because the operation of transport networks varies over time. Frequencies in public transport networks change throughout the day or months of the year, changing travelling times (more reduced in peak hours of higher frequency of services). In the case of road networks, by contrast, during peak travelling times, traffic congestion increases time and, consequently, reduces accessibility. Despite this clear dynamic component, however, most urban accessibility studies adopt a static perspective, ignoring the fact that accessibility conditions change dramatically throughout the day.

In several works carried out at tGIS, we have studied road accessibility with this dynamic perspective, incorporating animated mapping to represent it (Moya and García-Palomares, 2017a and 2017b). For this, we used TomTom road network data and the *TomTom Speed Profiles* product, which provide information on the speeds of each section of the network every 5 minutes.

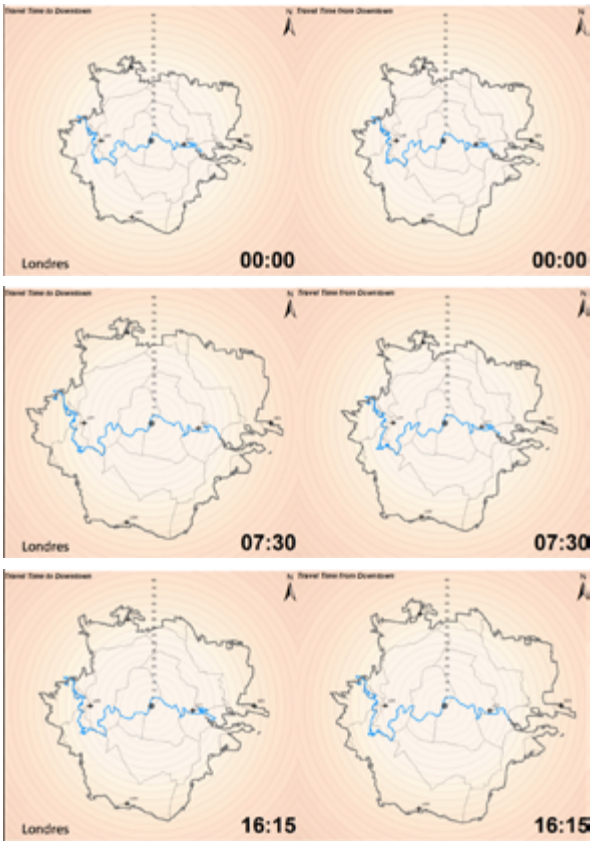

Figure 4: Cartogram of the city of London. The size of the city depends on the times of city centre entry and exit. Several moments in time are shown as part of an animated map that shows the situation throughout a typical working day and every 15 minutes

In one of those works, Moya and García-Palomares (2017a) show the usefulness of animated mapping when visualising changes in accessibility in the city of London as a result of daily congestion. Taking advantage of

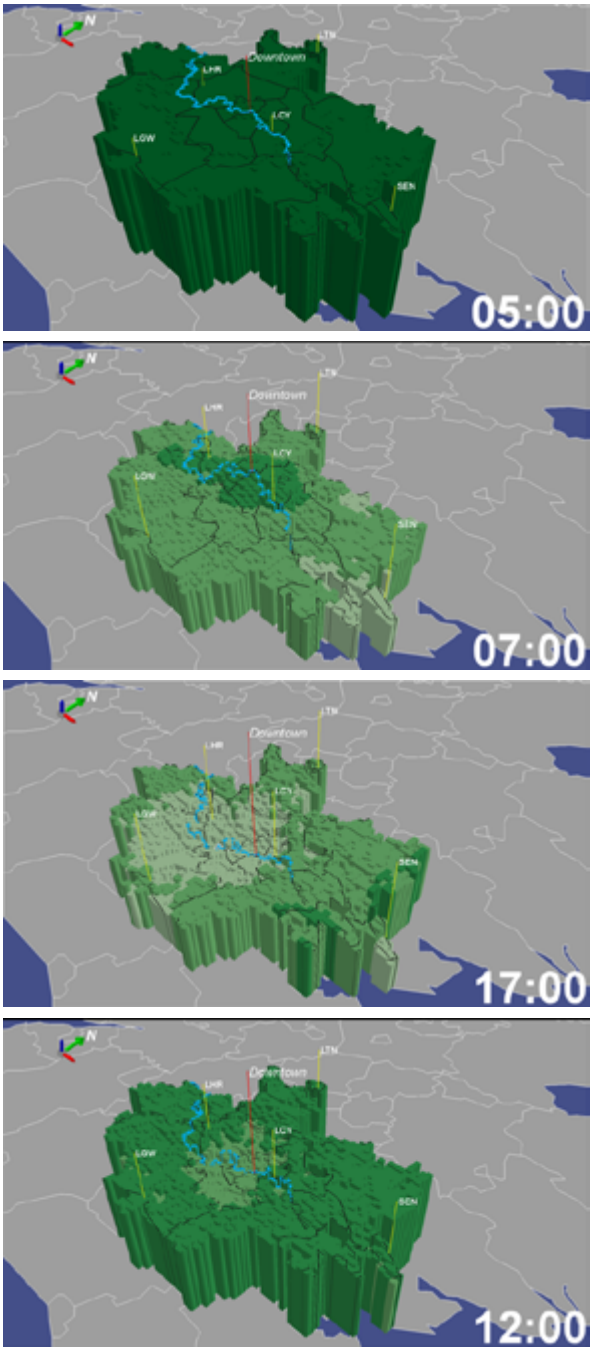

Figure 5: Cartogram of the distribution of accessibility losses in the city of London. The height of the bars shows the relative loss of accessibility, the lower the bar, the greater the loss of accessibility for that space. Two moments in time from an animation published in the Journal of Maps *are shown*

cartograms, the way the size of the city of London changes as a consequence of congestion is represented (figure 4). These cartograms show the boundary of the city of London and the location of some of its reference elements (the River Thames and the location of its airports). At night, in a free flowing situation, the real size and form of the city can be seen. As congestion increases, however, the size of the city 'grows'. This growth is proportional to the increase in distance times from the reference points to the centre of London. The city grows significantly in the early hours of the morning, when the access roads to the centre are congested, and also in the evening hours when people leave work. In addition to the dynamic cartogram, a 3D extruded map has been created showing the different levels of accessibility obtained in each grid cell and at each time (every 15 minutes). The height and colour of each column represents the level of relative accessibility compared to the free flowing situation. The animation shows how accessibility is reduced as congestion increases. Thus, during the night, in a free flowing situation, all of the cells have the same height, while the heights decrease in the moments of greatest congestion, and do so more in those cells whose accessibility is more affected by these losses (figure 5).

4. Final considerations

In this text, we have sought to show the opportunities provided by the new data sources in the analysis and representation of different urban dynamics, relying on forms of animated cartographic representation. This form of representation allows us to take advantage of the time aspect of the data, especially that which shows the daily dynamism of our cities. Using new data and maps, we can address new research topics or old topics from different perspectives.

In order to do this, however, we need to thoroughly understand the nature of new data sources. Our goal in the first part of the text was to describe the characteristics of new data and, depending on them, the advantages, limitations and challenges they present. We have to face new challenges effectively and, fortunately, geography is in a favourable position to tackle them. In Geography we have often had to work with large databases, with remote sensing and with GIS. The data was not massive, but it was cumbersome and tedious to handle, which forced us to automate processes and find solutions for its management. GIS and remote sensing has enabled us to deal with data processing tasks that are somewhat similar to those that need to be done with big data sources.

Working with space- and time-referenced data is obviously not new to geography, so we should be well positioned to deal with the new scenario. Spatial analysis techniques, for

example, the typical overlaying of layers in a GIS, make it possible to enrich data and overcome some of the limitations presented by new data sources. Analysis and spatial statistics facilitate the interpretation of data and obtaining research results. Finally, the management of maps also puts us at an advantage when it comes to visualising and presenting the results in a didactic and attractive way, and adapted to the need to represent information in the dual space-time perspective. We are in a good position and we should make the most of it.

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Historical cartography of the world during the middle Ages, so different the conception between Islamic and Cristian view?

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Abstract

During the middle Ages, and with the expansion of the Islam in Europe, we find, apparently, two different worlds, but which base on the same cultural sources: the classic world. At the same time, each one creates its own cultural conception, where the cartography is included. In the Islamic case, it combines the Greek tradition with the Balkhi school, which reflects its own political and religious systems. The cartographic production was born of this union is a continuation of the Greek style, and that appears in works such as those of Al-Idrisi, Al Byruniy or Al-Ma´mun. On the other hand, cartographic works of the Christian world are mainly in monasteries, places with money and expertise hands. Its world vision is based on the maps known as T-O, which are extremely similar to those of helenic tradition and, finally, to Islamic conception. Some examples of this rich production are the world maps of Albi, Hereford and Ebstorf. Through the comparison between maps of both traditions, we can stablish a similar development and a view of the world under similar religious concepts. The differences between the both cultures that were remarked along the history, fall when it comes to cartographic terms.

Keywords: cartography; christianism; islamism; tradition

1. The challenge of analysing the conception of different cartographic cultures

When it comes to analysing different cartographic backgrounds, first of all we should clarify the different meanings connected with cartography or map. In this way, Harley and Woodward (1987, 16) pointed out that the maps were "graphic representations that make easier the special comprehension of things, concepts, conditions, process or events of human world". Draw on this idea, Hansen (1995, 5) explained the concept of cartography as graphic information related to a partial or total part of a space, and together with previous studies, he contributed to a new cartographical caption, which until that moment conferred to the map a neutral one-it means, impartial-, as it has been though by experts such as Robinson (1952, 1976). The new interpretation of a map implied the analysis of the context, mapmaking, techniques, interests or social conditions that surrounded it, and got away the word impartiality. In the new definition, maps acted as guardians of power (Harley, 2005: 82), so they described the history depending on the someone´s interests. In this way, Pickles considered the process of mapmaking was a creation of new objects, new perspectives of the world, but never a real or objective reality ((Pickles, 2004: 3).

Following this idea, for geography such as history – complementary disciplines, the cartography, a branch of knowledge relative to both of them, is, only the perception of the spectator in the moment. The selection of information in the maps is by will and personal choice (Crampton and Krygier, 2005: 11-33). For this reason, the analysis from the present not only should be executed over the maps, but over the political and social contexts behind them.

However, we should not forget that the researcher´s opinion is subjective and the assess of a document depends on a point of view, thoughts, motivations, knowledge and ideas. How could be the same study, one made by a historian than another one made by a geographer? Even two geographers did not have the same answer. Each person has his own world vision and it is very hard to guess those thoughts that the mapmaker had at that moment, to know what the mapmaker wanted the spectators think about the map and see through it (Niemann, 2012).

The observers of cartography must take into account that a mapmaker created in a precise moment his own vision of reality, showing a mental projection that cheats the observer. We can talk then about manipulation, which comes from acquired rules during the learning process, and which differ depending on contexts and social traditions. In this aspect, Foucault can be demonstrative:

*The rules allow us to make judgements, allows us these judgements would be identified as true and others as false, they allow us to build the mapmaking, a model or a classificatory system… (*Philp, 1983: 29-52).

But, manipulation is difficult to be analysed. In this sense, comparing different cartographic systems can be clarifying (Gombrich, 1975: 119-149). Through this action, the spectator obtains a clear visual communication of different models of reality, but not a complete image because society assumes an specific scientific result, and rejects the idea of analysing the ethic precision of each map as a partial certain (Arnheim, 1986: 194-202).

For these reasons, we have decided to show that, despite of different cultural, social and political context of Islamic and Christian cultures, the background is the same. The veil of imposed rules by the power falls in terms of cartography, which reflects the same way of thinking, acting and understanding the reality of the world, understood as a cultural idea more than a geographical one. Latin Christians and Islamic people shared the same background. The scholars of both religions and who worked in different spheres of knowledge were influenced by geographical and cosmologic traditions of Greece and Rome, based upon the Greek idea of the world as "*oikoumene*". However, at first sight, it seems that the evolution of both cultures during Middle Ages, went to a different development of the world idea.

The long medieval period allows us to see the different structures created around the world idea and its evolution (Relaño, 2002.). Whereas in the Latin Christian tradition, the differents part of the Earth or Imago mundi played an important role in politics, the Islamic tradition did not take into account. Both of them imagined a world divided in three parts, but while the first one remarked the presence of three continents as an immovable structure, the second one were always opened to other possibilities. Although, we are aware of each map supposes an unique element, the goal of this study is to make a generalization from specifics observations and put together the common characteristics of each tradition (Swedberg, 2005:119–121).

2. The ideas about the world in the Antiquity: the origin of everything

The main idea developed by the Greeks since the 5 century B.C. in terms of cartography was a world or *oikoumene* in which the Mediterranean Sea was the centre and surrounded by soil. However, the difficulty was where the boundaries were.

Hecateus of Mileto, who lived in the 5 century B.C. considered that the world had Asia and Europe. This idea was reflected also in the Roman context, such as Marco Terencio Varro, Seneca or Marco Aurelio (Roller, 2015: 50; Dueck, 2013, y Sonnabend, 2007). The difference, although the number was the same, was the form. They had to wait until Herodoto, in 424 B.C., who thought about the possibility that another continent existed, called Libya, thought as part of Asia and which was, in fact, Africa (Roller, 2015: 51; Zimmermann, 1997; Sonnabend, 2007: 60; Lewis y Wigen 1997: 22; Oschema, 2013:108). More authors, without no possibility in knowing where the boundaries were, stipulated that the water was.
For this reason, the Tanais river-Don-, in Russia, was the limit between Asia and Europe. Polibio, doubting about the boundaries between Africa and Asia, stablished the Nilus river as natural limit. Decisions that remained along

Figure 1: Cosmographia *of Claudio Ptolomeo, 1482, Biblioteca Nacional de España*

the centuries (Oschema, 2013: 109–111 y 209–218). Moreover, Greek and Roman authors did not discuss only about continents and boundaries, but also for the size of the planet, something joined to the idea of civilization. Herodotus excused the size of Africa accusing the lack of life opportunities. Plinius, on the other hand, stablish that the world was divided in twelve parts, corresponding five to Europe, so it was superior than other parts (Sonnabend, 2007: 61.). Ptolomeus thought of a figure of the Earth as a circumference of 31.000 kilometres of diameter, data that was reproduced by Pierre d´Ailly in his book Imago Mundi and settled the basis for the calculus od different routes from Europe to Asua, such as Cristopher Columbus did in 1492.

Figure 2: Map of Zones of Macrobio. 10th century a.C.Berlin, Staatsbibliothek Preußischer Kulturbesitz, Ms. Phill. 1833, fol 39v

Another essential question thought by Greek wises was the division of the planet in climates or latitude fringes. Related to that, the knowledge of Alfagrano about climates, latitude in degrees-stablished in one degree like 56 miles and 2/3, is remarkable. This means that the world, from Spain to India by the East, was more than the half of the circumference. This model would be known in the Middle Ages as the Macrobius system or zone maps.

Figure 3: Macrobius Map included in a German manuscript of the 11 century A.C.

All the authors implied in the discussion about the geographical order accepted the existence of three continents or pars mundi as an absolute true. Although

some books of that time and the beginning of the Middle Ages, such as Paulus Orosio, Marianus Capella or Saint Isidorus of Seville, reflected questions without being clarified, the division was the model to be followed and its origin desappeared.

3. The Latin Christian cartographic tradition: the first daughter of Ancient heritage

The Latin Christian medieval tradition characterized along the centuries for her T-O maps. Orbis Terrarum maps were a cartographic pattern that appeared firstly in the Etymologies of Saint Isidoro of Seville but, in fact, was a reintroduction of a Roman cartographic tradition created by Marco Vespasiano Agripa, general and close person of the emperor, Caesar Augusto, from who we know that asked for a world map with all the data obtained during his trips.

Figure 4: T-O map in the Etymologies of Saint Isidoro of Seville in the 12 century A.C. The British Library, signature c5933-06, Royal 12 F. IV; folio - f.135v.

This cartographic tradition represents the three known continents: Asia, Europe and Africa, under the silhouette of these two letters (T and O). This kind of maps were not only for nautical purposes but were a book of Biblical events such as the salvation history, knowledge of vegetal and animal kingdoms and the world of myths and monsters. The superior half of the circle was occupied by Asia, and it was a clear theological influence-although it was based upon previous cultures, with the Christians acquired a new sense-, because it emphasised the Biblical meaning of Orient (The Terrene Paradise was in the Extreme Orient). Moreover, it was the origin of "orientation", because all the maps were situated with Orient in the superior part of the map and not with our North-which appears with Ptolomeus and was popularised with Mercator-. On the other hand, Europe was in the left side and Africa was in the right side of the T. In the Christian conception, they represent the Trinity. The existence of another continent, called Terra Australis, a mythical continent placed in the South, was an speculative issue during Middle Ages, but the Holy Church rejected because a fourth continent was incompatible with the heritage of Noe, divided between his three sons. Moreover, the add of Africa created a debate because only the habitable world can be represented, and population did not know if Africa was habitable. The Mediterranean Sea is the vertical part of the T and the Niles, Dardanelles and Black Sea are the horizontal one. [(Falchetta, 2006: 637–639, (n.º 2489) and 641, (n.º 2506). The O symbolised the sphere of the Earth, the seas that surrounds the planet, as the Aquiles´shield made. The place of water indicates its representation as communications and commercial lines between cities (Barber, 2006: 10–13; Reichert, 2013: 31–33).

Figure 5: T-O map, Etymologies of San Isidoro. Tours, Bibliothèque municipale, Ms. 844, fol. 110r

Being made in religious environments, the main idea of T-O maps was to reflect the symbolic world, a religious vision. In the case of Latin Christian maps, the distribution of the world is a T as a crucified Christ, reason why some of them were in the walls of some churches, such as the Hereford map. Their design was modified along the time, changing from a sphere to an elliptic or oval, as well as the Christ position, changing from hanging in the cross to blessing. The idea that the mapmakers wanted the spectator see in

the Orbus Terrarum was the divine perfection when God created the Earth and whom centre was Jerusalem.

Furthermore, map worlds accomplished the goal of geographic atlas. Maps were full of recognisable places and that allows it to seem a current map. For example, it is the case od Ebstorf map which can be catalogue as the most ancient map of Germany because the representation of cities, rivers and other topographic elements have no precedents, overall in the part of the North, in other words, Lüneburg-Braunschweig and its evironments.

Figure 6: World map of Salterio in Westminster, c.1260. This map is a classic example of Christian encyclopaedic world maps

However, these map worlds were not only geography teacher, but travel guide. They wanted to show the places that the tourists should visit at that time or what obstacle the traveller could find. Despite of the current belief about people during Middle Ages did not travel, nothing more far from reality. Common citizens travelled too. Prosperous farmers could make peregrination trips to Rome, Santiago of Compostela or Jerusalem. However, poor people of solemnity could look at maps and know these sacred places, although the way was metaphoric, such as for example Ebstorf and Hereford maps did. In the case of Africa, was not visited. It was remarked the non knowledge and fear that these lands provoked since Plinius the Old, who in his Natural History, made reference to "the inhabitants of Africa dig in the Earth and use the holes as houses; the meat of snakes is their food, they do not have voice, but something like a roar; and the do not have language" or "the do not have heads, but their mouths and eyes are in their chests"

Figure 7: MONIALIUM EBSTORFENSIUM MAPPAMUNDI, *attributed to Gervasio of Ebstorf, ca. 1300, Lüneburg Museum*

Additionally, the T-O maps wanted to show Biblical and historical events of the world. They show exotic cultures, where wild animals and monsters live, as well as historical events, famous kings such as Alexander the Great, Greek legends as for example the Minotaur labyrinth in Creta and the miracles od some saints, emblematic facts like Noe´s arch, etc. Finally and undoubtedly, they had a decorative task, because the bare of the church walls, despite of being coloured at that time, needed objects (Mauntel, Oschema, Ducène y Hofmann, 2018).

The image that we observe is not the exact one from medieval worldview, neither from a Christian one, because in the Islamic culture they have also these examples. In other words, although Saint Isidoro of Seville it is the first one in reflecting in his Etymologies this conception, is a derivation from Roman Empire, lost with the exception of the Tabula Peuntingeriana. Despite of being a derivation from previous works, the confer a new scheme. The continuous copy during years without knowing the basis led to the change in a lot of details, such as the exaggeration or elimination of something that the copyists thought as a geographical mistake. The result was, from 8th century A.C when the first maps appeared, the creation and fixation of a cartographic pattern. There are different theories about what it represents: one of them suggest that the representation of a equilateral triangle is the Trinity

and the circle the symbol of perfection. In this way, the observer found a divinity representation in the Earth. The conception of the world in three parts finished in the 15 century A.C, even when other patters or tendencies have been created, as the case of nautical charts. A proof of this coexistence is the Fra Mauro world map (1450. D.C.), considered as a reference work because of its perfection in contents.

Figure 8: Il Mappamondo di Fra Mauro, de Fra Mauro, ca. 1450, Biblioteca Nazionale Marciana

4. The Islamic tradition and its conception of the world

If we compare the Islamic cartography to Christian maps, the first one shows a great development related to design and geographical knowledge. Although if we deep into the analysis, we discover big similitudes between both traditions. After the conversion of Persia in the 654 AD., the Greek culture was combined with the Islamic, being developed the last one at a huge scale until the 19 century. The inclusion of classic knowledge made that, in some aspects, the background would be the same that the Christian culture.

The idea of the world is the best example. The Isamic tradition looked for the boundaries of the inhabited space, zona habitabilis for Latin culture and "rub' al-ma'mūr" for Arabs. In this way, the inclusion of Greek cartography stands out, that is, the division of the world into climates and surrounded by "al-baḥr al-muḥīṭ" or bodies of water. Livable world that stretched 180º between the so-called Eternal Islands or Canary Islands and China. Islamic cartographers thought that the world was divided into four parts by the equator and the meridian, with only a quarter of the northern part being inhabited or "fr 'al-ma'mūr". In turn, the world was divided into seven climates that gave the population certain characteristics. However, there are discrepancies between the Arab-Islamic authors.

The Hellenistic continental divisions appeared in some works, while other Arab authors preferred a different system. In spite of this, it has been proven that this last conception was also not outside the Greek influence, especially of Ptolemy. Ptolemaic ideas were very present because, while in the West it came by translations, that is, secondary routes; In the case of Arab schools, Greek knowledge was acquired immediately after the conquest.

Proof of this is the use of his works in the project initiated by the Caliph Abbasida al-Ma'mûn in 833 AD, the cause of the Persian cultural revival and central axis of the so-called Golden Age of Islamic culture. He also promoted the so-called "School of Wisdom" that his father Al Rasidh founded in Baghdad, in which he ordered translations of Egyptian, Indian and Greek books into Arabic. The most important cartographic project he carried out was known as "ṣūrat al-ma'mūniyya", or the "ma'mūnian map", and preserved in the work of al-Ḫwārizmī, allows us to appreciate that the most used source of names for the Arab cartographic works was the Geography of Ptolemy.

The unprecedented Islamic cultural growth also manifested itself in the fields of mathematics and astronomy, disciplines intrinsically related to geography. This is also demonstrated by Arabic literature, which specifies that Al-Bīrūnī (1048 AD), who calculated the obliqueness of the elliptical and the terrestrial radius, and whose knowledge was not surpassed until after the 19th century. This, copied by Yāqūt (1229 AD), claimed that Greek scholars divided the land mass into three segments: Libya ("Lūbiya"), Europe ("Awrafī") and Asia ("siyā"). (Yaqut, vol. 1: 73). Also, to compose the image of the global world map, both Christian and Arab elements were used, and therefore, Greek. For example, Al-Bīrūnī uses the same Christian system when it comes to dividing the world, and therefore, humanity. While the Christian religion did it among the three sons of Noah, in the Islamic tradition the division of the land between the three sons of the mythical king "Afrīdūn" and the seven "kišwār". In the first case, place names are used

to describe parts of the world; in the second case, the "kišwār" constitute a coherent set of populations, which are situated in relation to Iran, but whose exact location is not clear. (Ducène, 2018: 59).

Figure 9: World map of al- Biruni from "Astrology elements"

And although, first of all, the own Arab system was judged as different from the Greek, and therefore to the Christian, both were a conjugation of the same idea, as demonstrated by the work of Al-Idrisi in 1166. This geographer, born in Ceuta, is the clearest example of the problems and similarities between the two theories. The knowledge coming from Ptolemy made that the main error of the ceo geographer resided in representing the world. He used both systems: the Christian division according to which the world was divided into seven climates or strips parallel to the equator, and the Arabic version, and fruit of the studies of astronomers, according to which the Earth has ten parts from West to East. These areas were identified with ūrufī ", which represents Europe and North Africa to the border with Egypt; "Lūbiya", which represents Egypt, Ethiopia and the Indian Ocean; "Ityūfiyā" (Ethiopia), representing Arabia, Yemen, India and China or "Usqūtiyā" (Scythia), representing Asia (Ibn Hurraddbih: 115). When using Ptolemy's climates, he had to change and deform the routes and distances according to the zones (Olsson, 2014)

Figure 10: Núzhat al-Mushtak fi-khtiraq al-afaq in Kitab Buyar, of Al-Idrisi, 1153, copy from Bodleian Library

Al-Idrisi unites in his work the three civilizations existing at that time: the Islamic world, the Byzantine Empire and the Christian West (Al-Idrisi: 6, 7, 17, 43, 103, 221, 939; Ibn Nagib: 11, fol. 3v). When he began to make it, he was critical with the most traditional sources, that is, he doubted dividing the map by zones or climates, and collected a lot of data from contemporary authors, navigators and explorers, as well as Greek books that gave instructions to navigate, known as Periploi, name that comes from sailor Scylax, who made a "periplus" or compilation of his trip around the Mediterranean in 350 BC (Pinto, 2016, p. 62–67; cf. ibid., P. 143–145). The union of elements of the three civilizations is also exposed in the introduction of biblical and fantastic elements as significant as Gog and Magog, typical of the Western Christian conception.

However, it was not the only Arab-Islamic tradition since Sahl Al-Balji (850-934) initiated a new tradition in clear contrast with Greco-Islamic and that contributed greatly to the evolution of world perception. In this world school it was represented surrounded by a body of water, the ocean (muhit, "ocean; what surrounds"), and a large part of the southern quadrant is of the mainland, which corresponds to the African borders. In this composition, both the Mediterranean Sea and the Indian Ocean are listed as gulfs of the surrounding ocean, whose waters approach in the Suez Isthmus. The Indian Ocean, despite appearing connected to the Pacific, is not connected to the Atlantic, which would soon find a solution. The high level of detail of the maps elaborated according to the uses of the Al-Balji school, especially in the provincial and regional

Figure 11: Núzhat al-Mushtak fi-khtiraq al-afaq in Kitab Buyar, of Al-Idrisi, 1153, copy from Bodleian Library

ones —very numerous in the case of the peninsula of Arabia, Iran or Al-Andalus— clearly distinguishes them from the that were drawn according to the Greco-Islamic tradition, more rudimentary. Another of the differentiating elements consisted of the type of divisions present in their maps. For the first time in the Islamic cartographic tradition, the authors began to consider geographical barriers as the elements on which they would rely to draw their divisions. This would, in the end, be a conceptual progress.

Figure 12: World map of al-Qazwīnī (Al-Balji), 'Aǧā'ib al-maḥlūqāt. Gotha School, Forschungsbibliothek, Ms. Orient. A 1507, fol. 95v–96r, copy made in 1622

We do not have to think that only the Western Christian world wanted to have knowledge about what Muslims were doing. These translations were bidirectional, in other words, there are also examples of maps from Christian tradition translated into Arabic (Pinto, 2018), thus showing great connectivity at the cultural level. The fact that has surprised the scientific community quite a bit is, despite representing a work, in chronological and geographical terms, that connected the Muslim and Christian world, to stay away from the learned Christian centers of Sicily, Italy or other centers of power; while other Arab disciplines such as calendars, star charts or horoscopes were the main basis of knowledge of the West. Gerard de Cremona, the wise man who translated many Arabic writings into Latin, seemed to have no record of the existence of this geographical work.

It is also remarkable that the development of maps typology is the same, in other words, it goes through from a sphere where the world is divided into three continents separated by rivers. The exponent of both worlds, Christian and Islamic, would be the "beatos", whose basis is that of Liébana, lost today, and the oikoumene of Ibn Ḥawqal of the 12th century (Ibn Hawqal: 3101, fol. 52v-53r).

Figure 13: Beato of Saint-Sever (11th century), based on Beato de Li.bana´s map (8th century)

Figure 14: Worldmap of Ibn ḥawqal, Kitāb ṣūrat al-arḍ. Istambul, Süleymaniye Kütüphanesi, Ms. Aya Sofya 2934, fol. 19r, copy made ca. 1200

Finally it is worth highlighting the style. The polychromy in the maps is very similar, in the Christian tradition as well as the Islamic one. On the use of different colors, just as Christians had done, to highlight geographical elements we have the testimony of al-Ma'mūn's map: "he uses color to distinguish the mountains from the Earth - red, yellow, green , etc. and set the number to more than 200". (Ducène, 2017: 75-77.) This polychrome iconography can also be found in the description of other maps of the same tradition. Isn't it surprising that in a world that seems divided, where at the political level, the crusades are the only link, there are more remarkable coincidences? In this way, we can appreciate that there are more elements that unite that separate.

5. Conclusions

Finally, if we compare Arab-Islamic maps, such as that of Al-Idrisi, with those that were being developed in Christian monastic centers, Arabic cartography shows a great development in terms of design and geographical knowledge.

Our study of the cartographic strategies used to represent the globe has led to the identification of a series of notable similarities between Latin-Christian and Arab-Islamic cartography. The most obvious of these relates to fundamental spatial notions. In general terms, after establishing the formal characteristics of the world maps, we can ask to what extent the cartographic development was individual, to what extent the specific cultural, historical or geographical characteristics of the Christian-Latin and Arab-Islamic cartographers influenced. It seems that the wonders of Asia and Africa dazzled both communities, that the same waters divided the world and that only three continents could exist.

The built and artificial character of this system of ordering the world only becomes visible through comparison: the Arab-Islamic and Latin-Christian traditions inherited the same Greek and Roman model, did not use them differently and did not produce an original cartographic traditions. The only thing we intuit through the discursive traditions analyzed is the concept of established space, which resulted in the beginning of a systematic use of cartography as a means of building territorial relations between two seemingly disparate cultural spheres.

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Teaching with GIS at the University, a proposal for employability: the Erasmus + MYGEO project

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Summary

It is a proven fact that the training in Geographic Information Systems (hereinafter, GIS) of students improves their employability. Thus, this training is the main objective of MYGEO project, which promotes the acquisition of key skills related to the use of GIS tools in higher education using two lines of action: first, focused on higher education teaching, promoting the use of GIS as transversal element in an increasing number of subjects; second, highlighting the importance of collaboration between universities and companies environment, as a source of mutual exchange of knowledge and experience based on the study of the needs of GIS industry regarding the demand for labor market. For these aims, a survey of the European GIS business has been launched and internships are being carried out in different companies from several European countries involved in the project, in order to validate the learning usefulness, but also to disseminate knowledge through a GIS portfolio.

Keywords: Geographic Information Systems (GIS), higher education, TPACK, Competencies, Big Geo Data, Professional profile.

1. Introduction and objectives

The improvement of the technologies applied to the geographical location or spatial reference of the entities and their integration in business is a n increasingly widespread fact, as is the case with the increasing number of geo-located services. Thus, there is a large number of jobs that today require skills related to Geographic Information Systems (GIS) and geo-location (Wilson, Wilson and Martin, 2019), for example, those related to the Cadaster, Land Registry, Common Agricultural Policy, precision agriculture, archeology, cultural heritage and more than a thousand performances described in the selection made by GIS geography (2019). In fact, in many companies GIS skills are demanded in their new hires, both those related to digital competence in generic aspects (analytical and critical thinking, entrepreneurial spirit or interpersonal communication), as specific to GIS (data collection; management and knowledge of the information offered by the services of the spatial data infrastructures and images from the observation of the Earth from space; as well as the subsequent storage, analysis, distribution and visualization of the information obtained).

Thus, the framework of Geographic Information Technology (GIT) or GeoICT expands, extends and changes (Ricker and Thatcher, 2017; Rickles and Ellul, 2017) acquiring a scientific character, so we can speak today about neogeography and Geographic Information Science (GIScience) (Goodchild, 2009). However, the difficulty of GIS and other technologies is known, both in their daily employment, and in their learning (Rickles, Ellul and Haklay, 2017). Despite of this, most of the university departments of Geography in the world are focused on teaching GIS tools itself (Carlson, 2007) as an essential part of science geographical either in person or remotely, as with one - third of the masters in GIS (Lukinbeal and Monk, 2015), with a growing participation of students in them.

The most widespread way of teaching GIS is to first explain the theory and then offer an exercise (Álvarez-Otero and Lázaro, 2019), as a laboratory that exemplifies the theory explained (Walsh, 1992; US Geological Survey, 2005). In general, fieldwork is not considered an essential element in the classes of GIS.

Therefore, we can say that teaching GIS as a specific subject, whether compulsory or optional, is a common occurrence in most universities that, from different sciences, have discovered the importance of Geographic Information Sciences. However, using GIS as another resource when teaching in different branches and subjects of geography is a fact that is beginning to be raised in university classrooms in recent years (Lázaro, Izquierdo and González, 2016; Carter, 2019; Mathews and Wikle, 2019). This possibility, more and more extended, derives from an increasing usability of GIS tools, which technological progress is fostering. Understanding usability of the product's ease of use, consistency and response time (Jiménez *et al.,* 2014).

In this context, MYGEO project arises, "Geo tools for Modernization and Youth employment" (2018-1IT02-KA203-048195), which defends a teaching methodology based on digital competences focused on the necessary aspects for the use of GIS in University teaching activities. It is a digital teaching competence applied in order to improve student learning and GIS competencies aimed at allowing the student to have a greater facility to access the job market. Higher education should go beyond using GIS as a separate subject in order to study the tool. It must be intended to encourage its use as a transversal element in itself teaching. So, MYGEO it is based on the following questions: What training university teachers need to teach the geographical subjects by using GIS so as to improve the learning experience? How to find a pedagogical use of GIS in the process of teaching and learning geography? How can GIS contribute to acquire professional skills? What is essential in academia and what is essential in the industry? How can match each other?

Thus, the aim of this paper is to apply a methodology to investigate the skills to develop by college teachers to integrate GIS as crosscutting element in higher education on geography and other Earth Sciences or Regional planning programs. Some of them are key competencies, necessary for all students, of all ages and everywhere. They are transversal, multifunctional and nonspecific; that is, they are not linked to predetermined contexts and situations (Murga, 2018).

The result of the applied methodology will offer GIS skills and competencies. We can remark that this paper uses a different methodology that the theoretical framework derived from Bloom's taxonomy and those employed by the ANECA or by Rodriguez *et al.,* (2016). The methodology followed aims to provide the university teachers ways to apply GIS in the subjects they teach. For this it has been necessary to also consider the point of view of the students using a questionnaire: they have shown their perception of what they are going to be asked in a job in the framework of the labor market; on the other hand, the needs of the GIS industry in relation to key competences of the companies and specific GIS competencies.

2. Methodology

For these purposes a research methodology is proposed for the educational community (teachers and students) and for companies: (1) investigating which teaching methods are the most appropriate, observing those university professors who use GIS in teaching their own subject through a bibliographic review in databases such as Web of Science and others; (2) Faculty focus groups about the training needs to use GIS for teaching; (3) Students focus groups based on a questionnaire about their thoughts of labor market GIS needs; (4) analysis of GIS industry regarding to GIS competencies.

The expected results are two curricula: one for university teachers to improve their GIS use in everyday teaching; and another designed to provide students with the training that the labor market demands.

3. Research design for obtaining results

3.1. Teaching geography in higher education using GIS

It is not an easy task to explain a subject or a topic related to the geographical space using GIS tools, as it requires GIS specific skills, so few teachers use GIS as a transversal element to teach geography (Shin, 2006). The achievement of this objective would mean that the traditional descriptive character of geography would be transformed by GIS competencies into meaningful, critical and intelligent geospatial thinking. This line is followed by the expert panel *GIS Body of Knowledge* (BoK GIS & T) defining theory, method, and technology (Wilson, 2014) and describing various GIS skills, so that the geo-technology would naturally integrated in the teaching speech (oral, written or in distance), using different models of teaching and learning (Voogt *et al.,* 2013; Tømte *et al.,* 2015; Melo, 2018). The first result of this analysis points to the TPACK model (knowledge of technological pedagogical content) designed by Mishra and Koehler (2006). Therefore other authors such as Hong and Stonier (2015), Rickles, Ellul and Haklay (2017) or Su *et al.,* (2017, 2019) agree that the model is well adapted to the use of the GIS technology as appropriate for containing geography integrated in various educational or teaching techniques.

3.1.1. TPACK model

Faculty using TPACK model integrates the three dimensions —technology, pedagogy, content knowledge— (Schmidt *et al.,* 2009; Drummond & Sweeney, 2017; Gómez Trigueros, 2018; Alvarez-Otero and Lazaro, 2018). This model involves the following questions:

a) Contents. What about in relation to the science itself? Teachers usually select the most relevant content of the subject to be taught. The great variety of contents of Geography goes beyond the traditional fact of considering it as an isolated discipline and synthesis science, towards the opportunity offered by its transdisciplinary character. Clark and Wallace (2015) define the transdisciplinary as the absence of boundaries between disciplines. Their potential to locate elements and entities in space related to any subject or science, make it auxiliary science of many other sciences, since it allows observing relationships and trends of elements or entities on the Earth. Some authors consider that the student should go beyond the study of the very scientific, and must also acquire basic skills needed for any science. In a similar way, Rip, van Lammeren and Bergsma (2014) have pointed out that there are three principal GIS skills: GIS-Web skills and other related as web services, web mapping, web tools, web sensors and participating web as story maps; skills for mobile applications based on geo-location; and programming skills requiring Python (Etherington, 2016) or R (Lovelace, Nowosad and Muenchow, 2019) integrated into a GIS.

b) Pedagogy. Some good practices have been selected from higher education teachers from literature review. It has been observed that teachers employ investigative techniques, flip teaching, field work combined to geo-catching, collaborative work and project-based learning (PBL) or problem based learning.

c) Technology. What tools are most appropriate to use for the teaching-learning processes? Integrating GIS tools directly, synthetically and applied in the subject to be taught is the objective pursued. For this, the technology is related to the topics of geo-technologies (De Miguel, Koutsopoulos and Donert, 2019; Delgado-Peña and Subires-Mancera, 2019), geo-data, big (geo) data (Goodchild, 2013; Gutiérrez-Puebla; García-Palomares and Salas-Olmedo, 2016), digital geo humanities (Dear, 2015). Thus, it is technology integrated in the geo-location, as affirm Rickles, Ellul and Haklay (2017) for the locational element as one of the most important parts of the geographical analysis that can be performed using GIS. Besides this, there are opportunities provided by many geospatial information sources, like Spatial Data Infrastructures, remote sensing images (Copernicus and Sentinel) or the data obtained by satellite navigation systems (GNSS), for example the American GPS or the European Galileo. With these technologies, it is also possible to collect a huge amount of personal data, for example, through geo-located surveys, such as survey123 or others.

All the data obtained will be thus referred to a specific location. The interaction of technologies focused on processes of landscape dynamics are defended by Petrus and others (2015), so we talk about geo-tools, which are tools that allow geographic analysis, and in

particular geographic information systems. Other tools of interest for geo-location are the Open Street Map (OSM) initiative, Wikimapia or MyMaps (Google), among many others.

Once the data are obtained, referred to the contents of a particular subject, the technology will allow them to be stored, analyzed and presented in the most appropriate way for efficient visualization, which leads to a more advanced technological level with 2D and 3D models. In this way, the cycle of integrating content, pedagogy and technology is closed, which will allow explaining the concepts of geography using GIS and focusing the contents in the essential concepts, leaving apart the debate of using open source software Sui (2014). The reflections, provided by the various rounds of the focus discussion -organized with the participation of Faculty from the four Universities participants at the project universities-, allowed writing a first draft with the basic elements that a course should have for teachers who want to use geospatial technologies as a transversal topic. The result of all this work is a layout that contains the most relevant elements that a geography teacher should know to teach geography in an efficient way using GIS for a massive open online course. This MOOC will bid in 2020 from the UNED Open platform.

3.1.2. The design of a MOOC that responds to the needs detected

For Petras *et al.,* (2015) teacher training should follow these steps: readings, small practical graduate examples (workshops) and a final project for replication and problem solving about what has been learned.

Besides this, some other relevant conclusions can be highlighted in order to integrate in the MOOC "Geospatial Tools for University Teachers":

a) Address the disciplinary contents of geography and other sciences with an spatial basis: data source management (servers information, geo-information downloads, processing, analyzing and visualizing geo-information), integration of the data with GIS in the cloud or with story maps, as some ways for developing interactive digital mapping in the 21st century.

b) Exercises with progressive difficulty will be provided, which in a sequential way, show the theory explained using the inductive method, the deductive, apply investigative techniques, *flip teaching*, field work -integrating *geocaching*, collaborative work and project-based and problem-based learning.

c) Other technological tools of interest for the different sciences are geo-located surveys, the Open Street Map (OSM) initiative, MyMaps (Google), Global Satellite Navigation Systems (GNSS), such as GPS or Galileo, for mobile devices. In another level, remote sensing or Copernicus program, digital models of terrain or 2D and 3D models. In the last decade the majority of citizens have participated in one way or another in the production of geographic data or in the generation of geographic information on a voluntary basis (Sui, 2014: 13). Some notable examples are the aforementioned initiatives OSM, Wikimapia, which are mash-ups created by users through Google Earth.

At the end of the course students will master: obtaining data through a geo-located survey from a GNSS (GPS or Galileo), assessing the usefulness and quality of Spatial Data Infrastructures (SDI) (Alvarez-Otero and Lazaro, 2017), storing, processing and analyzing geo data using GIS tools, and visualizing and communicating data through cloud GIS in the cloud. Thus, all these GIS tools and skill will be useful for the teacher to teacher their respective courses, whether geography courses or another topics.

3.2. Learning Geography at the University using GIS

Needs for students have been obtained using the aforementioned focus groups. These discussions have been organized by the four participating universities, in order to agree on a training program that will have as outcome a second MOOC, this exclusively for students. Besides this, some government and GIS specialized companies have participated in a separate semi-structured questionnaire. Thus, students and companies, independently, should choose to prioritize the importance of two types of skills for professional performance, generic skills or GIS skills. Some of the items for the questionnaire come from the GIS Body of Knowledge, as well as other relevant publications (Alqvist, 2017; DiBiase, *et al.,* 2006; DiBiase *et al.,* 2010; Unwin *et al.,* 2011). Preliminary results have determined four generic skills (table 1) and four GIS skills (table 2).

1. Analytical and critical thinking	2. Business competences	3. Interpersonal skills	4. Technical competences
- Creative thinking - Knowledge management - Model building - Problem solving skills - Research skills - Technical writing - Technological literacy - Systems thinking	- Ability to see the "big picture" - Business understanding - Buy-in/advocay - Change management - Cost-benefit analysis (ROI) - Ethics modeling - Industry knowledge - Legal knowledge - Organizational skills - Performance analysis and evaluation - Visioning	- Coaching - Communication - Conflict management - Feedback skills - Group processes understanding - Leadership - Questioning - Relationship building skills - Self knowledge / Self-management	- Geospatial sensor - Cartography / Graphic representation. - Computer programming skills - GIS theory - Photogrammetry - Topology - Communication network - Storage technology (data formats included) - Spatial reference systems - Mobile - Scale and resolution

Table 1. Key competencies selected for consideration by students and companies, who will sort and rank according to their degree of need in the workplace

1. Source	2. Store	3. Analysis	4. Data geomatics
- Ability to assess - Metadata - Open data - Geo-referencing - Data coming from GPS, drone, radiometer…	- Big data. - Data model/data cloud - Validation processes. - Data integrity - Data maintenance and data protection of geodata.	- Spatial information. - Thematic information - Tools	- Visualization 2D, 3D, VR - M2M - Dashboard. - Applications

Table 2. Specific GIS competencies established in terms of work tasks and essential knowledge and skills required for a professional to succeed

GIS competencies encompass skills and the application of geospatial intelligence to the key work tasks, knowledge and skills essential for professional success. They have been organized for ranking in the questionnaire passed to students and companies in four areas summarized in table 2.

1. Source. They describe the necessary knowledge to collect, manipulate and manage data using geospatial equipment, techniques and methods. In particular, the basic use of GIS, global satellite positioning systems (GPS), topography and cartographic skills.

2. Store. They include elements that describe the knowledge necessary to acquire, manage, recover and disseminate data that facilitate the integration, analysis and synthesis of geospatial information. They seek ensure that the quality of data match professional and industry standards.

3. Analysis. It describes the knowledge necessary to ensure that the various elements and approaches of GIS analysis are correctly understood so that the adequacy of the obtaining, storage, management and visualization of data. This includes the ability to think spatially and perform spatial analysis with geographically referenced data (geo-data) and data modeling for proposing spatial prototypes or scenarios.

Data geomatics. It describes the ability to create effective visual and analytical products that faithfully transmit the content or topics to which the data refers, such as maps, graphs, diagrams, statistics, databases, and tables. The use of cartographic and visualization principles generate products that represent information about the space, so that they can be easily understood by the decision makers.

Results obtained will allow defining training needs of students in order to design GIS MOOC for students according to business needs. MOOC curriculum will be ratified by internships at the geospatial companies involved in the project.

4. Validation of results

For the validation of the designed methodology, some indicators have been proposed for each designed actions.

In the case of the two MOOCs, the one for teachers and the one for students have been proposed:

- Number of people who start the MOOC, number of people who follow at least the first module and number of people who finish it, all of them are data given by the MOOC tool itself.

- Number of visits to MOOC videos.

- Follow - up to users through opinion polls, about the time invested in each MOOC module, degree of difficulty and waiting time for a response from the mentors.

Regarding the modernization of the teaching activity of the teaching staff, the proposed indicators on the impact and dissemination will be the number of subjects in which GIS tools have been introduced, among the participants in the project, since the MOOC will promote the delivery a specific topic using GIS tools. The dissemination of the project in scientific events and publications will be other indicators to consider in relation to the success of the project. The number of people who have approached the project in one way or another will also be an indicator of its dissemination. Student evaluations will also be important, as it seeks to improve the teaching experience of teachers and students.

In relation to internationalization and employability, it will be the results of the GIS MOOC elaborated in the mobility, which will provide indicators for its evaluation. A follow-up will be carried out on the obtaining of employment of the students who carried out the internships in companies.

5. Conclusions

With all these elements, it is intended to transform the traditional descriptive character of geography teaching into GIS competencies, to achieve critical geospatial thinking and thereby increase the employability of higher education students. Thus, the acquisition of skills and abilities in GIS are essential, so it has been encouraged that faculty develop teaching and GIS skills to use as a crosscutting element in the teaching of any subject related to geography or with a spatial perspective.

So that these actions and objectives are possible, as a result of the research carried out, two MOOC courses are being prepared, one specific for teachers, with teaching examples that are transferable to the university classrooms, and another for students, focused on the competences that are they have considered more important after the rounds of discussion groups to students and companies.

In both cases, an applied competence is sought. In the first case to the university classrooms and in the second to the world of business, both of a generic nature or key competencies (analytical and critical thinking, entrepreneurial spirit or interpersonal communication), as well as GIS specific character, which would integrate the ability to collect data taken in the field work, the ease in the use of the services of the SDI and remote sensing from the observation of the Earth from space (European program Copernicus and its Sentinel satellites), for later analysis, processing, distribution and visualization using GIS.

The necessary modernization in the teaching methodologies of Geography in all its branches is a key outcome for the project; and also, to prepare students in key competencies for the business world and in specific geospatial technologies that respond to the demands of the labor market; last, to validate the designed methodology and reinforce the importance of university-business collaboration, and thus add value to teaching geography and geospatial technologies in higher education.

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Cartographic reconstruction of land use and fire history through geohistorical sources

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Abstract

Fire has always been one of the tools used by human societies for land management. The aim of this study was to clarify the complex historical interaction between fire use and landscape changes in the Iruelas valley (Ávila) by identifying and compiling data from various geohistorical sources. This allowed us to create a georeferenced database of 479 historical fire records since 1564, together with a cartographic reconstruction of historical land uses in the 20th century. The local scale maps created show a greater frequency of fires in forest transition zones between 1906 and 1956, and in areas with stable land cover between 1956 and 2000. Our conclusions confirm the correlation between the non-linear evolution of the fire regime pattern in the mountain regions of inner Spain and abrupt socio-ecological changes.

Keywords: Ávila; local scale; fire; Iruelas; landscape; Pyrogeography; risk

1. Introduction

There is growing concern today about the impact and consequences of forest fires, particularly due to climate change, a phenomenon that is increasing the frequency and intensity of fires across Europe (Moreira *et al.,* 2011; Conedera *et al.,* 2018). The Iberian Peninsula is among the most severely affected regions by this problem (San-Miguel-Ayanz *et al.,* 2018).

Although forest fires cause some of the greatest changes in plant ecosystems, they are also part of the nature and dynamics of these systems, particularly in the Mediterranean (Keeley *et al.,* 2012; Pausas & Keeley 2009). Problems arise when changes in the fire regime rapidly destabilize the socio-ecological system, exposing more land to risk (Pausas & Keeley 2014). These processes are further aggravated by the effects of climate change, and generate a complicated situation of uncertainty. In this context, the European scientific community recently pointed out that: *"Fires are symptoms of socio-economic and land-use problems, such as destabilised rural areas that result from rural depopulation, an increase in pressures from tourism and the inadequate management of forests. Forest managers should invest more in understanding the dynamics and consequences of fire regimes, rather than simply trying to control them"* (Bastrup-Birk, 2016: 43)

In European Mediterranean countries, fire has always been associated either directly (ignition and extinction) and indirectly (fuel management, prevention measures, and populational and behavioural changes) with human activity (Turco *et al.,* 2016). This close interaction has evolved over the millennia into a complex dialogue that has endured the crises and rupture that follow substantial changes that are not limited to the present or the most immediate past.

Several recent studies have shown how changes in land use have altered fire regimes (Viedma *et al.,* 2015). Most of these studies have relied on geostatistics, sourcing their data from fire reports and remote sensing (Chuvieco *et al.,* 2010 and 2012; Koutsias *et al.,* 2010; Moreno *et al.,* 2014; Rodrigues *et al.,* 2014), which has reduced the time scale of analysis to the second half of the 20th century and the beginning of the 21st. There is little information available on the long-term changes caused by fire in the rural

environment, due to the lack of continuous data on which to base an overall and comparative analysis of secular trends (Schelhass *et al.,* 2005). Some studies on the history of fire regimes in Spain have shown, however, that the effects of fire on ecosystems and landscape vary from one region to another, depending on the local frequency of fire and the ecological parameters that influence regeneration patterns (Lloret & Mari 2001; Pausas & Fernández 2012).

The main objective of this study has been to reconstruct the social and spatial historical record of forest fires in a mountain region using data from various geohistorical sources (Montiel, 2018). Earlier studies have provided continuous data series on the frequency of fires in the Central Mountain System and Sierra Morena since the 16th century, which have been more or less accurately geo-referenced, depending on the level of detail of the sources consulted (Camarero *et al.,* 2019). Based on this information, a historical map of local land use has also been created in order to analyse the correlation between landscape configuration changes and changes in the fire regime in preceding centuries.

This chapter presents the results obtained for the Iruelas valley, located on the Alberche river on the northern slope of the Central Mountain System, in the province of Ávila. Here, it has been possible to document the complete series of forest fires since the mid-16th century, and to reconstruct the evolution of land use since 1906.

2. Study area: the Iruelas valley

The province of Ávila contains some of the regions most affected by fire in the history of the Iberian Peninsula, and is still the most at-risk region (Palacios, 2013). The Sierra de Gredos, in particular, is among the mountain regions most affected by both natural and intentional fires. This is because farmers regularly used burning as a means of land management, particularly to open pastures for their livestock. In fact, the first documentary evidence of the use of burning to facilitate farming in Spain, which was penalised by law, is recorded in Barco de Ávila in the year1211: "*Any livestock farmer who, from the first of May to the end of the month of October, is found with tinder or flint shall pay said Council a fine f 100 maravedíes for each time. And anyone who burns any brush land or forest at any time during the year, shall pay a fine of 2,000 maravedíes to the Council, plus retribution for the damage caused*" (De la Fuentes Arrimadas, 1925)

The Iruelas valley, located on the northern slope of the Sierra de Gredos on the south-eastern border of the province of Ávila, has recorded the largest number of fires in the holecene in this mountain range (López Sáez *et al.,* 2010; López Sáez *et al.,* 2014) (fig. 1). The valley, a region of considerable orographic and landscape variability, rises over the El Burguillo reservoir in the middle of the Alberche valley, up to the summit that separates it from the Tiétar valley (Cerro de Casillas, 1768 m). It has a mild, humid climate typical of its orientation and altitude, which favours the development of forests of predominately maritime pine (*Pinus pinaster),* although Austrian or black pine (*Pinus nigra*), scots pine (*Pinus sylvestris*), oak trees (*Quercus pyrenaica* and *Quercus toza),* holm oaks *(Quercus rotundifolia)* and alders *(Alnus glutinosa)* can also be found (Ferreras *et al.,* 2013; Molina Moreno, 1992). The extensive regions of ferns and various species of gorse are a consequence of historical and recent fires.

The Iruelas valley is also a valuable protected natural space (Nature Reserve since 1997; Special Protection Area for Birds, ZEPA, in 1991; and Site of Community Importance [SCI], in 1998) that is rich is various resources that have been exploited since the first forestry management regulations passed in 1885 (wood, resin, firewood, pastures, honey, chestnuts, mushrooms), in addition to its touristic and recreational potential (Genoa *et al.,* 2009). The landscape, therefore, bears the traces of different management systems and the effects of numerous alterations, particularly caused by fire (Martínez Ruíz, 1996).

The particular characteristics of this area made it a good candidate for study, since it met our principle study criteria: representative of the landscape of the Central Mountain System, and a history of fire. The first criterion was determined after compiling and processing regional information, specifically, topography (slopes, height and orientation) and hydrography (water catchment areas), plant formations (National Forest Inventory), land uses (CLC-2000; Map of Land Use and Exploitations, 2009), land ownership and management regimens, and forest management, exploitation and protection systems (Regional Government of Castile and León). To determine the second criterion, we analysed the significance of place names as a source of historical information on fire in the territory, using NOMGEO (a Spanish dataset of place names), the Concise Gazetteer compiled by the National Geographical Institute of Spain, and a review of the literature (Llorente, 2011). We also performed a preliminary search of the Spanish National Newspaper Archive, the

Archive of the Ministry of Agriculture and the Provincial Historical Archive of Ávila.

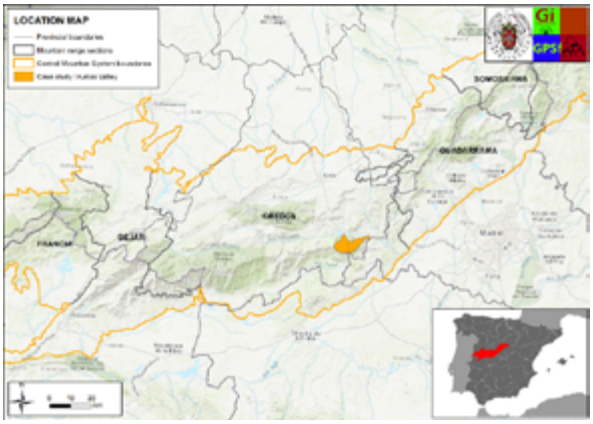


Figure 1: Location of the Iruelas vallley in the province of Ávila and in the Central Mountain System

Source: Mata & Sanz, 2004. Compiled by authors

The basic spatial units used to delimit the study area were the microbasins obtained by the Spanish Ministry of Agriculture, Fisheries and Food from the digital terrain model with 100 m resolution and a scale of 1: 25,000. Based on these data, the region used to reconstruct the land use and historical forest fire map includes the Balsaina, Yedra and Alberche microbasins, and encompasses a total area of 7,563 hectares, currently covered by forest. The area includes the towns of El Tiemblo and El Barraco, and covers practically the entire area of the forests of public interest (FPI) n.º 60 ("Valle de Iruelas", belonging to the Association of Ávila) and n.º 89 ("Pinar del Valle", belonging to the City Council of El Tiemblo). Neighbouring towns were also included in the documents collected in order to add more context to the local analysis.

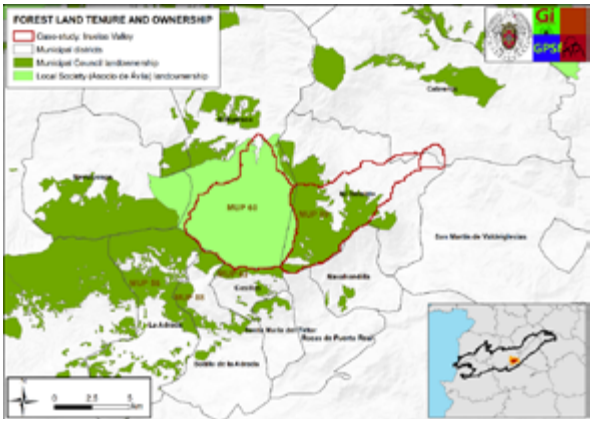


Figure 2: Delimitation and forest area of the study region

Source: Spanish Ministry of Agriculture, Fisheries and Food; Regional Government of Castile and Leon. Compiled by authors

3. Results

3.1. Changes in land cover and land use based on 1902 maps, aerial photographs from 1956, and CORINE Land Cover 2000

The CORINE Land Cover (CLC) inventory provides standardised data on land use in all European countries from 1990, updated in 2000, 2006, 2012 and 2018 (Feranec *et al.,* 2016). There are no retrospective data on this essential parameter in landscape dynamics, although in Spain there are 2 very powerful primary sources on which to reconstruct the evolution of land cover and land use: (1) the cartographical notes made between 1870 and 1950 by the Geographic and Statistical Institute, which formed the basis of the first National Topographic Map; and (2) the *Vuelo Americano Serie B* aerial photographs (1956-1957).

The cartographic notes dating to the late 19th and early 20th centuries are preserved in the Technical Archive of the National Geographic Institute (IGN, in Spanish), and consist of a collection of altimetric and planimetric maps of most towns and cities at a scale of 1: 25,000, with sufficient accuracy to obtain the corresponding 1: 50,000 map. The hand-drawn planimetric maps usually offer detailed information on land uses that can be digitized and reclassified according to the three-tier hierarchical structure of the CLC in order to perform a diachronic analysis. figure 3 shows the original format and structure of one of these historical planimetric maps, corresponding to the central sector of our study area.

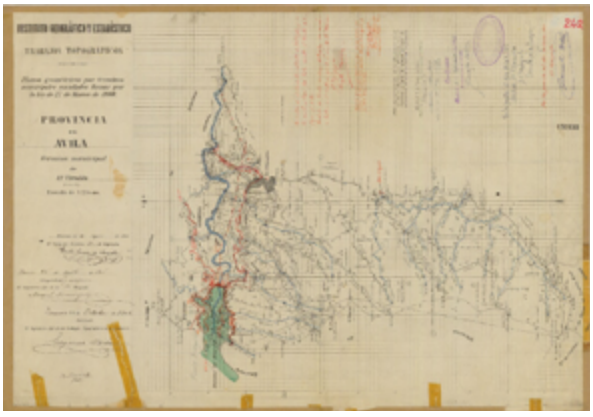


Figure 3: Planimetric map of El Tiemblo, province of Ávila (1906)

Fuente: IGN

We have planimetric maps of the Iruelas valley with information on land cover and land use in the 3 towns included in the study area: El Tiemblo (050331, 050332; year 1906), El Barraco (050038, 050039, 050040, 050041,

Level 1	Description L1	Level 2	Description L2	CLC2000 Classes
1	Farmland	11	Cropland	Arable land (2.1) Permanent crops (2.2) Heterogeneous agricultural areas (2.4)
		12	Pasture grassland	Pastures (2.3) Natural grassland (3.2.1)
2	Seminatural grazing land			Sparsely vegetated areas (3.3.3)
3	Agroforestry			Agroforestry areas (2.4.4)
4	Forest and woodland	41	Forest and other wooded land	
		42	Forest	Forests (3.1) Transitional woodland srub (3.2.4)
		43	Shrubland	Moors and heathland (3.2.2) Sclerophyllous vegetation (3.2.3)
5	Other			Artificial surfaces (1) Water bodies (5) Bare rocks (3.3.2) Burned areas (3.3.4)

Table 1. Harmonized classification of CLC2000 from the historical LULC-defined classes

050042; year 1936) and Cebreros (050095; year 1907). The original maps were digitalised and the categories standardised according to the CLC model (table 1) in order to reconstruct the situation in the early years of the 20th century (fig. 4) and perform a comparative diachronic analysis. The map obtained shows the effects of ploughing, grazing, and intensive forest use since the mid-18th century (Carreras & Tafunell, 2006; López Merino *et al.,* 2009). This was a productive farming system organised according to soil potential. The forest was reduced to the area near the reservoir, the alluvial lands on the valley floor were cultivated, and the high, stony ground was used for grazing.

We also plotted a map of land cover and land use in the mid-20th century using photographic interpretation. This shows how the situation changed considerably as a result of protective forest management and the resulting spatial reorganization of grazing (fig. 5). Even taking into account a degree of subjectivity in the early 20th century map and the discretionary criteria applied in the reclassification of land cover and land use to harmonize the different sources of information, the comparative analysis of the two maps highlights the radical transformation from agroforestry to a landscape dominated by forest growth. CLC2000 data also show the densification of the forest and the increase in the extent of grazed wasteland resulting from the abandonment of forest management (fig. 6). The contrast between the situation at the beginning of the century, when more than 60 % of the surface area of the study region was occupied by agroforestry, and the situation at the end of the century, when a similar proportion had been taken over by forest, shows the destabilisation of the social-ecological system and the increased risk of forest fires or other types of environmental change (fig. 7).

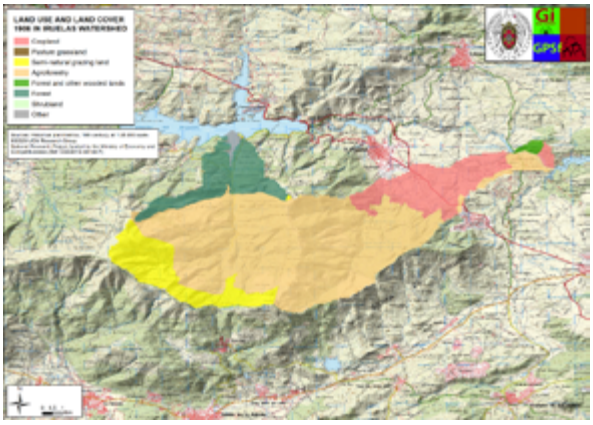


Figure 4: Map of historical LULC in Iruelas valley at the beginning of the 20th century

Source: Historical planimetries from the Spanish National Geographic Institute, 1870-1950. Compiled by authors

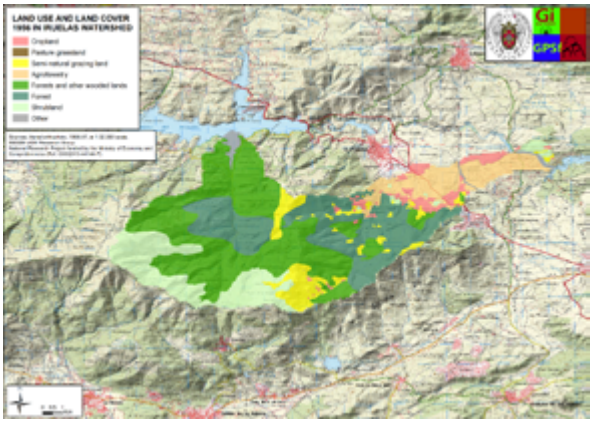


Figure 5: Map of historical LULC in Iruelas valley in the mid 20th century

Source: *Vuelo Americano serie B* aerial photographs 1956-1957, IGN. Compiled by authors

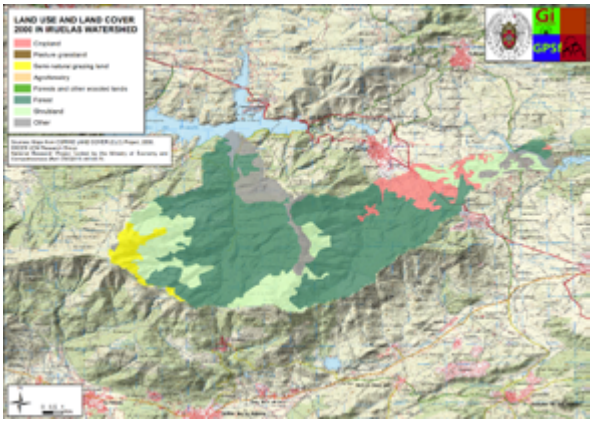


Figure 6: Map of historical LULC in Iruelas valley in the late 20th century

Source: CORINE Land Cover 2000. Compiled by authors

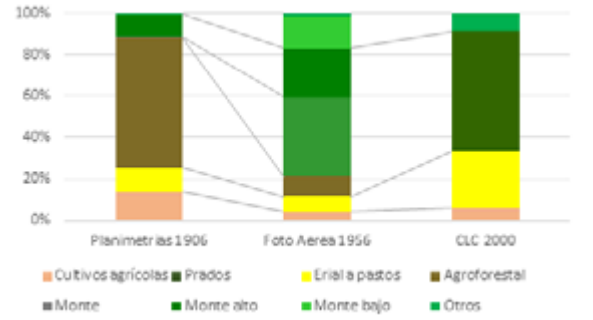


Figure 7: Changes in land cover and land use in the Iruelas valley in the 20th century

Source: MTN planimetric maps 1870-1950, IGN; *Vuelo Americano* serie B aerial photographs 1956-1957, IGN; CORINE Land Cover 2000. Compiled by authors

3.2. Reconstruction of the fire history in rural areas

Although fire has always been used in Spain as a multi-purpose tool for heating, cooking, burning stubble, improving pasture for livestock, preparing the land for cultivation, etc., despite the ever-present risk of uncontrollable propagation, the fire statistics registry was only started in Spain in 1968; however, forestry authorities had already begun to issue proto-statistical fire reports in 1961, which were later used to draw up the Ministry of Agriculture's first annual reports. Prior to this date, various forms had also been used at specific locations and times to report fires affecting public forests, for example, the series of monthly (1879-1900) and quarterly (1901-1914) district reports of FPI fires complied by technical and junior personnel, and the annual exploitation plans, which recorded the special auctions of products from fires and the area reserved for grazing for the same reason (Araque, 1999). These sources are archived in the Ministry of Agriculture, and some extracts have been occasionally used by researchers to analyse the historical background of the *Estadística General de Incendios Forestales* (general statistical information on forest fires [EGIF] (Pausas & Fernández, 2012).

To bridge this critical information gap and understand the changes in the fire regime that led to the current fire risk situation, we searched different geo-historical sources and drew draw up a systematic and detailed reconstruction of the historical fire records. This enabled us to create a database containing 51 alphanumeric fields (quantitative and qualitative) that currently has over than 6,500 records of fires from 1497. We extracted 479 records dating back to 1564 from this source for this study of the Iruelas valley (selected micro-basins and surrounding towns). All records obtained have been georeferenced to locate, either accurately or randomly, the ignition point in the corresponding perimeter, based on the level of detail in the source data (exact point of ignition, site, forest-farmland, town) (fig. 8).

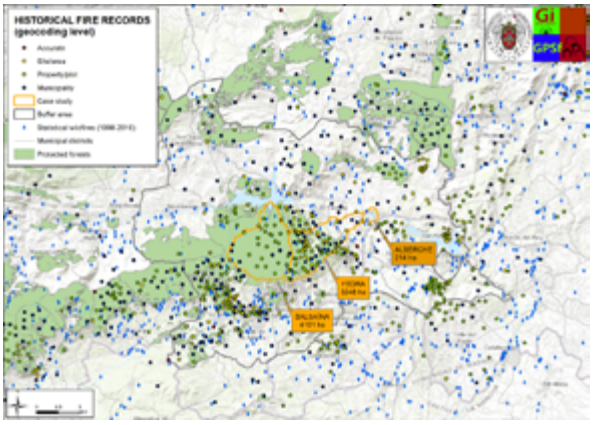


Figure 8: Georeferenced historical fire records in rural areas

Source: RHIF - UCM-GPSF Research Group Compiled by authors

We reconstructed and analysed the historical records of forest fires by separating the period (from 1968 to the present) for which we have complete statistical information (from the General Forest Fire Statistics (EGIF, in Spanish) and GIS of the Regional Government of Castile and Leon), and the historical pre-statistical period. The latter period can be divided into two subperiods: the most recent stage of forest administration (1848-1968), in which all fires in public forests were documented; and the earlier stage, for which we obtained all rural records of fires that, due to their impact on the economy and the legal and political system prevailing at that time, have been reported and documented since the 16th century in the natural region of the Central Mountain System.

Documentary archives	1600s	1700s	1800s	1900s	2000s	TOTAL
GAA	-	-	-	-	12	12
NHA	-	-	4	-	1	5
PHA	-	-	3	2	33	38
AA	-	-	-	189	5	194
EDCL	-	-	-	-	4	4
ASOCIO	-	-	4	-	-	4
GPA	-	-	-	5	-	5
GAS	2	1	-	-	-	3
ACG	-	-	-	23	7	30
MA	-	2	3	32	71	108
DNA	-	-	-	26	43	69
BIBLIO	-	5	1	-	1	7
TOTAL	**2**	**8**	**15**	**277**	**177**	**479**

Table 2: Historical fire records in the Iruelas valley collected from the geohistorical sources

Source: RHIF - GUCM-GPSF Research Group Compiled by authors

To extract data from the long and complex pre-statistical period, we consulted geographical and documentary sources held in archives and libraries. In the case of the Iruelas valley, a large number of records are held in the Agriculture Archive (AA) due to the territorial importance of the FPIs in this area. The holdings of the Spanish National Historical Archive (NHA), the Provincial Historical Archive (PHA), the General Archive of Simancas (GAS) and the Asocio Archive (ASOCIO) are smaller, but the records are highly representative and of great documentary value. The General Administrative Archives (GAA), the General Palace Archive (GPA), the Archive of the Civil Guards (ACG) and the Archive of the Environment Department of the Regional Government of Castile and Leon (EDCL) have provided some extremely interesting records of forest fires at critical stages of the change in the fire regime (late 19th and mid 20th century). However, the main source of information has been the Municipal Archives (MA), which give a comprehensive overview of the rural environment and local life, and includes documents dating back to the 17th century. We completed the historical record of forest fires by searching the literature (BIBLIO) and conducting a systematic search of the Spanish National Digital Newspaper Archive (DNA), which allowed us to the identify fires that received the widest media coverage. Using all these sources, we compiled a record of all forest fires in the study region reported in existing documentary sources from the mid 16th century to the present day.

An analysis of this long record reveals a series of substantial changes in the type of fires, their spatial distribution, and their cause, with abrupt manifestations and time lags attributable to the local socioeconomic situation. However, the spatial pattern of fire foci remains largely unchanged until the middle of the 20th century, and contrasts with the typical dispersion observed in the statistical period (fig. 9).

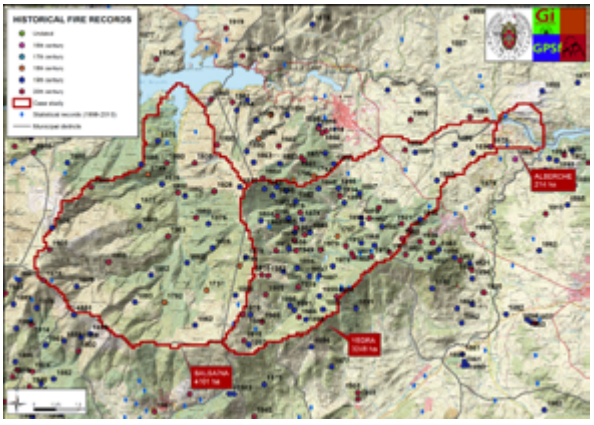


Figure 9: Map of historical fire records since the 15th century in the Iruelas valley

Source: RHIF - UCM-GPSF Research Group; EGIF - Ministry for Ecological Transition. Compiled by authors

Until the end of the 18th century, the predominant pattern in the Central Mountain System in general, and in the Iruelas valley in particular, was low intensity fires that affected very small areas (generally less than 5 hectares). Fires were very common in the region, and most were well controlled. There is abundant evidence and reports of the use of fire by livestock farmers since medieval times, not only from the medieval sheep farmers' association, the *Mesta* (López Merino *et al.,* 2009; López Sáez *et al.,*

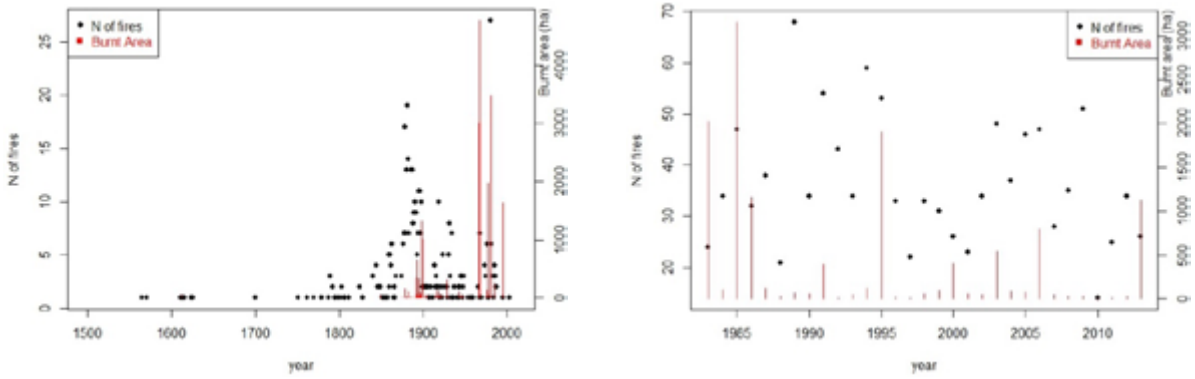


Figure 10: Evolution of the number of fires and burned area in the Iruelas valley in the pre-statistical historical period and in the statistical period

Source: RHIF - UCM-GPSF Research Group; EGIF - Ministry for Ecological Transition. Compiled by authors

2010), but also from local associations, such as the *Asocio de Ávila*, created to defend the interests of a group of medieval cattle farmers (Luis & Ser, 1990; Palacios, 2013). There are also reports of large fires in the period before the 19th century, such as the one that raged for three days in August 1792, burning 4,790 pines in El Barraco, or the fire that broke out on August 24, 1777 in 8 spots in the pine forest of Piedralaves, near Iruelas; it took the local community three days to extinguish the fire, which consumed 1,508 pine trees, oaks, new holm oaks and junipers.

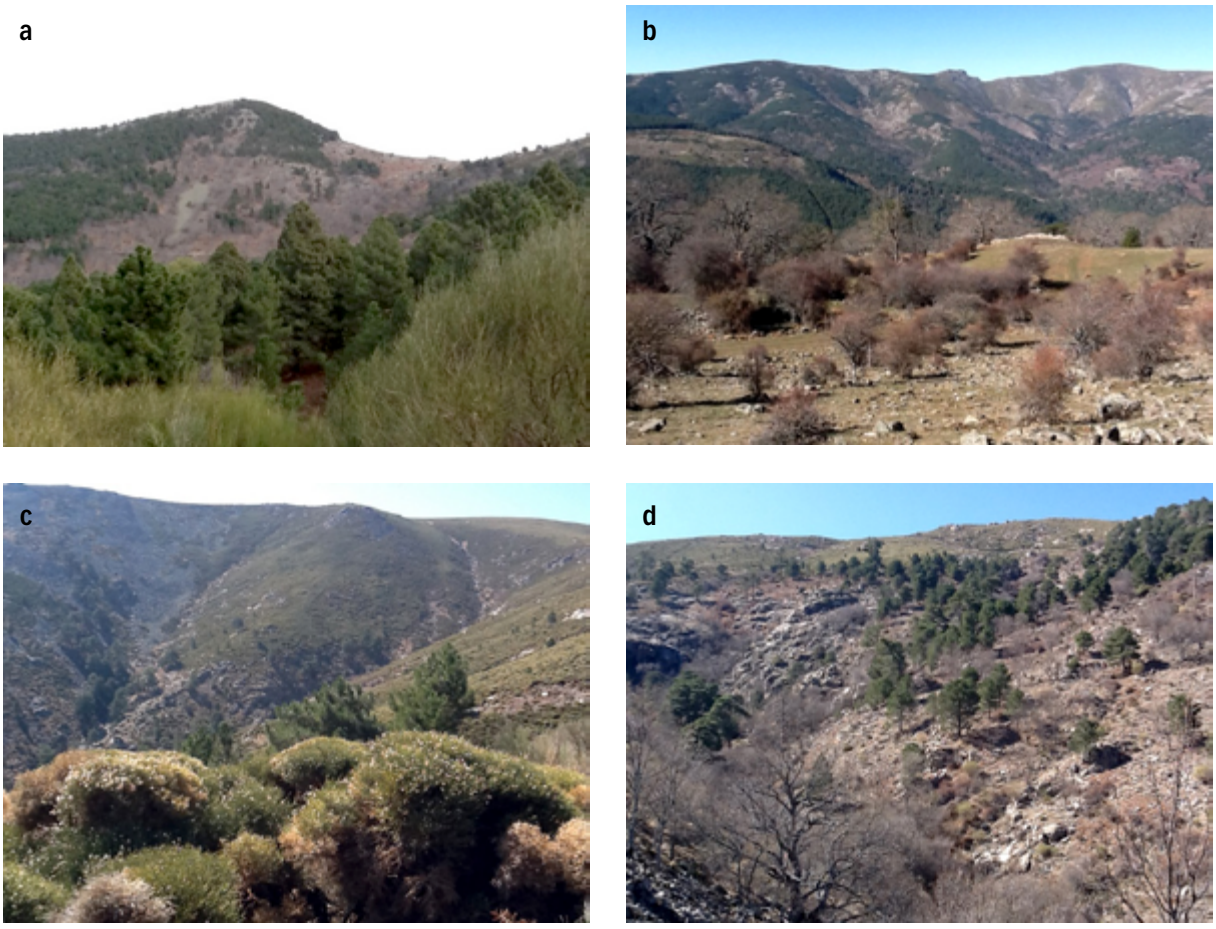
By the beginning of the 19th century, the number and extent of forest fires had increased significantly, clearly as a consequence of the Liberal Reform and the ongoing reorganisation of farmland (land rental and ownership systems; forestry management systems) resulting from the seizure and sale of property and the creation of the forestry advisory board. The socio-economic changes and socio-political upheaval of the early 19th century increased the risk of fire and aggravated the problem of forest fires. The creation of the forestry advisory board in the 1850s led to an increase in the records of forest fires and the emergence of documents reflecting concerns about the phenomenon in political circles. All these factors resulted in an abrupt change in the fire regime in the last quarter of the nineteenth century, with a significant increase in the frequency and extent of fires, most of which were the result of arson.

Finally, the mid twentieth century saw a second abrupt change in the fire regime, this time due to the effect of the energy transition on the economy, territorial organisation, and the lifestyle of the population. This change took longer to come into effect in the Iruelas valley, due to the persistence of traditional territorial structures and forms of organization until the 1980s (fig. 10).

4. Discussion: Landscape transformation and changes in the fire regime in the Iruelas valley

The term "fire regime" refers to the characteristics of fires in a given place over a given period of time (Krebs *et al.*, 2010; Moreno et 2014), and is the result of the interaction between climate, topography, local environmental conditions and changes in land use and cover (Turco *et al.*, 2016). There is evidence of abrupt changes in the fire regime in the mountainous regions of inner Spain over the last two hundred years. These changes were the result of critical socioeconomic political changes that marked major or minor turning points, which we have called pyrotransitions, at the end of the 19th century and the middle of the 20th century, albeit with slight spatial and timing differences determined by local conditions and circumstances (Montiel, 2018).

In the Iruelas valley, recent changes in the fire regime have been the result of transformation of the rural landscape in the wake of economic progress, which has been reflected in changes in land use and land cover. Similarly, changes in the fire regime over the last few hundred years have affected the configuration of the landscape, resulting in a stark contrast between areas that have remained fire-free for more than a hundred years (Photo a), areas affected by frequent fires (Photos b and c), and area affected by a succession of large fires (Photo d). This shows, therefore,



Photos: (a) Slope with P. pinaster and Q. pyrenaica that has been fire-free for the last two hundred years, and a sheep pen that has been affected by fire since the 18th century; (b) Old grazing area; (c) Tract of gorse bushes on the summit; (d) Southern slope affected by the great fires of 1898 and 1900

Credits: authors

the dynamic interaction between changes in fire regimes (recurrence and intensity) and changes in the forest landscape (dominant species; vertical and horizontal vegetation structure).

The vegetation found today in the Iruelas valley shows the traces of intense human exploitation in which fire has played an important part. Resin farming and livestock grazing, the main long-term uses of natural resources, have favoured the predominance of fire-prone pine forests, together with tracts of gorse, compatible with historic or recent fire activity. For example, the north west border of the Iruelas valley, which has a long history of livestock grazing (López-Merino *et al.,* 2009), is predominantly populated by different species of gorse (*Echinospartum barnadesii* and *Cytisus oromediterraneus*) with only the occasional pine tree. On the southern slope, the site of two large fires just over a century ago (1898 and 1900) and none since, we find sparse pine forests with rather dense tracts of *Echinospartum barnadesii* and *Cytisus oromediterraneus*. Further down the slope we find broom (*Genista cinerascens*), and later some rose hip (Rosa sp.), and white hawthorn (*Crataegus monogyna*) bushes and flowering gorse (*Genista florida*). In La Quesera and Cantos Gordos, located on the western slope of the ridge that connects the summits of Casillas (30TUK6867, 1770m) and Parra (30TUK6972, 1635 m), which has had no fires in the last two hundred years (Photos a and b), we found a rather dense resin pine forest (*Pinus pinaster*), with large specimens, few clearings and good regeneration. Further down the slope, we start to see oaks (*Quercus pyrenaica*), with some holm oaks (*Quercus rotundifolia*) in the clearings, which have the appearance of grasslands, suggesting that the vegetation has adapted to years of intense grazing (Ferreras *et al.,* 2013).

An examination of the land and a spatial and temporal analysis of the patterns of land use and fire show the dynamic interaction between fire regimes and the landscape over various cycles of stability and

destabilization of the socio-spatial system. This trend has also been observed in other parts of the world (Brown *et al.,* 1999; Kelly *et al.,* 2013). Intense forest regeneration occurred during the first half of the 20th century in the Iruelas valley, as a result of the regulation of traditional land uses and the management of forests of public interest by the forestry advisory board since the middle of the 19th century Most of the forest fires recorded over this period occurred in areas affected by changes in land cover and land use, particularly in areas of forest regeneration.
At the same time, we observe that the fires recorded before this time did not prevent the progressive evolution of plant formations (fig. 11)

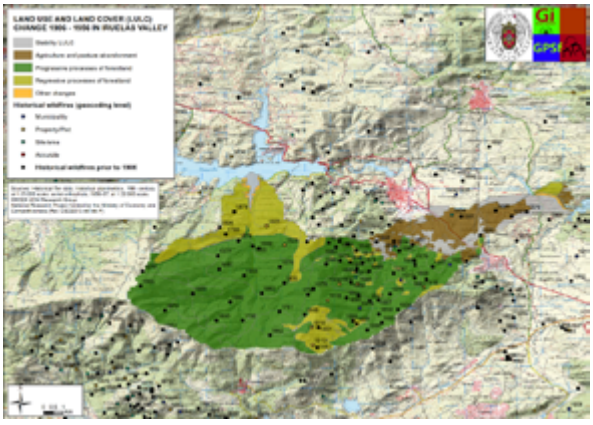


Figure 11: Map of LULC changes and historical fire records between 1906 and 1956

Source: MTN planimetric maps 1870-1950, IGN; Vuelo Americano serie B aerial photographs 1956-1957, IGN; RHIF UCM-GPSF Research Group. Compiled by authors

In the second half of the 20th century, changes in land cover and land use are at odds with the general theory of forest transition (Perz, 2007; Iriarte-Goñi & Ayuda, 2018). The landscape in the Iruelas valley is far more stable, with regeneration processes even being replaced by forest degradation as a result of the socio-spatial characteristics of each town and the organization of the local economy (fig. 12). The distribution of forest fires does not follow landscape dynamics, and adopts a far more random, independent spatial pattern that makes forest fires even more unpredictable (fig. 10). Unlike the general trend in the region, fires are actually increasing in areas where there are no changes in land cover and land use (table 3).

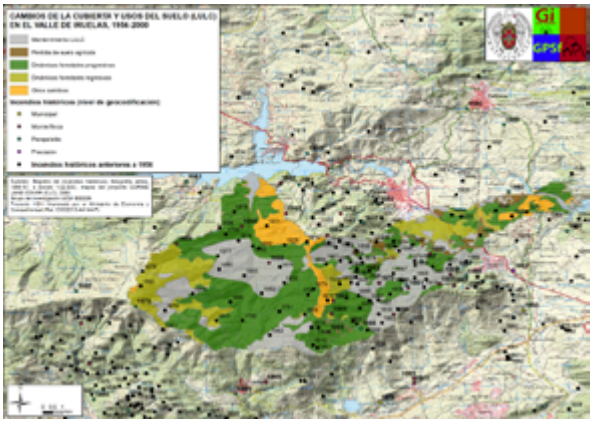


Figure 12: Map of LULC changes and historical fire records between 1956 and 2000

Source: Vuelo Americano serie B aerial photographs 1956-1957, IGN; CORINE Land Cover 2000; RHIF UCM-GPSF Research Group. Compiled by authors

5. Conclusions

The cartographic reconstruction of historical land use and forest fires in the Iruelas valley (Ávila) has shown the interaction between landscape dynamics and fire regimes in the 20th century, and their influence on the configuration of today's fire scenarios (Montiel *et al.,* 2019). Firstly, we have found that the high frequency, low intensity fire regime of the territory has given rise to a landscape that can withstand large fires, and has considerable capacity for ecological regeneration (San Miguel *et al.,* 2017). Secondly, the distribution map of historical fires relative to changes in land use shows the link between the destabilization of socio-spatial systems and the risk of fires in the pre-statistical period (Montiel, 2018).

LULC changes	1906-1956		1956-2000	
	N Fires	Burned area (ha)	N Fires	Burned area (ha)
Stability LULC	1	no data	9	1,201.00
Agriculture and pasture abandonment	6	299.00	0	0.00
Progressive processes of forestland	24	1,409.75	7	1,190.00
Regressive processes of forestland	6	4.40	1	1,975.00
Other changes	0	0.00	1	no data

Table 3: Occurrence of fires in the 20th century according to transition of land uses

Source: UCM Fire History Dataset. Compiled by authors

Changes in the fire regime or "pyrotransitions" occur discontinuously, in association with territorial changes. In the case of the Iruelas valley, we have documented a pyrotransition at the end of the 19th century caused by new forest management systems that resulted in the reorganization of the land. This is evidenced by the marked process of forest reconversion that occurs in the first half of the century. However, the second pyrotransition is less clear, and occurs later, as a result of the increase in forest mass due to the progressive abandonment of forest management, followed by a process of landscape stabilization during the second half of the century. Most forest fires occurred in the areas affected by these land use dynamics in both periods (forest transition zones in the first half of the century, and areas of land cover stability in the second half of the century).

Finally, the research methodology applied in this study has highlighted the great potential of documentary sources to bridge the gaps in statistical and territorial information obtained through remote sensing studies. We defined a systematic archival research method to reconstruct land use maps and historical fire records in the mountainous regions of inner Spain. This same approach can be used all over Spain, and will enable researchers to choose other regions that are representative of the problem of forest fires and obtain the same type of data and maps.

Given the regional diversity territorial and the importance of long-term historical processes, geohistorical documents are the key to understanding the socio-spatial elements of the fire regime, and can guide risk management policies at the local level.

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General Palace Archive (AGS)

General Archive of Simancas (GAS)

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