

Contribution of the Spanish Committee to the 35th  
International Geographical Congress  
**Celebrating a world of difference**

# **DIVERSITY, DYNAMICS AND RESPONSES TO THE GLOBAL CHANGE**

**Spanish Committee of the  
International Geographic Union**



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# **DIVERSITY, DYNAMICS AND RESPONSES TO THE GLOBAL CHANGE**

**Spanish Committee of the  
International Geographic Union**



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# INTRODUCTION

# Introduction to the Contribution of the Spanish Committee to the 35th International Geographical Congress

INTERNATIONAL GEOGRAPHICAL UNION,  
DUBLIN 24-30 AUGUST 2024

The Spanish Committee of the International Geographical Union (IGU) has been providing the International Geographical Congresses of the IGU for sixty years with the publication of its *Aportaciones* (contributions). It did so for the first time through the Aportación of the Elcano Royal Institute and the Institute of Pyrenean Studies of the Spanish National Research Council (CSIC) to the Congress held in London in 1964.

Today, the Spanish Committee represents a good sample of the geographic collective of Spain, reflecting the vitality of our discipline and its vocation for international projection. According to its statutes, the Committee is currently formed by members of the Royal Geographical Society (RSG), the Spanish Geographical Association (AGE), the National Geographic Institute (IGN), the Army Geographical Centre (CEGET), the Institute of Economy, Geography and Demography (IEGD) of the Spanish National Research Council (CSIC) and the Catalan Society of Geography (SCG). The first section of this book presents the current affairs of all these institutions.

In keeping with the theme of the Congress, the Contribution we present here revolves around the issue of **global change**. This choice responds to the urgency of facing the multitude of overlapping and chronifying crises (starting with the financial crisis of 2008 or the health crisis of 2020, together with the climate crisis), to the point of making us glimpse an epochal change that demands the attention of Geography.

To address the diversity, dynamics and responses to this global crisis, the blocks of this Contribution embrace three different perspectives, sets of variables and disciplinary approaches, all referring to the Spanish geographical scope. This Editorial Board invited prominent members of the Spanish geographic collective to develop the papers that open each block and launched an open call for papers through which they were evaluated by single-blind peer reviews and selected a dozen more articles that expand and enrich each thematic line. The papers that make up this Contribution are authored by prominent members of the institutions represented in the Spanish Committee, especially from the SCG and the permanent commissions of the AGE working groups.

The first set of studies analyses **environmental change**, with perspectives from climatology and the study of extreme phenomena on a global and regional scale, water resources and the transformation of ecosystems. Its contributions delve into the knowledge of forest landscapes with a strong cultural imprint, the renaturalization of urban river courses or the evolution of international policies to promote sustainability. A second block of contributions focuses on

the study of **territorial, demographic and social changes**; in this case with two introductory papers. The first deals with geodemographic studies with a focus on urban and rural areas, the thematic importance of aging, migration, gentrification, touristification and the housing crisis. The second deals with depopulation as a territorial challenge, its opposite in the growth of large urban areas with the accentuation of imbalances in hierarchies, the necessary energy transition, the gastronomic specialization of tourist destinations or the lights or shades of post-COVID19 tourism regrowth, while demonstrating the resilience of rural spaces or the contributions of geography to the analysis of geopolitics.

The last and third section contributes to address **global change from the perspectives of education**. Firstly, the contributions of the Spanish geographic community to education oriented to ecosocial sustainability are analysed, with particular attention to territorial information as a method; secondly, the emergence of a new geographic-educational paradigm focused on global change, based on contents related to sustainable development, land-use planning, globalization, geographic information technologies, geopolitics or climate emergency; finally, the development of geographic information technologies are studied, based on the example of the application of Spatial Big Data for the knowledge of mobility flows in urban agglomerations.

This Contribution of the Spanish Committee to the 35th International Congress of Geography is a record of the contribution of the Spanish geographic collective to the study of global change, which sets the current planetary agenda. Without precedent in the history of the Earth, a single species, the humankind, is the cause of the deterioration of ecosystems, global warming or the extinction of other species. But humanity is also capable, like no other, of demonstrating a capacity for reflection, responsibility and vision for the future. We believe that geography can help not only to interpret global change, but also to promote a radical transformation that will provide us with opportunities for better futures. This is our challenge and we will continue to work to achieve it.

The Editorial Board and the Spanish Committee of the International Geographical Union

# **PRESENTATION OF GEOGRAPHICAL INSTITUTIONS**

# Spanish Geographical Association (AGE)

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## 1. BRIEF HISTORICAL REFERENCE AND CHARACTERISATION OF THE ASSOCIATION

Following the thematic thread of texts previously written by geographers who have formed part of the Governing Board of the Spanish Geographical Association (AGE) (Olcina, Lois and Mínguez, 2020; Olcina, González and López, 2022), this presentation summarises the characteristics and current activities of the association.

The AGE, Asociación Española de Geografía (Spanish Geographical Association) was created in 1975 within a politically, socially and economically complex context; at the beginning of the democratic transition that commenced in Spain after the death of Francisco Franco. Therefore, next year the association will be celebrating its 50<sup>th</sup> anniversary. Together with the AGE, there are other associations related to the geography discipline in Spain with a long trajectory, such as the Real Sociedad Geográfica Española (the leader of Spanish geography societies founded in 1876), the Societat Catalana de Geografia (1935) and the Sociedad Instituto Vasco de Geografía Andrés de Urdaneta (1977). Furthermore, there are state or regional cartographic entities or organisations (Instituto Geográfico Nacional, Servicio Geográfico del Ejército, regional cartographic services) whose production has been and continues to be a very important territorial management instrument. This panorama of organisations and associations for promoting geography was consolidated with the creation of the Colegio de Geógrafos (Professional Association of Geographers) (1999) and the Sociedad Geográfica Española (1997).

Since its creation, the principal objective of the AGE is the “promotion and development of Spanish geographical science”. To do this it was formed as a non-profit organisation financed with its own resources or with grants from public or private entities for specific purposes (congresses or publications). Logically, in its almost 50 years of history, on different occasions the association has updated its documents referring to its internal operations in order to adapt to regulatory, economic, social or technological changes. The latest versions of the statutes and the regulations were approved in 2018 and 2019. In this statutory reform (2018), the name of the association was changed from its original name (Asociación de Geógrafos Españoles) to the current Asociación Española de Geografía AGE<sup>1</sup>, more fitting with a twenty-first century organisation.

The AGE is an association with a presence in all of the autonomous regions of Spain and attempts to respect the different territorial sensitivities. Its internal operations are governed by the principles of democracy, transparency and participation. The Board of Directors is partially renewed every two years and the duration of the terms of office is four years with a limitation of two mandates. In the same way as other geography societies, given the internal thematic breadth of the discipline it is organised into [working groups](#) (currently 15), which carry out activities autonomously. According to Mata Olmo (2013), a professor of the Autonomous University of Madrid and president of the AGE between 2005 and 2009,

<sup>1</sup> The change of name was approved by the Sub-Directorate General for Archives and Documentation of the Spanish Ministry of the Interior on 15 March 2019.

a fruitful relationship 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.

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 working groups may be freely and transparently accessed through the [AGE website](#), which has become an important consultation tool for the Spanish geographical community.

As of 1 April 2024, the association has 1,202 members. Almost 50 years ago it only had the 200 founding members and since then their number has evolved positively, taking into account the amount of geographers in the country. This growth confirms the idea of maturity highlighted by Professor Méndez Gutiérrez del Valle, of the Higher Council of Scientific Research and president of the AGE between 2001 and 2005. During the first twenty years of the Association's existence, the growth in the number of members was particularly significant and was related to the creation of new universities and the increase in the workforces of the existing ones (Méndez, 2004). Since 1995, on the other hand, the number of members has been more or less stable with a modest but constant growth since 2016, due to the diversification of the activities of the AGE. This increase is also reflected in the participation of the associates in the majority of the Working Groups, which gives us an idea of the interests and principal lines of research and work within the field of Spanish Geography (Figure 1).

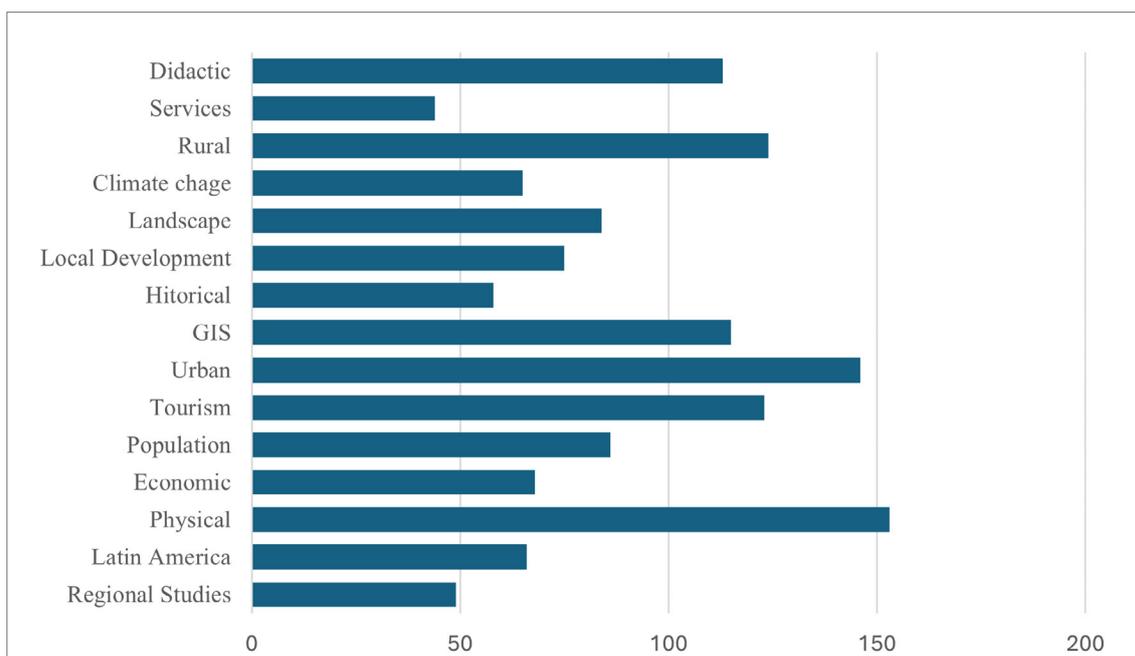


Figure 1: Number of members of the Working Groups of the AGE.

The associates are mostly academics, given the connection of the association since its constitution with the university world and the Higher Council of Scientific Research. However, its members also include Secondary and Baccalaureate teachers, all involved in the Geography Didactics Working Group, together with young pre and post-doctoral researchers. Nevertheless, the presence of professionals who work in public administrations, institutions or companies is still weak. These mostly include professionals related to local and territorial development, urban planning and spatial data analysis. There are also foreign associates, although their presence is testimonial. The majority are from Latin American countries with which the Spanish universities have strong ties. Finally, it should be noted that, similarly to many other scientific associations, although the AGE has more male members than female members, the gender gap is closing. The percentage of male and female members is currently 76% and 24%, respectively.

## 2. ACTIVITIES OF THE AGE

The Spanish Geography Association has carried out many scientific activities, some with a long tradition, such as the general geography congresses that are held biennially in collaboration with the Geography departments of the Spanish universities that act as headquarters. This is an important element of the identity of Spanish Geography. Since 1975, the year when the AGE was created, it has held, without interruption, 25 general congresses. The next one is programmed for 2025 at the University of Extremadura. They constitute the most important meeting 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. 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
IV	University of Oviedo	1975
V	University of Granada	1977
VI	University of Illes Balears (Palma)	1979
VII	University of Navarra	1981
VIII	University of Barcelona	1983
IX	University of Murcia	1985
X	University of Saragossa	1987
XI	Complutense University of Madrid	1989
XII	University of Valencia	1991
XIII	University of Seville	1993
XIV	University of Salamanca	1995
XV	University of Santiago de Compostela	1997
XVI	University of Málaga	1999
XVII	University of Oviedo	2001
XVIII	Autonomous University of Barcelona	2003
XIX	University of Cantabria	2005
XX	Pablo de Olavide University (Seville)	2007
XXI	University of Castile-La Mancha	2009
XXII	University of Alacant	2011
XXIII	University of Illes Balears (Palma)	2013
XXIV	University of Saragossa	2015
XXV	Autonomous University of Madrid	2017
XXVI	University of Valencia	2019
XXVII	University of La Laguna	2021
XXVIII	University of La Rioja	2023

Table 1.  
Source: AGE.

The publishing activity constitutes an important part of the association's work. It publishes the minutes of the general congresses in its name, together with those of the Working Groups and the results of other studies arising from the general activity of the association or the groups. Within this context, the journal *Boletín de la AGE (BAGE)* constitutes one of the principal activities of the association and the binding element of its vocation of promoting geographical science. Its inclusion in high quality prestigious international and national publishing indices (JCR, WoS, Scopus, etc.) enables the international promotion of AGE

and facilitates the capture of members from other countries. The association also publishes the journal *Didáctica Geográfica*, edited by the Geography Didactics Working Group. It is a specialised geography journal and a reference in Spain in topics related to research and educational innovation with respect to Geography and its teaching. Another of its journals is *Geofocus*, edited by the Geographical Information Technologies Group and focused on these types of technology. They are both indexed in Scopus and other databases.

In this facet of promoting, communicating and disseminating geographical research, the AGE undertakes other relevant activities such as the Research Awards that recognise the research excellence of Spanish Geography: the Roser Majoral Moliné 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 each edition (Olcina et alii, 2020). Meanwhile, the working groups also carry out a broad range of activities. They hold biannual colloquies and have their own awards (for doctoral theses, final year projects for Masters and Undergraduate degrees, etc.). They also organise specialised themed field workdays and generate publications, among other activities.

The collaborative ties with public and private entities are close and fruitful. The association has signed more than 20 agreements with the objective of reinforcing the weight of Geography in different facets of Spain's social and academic reality. In recent years, the collaboration with the Spanish Royal Academy (RAE) for the review of the compilation of a long list of geographical terms of the RAE's Dictionary has been particularly relevant. It also signed an agreement with the National Geographical Institute for the scientific management of different editions of the *Atlas Nacional de España*, the latest of which is currently under construction. The work with the Universidad Internacional Menéndez Pelayo has enabled the creation of a *Geography School* to give continuity to the annual programme of the prestigious Summer Courses of this university in Santander. The first edition of the School (August 2024) will start with a course on studying the city and the challenges of housing in Spain. It has also signed agreements with institutions such as the Andalusian Historical Heritage Institute for consultancy in the design of training courses or with important companies in the field GIS, such as ESRI, which, thanks to the collaboration agreement established since 2019, has created a geovisor to present its results.

The collaborative work is particularly active with the Colegio de Geógrafos (Professional Association). In fact, 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. One result of this joint work is the organisation of the Spanish Geography Olympics in its different phases (regional and national) aimed at students of the second year of Baccalaureate and which is now in its 15th edition. In addition, together with the Colegio, it organises the New Culture of Territory Award. This initiative began in 2009 and is held biennially. This award 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 (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 and 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 two categories of diffusion and management of which the prize has been composed since this year. In 2021 it was awarded to the TVE television programme El Escarabajo Verde (dissemination category) and the Fundación Santa María de Albarracín (management category) and the prizes of last edition (2023) were awarded to ECODES - Fundación Ecología y Desarrollo (Action/Management category) and the Federation of regional radio and television bodies (FORTA) (Dissemination category).

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 Bacalaureate Geography teachers due to the teaching innovation topics addressed within the relationship between new technologies and geography teaching. In this field of action we should highlight the yearly *Explica Geografía con tus fotos* award (Explain Geography with your photos), aimed at Secondary Education and Bacalaureate students and the Educational Innovation Award. Also important are the projects for the design of teaching materials and resources in collaboration with the CNIG and the IGN.

### 3. INTERNATIONALISATION OF THE AGE

As indicated by professors Olcina, Lois and Mínguez (2020) in their presentation text of Spain's contribution to the IGU Congress in Istanbul, in the early years after the constitution of the AGE, except for the French influence, the fraternal relations with Portugal and occasional news from Anglo Saxon publications, the situation of Spanish Geography was one of international isolation. The discipline in Spain had been focused on applying the classical regional-landscape method and few Spanish geographers had enjoyed training and research stays abroad and even less so in non-Spanish speaking countries. However, from then, Spain's university geography together with the AGE undertook the internationalisation of the discipline.

The AGE has created and maintained a highly fruitful cooperative relationship with geographical organisations and associations in Europe and Latin America. The collaboration with the *Associação Portuguesa de Geógrafos* (APG) has been particularly special due to the close ties existing between the promoters, also experts in the discipline, of the two institutions (Ribeiro, García Fernández, Terán, Cabo) in the 1970s. This gave rise to the biennial celebration of an Iberian colloquium, which has consolidated the institutional work and research relations between teachers over the last four decades. Since 1979, sixteen Iberian Geographical Colloquies have been held in different cities of the two countries and the next Colloquium is to be held in Coimbra in October 2024. However, the relationship with the *Associação Portuguesa de Geógrafos* (APG) is not limited to the joint organisation of Iberian Colloquies but has also generated the creation of a joint repository of academic geography journals. Moreover, there is an active and regular presence of representatives of the APG in the AGE congresses and vice versa.

IBERIAN GEOGRAPHICAL CONGRESSES		
Edition	University	Year
I	University of Salamanca - Spain	1979
II	University of Lisboa - Portugal	1980
III	University of Barcelona - Spain	1984
IV	University of Coimbra - Portugal	1986
V	University of León - Spain	1989
IV	University of Porto - Portugal	1995
V	University of Cáceres - Spain	1995
VI	University of Lisboa - Portugal	1999
VII	University of Huelva - Spain	2004
VIII	University of Évora - Portugal	2005
IX	University of Alcalá de Henares - Spain	2008
X	University of Porto - Portugal	2010
XI	University of Santiago de Compostela - Spain	2012
XII	Guimarães University - Portugal	2014
XIII	University of Murcia - Spain	2016
XIV	University of Lisboa - Portugal	2018
XV	University of Salamanca - Spain	2022
XVI	University of Coimbra - Portugal	2024

Table 2. Source: AGE.

With respect to France, the AGE has collaborated closely with the *Comité National Français de Géographie*. The French-Hispanic Geography Workshops have been organised since 2016. The next edition will be in 2025 in the University of Saragossa. It also collaborates in the organisation of the *Nuit de la Géographie* and has established an action unit (AGE-Comité National Français de Géographie) in EUGEO and in the UGI.

SPANISH-FRENCH CONFERENCES		
Edition	University	Year
I	University of Granada	2016
II	Université Paris - 8	2017
III	University of Seville	2019
IV	Université de Lille	2021
V	Université de Toulouse Jean Jaurès	2023

Table 3.  
Source: AGE.

The AGE is also highly committed to EUGEO and EUROGEO (two European geographical societies with different profiles). EUGEO is an organisation that incorporates around thirty associations representing the EU countries. The AGE regularly attends the meetings and 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. Professor Rafael de Miguel from the University of Saragossa, associated with the AGE, was the president of the EUROGEO and many Spanish geographers publish their articles in the *European Journal of Geography*, its scientific vehicle of expression.

In addition, the AGE actively participates 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. Since its creation, attending the IGU congresses, forming a delegation and becoming part of its management bodies or Working Commissions constitutes an important objective for the members of the AGE and other Spanish professionals of the discipline. In fact, only a year after the association was established, a group of geographers decided to participate in the IGC of Moscow in 1976. In 1980, in Tokyo, Professor Joan Vilà Valentí of the (University of Barcelona) was elected Vice President of the IGU, a position which he held until 1988. Professor Vilà had been a member of 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 particularly focused on 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: Roser Majoral, M.<sup>a</sup> Dolors García Ramón and María Sala. The presence of the geographers from Madrid, Josefina Gómez Mendoza and Manuel Valenzuela was also highly important. In this respect, we should highlight the relevance of the Spanish contribution to the Washington Congress of 1992, with an overall review of Spanish Geography 1970-1990, a joint edition of the Spanish Committee. The contribution to The Hague 1996 was published through a special edition of the AGE Bulletin in Spanish and in English. For Seoul 2000, Glasgow 2004, Tunisia 2008 or Cologne, 2012, Spain resumed its participation 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 the participation of Spanish colleagues in the Working Commissions of the Union has increased. In this respect, we can highlight that first, Professors Jacobo García Álvarez of the Carlos III University and Josefina Domínguez Mújica 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 of Steering Committees of the Commissions has increased continuously, with ten in the year 2019. An important milestone in this respect was the appointment of Professor Rubén C. Lois González from the University of Santiago de Compostela as Vice President of the IGU in 2018. His work in the IGU has focused on improving the projection of geography written in the Spanish and Portuguese languages 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.).

## 4. FINAL REFLECTIONS. THE FUTURE

The advance made by Spanish Geography in recent decades is evident, from both a scientific and applied point of view. However, another aspect, which is in no way minor, is that it is also a science with strong social implications and the capacity to generate and intervene in many citizen debates, from everything related to the climate crisis to the problems of accessing housing, including renewable energies or the territorial impacts on tourism, among many other aspects.

Spanish Geography, which is increasingly associated with the science of the territory, is currently in a good moment. Geographical knowledge is necessary, and we are sure that this will be acknowledged. In addition to all of this, we should add the fundamental role of cartography in society. All geographers understand that it is not possible to plan without geographical knowledge. Similarly, it is becoming increasingly evident that it is not possible to communicate without cartographic knowledge.

Geography is a transversal science. An auxiliary and necessary discipline for many other disciplines. An example: in the academic year 2022-23, there were 29 Geography Degrees in Spanish universities, but the teaching staff of the Geography departments participated in 126 Masters Degrees. This implies that the "new" geographers are also arriving through masters or doctorate studies, not only through undergraduate degrees.

There are many challenges. On a national level, Spanish Geography will have to adapt to emerging themes, seek a greater (or improved) positioning on different educational levels (from Primary to Secondary and also Professional Training) or reinforce its social image, educating and explaining to different economic and social agents what Geography is, what we study, our employment options and in which research fields or topics we are pioneers and recognised as principal scientific experts. But we also face an enormous challenge on an international level. Recently, Spain was proclaimed as the only candidate for hosting and organising the International Geographical Congress of 2032 (IGU). In the more than 100 years of history of the IGU, Spain will host its general congress for the first time.

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# Army Geographical Centre (CEGET)

## TASKS AND CURRENT CAPABILITIES OF THE ARMY GEOGRAPHICAL CENTER IN THE GEOSPATIAL FIELD

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## INTRODUCTION

*“The Army Geographical Center (CEGET) is the body responsible for providing the Army with the necessary capability to offer geospatial support to units in operations and exercises. Additionally, it is tasked with executing activities related to the demarcation of land borders.”*

Current technological advancements and processes in digital transformation (DT) and information and knowledge management (IKM) necessitate constant adaptation to a new environment. This environment demands more modern products of high quality and accuracy that must be produced efficiently (with limited resources) and within shorter timeframes.

The initiatives and proposals identified in the near future foresee greater efforts in research, innovation, and collaboration with universities or companies in the civil sector.

## 1. GENERALITIES

### 1. INTEROPERABILITY

The workload for the benefit of interoperability represents one of the greatest efforts made at the Center. It involves creating geospatial products that are interoperable with our allies to be accessible to as many countries, organizations, and, ultimately, users as possible (fight off the same map).

### B. TASKS

The CEGET performs multiple tasks within the geospatial information (GI) cycle:

- i. Identification of needs.

## ii. Acquisition:

- Acquisition and generation of GI through internal production.
- Acquisition and generation of GI through participation in multinational production groups.
- Collaboration with specialized agencies of the General State Administration (AGE), such as the National Geographic Institute (IGN).
- Participation in GI standardization groups, geospatial information systems (Digital Map), Spatial Data Infrastructure (IDE), etc.
- Border demarcation.
- Topographic work.

## iii. Preparation and designation of GI:

- Quality control of GI and its metadata.
- Identification of possible deficiencies.
- Generation of the GI catalog: e-catalogue.
- Maintenance of the Army's Geospatial Database.

## iv. Dissemination of GI:

- Collaboration in the National Geospatial Warehouse (AGN) portal.
- Administrator of the Army Geospatial portal.
- Responding to GI requests from units, including printing on paper and special media.

## v. Exploitation of GI:

- Provide reachback support to requesting units:
  - GI management.
  - Operations planning support.
  - Geospatial advisory.
  - Support for the management, configuration, and administration of GIS.

## C. FUNCTIONAL RELATIONSHIPS

To carry out the above tasks, the CEGET maintains a series of functional relationships with various entities of the Armed Forces (FAS) and the AGE. The most notable are:

- Armed Forces Intelligence Center (CIFAS).** The relationship with the CIFAS Cartographic Coordination Section (SCC) is very close and regulated by RD 521/2020. Through this relationship, working links are established with other army production centers: Naval Hydrographic Institute (IHM) and Air Cartographic and Photographic Center (CECAF), covered by the 2021-24 Armed Forces Cartographic Plan (PLANCARFAS).
- Ministry of Foreign Affairs, European Union and Cooperation (MAEUEC).** CEGET is responsible for land border demarcation, forming joint commissions with France and Portugal, dependent on the MAEUEC's international boundary commissions with these countries. Work is currently underway to incorporate a new actor, Andorra, and to sign a boundary treaty.
- IGN.** The IGN is responsible for national GI, as well as the National Cartographic Plan, which includes national cartography produced by the MINISDEF under the PLANCARFAS. CEGET draws on national GI from the IGN. The IGN supports CEGET in border demarcation with France and Andorra. A cooperation protocol has recently been signed between both entities.
- Universities.** There is a traditional collaboration with the Polytechnic University of Madrid, especially with the Higher Technical School of Surveying, Geodesy, and Cartography Engineers and the Higher Technical School of Mining and Energy Engineers.

## 2. ACQUISITION, PREPARATION, AND DISSEMINATION OF INFORMATION AND GEOSPATIAL PRODUCTS

The main task of CEGET is the acquisition, preparation, storage, and dissemination of geospatial information and products. These products can include databases for use in information systems, raster elevation models, orthoimages, cartography, 3D scenarios, etc.

Depending on whether the products belong to standard series or are custom-made, they can be divided into:

- **Standardized products:** those belonging to standardized series, subject to rigorous production and preparation standards.
- **Non-standardized products:** those that are opportunistic and do not belong to any standardized series, which can be presented in the required format, scale, or data level as needed.

These products can correspond to:

- **National territory.** With complete and updated production from the IGN and other AGE entities, CEGET focuses on products aimed at unit preparation and those of scales required by international commitments not produced by other institutions, as well as non-standardized products as needed.
- **Areas of interest for National Defense (outside NT).** Under the project direction of CIFAS's SCC, CEGET manages at the technical level the multinational co-production programs and/or executes the production of GI for several of them, aiming at the acquisition and generation of geospatial products with different characteristics.

Most of CEGET's GI acquisition and production is included in multinational co-production programs as stipulated in PLANCARFAS, allowing allied countries to synergize efforts to achieve maximum production of priority interest areas for the participating countries.

Fulfilling agreed commitments allows for the exchange of GI, providing the necessary data for the development of Armed Forces operations, addressing national and international emergencies, etc.

At the international level, the following current projects stand out:

- **MGCP**, Multinational Geospatial Co-production Program. It is a global vector planimetric database, with  $1^{\circ} \times 1^{\circ}$  cells, suitable for GIS exploitation or producing 1: 50,000 or 1: 100,000 scale cartography.
- **MUVD**, MGCP Urban Vector Data. An associated program under the MGCP Memorandum of Understanding (MOU) to capture planimetric vectors of urban areas of interest at a 1: 5,000 scale.
- **TREx**, TanDEM-X High Resolution Elevation Data Exchange Program. Global elevation raster data with  $1^{\circ} \times 1^{\circ}$  cells and approximately 12 m spatial resolution, suitable for producing cartography larger than 1: 50,000 scale.
- **MMP**, MGCP Mapping Program, de facto associated with MGCP, deals with producing 1: 50,000 or 1: 100,000 scale MTM (MGCP Topographic Map) format cartography derived from MGCP planimetric data.

At the national level, collaboration with the IGN in the 2010s resulted in:

- **BTN100**, 1: 100,000 scale National Topographic Base. A database with the entire national territory was produced, suitable for producing 1: 100,000 scale cartography; these data are complemented with proprietary acquisition in the production of the CEGET M682 series.

## A. ACQUISITION OF GI

GI acquisition is carried out in various ways:

- **Acquisition through internal production with own or external means.** CEGET personnel or through contracting procedures capture information through photogrammetric methods (with GIS software for geographic and cartographic databases) or topographic methods (for specific tasks). When acquisition is contracted, quality control is performed by CEGET personnel.
- **Acquisition through information exchange.** CIFAS's SCC has signed various MOUs or Technical Agreements (TAs) with allied nations allowing GI exchange. Multinational co-production programs also facilitate this exchange, as does NATO membership, which provides available data when a situation or exercise requires it.

Programs considered as GI acquisition include MGCP, MUVD, and TREx.

## B. GENERATION OF GI

With the acquired data, standardized and opportunistic products requested by the Armed Forces are generated. These products are generated in the same ways as acquisition: own generation, outsourced, or exchanged. Quality control of generated products is always internal to CEGET, and multinational co-production programs require quality assurance of production by another project partner country or initial certification in the case of the MUVD program for urban data capture.

For interoperability, the implementation of a geospatial policy in the Atlantic Alliance began in the late 1980s, leading to the adoption of new production scales and new designations for those retained.

Currently, the cartographic series produced at CEGET are:

- Special series of ortho-maps for maneuvering and shooting ranges (CMT) with standardized allied symbology, in various scales from the largest to 1: 50,000.
- Series L for the Peninsula and Balearic Islands, Autonomous Cities, and Canary Islands, respectively, with classic symbology, 1: 50,000 scale.
- Series L for the Canary Islands with standardized allied symbology, 1: 50,000 scale.
- Various 1:50,000 series of areas of interest for National Defense.
- Series C for the Peninsula and Balearic Islands with classic symbology, 1: 100,000 scale.
- Series Joint Operation Graphics (JOG) Ground, 1: 250,000 scale.
- Series 1:500,000 scale.
- Map of Spain 1:1,000,000 and 1: 1,500,000 scales, with classic symbology.

Programs considered as GI generation include MMP and BTN100.

## C. PREPARATION AND DESIGNATION OF GI

Preparation and designation are standardized according to NATO STANAG (Standardization Agreements) and technical product documentation established by NATO.

Due to the diversity and large quantity of generated products, they must be cataloged to facilitate effective searching according to needs. CEGET generates metadata for each product to be used in a metadata catalog service to facilitate GI searching by users. Metadata follows the e-catalogue format established in NATO.

## D. DISSEMINATION OF GI

The CEGET contributes to the digital transformation of the Army through the development of a service-oriented architecture (SOA), with the aim of making it easier for authorized users to access product catalogues and the available GI, eliminating bureaucratic procedures. This contribution is complementary to CIFAS's efforts, so that:

- The SCC manages the AGN of data for all the Armed Forces, a tool that allows access to the GI produced by the three production centers of the armies, as well as that acquired through the different international agreements. Likewise, the AGN has the possibility of accessing external web services (IGN, cadaster, etc.).
- For its part, CEGET has developed a Virtual Geospatial Community to provide service to the ET, complementary to the previous one and which will provide the following products and services:
  - GEO documentation repository, with the regulations and specifications of GEO products in force.
  - Geospatial forums, where users can share their experiences, doubts and work for the benefit of the ET GEO community.
  - Catalogue service for standardized products produced at the CEGET.
  - Download services for printable standardized products.

The cartographic series are stored in the CEGET Finished Products Warehouse in paper format, with a stock that allows their rapid distribution to the units.

## 3. PARTICIPATION IN NATIONAL AND INTERNATIONAL WORKING GROUPS AND ORGANIZATIONS

The contribution to interoperability mentioned above focuses on participation in international working groups of the aforementioned projects, as well as the feeding of international databases (such as the International Geospatial Warehouse [IGW], fed with products from the MGCP and MUVD programs) and national databases (such as the AGN, or CEGET's own databases or shared with the Portuguese geospatial information center). Without forgetting that as the CEGET is the national responsible for the delimitation of international land borders, as a result of this fieldwork, the border delimitation with France and Portugal is also provided to the IGN.

In the international arena, the aforementioned co-production projects and the working groups listed below stand out:

- **MGCP**. Technical Panels.
- **TREx**. Technical Panels.
- **MUVD**. Technical Panels.
- **DGIWG**, Defense Geospatial Information Working Group. Working group in which the interoperability standards of allied countries in geospatial matters are defined.
- Eurocorps, participates in the GEOMETOC expert group.
- **MN-GSG**, Multinational Geospatial Support Group. CEGET participates in geospatial exercises organized by this multinational group that offers its services to NATO and the EU.

- **International boundary commissions and mixed boundary commissions**, with France, Portugal and, recently, with Andorra. The head of CEGET chairs the bilateral commissions, of a technical nature, for the delimitation of land borders: the Joint Commission on Demarcation (CMA) with France and the Joint Commission with Portugal (COMIX). In addition, he participates as a member in the international boundary meetings chaired by the MAEUEC: International Commission of the Pyrenees (CIP) with France and International Boundary Commission (ILC) with Portugal. CEGET staff are part of the technical Working Group (WG) and the Joint Commission (CM) with Andorra.
- **UGI**, International Geographical Union. Of a non-military nature, CEGET participates with material and documentation for the exhibitions that are organized biennially. The head of CEGET is a member of the Spanish committee.
- **ICA**, International Cartographic Association. Of a non-military nature, the CEGET participates with material and documentation for the exhibitions that are organized every two years.

At the **national level**, in addition to the PLANCARFAS follow-up meetings, the following can be mentioned:

- **CSG**, Higher Geographical Council. The head of the CEGET is a member of the Standing Committee of the Council. Dependent on the CSG, the CEGET participates in the following specialized commissions:
- **CESG**, Specialized Commission of the Geodetic System. The head of CEGET presides over it.
- **CENG**, Specialized Commission on Geographical Names. Participation as a member.
- **CEGG**, Specialized Commission of Geodesy and Geophysics. Participation as a member in the Geodesy Section.
- **RSG**, Royal Geographical Society. The head of CEGET is a member of this society aimed at promoting geographical culture in Spain.
- **TOPCART**, International Congress of Geomatics and Earth Sciences. The CEGET participates with the assembly of exhibitors and giving conferences.

## 4. GEODETIC AND TOPOGRAPHIC WORKS

One of the tasks of the CEGET is to carry out the geodetic and topographic field work required by the ET. This support is extrapolated, on request, to the rest of the MINISDEF and even to other AGE institutions.

At this point, there is room for topography work delimiting the properties and areas of interest for National Defense in TN.

### A. FIELD QUALITY CONTROL OF ACQUIRED GI

National cartography, and especially that of the CMTs, requires the field review of the data captured in the office by photogrammetry, and the topographic survey of the military installations that are reflected in the military thematic layer.

### B. BORDER DELIMITATION

As mentioned above, the CEGET is the national responsible for the delimitation of the land border. In addition to participating in the various commissions and technical working groups, it annually carries out the following topographical field work:

- i. **Portugal.** Review, maintenance and replacement, where appropriate, of the more than 5,200 border signs that materialize the border. A team of 2 PAX from each country participates annually, working together.
- i. **France.** Obtaining precise coordinates of the more than 750 signals. Annual campaigns are carried out with teams of 2 CEGET PAX supported by the IGN. The French delegation participates sporadically.
- i. **Andorra.** In 2022, work began on the definition of the delineation of the border and, if determined by the Ministries of Foreign Affairs of both States, the signing of a boundary treaty with Andorra. The CEGET, together with the IGN, have begun field work to define and legally argue the layout of this border.

## C. OTHER TOPOGRAPHICAL WORK

The Army's geographical unit (UGET) of the CEGET carries out all types of topographic work that is orderly and that requires the use of precision means and procedures. The most frequently performed jobs are:

- i. Survey of coordinates in property boundaries.
- ii. Support for the deployment of weapons systems at various national airfields and in Herat and Qala-i-Naw (Afghanistan).
- iii. Generation of orthoimages and terrain elevation models of high spatial resolution using sensors on RPAS platform.
- iv. Generation of 3D models using laser-scanner sensors.
- v. Any other topographical work that may be required.

# 5. GEOSPATIAL SUPPORT FOR PLANNING AND CONDUCTING OPERATIONS

## A. GENERAL

The CEGET provides the ET and its units with the geospatial support capabilities that are determined for the planning and execution of operations. This support can be given through two modalities:

- i. **Geospatial support for reachback.** It is the one provided by the CEGET from its facilities. This type of support is provided on an ongoing basis through requests from units and headquarters. It is also provided to units that are deployed in the area of operations (ZO). It is a support in geospatial analysis generating and/or supplying digital products, support in printing and distribution of cartography.
- ii. **Deployable geospatial support.** It is provided by deployable elements of the UGET directly to headquarters or large units in exercises or in ZO. In addition to those mentioned in the previous case, we must add the reproduction and distribution of products in physical support and support in capturing geospatial data in close time to the real time, as part of the OER (Rapid Environmental Assessment) concept.

## B. SUPPORT TO INTERNATIONAL ORGANIZATIONS

CEGET offers its capabilities to various international organizations. Generally, the UGET is in charge of carrying out this support, for which some or all of its capacities are offered to the following organizations:

- **MN-GSG.** Mentioned above, CEGET has offered field data capture capabilities and reachback printing support.
- **NATO.** The CEGET offers the different deployable capabilities of the UGET and reachback at the request of the organization.
- **Eurocorps.** The CEGET offers the deployable capabilities of the UGET for the ad hoc constitution of the CGSU (Combined Geospatial Support Unit).
- **EU.** The CEGET offers the deployable capabilities of the UGET to support the Battle Group.

## C. OPERATIONS AND EXERCISES

### i. Operations

CEGET has participated in the following multinational operations:

- UNPROFOR. CEGET already provided geospatial support in Bosnia and Herzegovina in the 1990s.
- Operation Free Hidalgo. CEGET set up a GEO cell during two rotations in the multinational brigade in Lebanon in 2007-08.
- Operation R/A (Afghanistan Reconstruction). CEGET deployed a field data capture team on several occasions to support the deployment of the PASI system in Herat and Qala-i-Naw (Afghanistan), twice in 2008, in 2009 and in 2012. Subsequently, in 2018, a joint CEGET-CECAF field data capture team was deployed in support of the MN-GSG for the lifting of obstacles to navigation in and out of Herat Airport.
- Antarctic Campaign of the ET. This Center has participated in different campaigns and has produced GIS from the area. Exercises The CEGET has taken part in a large number of exercises, both national and multinational.

### ii. Exercises

The CEGET has taken part in a large number of exercises, both national and multinational.

## 6. RESOURCES

The material resources available are adequate and are continuously being improved or renewed in order to adapt to the new possibilities and technological advances in the geospatial field.

### A. MATERIAL RESOURCES

The CEGET uses computer resources in its daily work that, without being specific, do require special characteristics to manage the GI and the necessary software.

Practically all the specific material is provided by the UGET. The CEGET has state-of-the-art materials such as:

- GNSS receivers (Global Navigation Satellite System, which includes GPS, Galileo, GLONASS, BeiDou, EGNOS...).
- Robotic total station.
- Laser-scanner station with LiDAR technology, fixed for use on a tripod.
- Indoor laser-scanner (manually portable)
- Fixed-wing mapping drone (Geodrone) with the ability to perform low-level photogrammetric flights.

The execution of a Geospatial Plan for Operations Support is pending, which is expected to provide CEGET with new protected mobile means to install mobile laser-scanner equipment

on them, portable laser-scanner equipment (back-pack), new fixed-wing and vertical take-off (VTOL) cartographic drones, as well as multicopters, all of them with different multispectral and Lidar payloads.

## **B. SPECIFIC SOFTWARE**

The most useful material or tool in many cases is software. In addition to the usual office automation packages and other commonly used programs, CEGET has an endless number of software licenses specific to the GEO field for the different jobs it carries out.

A special case of software is the Digital Charter, GIS developed at CEGET, as well as the navigation application for Android mobile devices of the same name. Desktop version 10 is currently being tested and, in parallel, the update of the mobile application for Android devices is under development.

# **7. OTHERS**

## **A. DIGITAL TRANSFORMATION (DT)**

The CEGET can play a significant role in the DT of the ET by organizing the GIC. Significant efforts are being made in DT activities, which will enable greater efficiency in the dissemination and utilization of GI by military users through various information services within military infrastructures and information systems.

## **B. R&D&I**

Regarding future projects, work is being done in three main areas.

The first is to automate as much as possible certain processes in information production to mitigate the increasing shortage of specialized personnel in GI production.

The second is to participate in/drive projects for the analysis and exploitation of geospatial data using artificial intelligence (AI or geointelligence) and machine learning (ML) techniques to develop algorithms and tools that complement the previous line of work. In terms of projects for the analysis and exploitation of geospatial data, there is particular interest in the following areas:

- Automatic identification of changes in cartographic elements from aerial/satellite images to evaluate the profitability of cartography updates.
- Automatic identification and extraction in vector format of both natural and artificial infrastructures and cartographic elements, including vegetation cover and land use from images.
- Automatic extraction of BIM (Building Information Modeling, i.e., 3D building data model) from point clouds obtained by image correlation or laser-scanner sensors. This would facilitate virtual reality or simulation developments in CMT or ZO.
- Automatic generalization of cartographic elements to reuse vector GI across different scales.

The third line of work is technological evolution to transition from traditional cartography to virtual scenarios and **digital twins**, achieving a high level of realism in information presentation, and being able to use AI algorithms and models on all types of information to make predictions.

The three aforementioned lines of work could encourage greater involvement in projects related to GEOINT or human geography.

# National Geographic Institute of Spain

## SYNTHETIC VISION OF SPANISH GEOGRAPHY THROUGH THE NATIONAL ATLAS OF SPAIN

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Since 1955, the National Geographic Institute (IGN) has been producing the National Atlas of Spain (ANE), a cartographic project of great importance and magnitude, in which maps, graphs, illustrations and texts offer an integrated and reasoned vision of the geographical and historical reality of our country.

The fact that it is a collection of annotated maps does not mean that it is simple: to describe a territory in a reasoned way is to try not only to say what it is like and describe its particularities, but also to clarify the reasons or factors of its configuration and provide valuable information for its explanatory understanding.

A national atlas is a necessary document for the public manager because it shows the state of the situation on different issues (environmental, economic, social, educational, etc.) in cartographic, graphic, and textual form. Furthermore, it provides scientific knowledge of the different aspects that characterise the territory and, at the same time, it constitutes an educational reference point for the general population.

It is therefore a complex project that contains a recapitulation and generalisation of contemporary scientific knowledge. The International Geographical Union itself defines it as “fundamental and complex geographical atlases of certain countries, containing a recapitulation and generalisation of contemporary scientific knowledge in the field of physical, economic and political geography of the country concerned”.

A national atlas is nowadays conceived as a multifunctional document in its aims, multidisciplinary in its execution, diverse and complex in its use of communication resources, albeit with a cartographic priority, open to thematic innovation and plural in the forms and technical supports used for its dissemination and use (Salinas, 2013).

## 1. BACKGROUND

### 1.1. GEOGRAPHICAL AND STATISTICAL REVIEW OF SPAIN

The National Atlas of Spain is a cartographic project with a long history. Its preparation has been made possible by the excellent scientific and technical preparation, the effort and enthusiasm of the professionals involved, and the commitment of the National Geographic Institute (IGN) to disseminate and continuously update the information represented in it, which must always be official, accurate and contrasted. At each stage of its evolution, the valuable heritage received from its predecessors has been highlighted, which has been the starting point for updating the contents.

In 1880, the then Geographical and Statistical Institute (IGE) launched a project to create the *Geographical and Statistical Review of Spain (Reseña Geográfica y Estadística de España)*. As General Ibáñez e Ibáñez de Ibero, director of the Institute at that time, pointed out in the prologue, this was a great project which, in order to be carried out successfully, “required the collaboration of the other management centres, and the assistance of the authorities of all orders, including prelates, and of some scientific establishments” (IGE, 1888: V), in addition to the data that the IGE itself possessed on territory and population.

The first Review (*Reseña*) was published in 1888, consisting of 1,398 pages, 23 chapters and a geographical map of the Peninsula and the Balearic Islands which, according to the prologue, is “necessary to illustrate its reading” (IGE, 1888: VI). In the 23 articles, the work covers topics such as territory, population, worship and clergy, army, justice, public works, public debt, agricultural, livestock and forestry wealth, elections, etc., and a curious last chapter - in the eyes of the 21st century - devoted to overseas territories. It is stated in the work that “In a book in which the Spanish nation is described under many of its multiple aspects, it did not seem natural to omit the overseas possessions, which are like an extension of the homeland” (IGE, 1888: 1.051). A perspective is given of the Great Antilla (island of Cuba), Puerto Rico, the Philippines, the Mariana Islands, the Carolinas and Palau.

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PROVINCIAL	GANADOS.						
	Lanar.	Caprin.	De vacca.	Vacum.	Asnal.	Mulr.	Cabalos.
Albacete.....	22 570	47 388	12 280	4 433	527	17 307	1 595
Alicante.....	71 356	15 743	1	1 045	5 714	15 437	1 172
Almería.....	143 295	20 320	1	1	4 514	5 147	474
Ávila.....	427 325	77 080	30 450	43 535	13 595	4 225	5 930
Badajoz.....	1 027 842	128 414	288 281	71 331	48 000	28 550	10 500
Balears.....	74 743	15 082	10 200	11 015	11 820	13 205	1 144
Batmanas.....	3 551	147 321	3 764	8 209	4 040	5 303	1 018
Burgos.....	423 340	49 800	10 143	20 007	20 000	4 107	8 416
Ciudad Real.....	320 081	104 395	30 074	50 543	12 882	8 648	8 025
Cáceres.....	37 530	74 285	12 000	10 000	10 000	10 000	10 000
Canarias.....	10 472	44 820	1 435	10 000	4 101	4 200	4 400
Cantabria.....	157 800	120 274	3 201	3 201	4 000	8 000	4 100
Castellón.....	107 800	70 474	5 704	12 201	10 000	10 000	10 000
Ciudad Real.....	320 081	104 395	30 074	50 543	12 882	8 648	8 025
Córdoba.....	107 400	12 800	12 800	12 800	12 800	12 800	12 800
Cuenca.....	470 374	38 374	4 812	5 205	10 800	13 085	3 145
Gerona.....	107 400	12 800	12 800	12 800	12 800	12 800	12 800
Granada.....	348 315	90 440	5 621	4 200	10 800	11 744	4 100
Guadalquivir.....	400 374	38 374	4 812	5 205	10 800	13 085	3 145
Huelva.....	423 325	77 080	30 450	43 535	13 595	4 225	5 930
Jaén.....	600 123	95 080	44 470	10 000	10 000	10 000	10 000
León.....	800 311	127 358	13 085	10 000	10 000	10 000	10 000
Lugo.....	30 000	5 000	200	10 000	10 000	10 000	10 000
Lleida.....	303 000	30 743	3 200	5 000	4 200	8 400	3 200
Logroño.....	114 300	30 147	40 000	10 000	10 000	10 000	10 000
Madrid.....	200 000	10 000	1 000	10 000	10 000	10 000	10 000
Málaga.....	114 300	30 147	40 000	10 000	10 000	10 000	10 000
Murcia.....	114 300	30 147	40 000	10 000	10 000	10 000	10 000
Orense.....	80 000	10 000	1 000	10 000	10 000	10 000	10 000
Oviedo.....	107 400	12 800	12 800	12 800	12 800	12 800	12 800
Palencia.....	470 374	38 374	4 812	5 205	10 800	13 085	3 145
Pamplona.....	107 400	12 800	12 800	12 800	12 800	12 800	12 800
Pinar del Río.....	107 400	12 800	12 800	12 800	12 800	12 800	12 800
Segovia.....	107 400	12 800	12 800	12 800	12 800	12 800	12 800
Sevilla.....	300 320	114 314	51 430	74 974	14 301	6 301	10 000
Soria.....	107 400	12 800	12 800	12 800	12 800	12 800	12 800
Tarazona.....	10 000	10 000	10 000	10 000	10 000	10 000	10 000
Terracena.....	107 400	12 800	12 800	12 800	12 800	12 800	12 800
Tortosa.....	107 400	12 800	12 800	12 800	12 800	12 800	12 800
Valladolid.....	140 312	64 300	10 000	10 000	10 000	10 000	10 000
Vizcaya.....	200 000	10 000	1 000	10 000	10 000	10 000	10 000
Zamora.....	140 312	64 300	10 000	10 000	10 000	10 000	10 000
Zaragoza.....	250 000	10 000	1 000	10 000	10 000	10 000	10 000
TOTAL.....	13 223 804	4 523 081	1 054 695	1 400 000	1 227 300	425 045	330 025

1. Page dedicated to livestock by type of livestock and province. Source: National Geographic Institute.

The map, at a scale of 1:1,500,000, drawn by Ibáñez de Ibero himself to represent the army's reserves and depots, is the only illustration accompanying the text. Published in black and sienna, it was reissued in 1902. The editing work was carried out at the print shop of the Geographical and Statistical Institute itself.



2. Map of Spain at a scale of 1:1,500,000 drawn up by Ibáñez de Ibero to represent army reserves and depots. Source: National Geographic Institute.

This first Review is not, therefore, a national atlas in the strict sense, as it only includes one map, but it can be considered as a forerunner of this one, as it is a synthesis of national statistics.

Despite the intention of updating the publication, a new Review was not undertaken until the beginning of the 20th century. It was published in three volumes, edited successively in 1912, 1913 and at the end of 1914. Volume I was devoted exclusively to the description of the territory, and the following two to human geography (population, justice, army, public works, communications, productive sectors, etc.).

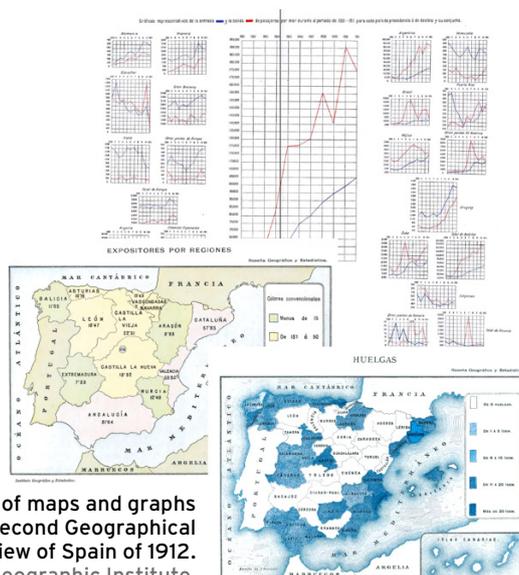
The great novelty of this edition was undoubtedly the inclusion of thematic cartographic plates, graphs and profiles. This was possible, among other factors, thanks to the creation of the Graphic Arts Section, which did not exist when the first edition of the Review was produced, as well as the labour of the bodies of Geographical Engineers and Statistics Practitioners, who were able to provide greater knowledge of the territory and the population.

The first volume includes several plates with climatological maps and graphs, a mining map, a geotechnical map, several topographical profiles and three maps corresponding to the judicial, civil and military divisions.



3. Map of the civil division of Spain included in the second Geographical and Statistical Review of Spain of 1912. Source: National Geographic Institute.

The following two volumes include some thematic maps (state of public works in January 1913, postal map, telegraph map, telephone network, ...) and numerous statistical charts on demography, strikes, army, health, agricultural and livestock production, and even displays by provinces and regions.



4. Examples of maps and graphs contained in the second Geographical and Statistical Review of Spain of 1912. Source: National Geographic Institute.

As a curiosity, many of the maps and graphics are signed by the recently created Graphic Arts Section, which according to the prologue of the Review "it will not be surprising (...) that having created a Graphic Arts Section, which can be compared with its similar ones abroad, there are facilities that were previously lacking as far as plans, maps and engravings are concerned (IGE, 1812: V).

We are still not dealing with a national atlas as such, but it is the foundation on which the following publications were developed, in which graphic resources (maps, statistical graphs, illustrations) are gaining more and more weight and quality.

## 1.2. STATISTICAL GEOGRAPHICAL ATLAS OF 1930

The second stage began in 1930, with a Royal Order that established the annual publication of a Statistical Geographical Atlas and entrusted its production to the Permanent Commission of the Economic Map of Spain, belonging to the Higher Geographical Council of the now called Geographical and Cadastral Institute of Spain (former IGE).

After the change of political system in 1931 and with the arrival of the Second Republic, the Higher Geographic Council disappeared and the Interministerial Commission on Cartography and Economic Geography was created with the purpose of producing the Economic Map or Economic Geographic Yearbook of Spain. The execution of this Economic Map was no more than a proposal and the project could not be carried out due to problems in the formation of working groups, the difficulty in obtaining data, and the lack of political will for the work to go ahead, or the poor management of those who had to carry out this work, as well as the outbreak of the Civil War.

## 2. THE FIRST NATIONAL ATLAS OF SPAIN (1955-1985)

The need to have works of synthesis of the nation's geography had prompted several countries in the first half of the 20<sup>th</sup> century to elaborate their own national atlases. Each country chose the content and methods of representation that best suited its needs or available means. But this did not allow for correlations between different countries, so from the XVIII Congress of the International Geographical Union (IGU) held in Rio de Janeiro in 1956, a Working Group on National Atlases (later to become the National Atlas Commission) was established. This commission was responsible for preparing and publishing a text which provided an analysis of existing national atlases, and made recommendations for those works in preparation, in order to unify criteria and make possible a later comparison of the works of some countries with others.

By 1965, the national atlases of Finland, France, Canada, Egypt, Czechoslovakia, USSR, Italy, Australia, Tanganyika (now Tanzania), Belgium, UK and Israel had been published, and those of Sweden, Denmark and Switzerland were being delivered as a loose-leaf collection. This was the model adopted by the National Atlas Commission set up at the Geographical and Cadastral Institute (IGC) in 1955.

The Commission was made up of a group of geographers including doctors and graduates in Geography with proven experience and prestige such as Amando Melón & Ruiz de Gordejuela, Manuel de Terán, Solé Sabarís, Vilá Valentí, Casas Torres, Sanz García, etc. and officials from the Geographic Institute such as Núñez de las Cuevas –who later became director of the IGC–, Nadal, Martín López, etc., together with other professionals from the graphic arts. All of them were connoisseurs of the cartographic language and tried to replace the old concept of written text with the modern concept of the map as a graphic image.

The first National Atlas of Spain, published in 1965, was begun in 1958 under the direction of Francisco Vázquez Maure. The cartographic techniques used in that edition contributed to the learning and practice of a new working methodology, different from the one that had been used until then, obtaining a considerable improvement in the quality of the final product.

The technique used, sgraffito on glass, was used in very few countries at that time and it was necessary to import the patent from Switzerland. The team gained considerable experience and quality in their work. A further advance was the use of the technique of stabilene insolate. For the first time, a 1:500,000 scale representation of the entire national territory was achieved. The data was obtained from the National Topographic Map at a scale of 1:50,000, which was completed prior to this work.

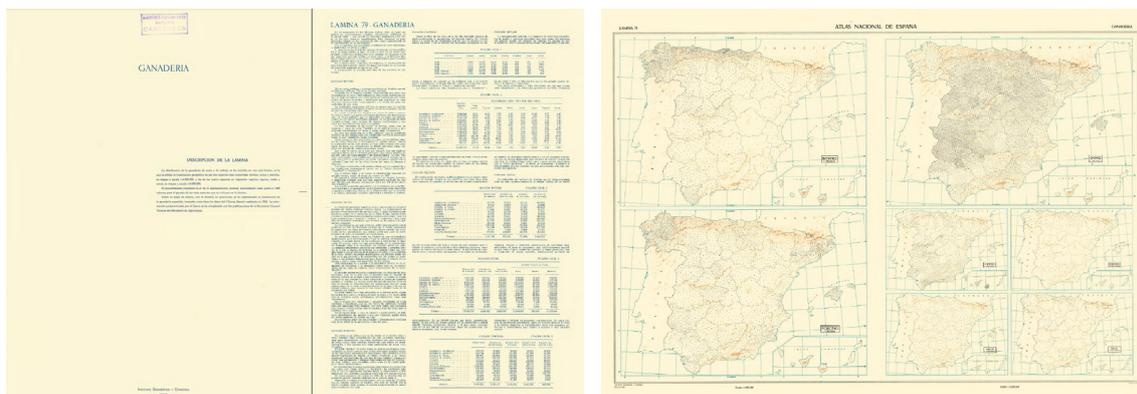
Despite the many difficulties that hindered the completion of the project, the 28 geographical plates and 24 of the 72 thematic plates of the initial 100-plate project were published in 1965, presented in a covered box. A Geographical Review of 227 pages and a Toponymic Index of 176 pages and approximately 40,000 toponyms were published later. The last updates of some of the geographical plates were made in the 1980s.



5. Contents of the 1965 National Atlas of Spain: foreword, index, geographical and thematic maps, geographical overview and toponymic index. Source: National Geographic Institute.

The plates of the thematic maps are very interesting because they consist of four pages, with a description of the plate (on the title page) by a small explanatory text with a brief description, indication of the data source, representation technique and, on many occasions, the author of the preparation of the maps and the corresponding explanatory texts; the thematic map (or maps) on the central pages, and, on the back cover, an explanatory text of the phenomenon represented and the corresponding data for the quantitative maps.

As an example, this is the plate dedicated to livestock:



6. Front cover, back cover and inside pages of the thematic plate no. 79 of the 1965 National Atlas of Spain. Source: National Geographic Institute.

Unfortunately, the work was left unfinished due to various circumstances, although the scientific approach in which the work was promoted was well conceived and even ahead of its time. In the words of Vázquez Maure, director of the Atlas, the work was stopped because “the socio-economic part was being elaborated and there were practically no true statistics. The honesty of the geographers at that time, D. Manuel de Terán, who collaborated in the Atlas, and Vázquez Maure, of total integrity, made them feel incapable of going ahead with it; information was available from different sources and the cartographic result, necessarily, was contradictory; (...) The honest thing was not to make those maps, out of modesty and love for Spain, but in no way for lack of economic means or incompetence on the part of the Geographic Institute” (Sanz, 1993: 65).

For the first time in Spain there was a work that synthesised through cartographic language the physical and human geography of the country, which is an essential material for governmental management of the territory, among other aspects.

### 3. THE SECOND NATIONAL ATLAS OF SPAIN (1986-2008)

On June 13, 1986, the Atlas received a new momentum through the Council of Ministers Agreement that initiated the new National Atlas of Spain, whose work was directed by Fernando Aranz del Río, the first Head of the Thematic Cartography and National Atlas Area of what is now called the National Geographic Institute (IGN).

The project began in 1987, with a multidisciplinary team from outside the Institute, with the participation of different ministries and bodies of the General State Administration (48 inter-ministerial working groups), the administrations of the Regions and numerous specialists supplying data and writing content.

The internal team of the National Atlas was made up of more than 40 people from different academic backgrounds, with geographic engineers (which is the own professional body of the IGN), topographers, geography graduates, cartographic draughtsmen and various graphic arts technicians (typesetters, printers, bookbinders...).

It should be noted that, for the first time in the history of the IGN, whose work throughout its existence had been the production of topographic maps, several geography graduates were hired for their qualifications in the production of thematic cartography. The management of the Atlas always appreciated the analytical capacity, the structural vision, the globalising synthesis, the harmony in the treatment of colour and the aesthetic presentation to show the cartographic rigour of our profession.

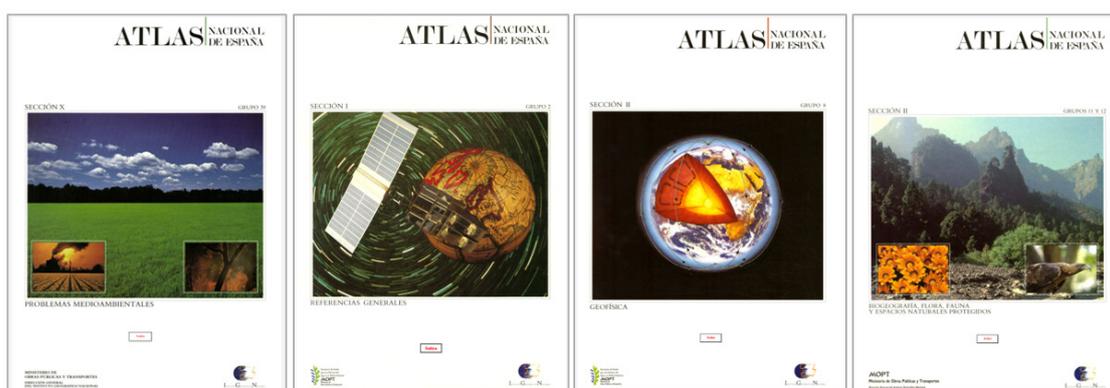
In the early years of the project, the task was not easy. The thematic structure and format of the work differed from the traditional, the new computer techniques and the use of computers to obtain the maps up to their final phase, prior to printing, were somewhat unfamiliar, and the composition of the work team with personnel different from the usual in the institution caused strangeness in the rest of the IGN technical departments, and somehow it was believed that the project, as on previous occasions, would not reach completion. But this was not the case, and a major work was successfully completed.

ATLAS NACIONAL DE ESPAÑA		
1 Presentación, introducción e índice	SECCIÓN I Ocupación del territorio Actividades económicas básicas	SECCIÓN X Otras actividades y servicios
2 Referencias generales	15 Ocupación del territorio y urbanismo	32 Organización del Estado
3 Referencias cartográficas	16 Minería	33 Turismo
3b Tablas de datos geográficos	17 Agricultura, ganadería, silvicultura y pesca	34 Sanidad
3c Mapas y paisajes	SECCIÓN VI Actividades industriales	35 Educación y Ciencia
4 Referencias históricas	18 Energía	36 Artes y Cultura
	19 Sector industrial	38 Deportes
	20 Datos generales	37 Trabajo, Seguridad Social y Servicios Sociales
	21 Construcción, obras públicas y edificación	38 Defensa, Seguridad y Justicia
	SECCIÓN VII Transportes y comunicación	
	22 Transporte por carretera	
	23 Transporte por ferrocarril	
	24 Transporte aéreo	
	25 Transporte marítimo	
	26 Transporte urbano	
	27 y otros medios de transporte	
	SECCIÓN VIII Comercio y finanzas	
	28 Actividades empresariales	
	29 Comercio interior	
	30 Comercio exterior	
	31 Finanzas y hacienda	
		SECCIÓN XI Problemas medioambientales
		39 Problemas medioambientales
		SECCIÓN XII El conocimiento del territorio
		40 El conocimiento del territorio: El Instituto Geográfico Nacional
		41 El conocimiento del territorio: Otros organismos oficiales
		SECCIÓN XIII Información sociológica
		42 Sociología familiar
		43 Sociología laboral
		44 Sociología cultural
		45 Sociología electoral
		SECCIÓN XIV Síntesis general
		46 Índice topográfico
		47 Índices generales

7. Thematic index of the National Atlas of Spain 1986. Source: National Geographic Institute.

The new Atlas was organised into thirteen thematic sections which were divided into 48 chapters - working groups - dealing with all aspects of the physical and human geography of our country through cartography.

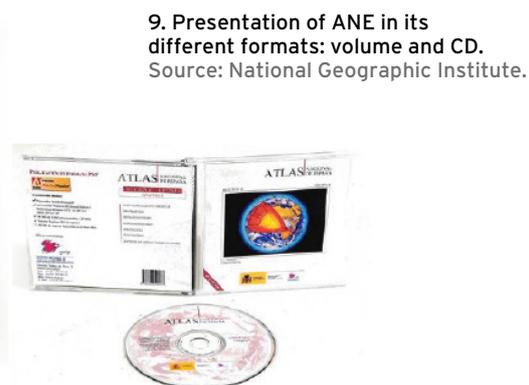
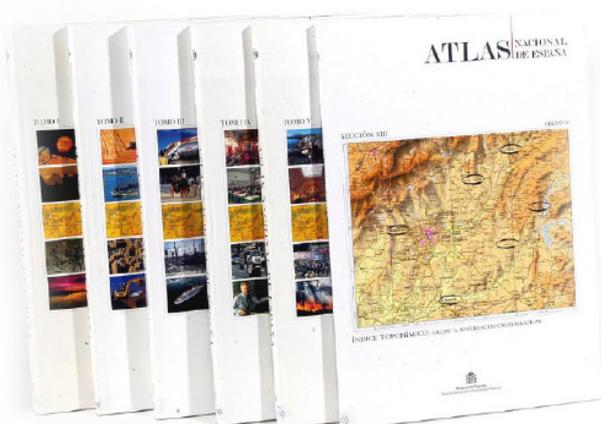
One of the great challenges of a national atlas is that the information it represents does not become obsolete before it reaches the final user. Given the length of the work, it was therefore decided that each cartographic editor should work on one (or several) of the 47 subjects in which the work was divided, so that progress could be made in parallel and so that the “booklets” or independent fascicles dedicated to each of the working groups could be published. In 1991 the first booklet of the Atlas was published, corresponding to the thematic group number 39 called “Environmental Problems” and from that moment onwards the 47 working groups were published continuously in 45 independent booklets, as the 11 and 12 (“Biogeography, flora and fauna”, and “Protected areas”) were grouped together for their explanatory continuity. In 1997, the first edition of the complete work was completed, both in fascicles and in volumes.



8. Covers of the first ANE booklets published in 1992.  
Source: National Geographic Institute.

The contents of the work were published both in the aforementioned booklets and in large-format volumes (five thematic volumes plus an additional one that includes the toponymic index), with more than 2,200 pages and more than 4,500 maps covering all of the topics that make up the country’s geographic reality. For several of the thematic groups, two editions were produced, for group 39 three editions and for group 31 (“Finance and Treasury”) up to four updated editions were produced.

Two editions of a multimedia product on CD were also produced based on the contents of group 32 “Organisation of the State”. Finally, a prototype of an interactive multimedia touch-screen video disc was developed based on the contents of groups 11 and 12, a very innovative medium at the time. At the same time, some thematic groups continued to be updated and were published first in the form of booklets, then as electronic books in PDF format on CD.



9. Presentation of ANE in its different formats: volume and CD.  
Source: National Geographic Institute.

At the same time, work was also done on the execution of prototypes of new ANE products. In response to criticism of the large size of the first edition (which was forced by the scale of the most detailed map, 1:2,000,000), which made it difficult to store and handle, the IGN management requested the production of a smaller publication to serve as a prototype. Thus began the publication of two volumes, in smaller format, compiling selected and updated contents of the thematic groups of the physical environment ("The Physical Environment 1" and "The Physical Environment 2"). This marked the beginning of the [series ANE Compendiums](#) (*Compendios del ANE*), which is still in force today.

In the following years some monographic publications were produced in this new format, thanks to the good reception of the users, dedicated to "Image and Landscape"; "Demography"; "Geology", "Geomorphology" and "Edaphology"; and "Tourism in Rural and Natural Spaces", directed by specialists in each subject. These publications are part of the ANE Monographs series, also in force.

The management of the ANE has always thought that in a work of this magnitude it is essential to have the participation of scientific and academic organisations that define the thematic contents, making an exhaustive selection of the information to be represented on the maps, organisations supplying official data, and cartographic institutions to elaborate, process, interpret and link these thematic contents with cartographic rigour, to constitute a great National Atlas.

In this sense, work began to develop a scientific network made up of specialists in the thematic contents, while the staff of the Cartography and National Atlas Area began the development of products with new formats, supports and technologies that have led to the new National Atlas of Spain for the 21st century.

## 4. NATIONAL ATLAS OF SPAIN OF THE 21<sup>ST</sup> CENTURY (ANEXXI)

Once the new project had been designed in terms of the computer tools (the information system developed in-house, the National Atlas Information System (SIANE), as well as commercial information systems and drawing and design programmes), the mock-up of the work, the updated cartographic bases and the protocols and procedures for action, the thematic contents had to be defined, which had to be necessarily revised from the contents prepared for the previous version of the ANE.

For the preparation of the new thematic structure and the scientific definition of its contents, the ANEXXI Network was created, made from scientific and academic organisations, promoted by the IGN and the National Centre for Geographic Information (CNIG), to ensure continuous scientific management guided by criteria of excellence in the preparation of the NSA and in the dissemination of the results achieved. The first agreement between the IGN-CNIG and the leading organisation of this network, the University of Alcalá, was signed in 2015.

The Network is now a consolidated reality. After a first stage of "filming" and important results, the Network was reconfigured in 2022 to further optimise its operation. Currently, the Spanish Association of Geography (AGE) is the organisation leading the Network, which is made up of 36 universities (practically all the country's public universities and two private universities), the Spanish National Research Council, the Royal Academy of History, the National Library of Spain and the School of Geographers. It brings the knowledge and experience of 137 researchers belonging to the Network, plus another significant number of scientific advisors from organisations not associated with this network who work in a coordinated manner in the 24 thematic working groups formed, one for each of the themes that make up the structure of the ANEXXI. In simplified form, the IGN is

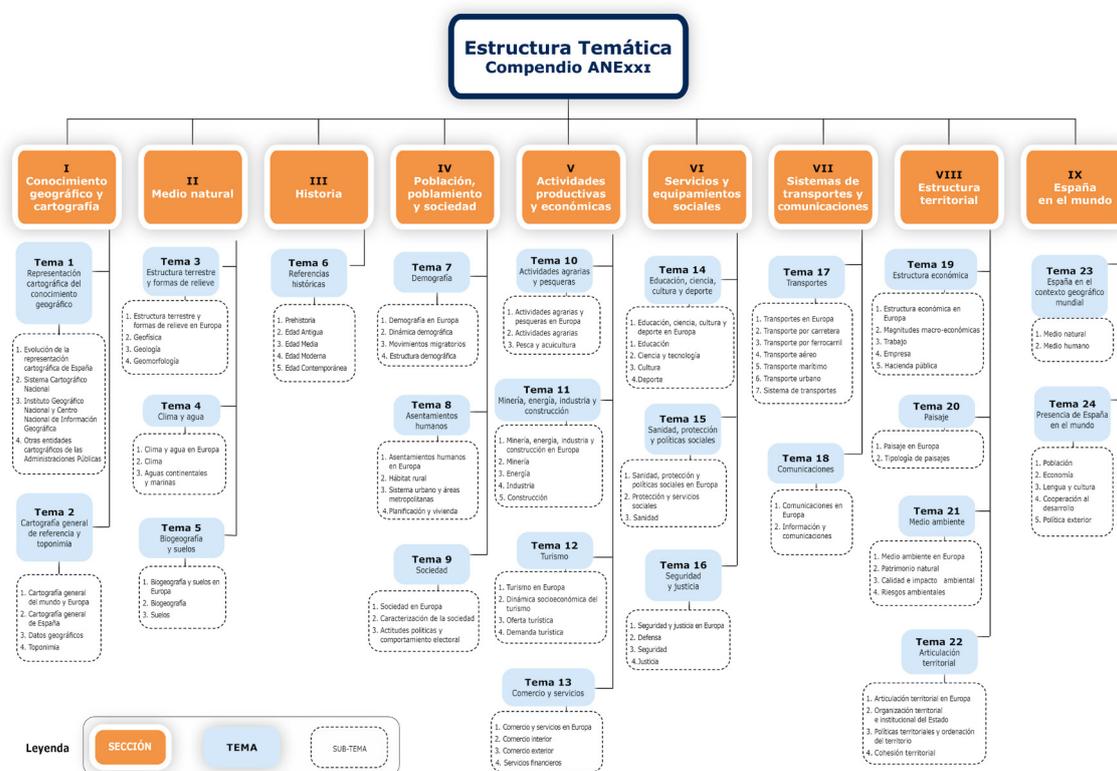
responsible, for the general and technical management of the ANE and its preparation; the CNIG for its publication and dissemination; and the Network for scientific management and collaboration and for contributing to the dissemination of its results.

Work was also carried out on the definition of new media and publication channels, so that digital books and individualised resources are also offered in digital format, and we have the ANE Geoportal as a website, as well as other cartographic viewers such as the interactive ANE.

#### 4.1. SPAIN ON MAPS. A GEOGRAPHICAL SYNTHESIS

The first product of this new stage was the compendium *Spain on Maps. A Geographical Synthesis*, the first paper edition of which was published in 2018. It consisted of a 620-page volume with more than 1,200 graphic resources, 827 of which were maps.

It is a reference work for the knowledge and research of the geographical reality of Spain, with continuous updating and dissemination through various communication channels. ANEXXI differs from previous atlases in that it presents a new thematic structure (included in the General series) with 9 sections divided into 24 subjects which, in turn, were broken down into 73 sub-themes (there are currently 93 as an additional sub-theme has been added to contextualise each subject in the European context); new fields of knowledge are included and, above all, current approaches in the treatment and presentation of other subjects which are already classic in any national atlas. It also incorporates the recent capabilities of information and communication technologies for its preparation and dissemination. In this sense, once the paper volume was published, the next objective was to publish it on the Internet, for which the ANE Geoportal was created.



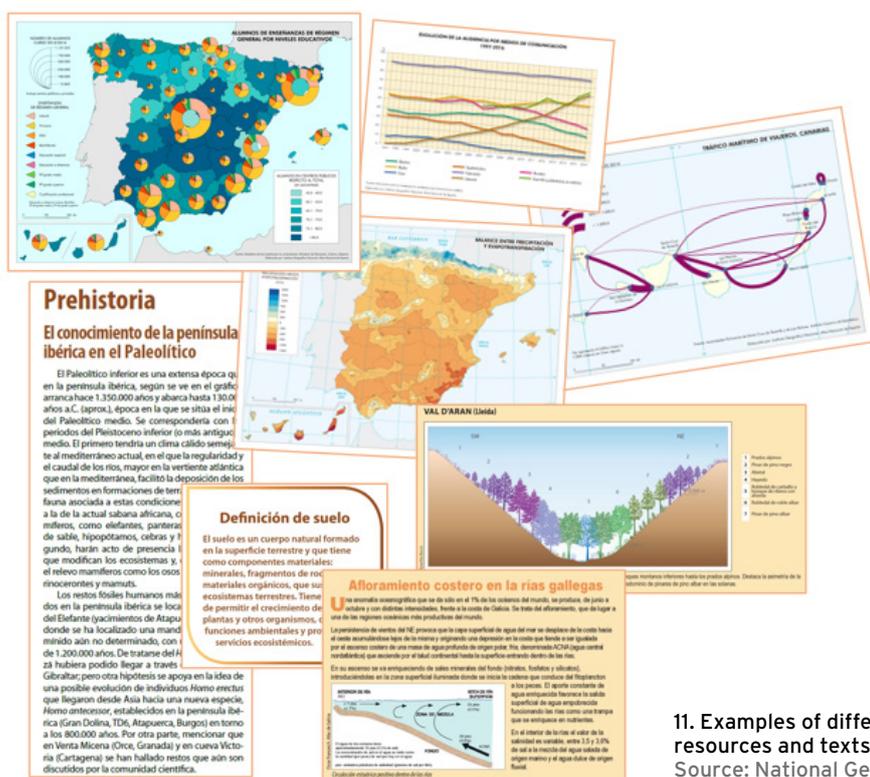
10. Thematic structure of ANEXXI. Source: National Geographic Institute.

The priority objectives of the project were:

- To provide a summary vision of the country and contextualise it in the world.
- To facilitate the availability of qualitative and quantitative data, truthful and reliable, supplied, above all, by the Public Administrations.
- To provide knowledge about Spain's territory, society and economy by a large team of scientists.
- To produce clear, legible and suggestive maps.

Only official data and, up to now, consolidated data were used to produce the Atlas. The data come from more than 120 official information providers. Both national and international organisations have been consulted.

Maps of Spain, Europe and the World were produced at different scales, graphs, illustrations and tables interwoven with explanatory texts (general, associated and highlighted), written by the scientific collaborators, which create an argumentative thread, and are combined with the graphic contents, unlike the old edition of the ANE, which had all the explanatory text on the first pages of each issue.



11. Examples of different graphic resources and texts included in the work. Source: National Geographic Institute.

#### 4.1.1. Diffusion Channels

The publication is still on paper, and it conditions the scales of the maps and the format of the work. This is why the Atlas is produced in the first place, but the contents are then reused in other media and channels. Thus, digital books are produced from it and the contents are combined in the web pages of the ANE Geoportal. This geoportal is linked to the ANE Interactive application in which the statistical maps have been regenerated. The ANE Finder application (*Buscón del ANE*) is also maintained, which is a search engine where you can find all the contents linked to the ANE from the Statistical Reviews and which is based on the elaboration of its own thesaurus (ANE Thesaurus) that includes all the concepts with their terms and expressions represented since its beginnings.

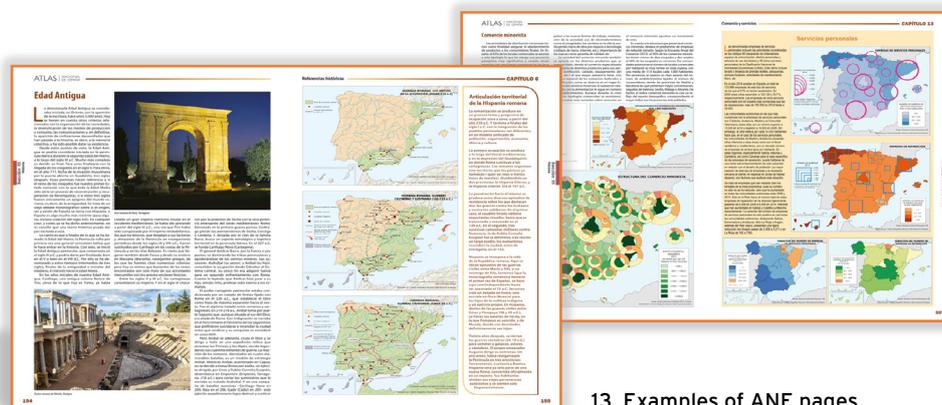
The results are interrelated. ArcGIS Online has now also been successfully tested to publish qualitative map services and story maps.



12. Outline of NSA dissemination channels.

### A) Paper books and digital publications

The hard-bound printed book can be purchased through the National Centre for Geographic Information (CNIG) online shop, and the digital publication can be downloaded free of charge in PDF format from the Institute's website [Libros Atlas Nacional de España - Instituto Geográfico Nacional \(ign.es\)](http://www.ign.es).



13. Examples of ANE pages.

**B)** In addition to the digital books, resources can be downloaded individually from the IGN website in the Download Centre and through a direct link from the ANE Geoportal. For each map, a JPG image file can be downloaded; a non-editable PDF; the cartographic bases used to create the map; the map metadata; and, if the information supplying organisation allows it, the data used and processed by the IGN to create the map.

### C) ANE Geoportal

The [Geoportal](http://www.ign.es) is our website (National Atlas of Spain - National Geographic Institute (ign.es)). It shows all the contents produced by the ANE and from it you can access the viewers, previous editions, highlighted maps, resources not linked to any specific publication, monographs, etc.

For each of the themes and sub-themes that make up the work there is a page with all the graphic resources (maps, graphs, illustrations) and explanatory texts, so that there are currently more than 150 pages where the reader can obtain the keys to understanding the reality of the selected theme. The texts contain hyperlinks to other parts of the same



14. ANE Geoportal home page.

work, to articles and explanatory videos on other websites, to promote a network of knowledge, and from each of the resources there are links to the Download Centre (CdD) and the interactive Atlas (Interactive ANE).

The technology used is MediaWiki, popular and collaborative software chosen for being a free, versatile, easy-to-navigate tool that allows easy structuring of information, as well as being well known to users as it is the base application of the famous Wikipedia (which also ensures that it is continuously updated and in line with new operating systems, web browsers, etc.).

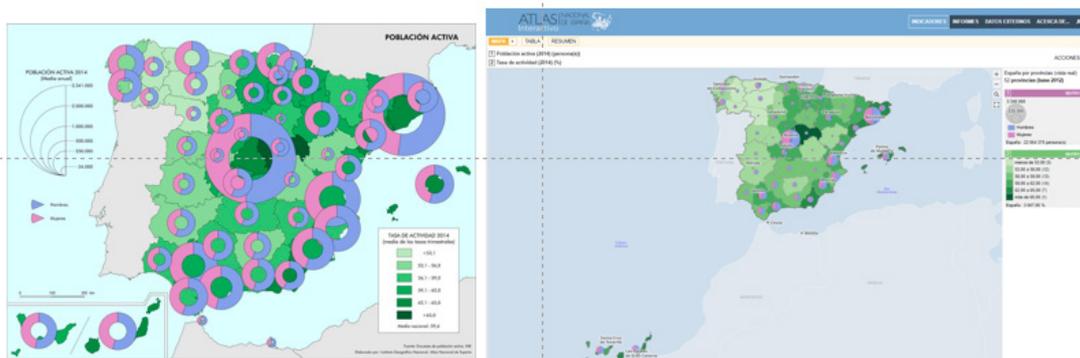
#### D) Interactive ANE

This viewer presents the quantitative maps elaborated for the ANE under the support of the Geoclip tool (<https://interactivo-atlasnacional.ign.es/#c=home>). The maps are interactive, so that, in addition to providing information on the data represented, zooming in on a given area or selecting territorial units, it is possible to change the colour palette, symbol size, interval thresholds, etc.

There are currently more than 600 indicators uploaded to the viewer, organised by theme, by representation system and by the work in which they were published. It uses four cartographic techniques: choropleths, proportional symbols, sectors and flows. The base maps used are of regions, provinces and municipalities.

In addition, the data can be consulted in table mode and the user can import his own data so that he can create his own map, or mix his indicators with those already used by the NSA.

The viewer can be accessed from the ANE Geoportal, from each of the links on the quantitative maps or from the Internet.



15. Example of a statistical map of the NSA, on the left, and its counterpart in the interactive NSA.

### E) ANE Finder (*Buscón del ANE*)

The Atlas Finder (<https://www.ign.es/ane/bane/>) is a very powerful application, ANE's own, that facilitates the retrieval and visualisation of the ANE resources. It keeps a record, in images, of all the editions of the National Atlas of Spain since its first version, including the Statistical Reviews, with more than 6,300 images.

The search engine is based on the Thesaurus of the National Atlas of Spain, created specifically for resource retrieval. The Thesaurus is a vocabulary of descriptors created using a controlled language, which conforms to established criteria in terms of form and relationships. It is based on the thematic content of all editions of the ANE. The descriptors, or keywords, have equivalence, hierarchical and associative relationships between them and are elaborated in accordance with the UNE 50-106:1990 standard. It can be downloaded free of charge from the CNIG Download Centre.



16. ANE Finder home page.

## 4.2. MONOGRAPH THE COVID-19 PANDEMIC IN SPAIN. FIRST WAVE: FROM THE FIRST CASES TO JUNE 2020

In 2019, the contents of the ANE were updated. The Atlas editorial team carried out an exhaustive critical review of the contents and methods of representation of all the data of the work, *Spain on Maps. A Geographical Synthesis*.

In 2020, it was affected by the COVID-19 pandemic and the preparation of a monograph about it. The monograph arises from the need to be useful during the first confinement and to contribute to an intelligent reading of what happened as a consequence of the pandemic in Spain in its spatial dimension and its health, economic, social and environmental effects, as well as to elaborate a tool to support research and teaching.

The monograph is an atlas that offers a geographic description of the impact of the pandemic with the utmost scientific rigour. The study extends from the first cases diagnosed in March 2020 to the end of the first wave in June 2020. It is structured in 3 sections, 19 subjects and 20 sub-themes. It was developed with the collaboration of numerous researchers belonging to the ANEXXI Network.

Like all ANE publications, it is based on official data provided by the General State Administration and the regional and local administrations.

For the first time, moreover, the work was produced in Spanish and English in both paper and digital format (digital book and geoportal) with the aim of offering the scientific community, and any interested citizen, an official image of Spain oriented at understanding the reality experienced during those months.



17. Graphic resources and index of the monograph on the COVID-19 pandemic.

**Contexto global de la pandemia COVID-19**

Tema 1 Origen y difusión de la pandemia en el mundo

Tema 2 Afectación de la pandemia en la Unión Europea

Tema 3 Efectos sociales, económicos y ambientales en el mundo

Tema 4 Efectos sociales, económicos y ambientales en la Unión Europea

Tema 5 Efectos ambientales

**Sección I**

**La pandemia COVID-19 en España**

Tema 6 Población, poblamiento y comorbilidad

Tema 7 Recursos sanitarios antes de la llegada de la pandemia

Tema 8 Primeros casos

Tema 9 Recursos movilizados

Tema 10 Fase ascendente de la pandemia

Tema 11 Fase descendente de la pandemia

Tema 12 Plan de Desactivación

Tema 13 Visión de conjunto

Tema 14 Indicadores epidemiológicos

Tema 15 Mortalidad general

Tema 16 Mortalidad estimada

**Sección II**

Tema 17 Comportamientos espaciales diferenciados

Tema 18 Salud

Tema 19 Empleo

Tema 20 Turismo y áreas metropolitanas

Tema 21 Calidad y comorbilidad económica

Tema 22 Medioambiente

Tema 23 Índice sintético de vulnerabilidad en Barcelona y Madrid

**Sección III**

**Efectos sociales, económicos y ambientales**

Tema 24 Gobernanza territorial

Tema 25 Impacto de la contaminación ambiental

Tema 26 Impacto en el medio rural, zonas rurales y zonas de montaña

Tema 27 Movilidad

Tema 28 Transporte por carretera

Tema 29 Movilidad Aérea

Tema 30 Transporte por ferrocarril

Tema 31 Transporte urbano

Tema 32 Transporte marítimo

Tema 33 Transporte aéreo

Tema 34 Movilidad sostenible y cambio de la movilidad

Tema 35 Variables y bases metodológicas para analizar el impacto de la pandemia en la movilidad de la población

Tema 36 Cambio en la movilidad a lo largo de la primera ola

Tema 37 Otros cambios observados durante la pandemia

Tema 38 Magnitudes macroeconómicas y sectores productivos

Tema 39 Magnitudes socioeconómicas

Tema 40 Agricultura y ganadería

Tema 41 Minería, energía, industria y construcción

Tema 42 Turismo

Tema 43 Trabajo

Tema 44 Desempleo

Tema 45 Políticas de fomento de la actividad

Tema 46 Equipamiento de Regiones Europeas de Empleo

Tema 47 Desempleo, pobreza y protección social

Tema 48 Hacienda pública

Tema 49 Salud

Tema 50 Educación

Tema 51 Acciones solidarias

Tema 52 Impacto ambiental de la pandemia

Tema 53 Indicadores ambientales de la pandemia

Tema 54 Represiones ambientales

Tema 55 Recursos atmosféricos

Tema 56 Energía

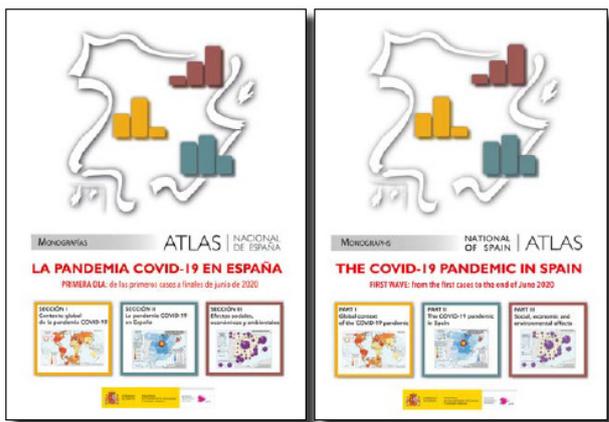
Tema 57 Recursos de Ecosistemas Acuáticos

Tema 58 Calidad del aire en tiempo real

Tema 59 Contaminación acústica

Tema 60 Contaminación de aguas residuales y emisiones de agua

Tema 61 Impacto en la salud de la población durante la primera ola de la pandemia



18. English and Spanish covers of the monograph on the COVID-19 pandemic.

Like all ANE publications, the monograph can be downloaded free of charge from the CNIG Download Centre and all the contents, in Spanish and English, can be accessed from the [ANE Geoportal](#) where the interactive version of the atlas can also be accessed.

## 5. PRESENT DAY

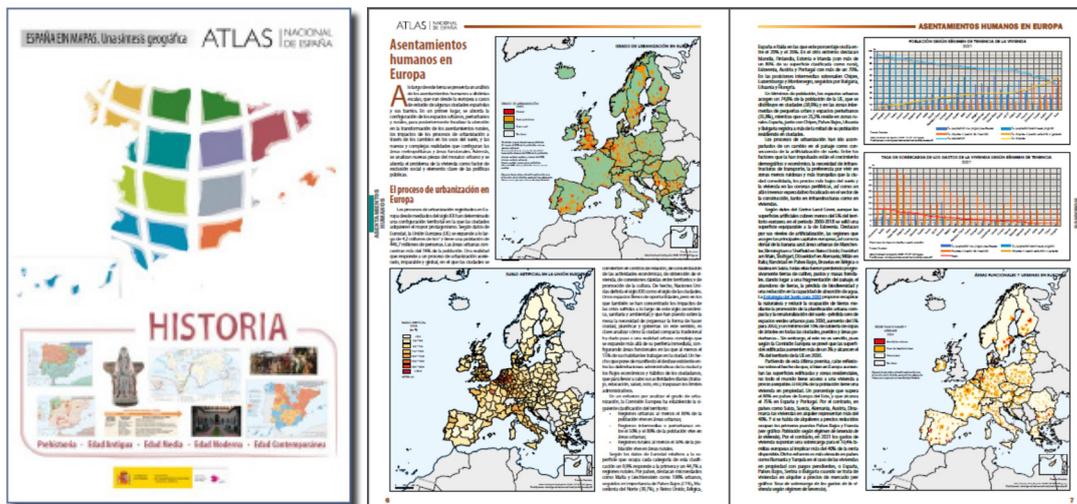
Following the publication of the monograph on the impact of the COVID-19 pandemic, the general series of the ANE has been updated. At the end of 2022, the ANEXI Network was also renewed, with new scientific contributors, who provide a more up-to-date view of the thematic contents.

In order to avoid the data becoming obsolete, the publication system of the work has also been modified, with a completion horizon of the first half of 2027. Instead of publishing a single volume with all the updated contents, it has been decided to publish the Atlas by thematic sections, first in Spanish and later in English, in order to achieve in the near future an international version of the ANE, which provides an image of the Spanish reality to the rest of the world, which is currently in demand by bilingual university degrees and because it is the language most widely used in the academic and scientific world.

The first section to be published in all formats and channels, at the end of 2023, was Section III "History" in Spanish, which will see its international version in 2024. It is also planned to publish Section II "Population, Settlement and Society", with completely renewed contents, more in line with the concerns of today's scientific community.

As a novelty, for each of the themes of the work, some pages dedicated to Europe will be included in order to contextualise the situation of Spain in its closest environment, mainly the European Union. The extension of the territorial framework represented in the cartography adds necessary information to better understand the personality of our country. Moreover, Spain can play a decisive role in the process of European construction and, on the other hand,

Community policies have a great impact on our daily life and on the general configuration of the social, economic and cultural situation in Spain.



19. Cover of the “History” section, and pages dedicated to Europe from section 8 “Human Settlements”.

## ACKNOWLEDGEMENTS

My thanks to Artur Charoyan, my coworker at the National Atlas of Spain, who translated and adapted this article into English.

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# Institute of Economics, Geography and Demography at the Spanish National Research Council

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## 1. BRIEF HISTORY OF GEOGRAPHY AT THE SPANISH NATIONAL RESEARCH COUNCIL

The first geographical research center of the Spanish National Research Council (CSIC), the *Juan Sebastián Elcano Institute*, was created at the same time as the birth of the CSIC, in 1940, as stated by Martín Lou (1992) on the occasion of the contribution that the Spanish Committee of the International Geographic Union (UGI) presented the XXVII Congress of the UGI that was held in Washington. At that time, geographic research was included in the Humanities area of the scientific institution. More than two decades later, in 1967, the *Institute of Applied Geography* emerged, after the transfer to Madrid of a department of the University of Saragossa with the same name. This new institute was incorporated into the Science area.

In the eighties (1986) both institutes were merged along with others such as Applied Economics, Agrarian Economics and Sociology, under the name of the *Institute of Applied Economics and Geography*. The purpose was to unify and rationalize the different human and material resources in a single center dedicated to multidisciplinary research in Social Sciences. In that same year, the Law for the Promotion and General Coordination of Scientific and Technical Research – known as the “Science Law” – was enacted, which was in force until 2011. The newly created *Interministerial Commission on Science and Technology* (CICYT) was in charge of planning, coordinating and monitoring the *National Plan for Scientific Research, Development and Technological Innovation*. It established the priority lines for the allocation of resources and funding. In those years, the CSIC’s purpose was to become institutionally independent from the teaching and disciplinary structures of the university, seeking to overcome the isolated efforts of leading researchers, through greater transversality of the research groups.

A few years later, the Institute of *Applied Economics and Geography* changed its name, becoming the *Research Center on Economy, Society and the Environment*, remaining in the area of Humanities and Social Sciences. A journey with a certain nominal invisibility for Geography in the institution then began. Its then director stated that “Geography at the CSIC is going through its worst moment, in terms of its recognition within the CSIC organizational chart, where it has gone from the existence of two Institutes of Geography to nominally disappearing in the current institutional organization” (Martín Lou, 1992). The researchers of the discipline tried to compensate by calling themselves the Department of *Geographical Studies*. This was also the name of the oldest magazine of Geography in Spain, and in Spanish, which has been published since 1940 at the CSIC.

Later (1996), the *Institute of Demography* was also annexed. Bodega and Martín Lou (2004) publish a new reflection on Geography at the CSIC, on the occasion of the contribution of the Spanish Committee of the UGI to the XXX Glasgow Congress. Having recovered the disciplinary name in the *Institute of Economics and Geography*, they insist on the difficult situation of Geography at the CSIC, imposed by an administrative structure that made institutional collaboration with the University difficult, and an allocation of human resources for research in competition with other disciplines from the area of Humanities and Social Sciences. However, they also recognized that the identity of Geography as a discipline was not only being compromised in the CSIC, but also in the university environment.

After various names, the year 2007 arrived when the institute became part of the *Center for Human and Social Sciences* of the CSIC (CCHS-CSIC), with the name of the *Institute of Economics, Geography and Demography* (IEGD). An idea of the relevance of Geography within the successive institutes since 1986 is given by the fact that of the eight directors since that date, four of them have been geographers: Julia López Gómez (1988-1989), M.<sup>a</sup> Asunción Martín Lou (1991-2002), Ricardo Méndez Gutiérrez del Valle (2009-2011) and Gloria Fernández-Mayoralas Fernández (2011-2019). This contribution is presented as an update of the one made by Fernández-Mayoralas (2021) on the occasion of the Spanish contribution to the XXXIV Congress of the International Geographical Union held in Istanbul.

## 2. CURRENT SITUATION AND ACTIVITY

After more than a decade and a half being part of the CCHS-CSIC, the *Institute of Economy, Geography and Demography* is one of the 16 institutes that constitute the Global Society Area of the CSIC (previously Humanities and Social Sciences area), the largest public institution in Spain dedicated to scientific and technical research. The voluminous bibliographic, statistical and, particularly, cartographic collections of the IEGD are currently part of the catalog of the *Tomás Navarro Tomás Library* of the CCHS, which draws on the collections preserved and expanded in the organization since its origins, linked to the Board of Expansion of Studies (JAE) in 1907. The TNT library has more than one million physical and electronic copies specialized in Social and Human Sciences, with a collection of more than 300,000 copies in free access, and preserves complementary collections in deposit, with more than 13,000 maps and plans, and more than 5,000 microforms, and those that require specific conservation measures, including incunabula prior to the 15th century. All of this has led to its recognition as an Asset of Cultural Interest in 2015.

Geographic research at the IEGD is structured around five research groups, and also includes two laboratories: *Network Aging Lab* and *Spectro-Radiometry and Environmental Remote Sensing Lab*. They are joined by two other laboratories: *Geographic Information Systems Lab* and *Statistical Analysis Lab*, which were created and developed at the IEGD, and which currently make up two scientific-technical service units at the CCHS: Geographic Information Systems and Digital Humanities Unit (SIGyHD), and the Statistical Analysis Unit.

Since 2013, the *Network Aging Lab* has been developing a free and open access virtual information system on older people (EN-RED). Previously, the *Senior Portal* was created and maintained (2001-2012), which was remarkably successful, with more than 12,000 visits daily in 2012. It is aimed at the academic and scientific world, at professionals in social and health services, and at society. The laboratory's aims are to create a virtual information service, in which information and documentation about older people is collected, systematized and transmitted; establishing an electronic knowledge transfer platform to support the scientific and professional community; develop content and value-added services to promote R&D&i in the field of Geriatrics and Gerontology and innovate in Information Society Technologies. EN-RED is organized into three main areas: Documentation and research, Resource Map (Residences, Day Centers, SAD, Telecare, Program, Hospitals) and Online Communication.

The *Spectro-Radiometry and Environmental Remote Sensing Lab* (Speclab) was created in 2007. Its objective is to develop basic and applied research in the field of remote sensing and more specifically in that of spectro-radiometry. One of the fundamental activities of the laboratory consists of obtaining spectral measurements and developing of protocols and analysis techniques that allow the derivation, alone, or in combination with information from airborne and/or space sensors, biophysical parameters and relevant indicators, in environmental management. The laboratory provides the technical and instrumental support necessary in the development of various lines of research (forest fires, precision agriculture, rural development, global change, etc.) where spectro-radiometry is a fundamental tool for the calibration and validation of physical and empirical models, among other applications. On the other hand, the laboratory tries to respond to the demand for training in the field of spectro-radiometry and its applications and to contribute to the establishment of good practices through the dissemination and exchange of experiences that may be useful to current and future users.

The *Geographic Information Systems and Digital Humanities Unit* (GISyHD) has its scope of application in Geographic Information Technologies (GIS, Remote Sensing, digital cartography) in research projects in Social and Digital Human Sciences. The SIGyHD unit offers interoperable solutions in the development of scientific projects from geoinformation, web mapping or digital humanities. Its applicability ranges from information sciences to the most recent database technologies, spatial queries and analysis, visualization, 3D modeling, web cartography, web map geoservices or the geosemantic web. The Statistical Analysis Unit (UAE) carries out its activity by providing advisory and support services in the application of statistical techniques in the field of scientific activity carried out in the departments and research groups of the CCHS.

Currently, the mission of the IEGD, made up of researchers from various disciplines, consists of specialized research around data science on social changes, migratory movements and population dynamics, old age and well-being, cross-border mobility in the European geopolitical context, the latest trends in agri-food, and nature and forest fires. Its staff is made up of researchers, predoctoral and postdoctoral hires, specialized technical hires and other technical and administrative staff. Research is financed through subsidies for R&D&I projects, obtained through competitions in public calls from national, regional, European or other supranational institutions, but also through contracts and research agreements with public administrations and private institutions. The IEGD is structured into two departments, Department of Population and Department of Applied Economics and Geography, which comprise five multidisciplinary research groups: Aging Research Group (GIE-CSIC), Demographic Dynamics Group, Multiscalar Geographic Analysis of Global Change Group, Cross-Border Human Mobility Group between East and West in the European Geopolitical Context, and Agri-Food Systems and Territorial Development Group (SADT).

Despite the drastic drop in the number of research staff since 2010, mainly due to the retirement of the majority of staff who had joined the organization since the 1970s, but also due to the little or no allocation of human resources during the economic crisis, the presence of personnel from the Geography discipline is important, with three of the IEGD research groups made up of geographers:

**A)** The *Aging Research Group* (GIE-CSIC), whose responsible researcher is Vicente Rodríguez Rodríguez, was established in 1989 in the Institute of Economics and Geography, based on the interest in the analysis of the aging of the Spanish population that in those years it began to be considered an issue of social relevance. The members of the Group accepted two commitments, contributing to the scientific heritage on aging in Spain, which has given rise to an extensive curriculum (projects and contracts, publications, participation in various scientific and dissemination activities), and interacting with other lines of social research, opening up their studies to other disciplines and research groups. The work has been structured around several lines of research, which have also served to accept the incorporation of predoctoral and postdoctoral fellows, both Spanish and foreign.

Currently, the research lines of the GIE-CSIC, which respond to the need for social research on population aging, are:

- **Aging and residential strategies:** analyzes aging in place and other forms of residential mobility according to the life cycle.
- **Aging and quality of life (QoL):** aims to know the most relevant dimensions of the quality of life of older people through a holistic model to discover its relevant components, the satisfaction achieved and the determining factors of the different domains.
- **Aging, health and dependency:** its development is justified by the growth in the number of elderly people and its implications (fragility and dependency, increase in diseases and health problems with age) and changes in family structure (role of women and their social and economic effects, care for dependent elderly), pensions and health spending.

**B)** The *Multiscalar Geographic Analysis of Global Change* Group, whose responsible researcher is Javier Martínez Vega, has as its main mission to generate scientific and technological knowledge by applying Geographic Information Technologies to the production and analysis of geo-spatial information for the evaluation and management of Global Change at various scales: from fine local observations supported by exhaustive field work to obtain information about the physical environment and human activities, to less detailed synoptic observations based on the interpretation of satellite images that allow a global vision of this issue.

The group focuses its research around three lines of research:

- **Environmental Remote Sensing:** From a multi-scale approach, key biophysical variables of the vegetation in terrestrial agricultural and forest ecosystems are estimated, and measurements obtained through sampling and field radiometry are related to those derived from multi- and hyper-spectral images obtained from aerial and spatial platforms.
- **Protected Areas:** Indicators are developed to evaluate and monitor the sustainability of individual protected areas, networks of terrestrial and marine protected areas, and their environments, from an integrated perspective that contemplates the four pillars of sustainability: environment, society, economics and governance. By using BACI-type semi-experimental designs, the aim is to determine whether protected areas or their networks are being effective in different socio-environmental aspects.
- **Forest Fires:** Multi-temporal modeling of the human risk of forest fires and their explanatory factors using different techniques. The urban-forestry, agricultural-forestry and pasture-forestry interfaces are analyzed as indirect indicators of causality linked to land use. The analysis of future scenarios of changes in use makes it possible to predict the evolution of the occurrence of fires in the medium and long term.

**C)** The *Cross-border Human Mobility between East and West in the Global European Geopolitical Context* Group, whose responsible researcher is Silvia Florentina Marcu, focuses its lines of research on international migrations, with special emphasis on human mobility in Eastern Europe. This to Spain, and the geopolitical and social changes of Eurasia. Through its research, it actively contributes to the state of the art at a global level, with theoretical, empirical and conceptual contributions, in the debate on human mobility in the 21st century, (with special emphasis on young people). Among the results, the conceptual, theoretical and empirical contributions on the topic of youth stand out, with special emphasis on the job insecurity of young people, their perceptions and work and professional experiences, the educational experience of Romani students, or the feelings of belonging of young people.

Since 2011, the IEGD has more than tripled its funding from competitive projects around research proposals related to longitudinal population studies, early conditions and late effects

on morbidity, disability and mortality, active aging, quality of life and gender, transformations in families and sustainable societies, temporary versus permanent migration, human rights, Eastern European migrations, agri-food systems, innovation and markets, innovative optical tools for the proximal detection of ecophysiological processes, remote sensing, etc. In line with these research proposals, the social transfer of knowledge has also been developed through participation in the commissions of the Senate for the Demographic Challenge, the Congress for the retirement (Toledo Pact), the Depopulation Commission of the Spanish Federation of Municipalities and Provinces, in the Parliamentary Commission for the Demographic Dynamization Plan of Galicia, in the Working Group on Depopulation and Aging of the Conference of European Regional Legislative Assemblies, in the scientific node of the IDEE (Spanish Spatial Data Infrastructure), and in consulting work for the United Nations Latin American Demographic Center, among other bodies and agencies for political decision-making.

The IEGD publishes the journal *Estudios Geográficos* (<http://estudiosgeograficos.revistas.csic.es>), which has been published continuously since 1940 and is the dean of journals in the discipline in Spain. Since 2018, the CSIC has been committed to recovering its journals by reformulating its editorial boards and promoting open and electronic access to all its publications. Currently, *Estudios Geográficos* is defined as a scientific journal with an international and interdisciplinary vocation whose purpose is the publication of research aimed at solving human problems that have a spatial dimension. The journal, which accepts manuscripts in Spanish and English, focuses on contributions of a conceptual, methodological or empirical nature, whose object of study is the territory, landscapes and geographical places. *Estudios Geográficos* is indexed in Web of Science: Emerging Sources Citation Index (ESCI), SCOPUS, CWTS Leiden Ranking (journal indicators), ERIH Plus, REDIB, and DOAJ, among other national and international databases. It is included in the Latindex 2.0 catalog and has the FECYT Quality Seal (recognition of its editorial and scientific quality).

Regarding the future of research in Geography at the CSIC, it is worth asking about the new vocations in the discipline. Despite the success of the IEGD groups in obtaining funding in highly competitive calls, and the relevance that the geographical perspective has in these research proposals, the new vocations with interest in applying to them do not come from the disciplinary field of the Geography. Possibly, the instability in the research career has overshadowed the expectations that, on the contrary, have been kept alive in the teaching career. However, it is also worth asking whether the training of new geographers is far from the lines of research in Geography at the CSIC, and perhaps other disciplines are occupying these markedly social with territorial projection approaches. In any case, a debate to be developed within Spanish Geography is the possible existence of a certain divorce between disciplinary identity and the necessary transversality of scientific research, where geographers will also have to find our place, as is the global trend in most universities.

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# Catalan Society of Geography

## INTERNATIONALIZATION OF THE SOCIETAT CATALANA DE GEOGRAFIA AND OVERVIEW OF GEOGRAPHY AT UNIVERSITY IN THE CATALAN LINGUISTIC DOMAIN

Board of the Catalan Society of Geography

### 1. THE SCG, CORRESPONDING MEMBER OF THE IGU

At the meeting held in Minnesota on March 30, 2023, the executive committee of the International Geographical Union (IGU) approved the admission of the Societat Catalana de Geografia (SCG) [Catalan Society of Geography] as a corresponding member. The letter with the official confirmation is dated July 16.

This direct involvement in the IGU is a great honor and responsibility for the SCG. It also represents a recognition of the internationalization of the SCG the same year it hosted the EUGEO congress in Barcelona. Furthermore, it strengthens the Spanish Committee of the IGU in preparation for organizing the International Geography Congress in 2032 in Spain.

### 2. 9<sup>TH</sup> EUGEO CONGRESS, BARCELONA, SEPTEMBER 2023

The Societat Catalana de Geografia hosted the 9<sup>th</sup> EUGEO Congress (Association of Geographical Societies in Europe) in Barcelona from September 4 to 7, 2023, under the theme “Geography for Our Common Future.” This is the most significant international geography congress organized to date within the Catalan linguistic domain. Notably, one of the innovations introduced at this congress was multilingualism, as previous congresses had only used English for communications. In this congress, however, presentations were given in Catalan, Spanish, French, Portuguese, and English.

The 750 registered participants were an all-time record for an EUGEO congress. Of these, 409 were men (54.5%) and 341 women (45.5%), showing a significant gender balance. Their origin was varied: a quarter from Catalan universities, a tenth from the rest of Spain, 8% from outside Europe and almost 56% from other European countries. The organization by the Societat Catalana de Geografia and the Universitat de Barcelona had 46 volunteers (24 women and 22 men), thanks to whom the congress ran smoothly and on schedule. A “purple point” was installed at the reception to act in case of sexual harassment, which was not activated due to no complains.

The number of sessions of the congress was 111, with a total of 829 papers, of which 784 were presented in person, in addition to 71 posters. The topics of the papers covered all fields of Geography, highlighting those classified as Human Geography (178 papers, 21.5% of the total), Physical Geography (137, 16.5%), Urban Geography (113, 13.6%), Mobility (103, 12.4%) and Sustainability (99, 11.9%).



EUGEO 2023 congress poster at the door of the Faculty of Geography and History of the University of Barcelona. The image illustrating the Congress brand is the work of Neus Aller, from the War series, created in 2022.

In the context of the congress, the Societat Catalana de Geografia published the book *Insights into the New Geography of Catalonia*. The paper version was given to the people registered to the congress, but the digital version can be freely downloaded through the following link: <https://scgeo.iec.cat/publicacio-digital-del-llibre-insights-into-the-new-geography-of-catalonia/>

For the Societat Catalana de Geografia, the 2023 EUGEO congress has been the biggest organizational challenge faced during the almost 90 years of its trajectory, which concluded with successful participation and operation. Only some of the proposed extra-congress activities fell short of expectations in terms of registrations, although they have been redirected towards the regular programming of the Societat. In addition to the visits to Barcelona's urban built environment, it is worth mentioning the Cinema and Geography session, hosted by the Filmoteca de Catalunya, which has been continued.

### 3. GEOGRAPHY AT UNIVERSITY IN THE CATALAN LINGUISTIC DOMAIN

In 2023, the discipline of Geography is widely represented in the public universities of the Catalan linguistic domain. There are nine universities where 4- or 3-years degrees or bachelor's degrees and master's degrees are taught: five in Catalonia, two in the País Valencià, one in the Balearic Islands and one in Catalunya Nord.

Other public universities in the linguistic area do not offer specific academic degrees in Geography, although they have geographers among the faculty and Geography is also taught within the framework of broader degrees (e.g., Humanities, Global Studies or History, Geography and Art History). This is the case at the Universitat Pompeu Fabra and the Universitat Oberta de Catalunya, both in Catalonia; at the Universitat Jaume I de Castelló, in the País Valencià; and at the Universitat d'Andorra. The Department of Architecture, Design and Urbanism of the Università de Sassari, which also has geographers on its faculty, is based in Alghero, a Catalan-speaking city on the island of Sardinia. On the other hand, there are no Geography studies in the private universities of this territorial area.

Territory	University	Initialisms	Degree title (course 2022-23)
Catalunya	Autonomous University of Barcelona	UAB	Geography, Environment and Spatial Planning
	University of Barcelona	UB	Geography / Geography and Global Change (since 2023-24)
	University of Girona	UdG	Geography, Territory and Environment
	University of Lleida	UdL	Geography
	University Rovira i Virgili	URV	Geography, Territorial Analysis and Sustainability
Region of Valencia	University of Alacant	UA	Geography and Land Use Planning
	University of Valencia	UV	Geography and Environmental Studies
Illes Balears y Pitiüses	University of Illes Balears	UIB	Geography
Catalunya Nord	University of Perpinyà Via Domícia	UPVD	Geography and Planning ( <i>Géographie et Aménagement</i> )

Public universities in the Catalan linguistic domain where a degree or bachelor's degree in Geography is taught.

The titles of the various degrees (see table) reflect the emphasis on the link between geography, the environment, sustainability and land use planning. This is a trend that has been reinforced over the last 15-20 years, which shows that Geography is a living discipline that echoes the present concern, particularly those that affect territorial dynamics and the challenges that society faces. Obviously, the challenge of sustainability is paramount, since social as well as environmental and economic variables converge in it. Thus, progressively, these curricula incorporate subjects of diverse themes and objectives, acting as a means of a new way of understanding Geography. However, it does not forget the defining features that have characterized it since its institutionalization as an academic discipline and, therefore, as a university discipline: that is, the understanding and analysis of spaces, of the territorial fact.

In the 2022-23 academic year, the teaching staff of the Geography departments of the nine universities totals 299, of which 29% (87) are women. By universities, the UAB (68) and the UV (46) have the largest ones.

During seven academic years, from 2016-17 to 2022-23 the students enrolled in the degrees (4 years) or bachelor's degree (3 years, UPVD), the UV had the largest student body, followed by the UAB. The feminization rate is 26%, with variations ranging from 39% at UPVD to 21% at UdG. During this 7-year period, the number of enrollments per course has been decreasing. By the 2022-23 academic year, 25% fewer students enrolled than in the 2016-17 academic year. In all universities the number is decreasing, except in the URV.

The number of new undergraduates' geographers (3 or 4 year-degrees) also decreases in the analyzed period. If in 2017 there are 228, 29% (66) women, five years later the total number drops to 148, with even fewer women, 27% (40). By universities, UV (232), UAB (218) and UB (216) accumulate 58% of the total number of undergraduates in the linguistic area. The highest rate of feminization corresponds to the UPVD, with 40%, while the UA and the URV show the lowest, with 21%.

There are 50 research groups in the nine universities of the Catalan linguistic area analyzed. These groups address a wide range of issues that highlight the versatility of the discipline and the breadth of topics of interest for research. However, each group addressed the issues according to the groups' interests and approaches. A breadth that ranges from fields such as the physical environment, whether of the coast or mountain areas; geomorphology;

landscape; climate and climate change; natural resources; energy; cartography; the use of GIS technology, remote sensing or drones; migrations; gender perspective; governance and local development; sustainability; social and urban policies; global change; economic geography; tourism and socio-territorial dynamics; natural and cultural heritages; geographical thinking; critical geography; geography didactics. All the above topics are addressed by at least one of the identified research groups.

David Pavón Gamero, secretary of the governing board of the SCG, has provided the information for this section, which has been addressed more extensively in the book *Insights into the New Geography of Catalonia*, cited above.

#### **4. DOCTORAL THESES DEFENDED IN GEOGRAPHY AT UNIVERSITIES IN THE CATALAN LINGUISTIC DOMAIN, 2000-2019**

The geography theses defended during the period 2000-2019 is 656. The annual evolution is of a sustained increase, with slight highs and lows. The peak in 2017 stands out, whose explanation is not endogenous. It responds to the deadline set by the Ministry of Education for the submission of started doctoral theses before the approval of Royal Decree 99/2011, which regulates doctoral education in the Spanish state.

The inventory and analysis come from a research project financed by the Institut d'Estudis Catalans covering the areas of economics, sociology and geography, carried out by the Societat Catalana d'Economia with the participation of Xavier Farriols and, the geographer Eduard Montesinos. The main source of information is the Teseo database, which contains the basic data on doctoral theses defended in Spain since 1976. Therefore, the analysis does not include those of the UPVD.

The most frequent fields of study of doctoral theses in the 20 years analyzed are in the area of social and cultural geography (where population geography stands out), the geography of human settlements (especially urban geography) and economic geography (especially with regard to the geography of tourism). Also noteworthy are political geography (development geography), environmental and landscape geography, and climatology. The remaining fields of study account for less than 5% of the theses defended.

In addition to the subjects of the doctoral theses, two other variables have been considered: the gender of the candidate and the language in which the thesis is written. Regarding the proportion of people who have received a PhD in Geography during the period 2000-2019, 61% are men and 39% are women. Although there are some differences between universities, they are not substantial. Finally, regarding the language, Spanish stands out with 61%, followed by Catalan with 21% and English with 12%. Portuguese accounts for 6%, while French and Italian do not reach 1% of the total. As for the use of Catalan, the difference between territories is notable. While in Catalan and Balearic Islands universities it is close to 50%, in Valencian universities it is practically unheard of.

# Royal Geographical Society

## THE REAL SOCIEDAD GEOGRÁFICA AND THE INTERNATIONALISATION OF GEOGRAPHY

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The Geographical Societies emerging throughout the nineteenth century were created within a political and ideological context with clear colonial overtones and the inevitable bias in the way the geographical reality was interpreted. All of these societies enabled the expansion of the knowledge of the world in many different anthropological, naturalistic and economic aspects. Today, there are very few places on the Earth that have not been discovered. However, so many changes have taken place over the last few decades that learning about them and analysing them constitutes a challenge to which the Royal Geographical Society continues to respond. It also assumes the responsibility of disseminating this knowledge among the wider society.

### 1. THE ORIGIN OF THE ROYAL GEOGRAPHICAL SOCIETY

The creation of a geographical society in Spain came about due to the general situation during the last quarter of the nineteenth century, which can be summarised as colonial expansion on an international level and regenerationism on a national level. In 1875, Francisco Coello attended the Congress of Geographical Sciences in Paris, where he coincided with Leopoldo I, who informed him of his intentions to expand across Africa. Back in Madrid and a little under six months later, Coello created the Sociedad Geográfica de Madrid, a prime example of a private association but established at the request of the public powers and permanently supervised by them. The intention was to create an instrument able to mobilise the cream of Spanish society to benefit the interests of the State, but with the autonomy and agility of a private organisation.

Therefore, from the moment of its creation, the Sociedad Geográfica de Madrid was particularly concerned about the international prestige of Spain and the defence of its interests abroad, particularly in terms of colonial distribution. Consequently, during the first months of its existence as the Sociedad Geográfica de Madrid (1876-1901), it participated in many acts and activities to serve Spain, sponsoring several expeditions to Africa, which would become Spanish possessions in the Sahara, Ifni and Equatorial Guinea. It also focused on Cuba and the Philippines, following the same prerogatives as the geographical institutions of other countries with a similar structure and nature, such as the *Royal Geographical Society* (UK), the *National Geographic* (EEUU), the *Société Royale Belge de Géographie* and the *Société de Géographié of Paris*, the oldest of them all, which served as a model for the *Real Sociedad Geográfica de España*.

In the first twenty-five years of the life of the Sociedad Geográfica de Madrid, the colonial objective was patent in the majority of its initiatives, such as the foundation of the *Asociación Española para la Exploración de África* in 1877, the organisation of the Spanish Conference on Colonial Geography and Trade in 1883, promoted by Joaquín Costa, the creation of the Sociedad Española de Africanistas y Colonialistas, which fostered expeditions such as those of Iradier, Bonelli, D'Almonte, Abargués de Sostén and Joaquín Gatell among others. In 1885, this Society came to be known as the Sociedad de Geografía Comercial and, with the support of the Sociedad Geográfica, from 1897, it began to regularly publish the *Revista de Geografía Colonial y Mercantil* (Journal of Colonial Geography and Trade), which had a life of twenty-one years before it was refounded as the *Boletín de la Sociedad Geográfica* (Geographical Society Bulletin).

The importance of the studies and services carried out by the *Sociedad Geográfica de Madrid* was acknowledged and appreciated by the Government of S.M., which, by way of the Royal Decree of February 1901, changed its name to the Royal Geographical Society. Subsequently, with the proclamation of the Second Republic, the name was modified to Sociedad Geográfica Nacional, but was changed back again in 1939 to the Royal Geographical Society, which is the name it still goes by today. This to-ing and fro-ing in the title was not only terminological but also reflected the political changes of the country, which particularly influenced the geographical society, given the close ties that it had always had with the public powers.

Despite these changes, the Royal Geographical Society has acted as a public entity, advising and collaborating with different State organisations. Its main function is to improve the knowledge of Spain's geographical reality and its international interests. It has been recognised in official provisions and in many practical manifestations over its almost 150 years of uninterrupted existence.

Today, the Royal Geographical Society is one more of the Spanish scientific societies that, on a regional, national and international scale, seeks to group together those interested in the study of Geography. Adapting to the different currents and trends in the evolution of the geographical science of the world that it studies and incorporating the new technologies in modern Geography, the Royal Geographical Society is a clear symbiosis between permanence and development, a constant feature throughout its history since its establishment in 1876.

In its origins, this objective was embodied in the study and defence of Spain's interests in colonial expansion. Subsequently, the Society's attention was directed towards other geographical aspects that were also strategic for the country. These aspects were and continue to be municipal toponymy, the maintenance of the historical and cultural heritage of the RSG and the internationalisation of Spanish Geography.

In this respect, the Royal Geographical Society acts as an advisory body for the competent authorities of Toponymy. The reports elaborated by the Royal Geographical Society prior to any municipal name change are obligatory, according to the Royal Decree of 27 June 1916, which was countersigned by the Count of Romanones as the President of the Council of Ministers. According to the studies carried out by the Royal Geographical Society, dating back to at least ten years beforehand, by one of its most prominent members, Manuel de Foronda y Aguilera (1840-1920), the name of 573 Spanish municipalities were changed in order to distinguish them from other homonyms.

This criterion still prevails today, in compliance with Article 28 of Royal Decree 1690/1986 of 11 July, approving the Regulation on Population and Territorial Demarcation of Local Entities, which reads: "*The approval by the Governing Council of the Autonomous Region of the cases of capital changes is subject to a prior report issued by the Real Sociedad Geográfica or the Real Academia de la Historia, as applicable*". [Own translation]

As a result, representatives of the Royal Geographical Society are present in different entities of the Consejo Superior Geográfico (High Geographic Council). The President of the Royal Geographical Society forms part, as an ex-officio member, of the Advisory Committee of the plenary meeting of the Consejo Superior Geográfico (art. 32.5.1 of R. D. 1545/2007 of 23 November, which regulates the National Cartographic System). Furthermore,

a representative of the society is a Permanent Member of the Specialised Commission of Geographical Names, appointed by the President of the Council on the motion of the RSG.

The reports on changes in names elaborated by the RSG constitute an aspect of particular geographical interest, despite the scarce attention that is paid to Toponymy by the academic institutions. Therefore, the writing of these reports, at a time when toponymic standardisation is becoming particularly relevant, especially in those autonomous regions that have their own language, is a highly interesting topic that goes beyond the strictly scientific dimension.

However, without a doubt, the history of the Royal Geographical Society constitutes a significant chapter in the history of Spain, which is reflected in the pages of its journal, *Boletín de la Real Sociedad Geográfica*, the oldest Spanish geography journal, given that it has been published since 1876 without interruption, except during the years of the Civil War. It is, therefore, an essential source for learning about the history of Spanish Geography of the last one hundred and fifty years and constitutes an undeniable cultural heritage of Spanish Geography.

Furthermore, it is necessary to clarify the enormous bibliographical and cartographic heritage that the Real Sociedad has accumulated since its creation; more than 5,000 books, approximately 8,000 leaflets, a collection of Spanish and foreign journals, with more than 1,120 titles and a map library with more than 8,000 maps, mostly from the nineteenth century, but with some unique maps from the sixteenth to eighteenth centuries. All of this is preserved in the Spanish National Library, with its own symbol.

## 2. THE ROYAL GEOGRAPHICAL SOCIETY AND THE INTERNATIONALISATION OF GEOGRAPHY

It is well-known that the International Geographical Union (IGU) was established in 1922. However, prior to this date, from 1871, scientists, who studied topics in which geographical aspects or those related to Geography met in different European cities. They contributed to the advance of this science with the research that they were conducting in their respective countries and institutions.

The first of these international meetings was held in Antwerp, as we have said, in 1871. The subsequent meetings, except for the one held in Washington in 1904, were held in the following European cities: Paris (1875), Venice (1881), Paris (1889), Bern (1891), London (1895), Berlin (1899), the afore-mentioned exception in 1904, Geneva (1908) and Rome (1913).

Spanish scientists attended all of these international meetings, many of them belonging to the previously mentioned "Sociedad Geográfica de Madrid", which had been created in 1876 and until the last third of the nineteenth century and beginning of the twentieth century brought together renowned cartographers, engineers, historians, etc. Therefore, the names of Coello, Ibáñez de Íbero, Torres Campos, Beltrán y Rózpide, Odón de Buen, among others, can be found among the participants representing Spain and the Royal Geographical Society in the different international meetings.

A detailed analysis of Spain's participation in this internationalisation of geography was published by Professor Teodoro Martín Martín, in the Bulletin of the Royal Geographical Society CLI, 2016, page 149-180 and Tome CLII, 2017, page 283-346.

The objective of this brief note is not to analyse the scientific results of each of these international meetings. Their contributions to advancing the development of geography are recorded in the minutes of the respective congresses and in the Royal Geographical Society Bulletin, the first Spanish geography journal. The Spanish representatives and members of the RSG attending the congresses published the scientific contributions and conclusions reached in each of them in the bulletin.

Spanish was often used. The President of the RSG, Francisco Coello, used it for the first time in the Venice Congress. In different meetings it was discussed whether the Spanish language should be used in the respective congresses. Although its incorporation had been agreed in 1904, it did not come about and has constituted a constant request by Spanish and Latin American geographers, which has still not been resolved.

During this period prior to the creation of the IGU, we would like to highlight that the participation of the RSG was prominent in terms of both the attendance of prestigious scientists to the congresses, who often chaired work commissions, and also the significant academic and applied contributions to the evolution of geography.

On 29 July 1922, at the General Assembly of the International Science Council (ISC) held in Brussels, the International Geographical Union (IGU) was constituted and its statutes were approved and published in the *Revista Española de Geografía Comercial y Mercantil*, Tome IXX, 1922, Page 360 -364. Spain was among the seven founding members.

In this assembly, the Royal Geographical Society was represented by Mr. Bergamín. Also attending on behalf of the Society were Odón de Buen and General Gómez Núñez who was appointed as Vice-President of the recently created International Geography Society. In Madrid, Odón de Buen and Gómez Núñez, informed the RSG of the creation of the IGU and, subsequently, a ministerial order approved Spain's adhesion and in 19 February 1923 the National Committee was constituted.

From that date to the present, the National Committee has had an uninterrupted trajectory, with a presence in the different congresses held since 1925 in Cairo to 2020 in Istanbul.

The Spanish Committee of the IGU, the current name of Spain's representation in its international congresses, has evolved in line with Spanish Geography. Therefore, with the increase in Geography Chairs in Spanish universities the representation of the RSG in the IGU has grown from one to the inclusion of representatives from other geographical institutions in the National Committee.

In the congress in London, a book with the "Spanish Contribution" was presented for the first time and edited by the Instituto Elcano and the Instituto de Estudios Pirenaicos. Since that first book that included the studies of Spanish geographers, as many volumes of the "Spanish Contribution" have been published as there have been congresses. On the other hand, the physical participation in the congresses has been irregular, with a greater presence in those that have been more economically affordable due to their territorial proximity.

However, the names already mentioned in a stage that we can now refer to as historical should be complemented with others that are more recent, such as: Casas Torres, Vilá Valentí, Vázquez Maure, Núñez de las Cuevas, Bosque Maurel or Valenzuela Rubio who are among those who have had a more active presence.

In order to complete this overview of the internationalisation of Geography conducted by the Royal Geographical Society we must cite two organisations in which the RSG actively participates: EUGEO and EUROGEO.

EUGEO is an association of Geographical societies, geographer associations and other organisations related to geography and geographical science in the countries of the European Union; all of them operate autonomously, bringing together a community of geographers belonging to a country or region. Although the founding partners were basically historical geography societies, many of them more than a century old, EUGEO is open to all Geography institutions that wish to work towards the creation and promotion of a shared idea of Europe.

The initiative for creating the European Geography Society was based on the Società Geografica Italiana, with the initial idea emerging in the meeting held in Rome in 1994. Ten societies signed the first statutes, including the Royal Geographical Society, and many more have joined since then. Therefore, before the extension of the European Union all of

the member countries were represented in EUGEO, except for Luxembourg and Greece, with Spain and Italy having two member societies each. Societies from the new member states of the EU have also joined.

On the other hand, the Royal Geographical Society has belonged to EUROGEO since its creation. EUROGEO is a non-profit association with members in almost every country in Europe. It brings together the European Geography teachers associations. In 1989, it was granted the status of advisory body of the European Council and from 2004 it has had full participation in the Council. Its objectives include the promotion of the European dimension in Geography teaching in European countries. To do this, it collaborates with different bodies and institutions and organises conferences and other events that promote good practices in Geography teaching and research. EUROGEO is the successor of the European Standing Conference of Geography Teachers Association (ESCGTA), emerging from the heart of the EU and in which the Royal Geographical Society has participated without interruption from the beginning.

In short, we can say that, since Antwerp in 1871, the Royal Geographical Society has actively participated in the internationalisation of Spanish Geography. It was the country's only representative before the creation of the IGU and, subsequently, it has been supported by other geographical institutions that make up the current Spanish Committee.

## CONCLUSION

Our Society continues to thrive because it has been able to adapt to the different currents and trends of geographical evolution. Also, because it has had the support of the institutions represented in its Governing Body and has been able to adopt the new technologies and forms of penetrating modern Geography, such as: digital cartography, geographical information systems and all of the applications related to observing the earth from space. Moreover, it has a huge potential wealth in terms of its members, who represent a wide variety of professions and who are united by their vocation and interest in Geography.

The long and complex trajectory of the Royal Geographical Society reflects not only the internal and external evolution of the Spanish geography community but also the vicissitudes of recent Spanish history and also, perhaps, those of its society.

## ABSTRACT

The Royal Geographical Society is an association that, as its Statutes state, seeks to bring together all those interested in the study of Geography, promote the advancement and dissemination of geographical knowledge in all its branches and in all its applications to social, political and economic life. The Royal Geographical Society is the oldest of the Spanish geographical societies, about to celebrate a century and a half of existence. Its history confers it a special value and it has become part of the heritage of Spanish geography and of the culture of the country.



# THEMATIC LINE 1

## ENVIRONMENTAL CHANGE

# From sustainable development to climate emergency

CONTRIBUTIONS OF THE SPANISH GEOGRAPHY  
TO THE STUDY OF ENVIRONMENTAL CHANGE  
IN THE 21<sup>ST</sup> CENTURY

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## ABSTRACT

The study of the environmental changes from Geography has undergone a notable transformation in the first two decades of the 21st century. The reasons have been due, mainly, to a consolidation of the internationalization of researchers and to the assimilation, partial or total, of foreign training programs that now integrate inter- and multi-disciplinary aspects into university teaching, transversal to the three areas of Geography. Our research presents an analysis of the contributions of recent Spanish geographical research in the fields of: 1) climatology and extreme events on a global and regional scale, 2) water resources in the context of global change and 3) the transformation of the ecosystems. In this preliminary analysis, the three aspects give a complete vision of the study of environmental change, how it aligns with international research, and what the challenges are for its future in the medium term.

## 1. RECENT GEOGRAPHY AS A SCIENCE OF ENVIRONMENTAL CHANGE

Geography has assimilated, in the first two decades of the 21st century, new tools and techniques that are typical, not only of the Earth sciences, but also of the social, economic, and political sciences and that serve as a guide to evaluate the new challenges facing society. The generalization of global change as a field of multidisciplinary environmental study has derived, in the geographical discipline, the interest from local and regional concepts, such as sustainable development, to more global ones such as climate emergency. This has positioned

the discipline as the most suitable for a comprehensive analysis in this area. It is not only important the vision of physical processes –traditionally assumed by Physical Geography–, but also the areas of Human and Regional Geography occupy relevant positions in the study of a systemic and territorial process such as climate change and its implications in the socio-environmental relations.

Geography, as a science of territory, has a fundamental role in the study of sustainable development and global change. On the one hand, it offers approaches, concepts and methodological tools based on the spatial analysis and the interactions between humans and their environment that other disciplines do not integrate into their methodological process. On the other hand, it adopts a critical position as a basis for generating new values and attitudes towards the environment, taking advantage of its proven usefulness to confront and provide solutions to the conflicts and problems that arise from the aforementioned interactions (Toro Sánchez, 2007). The participation of Geography as a science implies, first of all, considering what Geography does today. Although its object of study is not empirically visible, it is the product of an abstract construction to describe and explain facts and phenomena that are a product of the relationship between the human being and the environment, which facilitates its capacity for comprehensive analysis of this relationship. This is an advantage over the study of sustainability, since Geography integrates the analysis of geographical space and that of human behavior in the same methodological and conceptual field.

This environmentalist, comprehensive and interdisciplinary approach to geographical research is not new, but it was restricted until the end of the 20<sup>th</sup> century to regional spatial scales, addressing territorial conflicts with well-defined limits. The entry on the scene of climate change as a global problem at the beginning of the 21<sup>st</sup> century, together with scientific advances in the knowledge of its physical bases and its potential impacts, blurred these limits and forced us to consider a broader perspective.

The result of the modification of the atmosphere by human actions in the last two centuries has produced a set of transformations in the territory for which we are not yet prepared. Climate drift forces us to take urgent measures (recently derived from the concept of “climate emergency”) and a comprehensive vision of the problem and its spatial domain is then required. In this sense, it is precisely the territory the object of study that has gained greater prominence in the context of international climate research in recent decades. As an example of this, the Intergovernmental Panel on Climate Change (IPCC) in its latest report (IPCC, 2021) already considers the future evolution of the climate dependent not only on the physical dimension through the transformation of the atmosphere by the emission of gases. greenhouse effect, but of the scenarios that describe possible socioeconomic trajectories (SSP, Shared Socio-economic Pathways). These scenarios are built according to a wide range of different options for future climate policies, for example: changes based on unequal development and growth, territorial conflicts, social gaps between regions, exacerbated nationalisms, loss of confidence in environmental policies, etc. The future now depends on the decisions we make, as a society, in the territory.

Geography must attend, in the context of this new era of change, to the new forms of territorial organizations that, predictably, will emerge from a context of almost total de-ruralization and concentration of the population in urban areas. These new forms will create new spatial needs, anthropized natural elements that will replace the current ones, increases in human pressure on natural resources, and changes in development models, for which Geography has tools with which to evaluate and diagnose sustainable alternatives. In particular, the responsible use of geographic information technologies must be useful today for the analysis of these alternatives, but it must also be complemented with approaches from other areas to prevent “scientific geography from becoming less and less sensitive.” (Chaparro and Meneses, 2015:13) and embracing the new possibilities offered by other disciplines such as Big Data or artificial intelligence. Environmental change must take the direction of a recovery of ecosystems aimed not only at returning an aspect of naturalness, but essentially at integrating it into the territorial context that represents the relationships between humans and nature, minimizing conflicts between both and prioritizing sustainable development.

## 2. THE CONTRIBUTION OF SPANISH GEOGRAPHY TO THE STUDY OF ENVIRONMENTAL CHANGE

The contributions of Spanish researchers and Geography research groups have already been exhaustively reviewed in the past. Probably the one that best summarizes the turn of the century is the work by Lasanta and Martín Vide (2013) *La investigación Geográfica en España (1990-2012)*. In it, the research panorama is drawn from all possible points of view, concluding that geographical science achieved, even then, a notable international projection in practically all areas. Those most related to environmental change (especially those referring to Earth sciences) were among the most prolific in terms of scientific production and success in calls for research projects. Ten years later, the trend has been consolidated and perhaps the only significant change is that now the research groups are more interdisciplinary, seeking cooperation not only in other geographical areas but in other disciplinary areas.

The work of Lasanta and Martín Vide quantified some little-known aspects of geographic research. For example, in that same work, Lázaro and González (2013) addressed a complete analysis of the theses defended in Geography departments between 1990 and 2012 using official information sources from the Ministry of Education. They then pointed out that 14% of the geography-related theses (52 in total) were associated with the descriptor "Earth Sciences" –which brings together other descriptors specific to physical geography (biogeography, climatology, geomorphology, and hydrography)–. Regarding the predominant themes, those that the authors categorize as "Environment, Ecology and Sustainability" based on the different associated descriptors, represented 16% of the total between 2007 and 2012, but there were others such as "Climate" or "Geomorphology", which they could also be added to the theme of environmental change, which would add up to a total of 21.2%. It is noteworthy to note that, although these theses were developed in departments of Geography, the doctoral students were not necessarily geographers. This fact is more pronounced today, when graduates from other disciplines, such as Environmental Sciences, Geology, Biology, and engineering related to the natural environment, are regular students in doctoral programs of Geography. This situation shows that the evolution of environmental change issues goes hand in hand with an adaptation in the research field of Geography, which offers very attractive higher education for different disciplines, covering aspects related to spatial analysis that other fields do not address.

On the other hand, Esparcia (2013), in that same work, points out that the majority of research projects of national calls carried out by geographers outside the area of Geography (approximately 10% of the projects and 17% of funding, data 2004-2012), were requested in the areas of Biodiversity, Earth Sciences and Global Change, which shows a high competitiveness of Geography in environmental change in areas outside the discipline itself in research calls. In the last decade, outside the period of this study, this trend has been consolidated. The high thematic specialization, especially in the field of physical geography, further dilutes the separation between geography and other disciplines of the Earth sciences. Spanish geographers are especially competent, particularly in the fields of climatology and geographic information technologies applied to the resolution of environmental problems, two topics fully integrated today in the "Earth Sciences" area of the State Agency of Investigation (AEI). Contrary to these data and a reasoning derived from them, the AEI places Geography (without separation between areas) in the Social Sciences, with a descriptor that necessarily guides projects to include social aspects. This often distances geographer researchers who focus their work on very specific descriptive, dynamic, and predictive aspects of natural processes.

## 2.1. CONTRIBUTIONS TO THE STUDY OF CLIMATOLOGY

Cuadrat and Martín Vide (2007), in their work *La climatología española: Pasado, presente y futuro*, reviewed the contributions of Geography to climatology in Spain from all points of view. A notable aspect of the presence of climatology in the academic field is that, as Martí *et al.* showed. (2007), 48% of the subjects of all Spanish university courses that addressed this topic were in the then Geography degrees. In the absence of an updated analysis, it is reasonable to think that this percentage has changed since the climate issue is already addressed from different disciplines. But, overall, the presence of climatology in Geography continues to be dominant.

However, it is in research where the greatest advances have been made in the last two decades. Spanish climatology reflects the discipline in Europe, where researchers from Geography predominate, mainly, in studies on climate reconstruction, regional climatology and interdisciplinary aspects where climate is an important explanatory factor for other variables. In any case, the geographical universe is varied and complex, and so are the interactions between researchers, who are increasingly involved in research dynamics with colleagues from other disciplines. In general, climate research in all areas (past climate variability, climate change, regional climatology, etc.) has experienced notable progress thanks to national and international publications and projects by geographically based research groups (with geographers as principal investigators) established in Spain. From the complete catalog of 113 research groups prepared by the Spanish Association of Geography (AGE, 2020), only 4 of them (3.5%) explicitly mention climate or climatology in their name (U. of Saragossa, U. Autónoma of Madrid, U. Barcelona and IPE-CSIC) but, together, they have hundreds of published articles and dozens of research projects in the last two decades. However, the scope of climate study normally also expands to other environmental groups in Geography that actively contribute with contributions in the same terms. In this case and adding the search terms: environmental, landscape, hydrology, geomorphology, biogeography, physical geography, and global change, the number increases to 37 (32.8%). In terms of gender, a worrying imbalance remains. In a recent analysis, Cañada (2023) evaluated twenty-one research groups dedicated to climate issues (not only in the field of Geography) that had female researchers on their staff. She observed that only in four of them (19%) the principal investigator (PI) was female, while in the rest women were part of the research team whose PI was male.

Regarding thematic working groups, the grouping of researchers around climatology has historically been very active. The AGE Climatology Working Group was founded in 1994. Since its inception, it was able to bring together a group of researchers and teachers with common interests, specialists in all areas of this very diverse area, always from the field of Geography. Although the study of Climatology has not changed much since then, the focus on some aspects has, especially on the consideration of risk of natural origin in a context of climate change and variability. The group's extensive history puts into practice previous experiences and, above all, people who work or are interested in risk management in relation to climate change and variability. Precisely, a new vision of the role of climatology with respect to climate change implies new opportunities and solutions, new ideas for risk management to which Spanish geographers have contributed thoroughly. In 2021, the working group was renamed as "Climate Change and Natural Hazards Group", representing a new vision, from Geography, of the new challenges posed by climate variability in the territory. Today, the group actively contributes to promoting the role that the discipline has from its different lines of work in the identification and management of natural risks in general and those associated with the climate emergency in particular.

Based on the experience of the AGE and at the initiative of a group of climatologist geographers, in 1998 the Spanish Association of Climatology (AEC) was created, which brings together more than a hundred experts from a wide variety of disciplines. Since 1999, it has been holding biennial conferences that are published regularly bringing together the contributions of scientists, and which represent the most up-to-date document on the state of the art of climate research in Spain.

## **2.2. CONTRIBUTIONS TO THE STUDY OF WATER RESOURCES AND THE TRANSFORMATION OF ECOSYSTEMS**

The dynamics of the study of water resources and the transformation of ecosystems have been very similar to that of climatology. In this case, these are areas that often cut across research groups. In their inventory of those existing in Spanish universities until the first decade of the 21st century, Olcina and Lois (2013) identified 4 research groups studying water and 14 more on topics such as physical geography, biogeography, environmental resources, natural hazards, and forest areas, which could be perfectly framed in the study of ecosystems.

Research on water resources has a double aspect that has historically been divided in the Spanish Geography: that oriented to physical processes and that which focuses on water as a good with a need for territorial management. On the one hand, the study of variations in the hydrological cycle, either through the study of flows, groundwater, water balance, droughts, extreme phenomena, etc., or through basin-scale simulations, prediction of water availability for consumption, or other types of modeling, has been widely developed by groups based on Physical Geography. Among them, those focused on the Mediterranean area stand out, especially those from the universities of Valencia, Murcia, Salamanca, Extremadura, Saragossa, the Balearic Islands and the IPE-CSIC, groups that concentrate the greatest international scientific productivity in Spain in the hydrological field. On the other hand, the approach to water as a resource in need of management is generally addressed by Regional and Human Geography groups, highlighting those from the University of Alicante and Pablo de Olavide.

The transformation of ecosystems brings together a wide variety of research topics, from changes in land use to changes in biogeochemical cycles, but also including a socio-territorial approach to analyzing changes in geographic space, where it is analyzed the ecological footprint and the underlying causes that drive changes in ecosystems. In this sense, the need to blend research profiles and analysis techniques has favored the consolidation (and creation in some cases) in recent years of interdisciplinary research groups dedicated to topics such as global change, landscape evolution, or sustainable development, among others. In these areas, the groups from the universities of Alicante (2), Autonomous of Madrid (2), Complutense (2), Cantabria (2), Castile-La Mancha, Extremadura, Granada (2), Murcia, Oviedo, Valencia, Barcelona, Balearic Islands and IEGD-CSIC stand out.

The landscape is probably the area of study, from the transformation of ecosystems, that the largest number of Geography groups work on. Most of the current studies on landscape focus on sustainable landscapes, those territorial structures where all the elements, factors, and dynamics of the relationships between human beings and the environment are combined, in balance and with a spirit of conservation. Precisely, the inclusion of anthropogenic activities is a key element in the construction of these territorial structures, differentiable based on their uses and forms. This approach has historically not been considered in traditional studies, which were limited to the usual ecological models and processes of ecosystems. Landscape has been configured in recent decades as the science of sustainability, where human value, what it contributes through the changes it produces, is the centerpiece of the sustainable landscape. On large time scales (decades, centuries, millennia), landscapes also undergo changes, and climate change is today one of the main drivers of current landscape transformation, only its dynamics are much slower than the usual processes that dominate the landscapes. dynamics of change (e.g. changes in land occupation, ecological succession, etc.). This favors the activity of erosive agents, changing sedimentation patterns, etc., ultimately, accelerating the transformation processes of ecosystems. All of these factors are addressed today, for the most part, from perspectives separate from Geography: on the one hand, the physical processes and, on the other, the socio-territorial ones, but there are groups in Spain like those mentioned above that already integrate these analyses in the same investigation.

### 3. BIBLIOGRAPHIC REVIEW

In the last two decades, we have witnessed a very significant increase in publications by Spanish geographers in high-impact international journals. Lasanta and Martín-Vide (2013) describe and analyze how this process developed from the last decade of the 20th century until 2012 and how the new generations of geographers with theses read in the first years of the 21st century, both from the departments of Geography of the different universities as well as the CSIC centers, opted for the internalization of their scientific production in line with that of their research activities, in a process that has been amplified over the last decade.

Without leaving aside the contributions to prestigious national journals and the significant contributions to the congresses of the Spanish Association of Climatology or the Spanish Association of Geography, the community of geographers thematically linked to Climatology has not been immune to this process. A community that, beyond the metrics –now being reconsidered–, or their usefulness to position itself in a more competitive situation when it comes to attracting resources for research, understands that this must be an essential characteristic for the dissemination of their work and the internationalization of their activities.

Through the Scopus database, a series of searches have been developed in order to analyze the quantitative dimension of the contributions made by Spanish geographers in the thematic field of Climatology that have been published in high-impact international journals. To this end, searches have been carried out for works by researchers affiliated with Geography departments of Spanish universities and different CSIC centers, using in the search criteria a set of keywords linked to research in Climatology and analyzing their presence both in the title as well as keywords. Only research articles published in SCI journals that appear in the Scopus catalog were searched. The terms (and variations of these) used in the search were: *climate, climate change, global change, climate variations, paleoclimate, Holocene, global warming, climate models, reconstruction, proxy climate record, anthropogenic effect, paleoenvironment, trend analysis, precipitation, rainfall, water resources, water management, water supply, water availability, river, catchment, flooding, floods, streamflow, hydrological modelling, droughts, drought impact, drought index, water, water scarcity, temperature, air temperature, warming, atmospheric temperature, temperature effect, sea surface temperature, heatwaves, coldwaves, ecosystem impacts, vegetation, forestry, biodiversity, ecosystems, forest, environment, trees, physiology, ecology, paleoenvironment, natural resources, dendroecology, dendroclimatology, runoff, soils, landforms, sediment transport, streamflow*. Thematic searches were also performed using a selection of keywords related to: i) climate change, ii) precipitation, droughts and water resources, iii) temperatures, and iv) impacts on natural systems, soils, erosion and climatic geomorphology.

The first search for a set of topics generically related to Climatology yields the results that, in the form of a temporal evolution of the number of contributions, can be visualized in Figure 1 (with absolute figures in Table 1). A total of 2,289 works published between 2000 and 2023 have been identified that we can classify within the generic thematic classification of “Climatology” in which geographers with affiliations in Spanish universities or research centers appear.

In this temporal evolution we could differentiate several stages. The first of them would cover the interval between the years 2000 and 2006, a period in which we could consider that the scientific production in prestigious international journals on topics related to Climatology by Spanish geographers was practically marginal, if not anecdotal. Nothing different, in any case, from the dynamics of other branches or disciplines of Geography (Lasanta and García Ruiz, 2013). In this period, only in 2006 there were more than 20 published articles, with only 5 in 2000. We could extend the second stage between 2007 and 2013. In those years there was a slow, but sustained, growth in publications, reaching to 87 in 2013. But it is from then on, that the most notable growth in scientific production in Climatology published by Spanish geographers is observed, reaching, in what we could define as the third stage, exceeding 200 in

the year 2019, until the maximum peak of 246 in 2020. Most likely related to the effects of the COVID pandemic, in successive years this trend is interrupted, observing a hiatus in the number of scientific contributions, but always at notably higher values than those recorded before 2020.

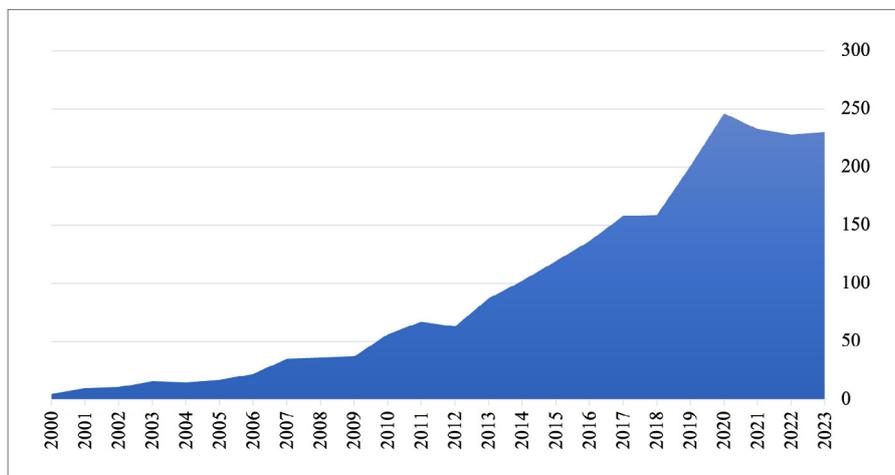


Figure 1. Temporal evolution of publications in prestigious international journals by Spanish geographers on Climatology. Source: Scopus.

As already noted, thematic searches have also been carried out grouping different topics related to i) climate change, ii) water (precipitation, droughts, and water resources), iii) temperatures, iv) impacts on natural systems and v) climatic geomorphology (soils, erosion, geomorphological processes). The results of the search for the number of publications that Spanish geographers have made on each of these topics are reflected in Figure 2. In this evolution, we can see a temporal pattern very similar to the generic one described above, of which it is worth highlighting the already noted accelerated increase that occurs from 2013 and the hiatus of the year 2020. If we go down the scale of analysis and observe each of the topics, we see that it is all those related to climate change that group together a greater number of publications, going from 3 to 11 between 2000 and 2006, from 21 to 43 between 2007 and 2013 and reaching 166 in 2020, with that slight subsequent decrease. Altogether, in this period 2000-2023, a total of 1,458 publications on climate change have been recorded. Everything related to water, precipitation, droughts, and water resources has also generated notable scientific production among geographers-climatologists. Between 2000 and 2023, up to 1,007 publications have been recorded in Scopus, with an evolution over time similar to that indicated above. Impacts on natural systems, climatic geomorphology or all topics related to temperatures have a more modest number of contributions in the total of this period, 900, 525 and 515 respectively, showing an evolution over time similar to the general one for the Climatology and that expressed by the work on climate change or water.

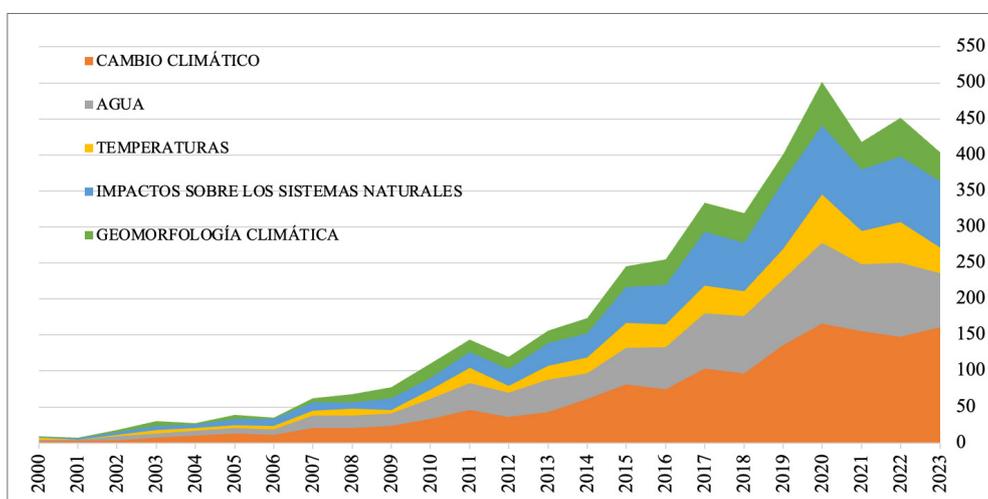


Figure 2. Temporal evolution of publications in prestigious international journals by Spanish geographers on topics related to Climatology. Source: Scopus.

	Climatology	Climate change	Water	Temperatures	Impacts on natural systems	Climatic geomorphology
2023	230	161	75	35	92	41
2022	228	147	103	57	91	54
2021	233	155	93	46	86	38
2020	246	166	112	67	96	60
2019	201	136	91	42	94	38
2018	159	97	79	35	67	41
2017	158	103	77	38	75	41
2016	136	75	58	32	54	36
2015	119	81	51	35	50	28
2014	102	61	36	22	33	21
2013	87	43	45	19	32	17
2012	63	36	34	9	23	18
2011	67	46	37	21	22	18
2010	56	33	28	13	16	20
2009	37	24	17	5	16	15
2008	36	21	17	10	8	12
2007	35	21	17	7	11	6
2006	22	11	8	5	9	2
2005	17	13	8	4	8	6
2004	15	10	7	4	5	2
2003	16	7	6	5	6	6
2002	11	4	5	2	4	3
2001	10	4	1	0	1	1
2000	5	3	2	2	1	1
<b>Total</b>	<b>2,289</b>	<b>1,458</b>	<b>1,007</b>	<b>515</b>	<b>900</b>	<b>525</b>

Table 1. Number of publications in prestigious international journals by Spanish geographers on Climatology and related topics.  
Source: Scopus.

## 4. CONCLUSIONS AND FUTURE CHALLENGES

Geography provides a complete vision of the study of environmental change, and Spanish researchers, who are no unconnected to this approach, align themselves with international research through projects and, especially, publications in top-level journals. The second decade of the 21st century was a period of unprecedented momentum for the internationalization of Spanish geographic research in the fields of environmental change. The analysis of the causes of this impulse reflects the results of a historical trajectory that, since the end of the 20th century, focused on the specialization of researchers and the transdisciplinarity of doctoral studies. Other underlying causes unrelated to the discipline also explain the increase in the number of publications, such as the change in the paradigm of national and international scientific evaluation, more oriented towards obtaining publishable results, or the opening of postdoctoral programs (postdoctoral stays, Ramón y Cajal, Juan de la Cierva, etc.), which promoted the connection with international networks.

Currently, as challenges for its medium-term future, improving the positioning of Spanish Geography in the study of environmental change involves increasing its interdisciplinarity, covering broader areas, uniting Geographies, applying a comprehensive environmental Geography, where the purely technical methods for the biophysical description of the territory are integrated with a social – and political, if the scope of study allows – analysis to infer the interactions between the physical environment and territorial development. After all, it is the field of study of the discipline.

There are already some approaches to this hybridization, such as Critical Physical Geography (Lave *et al.*, 2018), which advocates a human approach with a social categorization and the use of techniques typical of Physical Geography, also with overtones of political ecology but integrating fully the spatial aspect (territorial rather, due to its consideration of the human aspect). Although there is still no real integration of this type of approaches in the Spanish geographic research, they emerge from outside as a more than solvent way to address new notions such as the climate emergency. Although this concept would have once been typical of the purest physical geography, describing processes and predicting behavior, today it addresses a problem – spatial, on the other hand – that transcends the biophysical dimension and focuses on a need for changes in the models of production, consumption, and social organization in the territory. Research groups from the three areas (human geography, regional geographic analysis, and physical geography) will have to work together to find solutions to this and other problems that are transversal to all of them, each one from their area of specialty.

Something similar happens when the problem focuses on the transformation of ecosystems. The traditional approach has focused on the physical part, but cultural changes, which are also part of the participatory process of modifying the environment, through changes in demographic patterns or productive activities, are not typical of a single area of the discipline. Natural factors are the framework on which change is based, while socioeconomic factors trigger decisions. In other words, decisions about land use favor processes of landscape transformation, often irreversible, for which an integrated perspective from the physical and human aspects is necessary.

Lastly, the field of natural risks is going to be one of the most important for Geography in the coming decades. The effects derived from a warmer atmospheric system, with greater accumulation of energy that spreads to the rest of the elements of the system, will favor an increase in the duration, magnitude, and frequency of extreme events. The study of risks has always been a field of Geography since, risk itself, deals with the territorial expression of actions carried out by human beings that have not considered the characteristics (physical, social) of the environment where they take place. This gives an important role to all areas of the discipline and involves the three parts of environmental change studied in this chapter: climatology as a hazard factor, water resources as a factor of exposure and vulnerability, and the transformation of ecosystems as a driving force transition towards risk situations in the territory.

In short, Spanish geographical research on environmental change has maintained a situation of sustained growth for three decades in terms of scientific production and project development, but it also has medium-term challenges that involve greater interdisciplinarity to address combined approaches that will be inevitable in a context where aspects such as natural risks will require an integrated territorial analysis.

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# Ecosystems and biodiversity

## BIOGEOGRAPHICAL VALUATION OF CULTURAL ECOSYSTEMS INTERVENED BY HUMANS. THE EXAMPLE OF THE CORK OAK FORESTS OF THE SIERRA DE ESPADÁN (CASTELLÓN -SPAIN-)

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### ABSTRACT

The Lurralde-on research group has been inventorying, characterizing and evaluating different ecosystems on a global scale, specifically more than 230 formations. On this occasion, a cultural ecosystem has been considered: the cork oak forests of the Sierra de Espadán in Castellón (Spain). There, forest exploitation provides significant economic benefits in addition to the abundant ecosystem services. Based on a random and stratified inventory of 10 plots of 20x20 m<sup>2</sup>, the cover of the species present is recorded. Data referring to natural, cultural, and structural criteria and possible threats are also recorded. Subsequently, each of the inventoried plots is assessed according to the LANBIOEVA methodology. In the case of the cork oak forests of Espadán, the phytocenotic and mesological values achieve notable evaluations. The territorial ones show discrete values, while the structural ones show medium to high values. Likewise, outstanding cultural values are also obtained. Threats are not excessively high. However, fires associated with global warming and summer heat waves are the greatest danger.

### KEYWORDS

Biogeography, *Quercus suber*, LANBIOEVA, cultural landscape, Sierra de Espadán.

# 1. INTRODUCTION

The processes of deagrarianization, in some cases, and intensification of agricultural production, in others, are producing notable alterations in the traditional models of use and management of large sectors of the Spanish and European rural space. Many of these areas, currently at risk of abandonment or overexploitation, constitute cultural landscapes created over centuries by traditional agrarian structures (De Jaime, 2009) through extensive use that respects conservation. We are talking about agricultural landscapes of high ecological, economic, social and territorial interest in the form of cultural forests, whose dynamics are being altered and which, having been left out of protection programmes, are not receiving the attention they deserve.

Thus, today there are still important forest patches that, without going into the abandonment vs. conservation or natural vegetative recovery vs. intensification assumptions, show management models that are sustained over time and highly sustainable, which various authors refer to as true models of cultural forests (Braga *et al.*, 2014; La Roca *et al.*, 2018; De Jaime, 2009); in other words, heritage landscapes where anthropic management maintains high levels of diversity, important landscape values and great social and economic relevance. It is worthwhile to characterise, classify, analyse and assess their value, as well as to implement protection, management and planning objectives and measures which, by the postulates of the European Landscape Convention, make them living landscapes that are well perceived and economically, socially and environmentally active (Consejo de Europa, 2000).

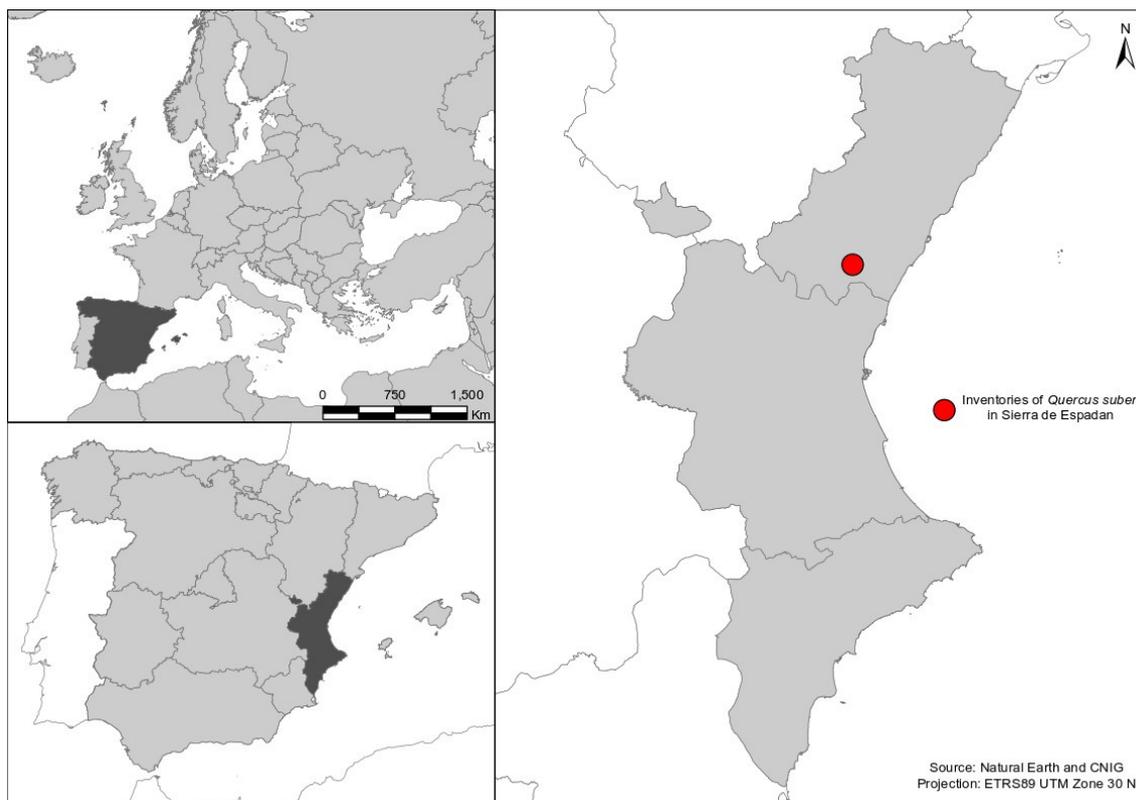
Some authors consider that the richness of fauna and flora species in the Mediterranean Basin reaches such high levels that they are among the world's biodiversity "hotspots" (Myers *et al.*, 2000, Mutke and Barthlott, 2005; Blondel, 2006; Barthlott *et al.*, 2007; Blondel *et al.*, 2010); which, associated with the great heterogeneity of the area and its complex historical changes, has allowed the arrival of species of very varied origin and the development of different biological systems, both natural and anthropogenic (Blondel and Aronson, 1999). These studies show that their species diversity tends to be higher than that of other habitat types, a trend that is observed for a rich array of organism groups and a wide range of spatial scales. This diversity changes as a function of scrub or abandonment of cultural forests, often due to the loss of livestock use, which underlines the role of human activity as an agent favouring biological richness (Myers *et al.*, 2000; Díaz *et al.*, 2003).

The interest in the conservation of cultural forests is even greater because of their ethnic diversity, linked to traditional, symbolic, mythical, sacred values, etc. (Tardío *et al.*, 2006).

A good example of this can be found in the cork oak forest of the Sierra de Espadán (Castellón, Region of Valencia, Spain) (Map 1) and, more specifically, in the Mosquera area, which phytosociologists determined as *Asplenio onopteridis-Quercetum suberis* (Costa, 1986, 1999) and the series *Asplenio onopteridis-Quercus suberis sigmetum* (Rivas-Martínez, 1987; Costa, 1987, 1999; Costa *et al.*, 2005). They highlighted the endemic character of this series and provided an explanation for its presence in the area, linked to the peculiarities of the habitat. Stübing (1998) interpreted the dynamics of the formation and pointed out the appearance of the *Pinus pinaster* Ait. pine forest in the first phase of degradation, followed by heathland and sagebrush (Peris *et al.* 1996; Costa *et al.*, 2005). The reference work: Blanco *et al.* (1997) refers to the cork oak grove of Espadán and highlights its singularity and the considerable differences with the neighbouring Catalan cork oak groves (Folch, 1981, Folch *et al.*, 1984). Allué and Montero (1989) provide a holistic view that considers the dynamics in diversity, productivity and biomass of the formation. They attribute the Mosquera forest patch an evolutionary or maturity level 7 within the sclerophyllous type, as a tree formation with certain herbaceous species, and classify it as a grove forest.

For the correct interpretation of this cork oak forest, it is important to know the secular management and management practices and their consequences on the development of the trees and scrub, as well as to be aware of the possible damage caused by recurrent fires. The data collected indicate that Mosquera is a forest that has been managed and planted successively throughout its contemporary history, to take advantage of the ecological potential of the environment (La Roca and Hurtado, 2011).

It is known that the use of cork dates back to ancient times. The closest references to Mosquera come from the neighbouring village of Benialí (Butzer *et al.*, 1985), where excavations brought to light its use in the Islamic period. Small-scale exploitation, practically for self-consumption, continued until the 19<sup>th</sup> century in Espadán (Vidal, 2007b). It is at this time that Madoz refers to the fact that “*the tireless hand of its inhabitants has replaced the scrubland and undergrowth that used to cover the land with beautiful plantations of vines, olive trees, fig trees and cork oaks*”. Thus, the cork oak became just another crop, coinciding with the interest it aroused in the unstoppable and booming Catalan cork industry, which, unable to make do with its resources, turned to producers in Castellon, thus making Mosquera a part of the industrial history of cork. The cork tradition was so notable and deep-rooted that a festival was traditionally held at the end of the harvest, in August, known as the “Mosquera cork festival” (Vidal, 2007a).



**Map 1. Location of the *Quercus suber* forest inventoried, characterized and valued within the Sierra de Espadán.**  
Source: Own elaboration from Natural Earth and CNIG.

The extraction of cork and firewood, charcoal and livestock, traditional activities that were episodically affected by fires, began to decline gradually half a century ago. The general clearing of the hillsides ceased completely with the industrial reconversion of the 1980s. Before that, in the 1960s, the extraction of wood and coal for fuel came to an end. Cattle ranching stopped in the area some 35-40 years ago. Today, cork harvesting continues, but at a slower pace and with less aggressive practices. When the clearing ceases, the forest is renewed at a faster rate. The woodland is advancing uphill, gaining surface area at the expense of the scrub, increasing its general size and becoming denser. This gives rise to an interesting process of environmental, landscape and, more centrally, plant dynamics, the results of which we have tried to diagnose and evaluate using the LANBIOEVA (*Landscape Biogeographical Evaluation*) methodology (Lozano-Valencia *et al.*, 2021).

The Lurralde-on research group has been applying this methodology for 35 years to more than 230 plant formations all over the world, with the fundamental objective of inventorying and assessing them with a view to their correct protection, management and planning. This methodology offers managers a powerful methodological corpus and a wide range of natural, cultural, structural and threat roots valuation criteria.

## 2. OBJECTIVES

The main objective of this work is to characterise, inventory and biogeographical assessment using the LANBIOEVA methodology of the cork oak forest of the Sierra de Espadán in the province of Castellón (Region of Valencia, Spain).

The method used makes it possible to obtain a series of indices and partial and global valuations that can provide the manager with a series of data for the correct protection, management and planning of these natural resources, as advocated by the CEP.

## 3. METHODOLOGY

### 3.1 BIOGEOGRAPHICAL INVENTORY

The inventory model has been tested, contrasted and applied on successive occasions to collect all the geographical, environmental, heritage and biogeographical data necessary for the correct characterisation and subsequent evaluation of each of the areas to be studied, analysed and managed. Once the *Quercus suber* forest of the Sierra de Espadán had been delimited, specifically within the sector of the Casa de la Masía Mosquera, the location of the plots (10 as usual) was determined (Table 1) using a stratified and random method established within the Arcview Pro Geographic Information System (GIS). For each of the inventories or 20 x 20 m<sup>2</sup> plots, data were obtained on the location and identification of the site (UTM coordinates, place names, etc.), general geographical and environmental aspects and features, photographs of the plots, and other general aspects. Then, the degree of cover of the moss, lichen and fungal mats was recorded according to the growing substrate (epiphytes and terricolous-saxicolous), as well as that of leaf litter and of the soil or bare rock itself. The plots and inventories have been visited three times: in autumn 2022 and spring and summer 2023 to avoid possible biases due to phenology and seasonality.

Code	Altitude m.s.l.	Exposure	Pending (°)	Coordinates	Soil	pH	Topographical situation
1	640	W	4	30S 0725159 - 4416768	Leptosol	5.6	Valley floor
2	683	N	32	30S 0725514 - 4416695	Leptosol	5.6	Middle slope
3	689	S	38	30S 072551 - 4416739	Leptosol	5.6	Middle slope
4	480	NW	56	30S 0723760 - 4416990	Arenosol/fluvisol	5.5	River terrace
5	553	N	38	30S 0724224 - 4417086	Arenosol/Leptosol	5.4	Low slope
6	590	S-SW	25	30S 0724592 - 4417146	Arenosol	5.3	Low slope
7	765	W-NW	15	30S 0725656 - 4416579	Leptosol	5.4	Medium slope with ravine
8	788	E	53	30S 0725615 - 4416377	Arenosol/Leptosol	5.6	High slope
9	792	S-SE	47	30S 0725464 - 4416412	Litosol	5.4	Water divide
10	720	W	33	30S 0725654 - 4416794	Litosol	5.4	High slope

Table 1. Inventory plots in the cork oak forest of the Sierra de Espadán.  
Source: They were prepared by the authors.

A sigmatistic valuation method of the Braun Blanquet school was used to determine cover, which determines abundance/dominance through mean cover with a scale of 6 classes (r= less than 1%, 1 between 1% and 10%, 2 between 10.1% and 25%, 3 between 25.1% and 50%, 4 between 50.1% and 75% and 5 between 75.1% and 100%) for each of the strata

[more than 5 m (A); between 1 and 5 m (B); between 0.5 and 1 m (C) and below 0.5 m (D)] and the overall plant grouping. In summary, all the species divided into large physiognomic groups (trees and shrubs, bushes and climbers, and herbaceous) were noted, and each of them was given a cover value within the 4 strata it can occupy. In the case of trees, cover was estimated above 5 m, but also in the intermediate strata (B, C and D). In the case of herbaceous plants, logically, the cover of D was estimated, and for those that exceeded this, the cover they occupied within C. Afterwards, the global cover of each of the species collected was estimated, that is, calculated according to the three-dimensional space they occupied within the 400 m<sup>2</sup> of surface area and also in terms of height.

Before assessing the cover of mosses, lichens, fungi, leaf litter and bare soil or rocks, the number of species occurring in each of the 4 strata was counted. The overall cover of each of the strata (A, B, C and D) was then estimated in the same way as for the species. For further calculations and comparisons between plots, the abundance-dominance data were transformed into their corresponding mean cover values (Braun-Blanquet, 1979).

### 3.2 BIOGEOGRAPHICAL ASSESSMENT

The LANBIOEVA valuation methodology is based on two fundamental and well-differentiated valuation concepts: Conservation Interest and Conservation Priority. The former is the sum of the scores obtained for natural interest and cultural interest. Natural interest is made up of four groups of criteria: phytocoenotic, territorial, mesological and structural. Phytocoenotic interest encompasses intrinsic characteristics of the vegetation and landscape such as diversity, naturalness, maturity and spontaneous regeneration or resilience; territorial interest considers attributes of rarity, endemism, relict and finicultural character; mesoecological interest assesses geomorphological, climatic, hydrological, edaphic and faunal functions at a local scale; the mesological evaluates the geomorphological, climatic, hydrological, edaphic and faunal functions at a local scale; the structural evaluates the richness per stratum, the cover per stratum, the richness of microhabitats and the connectivity and extension of the vegetation patch. Cultural interest takes into account two groups of values: heritage, which evaluates three sub-criteria (ethnobotanical, perceptual and didactic value), and structural cultural, which takes into account the structural physiognomic and the structural cultural values.

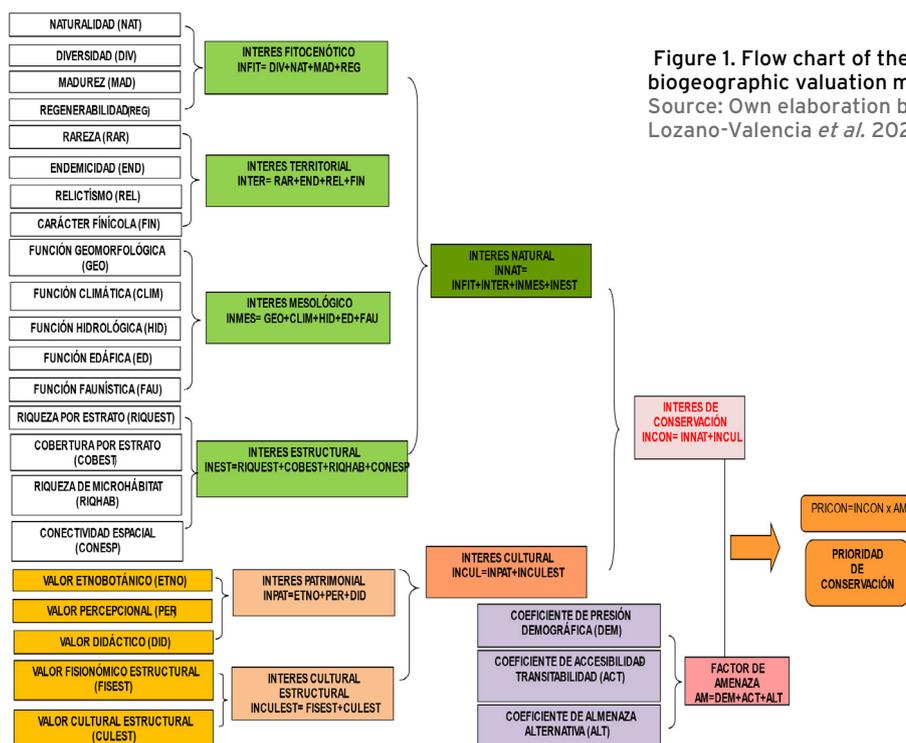


Figure 1. Flow chart of the LANBIOEVA biogeographic valuation methodology. Source: Own elaboration based on Lozano-Valencia *et al.* 2021.

The Conservation Priority is obtained by multiplying the Conservation Interest by the Threat Factor that weighs on the vegetation unit concerned, in this case, the cork oak forest of the Sierra de Espadán. This is calibrated according to three parameters: demographic pressure, accessibility-transitability and alternative threats. The population pressure coefficient gives priority to or penalises situations of high or low population density, with greater or lesser danger of alteration of the vegetation; the accessibility-transitability coefficient values the greater or lesser ease of access to the enclave, and the “friction” it shows to human transit; the alternative threats coefficient calibrates other types of risks and dangers to which the integrity of the plant grouping concerned may be subjected (Figure 1).

## 4. RESULTS AND DISCUSSION

Table 2 shows the synthetic inventories for each location where characterisations and assessments have been carried out.

Strata	Species\Relévé	1	2	3	4	5	6	7	8	9	10
TREES AND SHRUBS	<i>Quercus suber</i>	3	3	4	3	4	4	3	4	3	4
	<i>Quercus rotundifolia</i>	r	1	r	r	2	2	2	r	1	1
	<i>Quercus coccifera</i>										r
	<i>Prunus mahaleb</i>	1			r						
	<i>Salix eleagnos</i>	1									
	<i>Crataegus monogyna</i>	1		1	1						
	<i>Erica arborea</i>	2	3	r	2	1	2	1	r	2	
	<i>Phyllirea angustifolia</i>	r	r		r	1	1				
	<i>Rhamnus alaternus</i>	r			1	r		r			r
	<i>Arbutus unedo</i>		r								
	<i>Cytisus villosus</i>				2						
	<i>Celtis australis</i>				1						
	<i>Olea europaea var. sylvestris</i>				1		r		r		
	<i>Nerium oleander</i>				r						
	<i>Pistacia lentiscus</i>				r	r					
	<i>Ficus carica</i>						r				
	<i>Pinus pinaster</i>							1		r	
<i>Juniperus oxycedrus</i>							1	r	r	r	
<i>Prunus dulcis</i>								r		2	
BUSHES AND CLIMBERS	<i>Cistus albidus</i>	r		r	r		1	2	3	1	1
	<i>Cistus clusii</i>						r			r	1
	<i>Cistus monspeliensis</i>										r
	<i>Ulex parviflorus</i>	1	1	3	1	1	2	3		3	3
	<i>Helianthemum organifolium subsp. molle</i>	r		1		r	1	1	r		
	<i>Daphne gnidium</i>	1	r	r	1	r	r	r	r	r	r
	<i>Asparagus acutifolius</i>	2	r	2	1	1		r	1	r	1
	<i>Lavandula stoechas subsp. stoechas</i>	r					r	3	r	r	
	<i>Euphorbia characias</i>	1			r	r					r
	<i>Rubia peregrina subsp. longifolia</i>	1	1	2	1	1		r	1	r	2
	<i>Lonicera implexa</i>	3	r		1						
	<i>Lonicera etrusca</i>				r						
	<i>Calicotome spinosa</i>	1	r	2	1	r	r	r	2	1	3
	<i>Rosa canina</i>	2			1						
	<i>Rosa agrestis</i>	r									
	<i>Rubus ulmifolius</i>	1	r	1	1	1					
	<i>Ruscus aculeatus</i>	4	2	r	1	3	1				
	<i>Smilax aspera</i>	2	1		2	4	r		r		
	<i>Osyris alba</i>	2		3	3	r					
	<i>Hedera helix</i>	1	4	r		3	r	r	r	r	r
	<i>Origanum vulgare subsp. virens</i>				1						
	<i>Arundo donax</i>				r						
	<i>Ballota hirsuta</i>				1			r			
	<i>Salvia rosmarinus</i>						1	1	2	1	
	<i>Thymus vulgaris subsp. vulgaris</i>						r	1	1	1	r
	<i>Helichrysum stoechas</i>							r	r	r	r
	<i>Stachelina dubia</i>								r		
<i>Chamaerops humilis</i>								r			
<i>Clematis flammula</i>			1								

Strata	Species\Relévé	1	2	3	4	5	6	7	8	9	10
HERBS	<i>Brachypodium phoenicoides</i>	r				r				r	
	<i>Brachypodium retusum</i>	2	1	2	3	2	2	2	3	1	3
	<i>Silene mellifera</i>	r									
	<i>Asplenium onopteris</i>	1	1	r	1	1	r		1	r	1
	<i>Polypodium cambricum subsp. cambricum</i>	1	r	r	3	1			r		1
	<i>Thapsia villosa</i>	r									
	<i>Sedum sedifforme</i>	1									
	<i>Vicia angustifolia</i>	r			1	r					
	<i>Vicia villosa subsp. pseudocracca</i>	1			1	r					
	<i>Sanguisorba minor</i>	1									
	<i>Geranium purpureum</i>	r	r	r	1						
	<i>Guillonea scabra</i>	r									
	<i>Carex halleriana</i>	1	r		1	1	r	r			1
	<i>Viola alba</i>	r									
	<i>Viola willkommii</i>	r			r						
	<i>Mentha longifolia</i>	r									
	<i>Myosotis ramosissima</i>	1			r	r					
	<i>Bromus tectorum</i>	r									
	<i>Lactuca tenerrima</i>	r									
	<i>Melilotus indicus</i>	r									
	<i>Biscutella calduchii</i>	1	r		r	r	1	1	1	r	1
	<i>Lagurus ovatus</i>	r	r		r	r					
	<i>Galium maritimum</i>	r	r	r	r	r	1		r	r	r
	<i>Galium lucidum</i>								1	1	
	<i>Silene vulgaris</i>	1			1	1					
	<i>Sedum sedifforme</i>		1		1	r	r		r	r	r
	<i>Umbilicus rupestris</i>		r		r						r
	<i>Centaurea paui</i>			r	r			1	1	r	r
	<i>Koeleria vallesiana</i>				r	r		r	r	r	1
	<i>Bituminaria bituminosa</i>				2	r					
	<i>Orobancha alba</i>				r	r					
	<i>Adiantum capillus-veneris</i>				1						
<i>Minuartia valentina</i>					r	r					
<i>Luzula forsteri</i>					r						
<i>Asphodelus cerasiferus</i>										r	

Table 2. Synthetic inventories in the cork oak forest of the Sierra de Espadán. Own elaboration. The scientific names are taken from Castroviejo (1986-2012).

As can be seen, the total number of taxa found in the cork oak forest of the Sierra de Espadán corresponds to 19 trees and shrubs, 29 shrubs and climbers and 36 herbaceous plants (Table 3). Species richness is quite high (Lozano-Valencia et al, 2021), especially if we take into account the number of taxa that are repeated in different plots. In this case this is the case for the following taxa: *Quercus suber* and *Q. rotundifolia*; *Daphne gnidium* and *Calitocome spinosa*; and *Brachypodium retusum*. Thus, only 5.95% would be represented in all locations, demonstrating a high degree of inventory-specific diversity. Most of these taxa, moreover, are acidophilic or indifferent to the acidity of the substrate. The following trees and shrubs appear on 9 occasions: *Erica arborea*; in shrubs and climbers: *Ulex parvifolius*, *Asparagus acutifolius*, *Rubia peregrina* subsp. *longifolia* and *Hedera helix*; and in herbaceous plants: *Asplenium onopteris*, *Biscutella calduchii* and *Galium maritimum*. Thus, only 9.52% would occur in 9 of the 10 locations. As was the case previously, most of the taxa noted show a clear tendency towards soils with an acid pH. The taxa found in 8 of the 10 plots were *Cistus albidus* in shrubs and climbers, and *Polypodium cambricum* subsp. *cambricum* in herbaceous plants. This means that 2.4% of the taxa are found in 8 of the 10 locations studied. Acidophilic species or species indifferent to the pH of the substrate continue to dominate and, in addition, 34.5% of all the taxa detected were found in only one of the plots studied.

Strata\Relévé	1	2	3	4	5	6	7	8	9	10
Trees and shrubs	8	5	4	12	6	6	6	6	5	6
Bushes and climbers	17	10	12	17	12	12	13	14	12	12
Herbs	24	10	6	20	18	7	5	9	9	10
Total	49	25	25	49	36	25	24	29	26	28

Table 3. Number of taxa by physiognomic groups located in each of the 10 plots. Source: Own elaboration.

As can be seen, the numbers of taxa, both in general and for the different physiognomic groups, are relatively uneven, with minimum numbers in the case of plot 7 with 24, followed by plots 2, 3 and 6 with 25 and plot 9 with 26. The most species-rich plots are plots 1 and 4 with 49 taxa, followed by plot 5 with 36 and plot 8 with 29. In general, the number of trees and shrubs is average compared to other plant groupings at the global scale (Lozano-Valencia *et al.*, 2021). In shrubs and climbers, however, there are some differences between the only 10 taxa in plot 2, the 12 in plots 3, 5, 6 and 9, followed by plot 7 with 13 and plot 8 with 14, and the maximum reached in plots 1 and 4 with 17. In this case, the values are high and respond to a relatively cleared and managed cork oak forest which, nevertheless, ensures higher diversity than those forests less managed or with passive management (Lozano-Valencia *et al.*, 2021). In herbaceous plants there are also notable differences, with the highest records for plot 1 with 24, plot 4 with 20 and plot 5 with 18, and, once again, the lowest for plot 2 with only 5 taxa, plot 3 with 6, plot 6 with 7 and plots 8 and 9 with 9. These records are average for this physiographic group in comparison with other formations on a global scale (Lozano-Valencia *et al.*, 2021). The forest is fairly mature, but the tree canopy is open, allowing light to pass through to the undergrowth, which gives rise to species-rich subshrub and shrub strata and, to a lesser extent, herbaceous strata. In general, these are plots on steep slopes, with poorly developed substrates, normally leptosols or even lithosols, on relatively acid colluvium and, above all, well managed and managed for the production of quality cork, which has meant that these stands have been conserved very effectively in recent years. It should be noted that we cannot propose a synthetic list that brings together and characterises all the inventories carried out. As can be seen, more than a third of the taxa are confined to a single location. In any case, acidophilic species or species indifferent to soil pH dominate, and the main competitor of *Quercus suber* is *Quercus rotundifolia*, which appears in 10 of the 10 locations, but with relatively low cover due to the control that humans exert on this species so that it cannot compete with the former and to maintain a profitable and high-quality cork production.

Another indicator of naturalness is related to introduced species. There are only two: *Prunus dulcis* and *Arundo donax*. These taxa are introduced, although, in this sector, they cannot even be considered as invasive or xenophytes since the former appears in two plots (plots 8 and 10), and the latter in one: plot 4. Furthermore, their cover is very low, less than 1%, except *Prunus dulcis*, which in inventory 10 has a cover of more than 25%, probably as a consequence of previously being home to a field of almond trees.

The percentage of taxa endemic to these forests is not negligible either. The following are recorded: *Helianthemum origanifolium* subsp. *molle*, *Silene mellifera*, *Guillonea scabra*, *Viola willkommii*, *Centaurea pauri* and *Minuartia valentina*. Except the last two taxa (endemic to the Sierra de Espadán), the rest are Ibero-Levantine endemics. These records are relatively high compared to forests in other sectors of the Iberian Peninsula. Relict and finicolous taxa have not been detected.

Concerning each of the criteria and groups of criteria, we can point out that the diversity parameter shows high to very high scores. Five plots scored 7 points, two scored 8, one scored 9 and another two scored 10. The average is 8 points, which is a remarkable score. However, as mentioned above, the restrictive effect of steep slopes, oligotrophic and acidic substrates and poor soil development should be taken into account in the discussion. On the other hand, the relatively open nature of the stands, due to their exploitation to obtain cork and, therefore, to form a pasture woodland, provides good conditions and niches for shrub and herbaceous species.

About the values and criteria of natural roots and, within them, the phytocoenotic value, the degree of naturalness corresponds to a forest with very few introduced taxa and where these, moreover, have minimal cover, which demonstrates the good condition of the forest. Except for plot 10 where the two previously introduced species taxa appear and *Prunus dulcis* also maintains a relatively large cover, two other plots, 4 and 8 have 9 points. The rest of the plots maintain the highest scores. The average is 9.6 points, an outstanding score. Maturity, the most important parameter in this group of criteria, shows high scores ranging from 17 points in plots 4 and 5 to 16 in the last 5 and 14 in the first two plots. The plots with lower scores correspond to a plagioclimax species since the cork oak grove benefits from human

management, due to its productivity in the form of cork, and species such as kermes oak, which would probably compete with the cork oak by imposing itself, are systematically eliminated or controlled. However, some plots with deeper and sandier soils could correspond to more developed and mature facies, meaning more evolved paraclimax or even on the threshold of what should be climax vegetation (18 points). In terms of renewability or resilience, all plots show 7.5 points corresponding to xerophytic forests with moderate capacity for spontaneous regeneration.

VALUATION	PARAMETERS	1	2	3	4	5	6	7	8	9	10	SINT.		
INCON	INFINAT	DIVERSITY	10		7	10	9	7	7	8	7	8	8	
		NATURALITY	10	10	10	9	10	10	10	9	10	8	9.6	
		MATURITY (x2)	14	14	14	17	17	16	16	16	16	16	16	15.6
		REGENERABILITY	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
		SUMMATION (INFINAT)	41.5	38.5	38.5	43.5	43.5	40.5	40.5	40.5	40.5	39.5	40.7	
	INTER	RAREZA (x2)	12	10	9.8	12.4	12.2	11	10.8	11.6	11.2	11.2	11.22	
		ENDEMICIDAD	4	4	2	2	2	2	2	2	1	1	2.2	
		RELICITISMO	0	0	0	0	0	0	0	0	0	0	0	
		CAR. FINÍCOLA	0	0	1	1	1	1	1	1	1	1	0.8	
		SUMMATION (INTER)	16	14	12.8	15.4	15.2	14	13.8	14.6	13.2	13.2	14.22	
	INMES	GEOMORPHOLOGICAL FUNCTION (x2)	20	20	20	20	20	16	16	16	16	16	18	
		CLIMATE FUNCTION	8.5	8.5	8.5	10	10	9	9	9	9	9	9.05	
		HIDROLOGICAL FUNCTION	8.5	8.5	8.5	10	10	8	8	8	8	8	8.55	
		EDAPHIC FUNCTION	8	8	8	8	8	8	8	8	8	8	8	
		FAUNAL FUNCTION	8	8	8	9	9	8	8	8	8	8	8.2	
		SUMMATION (INMES)	53	53	53	57	57	49	49	49	49	49	51.8	
	INEST	RICHNESS by stratum (x0.5)	7.5	7	6	8.5	7.5	7	7.5	7	7.5	6.5	7.2	
		COVERAGE by stratum (x0.5)	7	6.5	6	6	7	6	5.5	7.5	5	8	6.45	
		MICROHABITAT richness.	6	7	7	6	6	4	4	4	4	4	5.2	
		SPACE CONNECTIVITY	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	
		SUMMATION (INEST GLOBAL)	39	39	37.5	39	39	35.5	35.5	37	35	37	37.35	
	SUMMATION (INNAT)		150	145	142	154.9	154.7	139	138.8	141.1	137.7	138.7	144.07	
	INCUL	INPAT	ETHNOBOTANICAL VALUE (X2)	20	20	20	20	20	18	18	18	18	19	
			PERCEPTUAL VALUE	10	10	10	10	10	7	7	7	7	8.5	
			DIDACTIC VALUE	10	10	10	10	10	7	7	7	7	8.5	
			SUMA (INPAT)	40	40	40	40	40	32	32	32	32	36	
		INCULEST	PHYSIOGNOMIC-STRUCTURAL VALUE	2	2	2	3	3	2	2	2	2	2	2.2
			CULTURAL-STRUCTURAL VALUE	3	3	4	4	4	4	4	4	4	4	3.8
SUMMATION (INCULEST) (x2)			10	10	12	14	14	12	12	12	12	12	12	
SUMMATION (INCUL)		50	50	52	54	54	44	44	44	44	44	48		
SUMMATION (INCON)		<b>200</b>	<b>195</b>	<b>194</b>	<b>208.9</b>	<b>208.7</b>	<b>183</b>	<b>182.8</b>	<b>185.1</b>	<b>181.7</b>	<b>182.7</b>	<b>192.07</b>		
PRIORIDAD DE CONSERVACIÓN	DEMOGRAPHIC PREASURE	1	1	1	1	1	1	1	1	1	1	1		
	ACCESSIBILITY-PASSABILITY	4	4	4	3	3	4	4	4	4	4	3.8		
	ALTERNATIVE THREATS	5	5	5	5	5	6	6	6	6	6	5.5		
	GLOBAL DANGER FACTOR	10	10	10	9	9	11	11	11	11	11	10.3		
	PRICON	<b>1,995</b>	<b>1,945</b>	<b>1,938</b>	<b>1,880</b>	<b>1,878</b>	<b>2,013</b>	<b>2,011</b>	<b>2,036</b>	<b>1,999</b>	<b>2,010</b>	<b>1,970.5</b>		

Table 4. Biogeographical valuations by criteria and interests of the different inventories carried out and following the LANBIOEVA methodology. Source: Prepared by the authors.

The sum of these first 4 criteria makes up the phytocenotic interest (INFIT), whose registers are relatively high, between 38.5 points for plots 2 and 3, 39.5 for plots 10, 40.5 for 6, 7, 8 and 9, 41.5 for plot 1 and, at the top, plots 4 and 5 with 43.5 points, with the highest values. The average value would be 40.7 points. Bearing in mind that the maximum for this parameter group is 50 points, the plots analysed would have outstanding values in the last two mentioned, while the rest can be qualified as notable.

The second group of criteria, those with territorial roots, tend to show low scores in the area in question (Lozano-Valencia *et al.*, 2021). The highest scores are recorded for the rarity parameter; firstly, because the cork oak grove is rare in the entire eastern sector of the Iberian Peninsula and, therefore, it would be worth 3 points for being rare at the phytosociological subsector level. In the second place, it has some species catalogued as vulnerable, such as *Juniperus oxycedrus*, monitored in the case of *Minuartia valentina* and a high number of species of lesser concern (Generalitat Valenciana, 2022). For this parameter, the best records appear in plots 4, 5 and 1 with 12.4, 12.2 and 12 points respectively, followed by plots 8, 9 and 6 with 11.6, 11.2 and 11 points respectively. At the bottom are plots 3 (with 9.8 points), 2 (10 points) and 7 with 10.8 points. The average shows a value of 11.22. Taking into account that the maximum value is 20 points but that records above 15 points are very rarely reached, these values are notable. Regarding the criterion of endemism, the cork oak forest of the Sierra de Espadán cannot be considered as such, but some of the taxa that comprise it can, as we have observed previously. The highest scores -always within discrete general assessments- are recorded by plots 1 and 2 with 4 points, followed by: 3, 4, 5, 6, 7 and 8 with 2 to record a single point in the last two. The average value is low, 2.2 points, but relatively high for the Iberian area. The degree of relictism, the cork oak forest as a group, should not be considered as such. There are also no relict species so the general score is 0 points. The plots evaluated do not have a finicolous character. These are low values but similar to those of other groups analyzed within the Iberian Mediterranean region.

With all this, the sum of values constituting the territorial value is discrete, with plots 1, 4, 5 and 2 standing out with 16, 14.4, 14.2 and 14 points respectively. At the bottom would be plot 3 with 11.8 points, 9 and 10 with 12.2 and 7 with 12.8.

The records obtained within the criteria of ecological or mesological roots are higher. The most important of them are geomorphological, for which all the plots have sufficient coverage and development to constitute a guarantee of a biostatic situation that prevents the existence of dragging and erosion down the slope of a regolith that, on the other hand, it appears little evolved and associated with important colluvium and a certainly high degree of slope. Hence, in half of the locations, the maximum score is obtained and in the other half 18 points, which is a single score step below. Closely associated with the geomorphological criterion appears the edaphic criterion, which is calibrated not only by the capacity to conserve the soil, but also to develop it and mineralize significant amounts of organic matter. In this case, all of the plots studied obtain the same score (8), which corresponds to a tree-like vegetation with an average retention or recyclability rate of organic matter. Regarding the climatic function, the fact that they are relatively open masses, but, at the same time, with good tree and shrub cover guarantees special microclimatic conditions; Hence, the most closed ones (4 and 5) receive the maximum score, while the most open ones (1, 2 and 3) receive 8.5 points and the rest 9. All in all, the average value is 9.05 points. The hydrological function is also notable in all the plots because, once again, their tree and shrub cover and their degree of development mean that precipitation is buffered and circulates, both through the plant mass and through the regolith itself, gradually. Thus, plots 4 and 5 receive the maximum score, 1, 2 and 3 8.5 points and the rest 8. The average value is 8.55 points, relatively high. Regarding the faunal function, the cork oak forest of the Sierra de Espadán receives 9 points for plots 4 and 5 and 8 for the rest, with the average value being 8.2. It should be noted that the cork oak forest has many frutescent plant species, diversity of vegetation strata (as it has various taxa in the 4 sampling strata) and interesting ecotones (riparian vegetation, resin pine forests, old crop fields and terraces, etc.), which is very important for different faunal groups (amphibians, lacertids, colubrids, insectivorous birds, rodents, mustelids, artiodactyls, among others).

The sum achieved by the different spots for this group of mesological criteria can be considered outstanding for plots 4 and 5 (57 points out of 60), also as outstanding under plots 1, 2 and 3 and notable for the rest. The average value is 51.8 points.

Structural interest is shaped, first of all, by the criterion of wealth by strata. Taking into account that the maximum potential is 10 points and that the best scores are recorded in plot 4 with 8.5 points, in plots 1, 5, 7 and 9 with 7.5 and the worst in plot 3 with 6 points, in 10 with 6.5 and 6 and 8 with 7, it is obvious that these are modest to high records; Indeed, these spots not only have a certain diversity of taxa, but also show great structural complexity, especially in the lower strata. This characteristic is reinforced in more open patches or plots with a diversity of strata due to lower tree cover. Closely related to the previous criterion, the coverage by strata also shows modest to high scores, which fluctuate between 8 points in plot 10 and 5 in plot 9. The average value is 6.45 points and is on the border of the notable. Regarding the criterion of richness in microenvironments, it should be noted that the records are quite important since, on average, there would be 5.2 elements. In this regard, the microenvironments of stone blocks are especially noteworthy, since most of the time these cork oak forests are arranged either on heterometric colluvia or directly on decimetric stone blocks. So are the dead or living trunks standing, the diversity of lichens and mosses and some other hypogean environment in the form of small rock shelters between the aforementioned stone blocks. The criterion of spot size and connectivity registers relatively high scores. All the plots have the same score since they are located within the same unit, relatively extensive (142.91 Ha) and with good connectivity, not only internal but external, since it is located next to other more natural formations. or less developed or well preserved (riparian vegetation, resin pine forests, holm oaks, etc. (Roselló, 1994 and La Roca and Hurtado, 2011). All in all, the score is 18.5 points.

The sum of the structural criteria offers modest to high values. The maximum score is obtained by plots 1, 2, 4 and 5 with 39 points, followed by 3 with 37.5 and 8 and 10 with 37 points. The lowest are recorded in plots 9 with 35 points and 6 and 7 with 35.5. To a large extent, this group of values is influenced by the last criterion, although the rest show significant records.

The sum of the phytocenotic, territorial, ecological and structural values makes up the natural value, which for the valued plots has the following hierarchy: 4 with 153.9 points; 5 with 153.7; 1 with 150; 2 with 145; and 3 with 141. At the bottom would be 9 with 136.7 points, 10 with 137.7, 7 with 137.8 and 6 with 138.

Regarding the values and criteria of cultural roots, in the first group appear those related to heritage value or interest and, within them, three criteria of great relevance. The first of them is the ethnobotanical, which presents the highest values in all plots. Not in vain, as has already been referenced, we are faced with an example of forest management and exploitation that is perfectly sustainable from an environmental but also, an economic point of view.

This tradition also goes back more than 100 years. You can also see great interest on the part of the population, especially the local population, in valuing these spots very positively, since they provided and still provide very interesting resources such as cork, wood, aromatic and food plants, as well as other ecosystem services. such as mushroom picking, walking, contemplation, aesthetic value, etc. The first 5 plots with maximum values for these two criteria (ethnobotanical and perceptual) and the other 5 with one point less stand out. The same occurs with the didactic value, obtained through interviews with qualified agents (teachers of various educational levels). In this case, the score is the maximum (10) for the first 5 locations and 7 points for the last 5.

All in all, the heritage value reaches the highest scores (40) in the first 5 plots and 32 in the rest, with the average value being 36 points and, therefore, a high score.

The first of the criteria related to the structural cultural aspect is that of physiognomic value, which shows a certain homogeneity in all the stains concerned. In this case, there are only 5 possibilities: high forest, low forest, pollards or headings, exploitation of cork and bark and bleeding. The cork oak, logically, has been used for its bark to obtain cork, even more so when, as is the case, this exploitation is documented and continues to be perpetuated today. Furthermore,

this same taxon, but especially the oak, has good wood, for planking and as quality material, only in two plots, in addition to the high forest and the cork tillage, have we been able to locate old pollarded posts, probably for obtaining of charcoal. In all cases, on average, two different dasotipologies appear; The exception is plots 4 and 5 where the tall forest, cork extraction work and some isolated pollarded trunks are maintained. The third is the structural cultural value, which in these locations contains ethnographic elements of certain relevance, such as platforms for obtaining charcoal, terraces, dry stone walls and/or traditional locks or stakes. In all plots, 4 of these ethnographic elements were located, while in plots 1 and 2 only 3 appeared.

The overall sum of the structural cultural interest fluctuates between 14 points for plots 4 and 5 and 10 for plots 1 and 2. Taking into account that the interest can range between 2 and 26 points, it is clear that it is relatively high values.

The final cultural value fluctuates between 54 points for plots 4 and 5 and 44 for plots 6 to 10. These are quite notable records considering that the maximum potential would be 66 points. It is clear that, while the structural cultural interest is not excessively great, the heritage interest is, on the other hand, outstanding, so that the former slightly weighs down the latter.

Adding the natural and cultural interest we obtain the Conservation Interest (which configures a finalist value per se that can have the same importance, if not more, than that of Conservation Priority), which shows quite notable records in all cases. Logically, there are important differences between the outstanding 207.9 points of plot 4 and the notable 180.7 of plot 9.

To properly calibrate the Conservation Priority, the threats that hang over each of the evaluated spots must be taken into account. The first of them is linked to the human population density, which, fortunately, is very low (1 point) in the 10 locations (less than 50 inhabitants per square kilometer). The second is with the degree of accessibility/walkability, which in all plots is medium to low, especially in plots 4 and 5, the rest show 4 points for this parameter. Alternative threats are low since, in most cases, there is a certain probability of fires; Only some activities, such as hiking, can leave, as has been confirmed, a certain amount of waste and generate some small impacts. The records fluctuate between 6 points in the last 5 plots and 5 in the rest.

All of this makes the Conservation Priority relatively low. Only in 3 cases is the 2,000 points barrier exceeded: plots 8 (2025 points); 6 (2002) and 7 (2000), 10 is left with 1999 points. In any case, as the Conservation Priority level is considered high above 1,500 points, the rest of the plots would also fall into the upper section.

Next, and so that the figures of each of the values and interests can be relativized even further about the 230 plant groupings studied on a global scale, we add table 5.

As can be seen, in almost all groups of criteria or interests the synthetic values are located in the third or fourth quartile, which implies high valuations. However, while for the phytocenotic interest the values are high, for the territorial interest they are not so high. For the ecological

Criteria / Interest Groups	P 25	P 50	P 75	P 100	Synthesis
INFIT	28	39	42.223	48.5	40.7
INTER	2.15	6.1	12.578	28.89	14.22
INMES	37.8	46	51.378	60	51.8
INEST	15.25	19	23.93	92.88	37.35
INNAT	87.25	112.15	130.1	186	144.07
INPAT	18.9	25	30	40	36
INCULEST	4	5.65	8	17.16	12
INCUL	24	30.25	36.23	54	48
INCON	111.85	142.4	163.65	228.08	192.07
AM	8	12	15.275	26	10.3
PRICON	1,129	1,602	2,103	4,288	1,970.5

Table 5. Biogeographic assessments by criteria and interests of the synthetic values analyzed and following the LANBIOEVA methodology. Source: Own elaboration based on Lozano-Valencia *et al.* (2021).

or mesological value, they are again very high (within the fourth quartile). Regarding structural value, the scores obtained are high and would once again be in the fourth quartile. However, if we take into account the record value of the last quartile (92.9), in this case, all the plots show low scores, although within this last quartile and, therefore, within the highest scores obtained to date. The sum of these values gives rise to natural interest, which again registers scores that, within the synthetic or average value, are located within the fourth quartile and, therefore, with high figures compared to the rest of the records obtained on a global scale. Regarding cultural values, the first, heritage, does not differ from the scores obtained within the natural criteria and marks scores located in the fourth quartile of highest records and also in a medium to high position. Especially notable is the case of the first 5 plots that show the maximum of the fourth quartile and, therefore, show the maximum value obtained to date for the other more than 200 formations. Structural cultural interest, however, registers more modest scores, although all within the fourth quartile. However, the synthetic or average value of cultural interest falls into the fourth quartile, that is, in the 25% of cases where the scores have been the highest and with scores, furthermore, closer to the upper limit than the lower limit. All of this once again indicates to us the high cultural values that the cork oak forest of the Sierra de Espadán possesses.

Conservation interest shows very good values for three plots that exceed or are in 200 points (1, 4 and 5). The rest range between 195 points in plot 2 and 181.7 in plot 9. In any case, these are values located in the fourth quartile, but within the average positions of the same.

Focusing on the issue of threats, the scores recorded are low, so all the plots would be located in the second quartile or, in other words, below 50% of the groupings. or less pressured plant landscapes to date (Lozano-Valencia *et al.*, 2021). In any case, just because the threat level is low does not mean that measures for correct management and conservation do not have to be considered. These low levels of threat give rise to a conservation priority that, in all the plots and also for the average values, are ranking within the third quartile, always in the highest values of the same helped by the magnificent values of the INCON but fortunately weighed down by low threat ratings. However, we reiterate that we are faced with a scarce, rare type of forest, with very abundant resources and heritage values that must be protected in a relatively active way, that is, maintaining the rational, sustainable and systematic exploitation activities that make that its state is the one we have described.

## CONCLUSIONS

Regarding the objective set for this work, an intense and exhaustive inventory exercise has been carried out and, after that, the characterization and evaluation of the plots studied, so that we can conclude that the goal has been met.

Once again it is demonstrated that the LANBIOEVA methodology is a powerful and effective tool for the inventory, characterization, analysis, diagnosis and assessment of plant landscapes. Furthermore, with this training the number of groups studied on a global scale increases.

Regarding the biogeographic composition, there is a great diversity of taxa that, however, are greater in the shrub and herbaceous strata, especially within bushes and climbers. Those species that are indifferent to the soil pH or acidophilous are dominant.

Interesting are the examples of endemic species (up to 6 taxa) (*Helianthemum origanifolium* subsp. *molle*, *Silene mellifera*, *Guillonea scabra*, *Viola willkommii*, *Centaurea pauri* and *Minuartia valentina* and those rare or vulnerable (2 taxa) (*Juniperus oxycedrus* and *M. valentina*). This again reiterates the importance of courtships inventoried in the 10 plots.

Regarding the biogeographic assessment, in almost all groups of criteria or interests, the 10 inventories and the synthetic one are located in the third or fourth quartile of all the plant groupings valued to date on a global scale, which represents high assessments. It is necessary to highlight very high evaluations in criteria such as diversity, naturalness, all mesological, heritage and, in general, conservation interest. This makes the active conservation of the cork oak forest of the Sierra de Espadán recommended. Its management model is sustainable and guarantees, to this day, the values mentioned above.

For its part, the threats are not especially great so the conservation priority is not substantially urgent. This not-too-high level of threat may also be given by the fact that it is a forest with clear economic exploitation, which does not prevent it from guaranteeing certainly remarkable natural and cultural values.

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# Urban river spaces are areas of special interest for the conservation of biodiversity

## A CASE STUDY IN MADRID (SPAIN)

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## ABSTRACT

This study analyses the importance, values and functions of urban river spaces in relation to the conservation and recovery of biodiversity, taking the case of the Manzanares River as it passes through the city of Madrid as an example. This river is considered to be an area of special interest as it constitutes part of the third largest metropolitan area in Europe and the second largest in the European Union. The Manzanares River is also a relevant case study as it was the subject of a recent “low-cost” re-naturalisation project, carried out between 2016 and 2019, with quite impressive results. This intervention, the most important of its kind undertaken in Spain, intensely transformed this urban river terrain, generating a semi-natural space of great ecological and landscape value on a local and regional scale. In this study, we also briefly examine the existing regulatory support for such interventions in urban fluvial areas, both in the European Union and in Spain.

## 1. INTRODUCTION

The expansion of urbanised territories has been accompanied by an increase in the integration of rivers and streams into the urban fabric (Shaw *et al.*, 2021), especially in more dynamic areas where economic and demographic growth has been more intense. These changes lead to the creation of river landscapes of a hybrid or semi-natural character, reflected in the intense biotic and abiotic alterations experienced by the river courses when they become a part of more urban locations (Francis, 2014; Gurnell, Lee, Souch, 2007). In many cases, far from losing their eco-landscape value, river spaces situated within

the confines of cities and metropolitan areas have become enclaves of special interest for the conservation of biodiversity (Everard and Moggridge, 2012). This fact is especially noteworthy when rivers are located in artificial areas with high-density occupation and significant fragmentation (Molina *et al.*, 2021; Naiman, Decamps and Pollock, 1993), as evident in the city of Madrid and its surrounding metropolitan area. Indeed, if we consider Spain alone, the extension of artificial areas increased by 29.5% during the period 1987-2000 (OSE, 2006) and it has been proposed that during the 21st century peri-urban areas are likely to become the most frequent urban scenario (Ravetz *et al.*, 2012). Therefore, it is foreseeable that land occupation will increase very rapidly and with it, more natural remnants like water bodies and watercourses will be incorporated into these new and more diffuse cities.

## 2. URBAN RIVERS, CONNECTIVITY AND BIODIVERSITY

One of the most relevant aspects of rivers that traverse urbanised areas is their function as environmental connectors. In many cases they represent the only real possibility to permeabilise intensely artificial and fragmented territories. Indeed, the compartmentalisation of territories, and the disconnection of habitats and landscapes, is one of the main problems faced when attempting to conserve biodiversity (Fielder and Kareiva, 1998; McCullough, 1996; Pickett *et al.*, 1997), especially in the current context of climate crisis. Urban rivers are often associated with areas that are maintained as green spaces. These rivers usually retain a stable flow and they are often disengaged from local climatic conditions. Conversely, extra-urban watercourses and natural or semi-natural wetlands suffer the effects of the climate crisis much more intensely (Molina, Allende *et al.*, 2023), consequences that are exacerbated by the increase in demand for consumptive uses, such as agriculture or industry. This situation seems to be more worrying in Mediterranean rivers, where evidence and models indicate clear reductions in flow (Nohara *et al.*, 2005; Garcia-Ruiz *et al.*, 2011). However, there is now more pressure on urban watercourses due to the increase in the effluent they must manage due to the shift and concentration of the population in cities. Although, this pressure seems to ensure that circulating flow is maintained in these rivers, in the mid-term at least (Figure 1).



Figure 1. (a) Discharge from the La Gavia wastewater treatment plant in Madrid (14/07/2023, 30TVK4366), designed to serve a population equivalent of 950,400 inhabitants, it constitutes one of the main inflows of the Manzanares downstream of the city. (b) However, the La Gavia stream (20/04/2023, 30TVK4366) remains dry for most of the year.

In many cases, urban watercourses provide the only real possibility to permeabilise what have become intensely artificial areas, such as large cities and their metropolitan surroundings, dominated by industrial estates and infrastructures. These peripheral areas, of great value and fragility, were identified as the “third landscape” (Clement, 2018): an urban-rural

interface that combines an expansive and changing urban hinterland, with residual natural spaces of high value in terms of their ecological and landscape diversity, the evolution -and disappearance- thereof usually being linked to local planning and development (Molina, Jendrzyczkowski *et al.*, 2023).

The role of cities in providing ecosystem services and in conserving biodiversity is increasing as urban areas develop (Bedla and Halecki, 2021), particularly given their continued and sustained expansion (Fernández-Juricic and Jokimäki, 2001). In Spain, there is currently strong growth of medium-sized cities (50,000-300,000 inhabitants), which is provoking the generation of extended and complex urban areas, which are more fragmented and less dense than traditional cities (Olazabal and Ballet, 2019). These new urban territories fit with what has become known as “suburbanised areas”, characterised by population deconcentration, with a lower population density and smaller plots for buildings (Berry, 1980).

The value of urban river spaces as environmental connectors is therefore becoming increasingly important. There is clear evidence of their role as ecological corridors, and of their intrinsic importance in maintaining the richness and diversity of their biological communities. The ease with which they can be recovered or improved, and the rising social awareness of their importance, has driven their consideration as areas for preferential treatment in public policies for urban planning, landscape recovery and the conservation of biological diversity (Molina, Jendrzyczkowski and Berrocal, 2021). For all these reasons, urban rivers are key spaces to preserve biodiversity. Accordingly, their conservation and recovery relies on the implementation of specific interventions and management models that take into account their value and functions, both at local and regional levels.

### 3. A REGULATORY CONTEXT FAVOURABLE TO THE RECOVERY OF URBAN RIVER AREAS

Policies that promote the construction of green infrastructures in Europe pay particular attention to urban river spaces. The European Commission's report *“Green Infrastructure: Enhancing Europe's Natural Capital”* highlights the value of green infrastructures in urban environments, pointing out the importance of managing the risks to these spaces. In addition, the Commission's report *“Promoting the use of green infrastructure in all EU policies”* set out considerations to help restore natural environments and enhance biodiversity.

These observations highlight the value of this network in *“reducing ecosystem fragmentation, improving connectivity between Natura 2000 sites and thereby achieving the objectives of Article 10 of the Habitats Directive”*. This latter proposal is directly linked to the *“EU Biodiversity Strategy for 2030”*, which sets out among its objectives to incorporate ecological corridors into *“a genuine Trans-European Network of Natural Spaces”*. It is also important to consider the European Green Pact, of which one strategic axis focuses on the recovery of biodiversity.

In Spain, Article 20 of *Law 42/2007 on the Conservation of Natural Heritage and Biodiversity, “Ecological Corridors and Mountain Areas”*, states that *“Public Administrations shall contemplate mechanisms to achieve the ecological connectivity of the territory in their environmental planning or in their Natural Resources Management Plans, establishing or restoring corridors, in particular between areas protected as part of the Natura 2000 Network and among those natural spaces of singular relevance for biodiversity. To this end, priority will be given to river courses (...) irrespective of whether they have the status of protected natural spaces (...)”*.

This legal mandate was further reinforced by the National Strategy for *Green Infrastructures, and of Connectivity and Restoration*, which was approved in 2021 and was based on an earlier scientific-technical document (Valladares and Forner, 2017). Section 4.1.3 of the

aforementioned strategy is related to "*Connectivity in the national territory*" and it indicates that different public administrations must adopt measures that favour ecological connectivity within the framework of their activities. In this respect, "river courses and riverside vegetation" are considered to be core elements of connectivity networks, at the same time serving as ecological corridors.

These considerations are captured within the Spanish Urban Agenda (Ministry of Development, 2019), which is in line with the European Union's Urban Agenda, the 2030 Agenda and the United Nations' New Urban Agenda. Strategic goal 1 of this Urban Agenda is of particular interest, proposing the organisation of territories and the rational use of land, with a view to its conservation and protection, which is contemplated through three specific objectives: 1.1. to organise the terrain such that it remains compatible with its environment; 1.2. to conserve and enhance natural and cultural heritage, and to protect the landscape; 1.3. to improve the green and blue infrastructures, and retain their link to their natural context.

In general terms, this objective considers that land-use and urban planning "*should protect, conserve and enhance natural and cultural heritage, and the landscape, while promoting the existence of green urban infrastructures that retain their natural context to the extent that is possible*". In the case of the objective 1.2, some lines of action are particularly noteworthy, such as those proposing "*to adopt measures for the conservation, enhancement and protection of nature and natural heritage, including the flora, fauna, landscape and existing ecosystems*". Similarly, and in relation to objective 1.3, three noteworthy lines of action have been proposed. Of particular interest are the references to the need to incorporate the concept of green urban infrastructures into urban planning and management, and the importance of creating networks of green and blue infrastructures, taking into account criteria of ecological connectivity.

There is also a recent *National Strategy for River Restoration 2023-2030*, approved in July 2023 by Resolution of the Secretary of State for the Environment. This updated strategy builds on the previous plan initiated in 2006 and like its predecessor, it is largely in line with the principles and objectives of the Water Framework Directive (*Directive 2000/60/EC of the European Parliament and Council, 23rd October 2000, establishing a framework for Community action in the field of water policy*). The strategic line of action 3 of the current river restoration strategy (*Development of specific actions*) is related to those activities defined in other State instruments that are related to biodiversity and green infrastructures. In particular, it foresees the development of restoration initiatives, given that in a context of global change "*river corridors are connecting elements that vertebrate the territory, providing a large number and variety of ecosystem services to modern society*".

Although urban watercourses have not been considered preferential areas for these river restoration strategies, some interesting initiatives have been carried out in metropolitan areas. This has mainly been the case in areas that have more intensely retained their natural features, and that cannot strictly speaking be considered urban or peri-urban areas. In this regard, it is worth highlighting the project that was set-up in 2018 for the *Fluvial Restoration of the Manzanares River in Madrid (Spain), extending from the Trofa stream to the San Fernando bridge* in the vicinity of "El Monte de El Pardo", one of the areas of greatest environmental and landscape value in the central Iberian peninsula. This programme was structured in two phases, consistent with the two territorial areas of intervention identified in the project: the first phase centred on the stretch from the "El Pardo" reservoir to the mouth of the Trofas stream; while the stretch that extended from this latter point to the San Fernando bridge was contemplated in the second phase. The basic aim of this intervention, as indicated in the background to the project, was to "*adapt the Manzanares river to climate change, improving its longitudinal and transversal connectivity, and habitat diversity*". (<https://restauracionfluvialriomanzanares.es/>).

It is possible that the initiatives in the newly established strategy, unlike its predecessor, will pay more attention to urban and metropolitan rivers, more numerous due to the apparently unstoppable expansion of cities.

## 4. THE MANZANARES RIVER IN THE CITY OF MADRID

### 4.1. STUDY AREA

The study focused on a 13.58 km stretch of the Manzanares River situated in the city of Madrid (Spain), a stretch that represents 47.3% of the municipal river sector. It is located in the urban centre and its southern sector lies in the first metropolitan fringe (Figure 2), between the Puente de los Franceses (579 m, -3.73600/40.434301, 30TVK3776) and the surroundings of the municipality of Getafe (553 m, -3.663948/40.342528, 30TVK4365: EPSG - 4326). This area of the river is the most anthropised in Madrid, passing through the entire central area of the city and 67% of its first urban fringe.

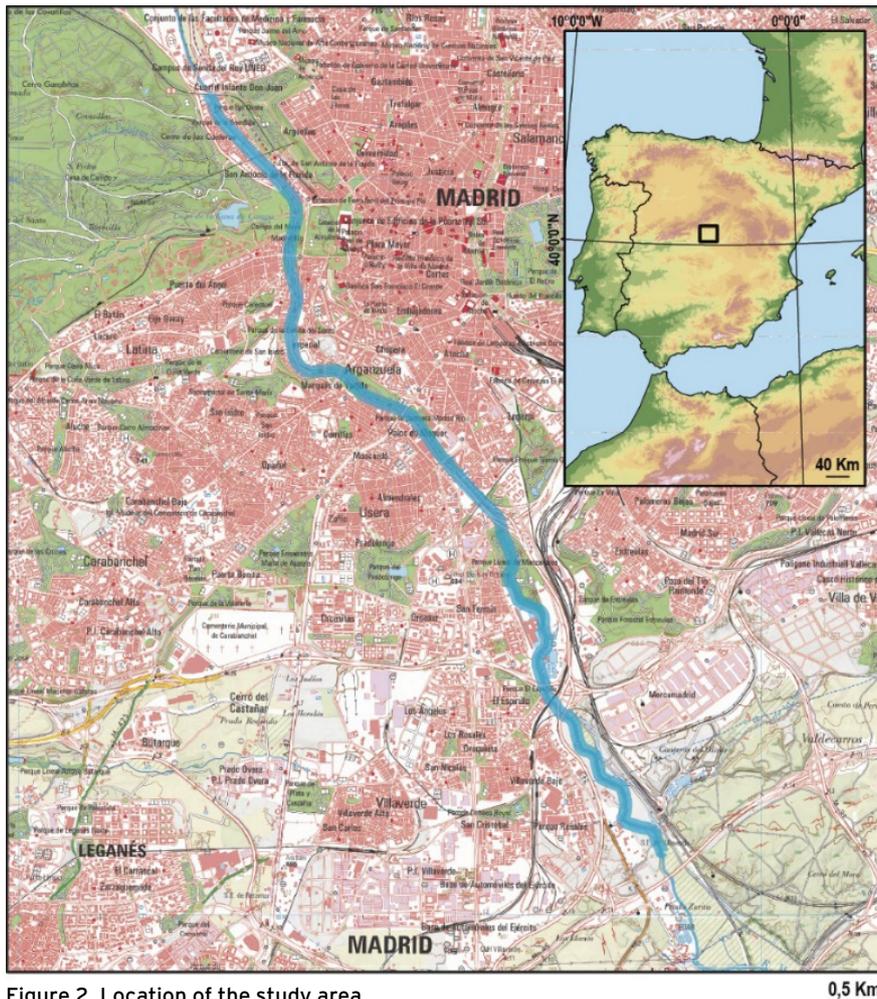


Figure 2. Location of the study area.

Source: Spain MDE USGS Shuttle Radar Topography, 2004.  
National Topographic Map IGN 1:25,000.

To study the flora, 19 sections (T1 to T19) were distinguished, matching the 19 UTM 1 km<sup>2</sup> grid squares in which the study area is located. For other analyses, the stretch of river analysed was divided into four sectors corresponding to different urban and peripheral divisions (Figure 3): Madrid Río (6.94 km), Madrid Río 2 (0.93 km), Parque Lineal 1 (2.52 km), Parque Lineal 2 (3.12 km). The most extensive sector is Madrid Río, occupying a central urban position and running through some of the city centre's historic neighbourhoods.

The data analysed here was obtained through fieldwork that commenced in December 2019 and that was then stopped until December 2020 due to the SARS-CoV-2 pandemic, and continued thereafter. Up to January 2024, 910 hours of fieldwork had been undertaken.



Figure 3. The urban section of the Manzanares River in Madrid.  
 a) Upstream of dam no. 7, the former “Vicente Calderón” stadium (28/08/2022, 30TVK3872).  
 b) Area surrounding Legazpi-Matadero (03/08/2023, 30TVK4071).  
 c) Parque Lineal 1 downstream of dam no. 10 (21/11/2021, 39TVK4170).  
 d) Parque Lineal 2, the area around the M40 motorway (25/11/2022, 30TVK4267).

## 4.2 A VALUABLE ENVIRONMENTAL CORRIDOR LOCATED IN EUROPE’S THIRD LARGEST METROPOLITAN AREA

In Spain, the Manzanares River in the city of Madrid is perhaps the most representative example of an artificialised urban river, not least due to the canalisation of most of its course, and to the expansion of the urban and metropolitan area through which it flows. As indicated previously (Molina *et al.* 2023), Madrid is now the third largest metropolitan area in Europe and the second largest in the European Union (NUTS ES300; Eurostat, 2023), and it is estimated that its population will increase significantly by 2050, perhaps reaching more than 150% its size in 2022 (Eurostat, 2022). Consequently, there has been a substantial extension of built-up areas and an increasing artificialisation of the city’s periphery is expected.

Despite this, the Manzanares River plays an important role as an ecological corridor, and it has significant intrinsic value due to its eco-landscape richness and diversity, and its central position among important Natura 2000 areas (Molina *et al.*, op. cit.). It should also be noted that this river course has achieved this position quite recently, particularly through the activities carried out between 2016 and 2018 as part of a re-naturalisation project promoted by the non-governmental organisation “Ecologistas en Acción”, and adopted by the Madrid City Council (Martín Barajas, 2016).

The first stage of this project involved opening the floodgates of the 7 dams that had been interrupting the flow of the river since 1946. In this way, the Manzanares River could partially recover its hydrogeomorphological dynamics, rapidly depositing phytostabilised sediments in a natural manner and allowing the transport of propagules downstream. This action, which was carried out at zero cost, was essential for the recovery of the river, and it was accompanied by other minor interventions related to morphological restoration and revegetation (Parrilla *et al.*, 2021).

### 4.3. THE VALUE OF THE FLORA IN URBAN RIVER AREAS

The flora of the Manzanares urban riverbank is composed of 591 taxa (Molina *et al.*, 2023, 2024), which represents 36.7% of the flora in the city of Madrid (1603 taxa: Bot. Mat., 2023) lying in 0.17% of its territory. Likewise, this figure corresponds to 22.3% of the regional flora in the Region of Madrid (2649 taxa: Grijalbo, 2023a), occupying 0.009% of its territory, and 6.63% of the species that constitute the totality of the Iberian flora. Most of these taxa have colonised the river space following the initiation of the river's renaturation project in 2016, highlighting the tremendous capacity for regeneration of this river space, its value on a regional level and its importance for connectivity. Moreover, these figures also reflect the rivers' strong diversity and dynamism, as indicated previously (Grijalbo, 2023b). Of all the taxa recorded, 197 are of special interest due to their unfavourable conservation status or their rarity at the regional and local level. Of these, 13 are species identified for the first time in the Region of Madrid, 28 are new records in the urban sector, 7 are taxa without references in the urban environment since the 19th century, 2 are species considered extinct in Madrid and 22 are elements included on the Madrid city's Urban Flora Red List (Bot. Mat., op. cit.).

The mean value of the floristic richness in each of the 19 sections of the study area was 213.52 taxa (s.d. 69.04), with no significant differences in the distribution of the richness/UTM 1 km<sup>2</sup> among these sections ( $t=0.0332$ ,  $p>0.05$ ,  $n=19$ ). Paradoxically, the richest section, with 338 taxa, was located within the urban area, around the Matadero-Legazpi area (T09, 30TVK4071, 1.32 km). The river is canalized throughout this section, although it has a large number of islands and sandy/silt-sand margins. The next richest sections, T15 (30TVK4268, 0.99 km) and T16 (30TVK4267, 1.31 km), are situated in periurban areas, Parque Lineal 2 with 278 taxa and Villaverde Bajo with 291 taxa. Indeed, it is precisely the fluvial Parque Lineal 2 sector that registers the highest mean value of taxa/UTM km<sup>2</sup> of 239 taxa (s.d. 73.3), followed by Madrid Río with 215.44 (s.d. 64.53).

Within the elements of special interest, it is worth mentioning the presence of 2 new native taxa in the regional flora: the geranaceae *Erodium chium* (L.) Willd and the brassicaceae *Sisymbrium erysimoides* Desf. A large number of taxa that have not been recorded in the city of Madrid since the 19th century were also detected in the river, including *Lepidium graminifolium* L., *Lotus pedunculatus* Cav., *Lysimachia vulgaris* L., *Persicaria amphibia* (L.) Delarbre, *Pteridium aquilinum* (L.) Kuhn, *Rubia peregrina* L., *Silene inaperta* L. subsp. *inaperta* (Figure 4).

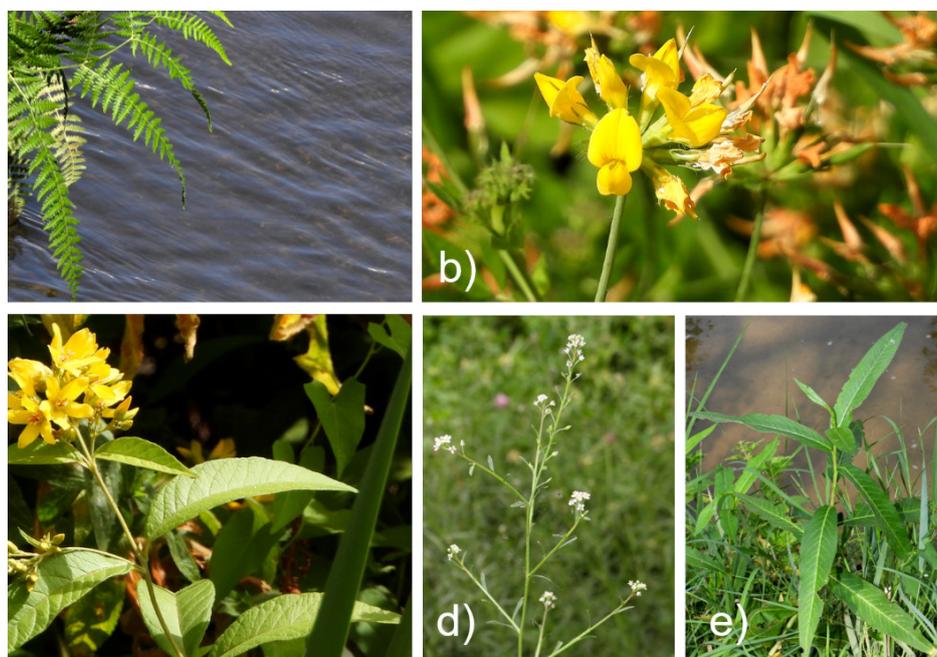


Figure 4. Flora of special interest, not recorded in the city of Madrid since the 19<sup>th</sup> century.

- a) *Pteridium aquilinum* (Madrid Río, 21/04/2023, 30TVK3972).
- b) *Lotus pedunculatus* (in the area around Puente de Segovia, 14/06/2022, 30TVK3873).
- c) *Lysimachia vulgaris* (in the area around Puente del Rey, 07/07/2023, 30TVK3874).
- d) *Lepidium graminifolium* (Madrid Río, 21/06/2023, 30TVK3875).
- e) *Persicaria amphibia* (Parque Lineal 2, 28/06/2023, 30TVK4267).

#### 4.4. CHARACTERISTICS AND VALUE OF THE WATERFOWL, FOREST-MARSH AND URBAN BIRD COMMUNITIES

Between December 2019 and January 2024, 146 bird species were recorded in the urban section of the Manzanares River analysed: 104 forest-marsh and urban birds, 42 waterfowl. This is a relatively high number considering that the Spanish avifauna, including rare examples, includes a total of 639 species (Rouco *et al.*, 2022). In addition to common birds, rare or very rare species were also evident in the urban environments, such as the little bittern (*Ixobrychus minutus*), squacco heron (*Ardeola ralloides*), purple heron (*Ardea purpurea*), goshawk (*Accipiter gentilis*), Eurasian sparrowhawk (*Accipiter nisus*), jack snipe (*Lymnocyptes minimus*), lesser spotted woodpecker (*Dryobates minor*), wryneck (*Jynx torquilla*), bluethroat (*Luscinia svecica*), sedge warbler (*Acrocephalus schoenobaenus*) and Eurasian Golden Oriole (*Oriolus oriolus*). The presence of other species was also noteworthy, such as the endangered kingfisher (*Alcedo atthis*) and Western jackdaw (*Coloeus moneduda*), and the vulnerable barn swallow (*Hirundo rustica*; Molina and Allende, 2024), threatened species according to the criteria of the Red Book of the Birds of Spain (López, 2021).

Overall, the urban bank of the Manzanares River is an area of special importance for the passage of trans-Saharan migratory birds and Mediterranean wintering birds, mainly chiffchaffs (*Phylloscopus collybita*, *P. trochillus*), pied flycatchers (*Ficedula hypoleuca*) and robins (*Erithacus rubecula*). The densities of the common chiffchaff were very high, with maximum records during their autumn passage in November when the peak of Mediterranean wintering birds that arrive in the centre of the Iberian Peninsula was recorded: 53.17 and 76.98 birds/ha in Parque Lineal on 09/11/2023 and 18/11/2023, respectively. These values were clearly higher than the maximum densities (more than 60 birds/km<sup>2</sup>) recorded in mosaic agricultural landscapes that include crops, meadows, pastures, hedgerows, boundaries and scattered copses (Onrrubia, 2021).

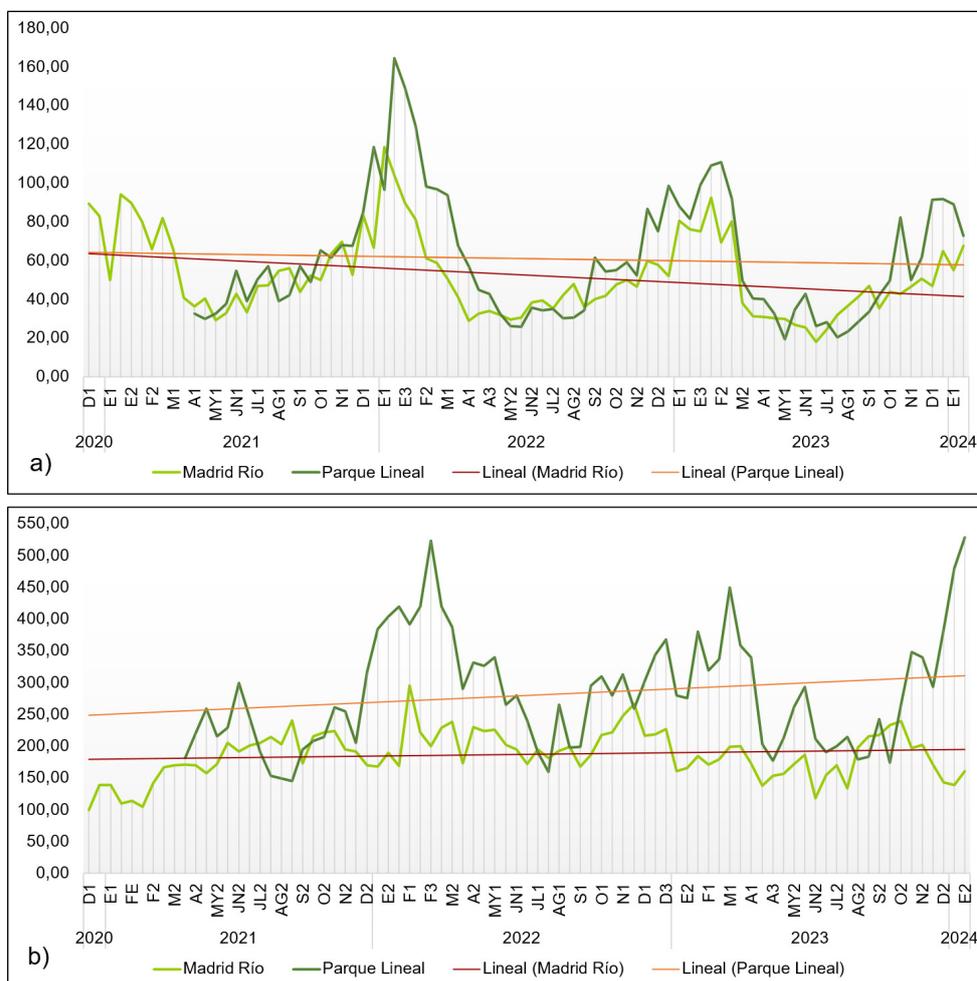


Figure 5. Evolution of the density of waterfowl (birds/km) (a), and of forest-marsh and urban birds (birds/10 ha: b).

There were no significant differences in the density of the waterfowl communities between Madrid Río and Parque Lineal ( $w=3444.5$ ,  $p=0.240$ ). Furthermore, when each species was analysed separately a strong specific correlation of these values was seen ( $r_s=0.927$ ,  $p<0.005$ ,  $n=37$ : Figure 5). In both cases, there was a decrease in the population trend over the duration of the study, which was largely due to the decline in the wintering population of gulls and of mallards (*Anas platyrhynchos*), a common anatidae the populations of which have been on the decline in Europe for decades (Dalby et al, 2013). The reduction in wintering populations of the most common gulls (*Chroicocephalus ridibundus*, *Larus fuscus*) is related to changes in the river landscape, mainly the reduction of unvegetated banks and islands due to their phytostabilisation. Overall, both species represent 80.15% of the sightings in the Parque Lineal and 58.18% in Madrid Río.

During the study period, the density of the forest-marsh bird communities increased slightly in Madrid Río and more significantly in Parque Lineal (Figure 5). As for the waterfowl, there were no significant differences in this populations between the two areas ( $p>0.05$ ), although the correlation in the composition of the communities was not as strong as that observed for waterfowl ( $r_s=0.4568$ ,  $p<0.005$ ,  $n=37$ ).

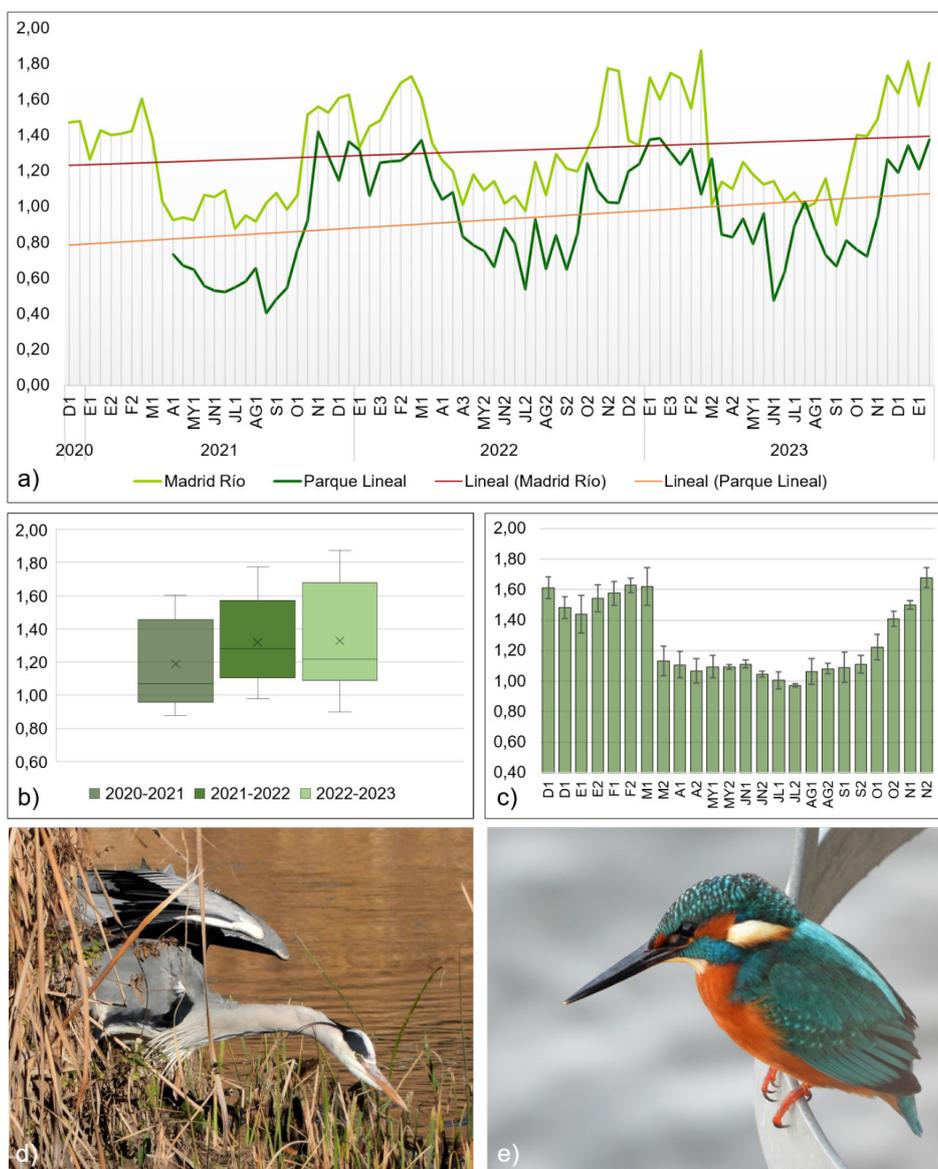


Figure 6. Evolution of diversity (*nats*). Waterfowl. a) Biweekly evolution in Madrid Río and Parque Lineal. b) Annual mean values in Madrid Río. c) Variation of the biweekly mean values in Madrid Río. Below, two water birds typical of the urban banks of the Manzanares: (d) Grey heron (*Ardea cinerea*: Dam No. 5, 30TVK3874, 20/02/2022), (e) Kingfisher (*Alcedo atthis*: Puente del Rey, 30TVK3874, 27/11/2022).

The urban nature of Madrid Río is witnessed by the dominance of two elements typical of these environments: the House Sparrow (*Passer domesticus*, 15.11%) and the domestic pigeon (*Columba livia*, 21.46%). In Parque Lineal, where there is greater variation, the dominant elements were the wood pigeon (*Columba palumbus*, 14%), the tree sparrow (*Passer montanus*, 13.92%) and the magpie (*Pica pica*, 12.2%). It is worth noting that the peaks observed in the winter of 2023-2024 reached a mean value of 421.03 birds/10 ha in the four fortnights of December 2023 and January 2024.

The diversity of waterfowl communities was similar in the two areas analysed ( $p > 0.05$ ) and displayed a positive evolution (Figure 6a). In the case of Madrid Río, this increase was continuous (b). The peak values coincided with the wintering and spring migratory passage, and the minimum values with the breeding period.

Unlike waterfowl, the diversity of forest-marsh and urban bird communities did not evolve in a similar manner in the two larger areas analysed ( $w = 2487.5$ ,  $p < 0.0005$ ), with a clear increase in Madrid Río and a considerable decrease in Parque Lineal. In the former, the increase most likely

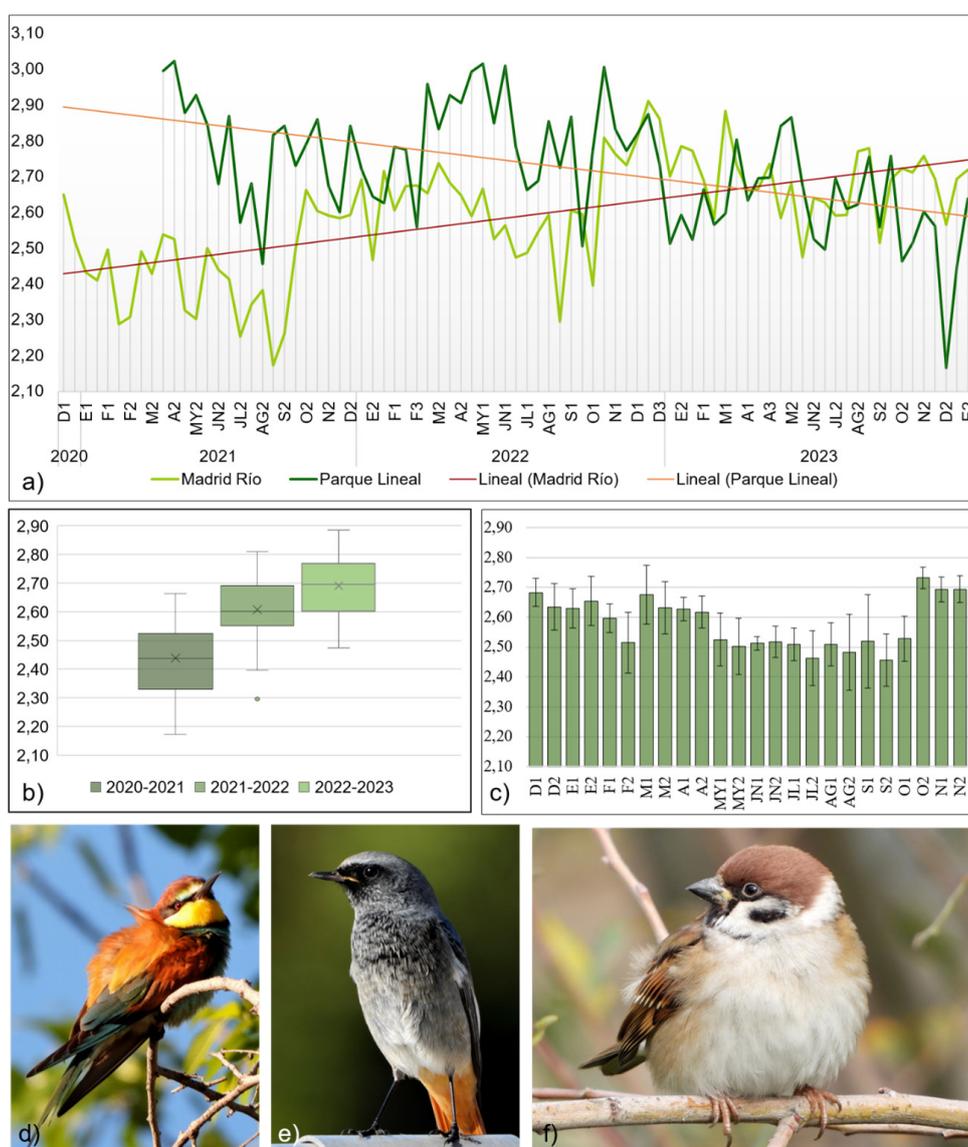


Figure 7. Evolution of diversity (*hats*). Communities of forest-marsh and urban birds.  
a) Biweekly evolution in Madrid Río and Parque Lineal.  
b) Mean values in Madrid Río.  
c) Variation of biweekly mean values in Madrid Río. In the bottom row, three birds common to the Manzanares riverbanks:  
d) European bee-eater (*Merops apiaster*: Parque Lineal, 30TVK4269, 24/04/2022).  
e) Black redstart (*Phoenicurus ochruros*: Parque Lineal, 30TVK4170, 01/11/2022),  
f) Tree sparrow (*Passer montanus*. Puente de los Franceses, 30TVK3874, 03/12/2023).

reflects the gradual increase in the complexity of the riparian vegetation and the micro-landscape diversity of the *bankfull* channel. In the latter, it could probably be attributed to the structural simplification of the riparian vegetation caused by the maintenance work carried out in that area.

As indicated elsewhere (Molina and Allende, 2024), maintaining the ruderal flora of the riverbank, along with the conservation of the mass of marsh and shrub vegetation (mainly *Rubus ulmifolius*), has a positive influence on the richness and density of the bird communities. Some of the plants frequently found on the banks of the Manzanares river are of special interest due to the large quantity of seeds they produce, such as *Carduus bourgeanus* Boiss. & Reut., *Carduus pycnocephalus* L., *Carduus tenuiflorus* Curtis, *Centaurea bofilliana* Sennen ex Devesa & E. López, *Chenopodium album* L., *Coryza canadensis* (L.) Cronquist, *Lactuca serriola* L., *Senecio vulgaris* L., *Silybum marianum* (L.) Gaertn. or *Urtica urens* L. The value of these common species of vegetation, typical of ruderal and weed pastures, is remarkable. Their seeds help maintain the population of wintering and breeding fringillids, as well as of many other species like the House Sparrow (*Passer montanus*), a dominant element in Parque Lineal. Moreover, the conservation of *Rubus* masses, systematically eliminated in this area, are of great interest due to their importance as a nesting substrate and a source of fruit, particularly relevant during the autumn passage of a good number of trans-Saharan migrant birds and the arrival of Mediterranean wintering birds. As in the rest of the temperate zone, the bramble and other fruit species are an important food resource for numerous bird species that behave seasonally as fruit-eaters, which are therefore involved in the reproductive biology of these species as they disperse their seeds (Gutián *et al.*, 2000).

## 5. CONCLUSIONS

Urban rivers are areas of particular interest for biodiversity conservation, especially when they are located in large urban and metropolitan areas with extensive built-up areas, fragmented by the creation of infrastructures and close to areas of high environmental value. In many cases, they represent the only real possibility to permeabilise cities, and thereby improve connectivity on a local and regional level.

The territorial relevance of these environments, already remarkable in the current situation, will increase in the short-term due to the continued and sustained expansion of cities, and their metropolitan contexts on a global level. The incorporation of rivers and streams into urban areas will become more common, and thus, environmentally sound management of these waterways will become increasingly necessary.

The management of these environments should be understood in terms of opportunity, a real possibility to improve degraded urban river areas that are often considered marginal areas in social and environmental terms, and unattractive for territorial intervention.

The expansion of urban areas over the urban-rural interface is also a good opportunity to protect the pre-existing biodiversity of river areas, and to improve connectivity at local and regional level. To this end, it appears to be necessary to design specific nature-based plans, programmes and activities, implementing criteria that aim to improve connectivity, and to protect and restore the biodiversity of river landscapes. These interventions must be supported by specific data and analyses of the areas of intervention, information that is often lacking, even in territories with a large and diverse scientific community.

The Manzanares river in the city of Madrid is a good example of this. This river, which has been greatly altered by the artificialisation of its course since the 1940s, has been the subject of an interesting renaturation project. The plan for recovery, promoted by a non-governmental organisation, has improved the ecological and landscape aspects of the river substantially, and while conserving biodiversity, its value has enhanced in terms of public use and social appreciation. Low cost interventions of this nature can have successful results and should be considered as a good territorial practice, applicable to other similar urban river areas.

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# Climate emergency and extreme events

## ENERGY AND SUSTAINABILITY: SOLUTION OR ALIBI

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### SUMMARY

Nowadays, sustainability has become one of the essential references in our society, in so far as, from an environmental point of view, this term is used to classify economic development policies into two different groups: those that are sustainable, which would be the “good” policies, and those that are not, which are, of course, the “bad” ones. However, this has not always been the case, so it is necessary to analyse the evolution of this concept in relation to the gradual development of environmental concern at a global level, which began in Stockholm in 1972 and has reached the present day with the establishment of the Sustainable Development Goals for 2030. Between these two dates, more than half a century of discussions, conferences, declarations, etc., that often hide advertising objectives with the intention of serving as an alibi for maintaining the same economic policies responsible for the current climate and energy crisis.

Sustainability is a term that is becoming more and more widely used and accepted, to the point that, we could say, it has become an environmental reference of our time. Although it has been in our dictionary for a long time, it was so with a very different meaning than it has today, so it can be considered, in a way, as a neologism. Originally, it was an adjective derived from to sustain: *that can be sustained*, a different meaning to the one we have in the environmental vocabulary. In this case, it is an adjective that conditions one of the essential issues of the current environmental problem, insofar as it allows us to differentiate between two forms of economic activity in relation to the environment: some that is sustainable and others that are not, and so it was extended to the most diverse topics that received some kind of environmental plus, if they were sustainable.

In other words, from an environmental point of view, this adjective is currently used to classify economic development policies into two different groups: those that are sustainable, which would be the “good” ones, and those that are not, which are, of course, the “bad” ones. If this were the case, we would already have the solution to the environmental problem generated by the industrial development model followed by the planet for the last two centuries: efforts must be made to implement “sustainable” development measures and penalize those that are not. This is the perspective of sustainability as a “solution”, increasingly defended by politicians, communicators and international agents, but which, from our point of view, is generally limited to a simple advertising claim or “alibi”, to maintain the same structure of economic and energy exploitation, but disguised under a fictitious environmental concern.

# 1. MAN AND NATURE: DUALISM OR COMPLEMENTARITY

From the very origins of rational thought, halfway between *myth* and *logos*, we have evidence of the peculiar existential attitude that has characterised human presence on Earth. On the one hand, man is aware of being an element of the whole of nature, but as a priority and high ranked, as the “king of Creation”. The external environment is the challenge, the danger to its own existence, which must be mastered to ensure his survival and the expansion of the species. For this reason, the belief that Nature was created for him gradually took hold, an idea that is more or less implicitly present in most of the cosmogonies of antiquity. In other words, from its origins, the human being sees himself *before and in front of the cosmos*, in front of nature, to the point that we could say that he only becomes aware of his “humanity” when he is aware that “he is not only nature” (Carpintero, 1999: 73).

Secondly, man has always had the feeling that he lives in a finite world and that, therefore, his end will come. This premonition has been felt by all cultures and at all times, especially in the Judeo-Christian tradition, with a common denominator: the punishment of the divinity in the face of wayward and rebellious creatures. The way of punishment is also paradigmatic and significantly related to natural disasters: floods, earthquakes, plagues, tongues of flame and other diverse adversities, etc. In other words, since Genesis, Man feels Man because he is not Nature, but at the same time he can be punished if he rebels against Nature, which is precisely what his human condition asks him to do. Thus, the expulsion from Paradise, the plagues of Egypt, the Flood, Sodom and Gomorrah, on the one hand, and the manna as the food of salvation in the desert, on the other hand (Tamames, 1993).

And this same feeling is also evident in certain currents of ancient philosophy such as, for example, Stoic philosophy, for which the primitive world was governed by a Natural Law or *Ius Naturale*, of divine origin, which made all men free and equals and in harmony with Nature. But, over time, men established their own law, the *Ius Gentium*, which gradually replaced and adulterated the natural primitive law. If someday social evils were of such magnitude that they compromised the future of Humanity, Human Law would have to be abandoned and returned to Natural Law, thus restoring primitive harmony (Laidler, 1933).

The search for this harmony has conditioned the desires of a large part of humanity throughout history, being reflected in numerous utopian and dystopian narratives, with some emblematic names that occupy a preeminent place in the genre, such as: Goethe's *The Sorcerer's Apprentice*, Wells' *The War of the Worlds*, Huxley's *Brave New World*, Orwell's *1984*, Callenbach's *Ecotopia*, and so on. Even, more recently, in some representative films of the genre, such as *Planet of the Apes*, *Dune*, etc. also inspired by famous novels of the same name.

But this concern about the origin and destiny of the human species manifests itself not only in the intellectual, literary or philosophical realm, but also in the more prosaic realm of economic life and international relations, which is the one that concerns us here. In this field, it is necessary to go back to the origins of the environmental question and the dilemma between environment and development, in order to try to determine how much there is a solution in the current concept of sustainability and how much an alibi. The origin of the issue dates back to the 1970s, coinciding with the first oil crisis, and its evolution can be followed through three United Nations conferences: Stockholm in 1972, Nairobi in 1982 and the Earth Summit in Rio in 1992, with the different scenarios, problems and solutions that arose at each one.

Initially, the question was about the dilemma between raw materials and waste. The possible depletion of the former was related, for some time, to population growth, in the same way that pollution by the latter gave rise to specific substitution and recycling treatments. But since the beginning of the century, environmental issues in general, and sustainability in particular, revolved around an essential problem: global warming due to greenhouse gases produced essentially in energy generation. This is the area that now concerns us most and where sustainability, sometimes, is a solution and sometimes, just an alibi to cover up the problem (Arroyo, 1992: 14).

## 2. THE 1972 STOCKHOLM CONFERENCE ON THE HUMAN ENVIRONMENT

The seventies of the 20<sup>th</sup> century began with two events that would condition the following years until well into the 21<sup>st</sup> century. On the one hand, the Yom Kippur War in the Middle East, in which the Arab countries confronting Israel and belonging to OPEC stopped exporting oil to the Western countries allied with the Jewish State, causing a serious energy crisis in the Western world. At the same time, and for a few decades before, a growing deterioration of the natural environment was becoming evident due to the increase in industrial waste and its poor recycling: pollution, chemical spills, plastic waste, residues and waste of different kinds (Arroyo, Camarero, Vázquez, 1997).

It is then that both phenomena: resource depletion and waste pollution, acting together, are felt by the population as two sides of the same coin, both unintended and unwanted effects of the economic development model followed by our world since the mid 19<sup>th</sup> century. The first compromised the *standard of living*, while the second threatened the *quality of life and way of life*. In other words, "shortage of resources and excess of waste", the beginning and end of the industrial system, which shows the fragility of the model and the need for correction (Arroyo, 1992: 20).

Before the Industrial Revolution, this issue was meaningless, since man's technical capacity to disrupt nature was very limited. But since the second half of the last century, the situation had changed and the successive technological revolutions, controlled by the most developed countries in full imperialist expansion, had accelerated economic growth, but at the same time compromised the future of the natural environment. On the other hand, the countries that led industrialisation made up a small part of Humanity, so their growth had little impact on the rest of the world. But if the same model were to be extended to the whole planet, catastrophe was assured.

This concern gave rise to new theories that sought to promote a different awareness of development, incorporating other more qualitative variables into the conventional indices used to measure economic growth (GDP) to measure its unwanted and unintended effects which, when counted as costs, would allow for a more adequate definition of economic development other than that of simple growth. The best known of these indices was Net Economic Welfare (NEW), which counted pollution, resource depletion, undeclared income, etc. as undeclared costs in GDP. Also, the Nobel prize-winning economist James Tobin proposed a tax on certain types of international transactions (Tamames, 1979).

On another front, but also as a symptom of this concern, a series of essays were published, which moved between the economic, the literary and the environmental spheres and had an enormous media impact. The best known and most representative was undoubtedly the essay by economist Kenneth Boulding (1966), *The Economics of Spaceship Earth*, which conceives of the planet as a spaceship with 3 billion passengers on board, a brilliant metaphor that had notable impact in its day (Rodríguez, 2013).

Some years later, in 1973, another economist E. F. Schumacher (1988) published another essay, also very successful, which insists on similar assumptions *Small is Beautiful: Economics as if People Mattered*. The book consists of four chapters: "The Modern World", "Resources", "The Third World" and "Organisation and Property", in which Schumacher sets out his theory of the unviability of the current development model, in which resources are inevitably being depleted and pollution is blocking Nature's possibilities for regeneration (Heilbroner, 1975).

In this situation, UNESCO convened a meeting in Paris in 1968 of scientists and intellectuals from all over the world concerned with the problems of the natural environment, under the title *Conservation and Rational Use of Biosphere Resources*, whose conclusions became, from then on, a reference point for environmental movements. But, above all, this meeting was the main spur for the convening by the UN, in 1972, of the first World Conference on this subject:

the *Stockholm Conference on the Human Environment*, and not just Environment, as it was later intentionally called, which is not an unimportant issue.

At the beginning, as we have just seen, the aim was to respond to the two basic concerns mentioned above: the destructive capacity of science and the structural poverty of underdevelopment, seeking a balance between science and technology on the one hand, and international relations and the development of decolonized countries on the other. In other words, all of them, elements of the social system, which affected the quality of life of the inhabitants of this planet, -hence the Human Environment-, while maintaining the necessary respect for the Natural Environment. For this reason, it was in developed countries that concern about environmental deterioration first arose, a consequence of the economic development model followed for a century before which, for these purposes and in these countries, seemed to have reached its peak. However, with hindsight, we must keep in mind that in the centres of economic and political pressure, it was always clear that it was impossible to make economic and industrial development compatible with environmental protection (Martínez and Roca. 2013).

The Conference proposed to the General Assembly the creation of the United Nations Environment *Programme* (UNEP), one of its best-known achievements, with the aim of promoting specific actions in this concern. But this programme was born with two very significant particularities: the first was the new name by which, from then on, this issue would be known, Environment instead of Human Environment; and the second was the headquarters where the programme was based, Nairobi, the capital of Kenya, a city which, due to its location and colonial origin, could be considered the antipodes of Stockholm and, as such, a subtle *nod* to underdeveloped countries. Likewise, the final Declaration of the aforementioned Stockholm Conference contains some very illustrative paragraphs of these contradictions and dissimulations, which then worried the chancelleries all over the world (Tamames: 1979, 193):

*Man is both the work and the maker of the environment around him [...] we have reached a stage where, due to the fast acceleration of science and technology, man has acquired the power to transform [...] Today man's ability to transform his surroundings, used with discernment, can bring the benefits of development to all peoples [...] wrongly or unwisely, the same power can cause incalculable damage to man and his environment.*

### 3. LIMITS TO GROWTH REPORT

In these circumstances and with these perspectives, the publication took place, in 1972, the same year as the Conference, of the Report on the Limits to Growth, better known as the Meadows Report after the name of its two main authors: Donella and Dennis Meadows. Carried out at the Massachusetts Institute of Technology (MIT) at the request of the so-called Club of Rome, that is, institutions all from the scientific, intellectual and academic world, the report consisted of a computer simulation of the growth possibilities of our world managing various variables that interact with each other, such as population growth, industrial development, the production of food and other resources and the pollution generated in the process. With all these variables, various scenarios were simulated, depending on their evolution and the intensity of their growth (World3 Programme). The conclusion could not have been more categorical and, at the same time, more logical: "*unlimited growth is not possible in a naturally limited world*", so if limitations are not placed on such growth in time, the planet's capacities could be exceeded at an indeterminate time in the next hundred years, starting naturally from the time the report was drawn up (1972), which would mean the "collapse" of growth and of the planet. On the other hand, the fateful prediction could be avoided without affecting the coverage of each person's basic needs, which would require a considerable effort of containment and redistribution at the same time. In other words, the authors were in favour of limited growth, close to *zero growth or steady state*, a highly debated issue at the time when the essential problem was seen as a variable

of population growth, a controversy that had been dragging on since the beginning of the previous century with Malthus famous work.

In 1992, twenty years after the publication of the original Report, a new version was published, entitled *Beyond the Limits to Growth*, with increasingly worrying conclusions, which nevertheless had little practical impact, due to the high economic costs that the application of measures in favour of the environment would have entailed as a brake on development, i.e. the basic dilemma of the problem up to the present day. But also due to the decrease in population growth, which until then had been considered the main handicap for the protection of the natural environment (Meadows, D. and D. and Randers. 1992: 45).

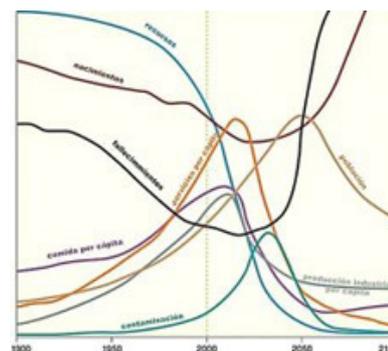


Fig. 1. Theoretical evolution of the key growth variables without intervention on its essential components (According to Meadows).

## 4. THE NAIROBI CONFERENCE AND THE BRUTLAND REPORT

But the concerns were different in the “developing” countries, as they were euphemistically known then. For them, the problem was the lack of development, not its quality, nor what might happen to the planet a century later, while its inhabitants did not have enough to eat the next day. This is how, Enrique Iglesias, then director of the Inter-American Development Bank, put it: *In the North the problem is the quality of life, in the South it is life in itself*. And so did Indira Gandhi, prime minister of an India in full development according to the industrial model, who said at the time: *The worst pollution is the misery of the masses*.

The final Stockholm Declaration already made a veiled reference to this evidence and to the dilemma between Environment and Development (Tamames, 1992: 193):

*In developing countries, most environmental problems are determined by under-development [...] they must aim their efforts towards development keeping in mind their priorities and the need to safeguard and improve the environment. To the same end, industrialised countries should effort to reduce the gap between themselves and developing countries.*

For all these reasons, in 1983 the UN convened the second conference on this subject in Nairobi, the headquarters of UNEP for ten years earlier, as we have already mentioned, which undoubtedly influenced the change of name of the new conference to deal with the aforementioned controversy: *United Nations Conference on Environment and Development*. For this very reason, all the Conference’s efforts were aimed at denying any incompatibility between the economic development model and environmental quality.

Thus, the final Nairobi Declaration placed special emphasis on recognising *the intimate and complex interaction between environment, development, population and re- sources, as well as the pressure exerted by the growing concentration of population*. This meant incorporating into the environmental issue most of the geographical imbalances existing at the time: demographics, habitat, food, migrations, impoverishment of biodiversity, etc. It also included energy and industry, and in particular the so-called urban challenge. A truly idyllic programme, with which no one can disagree, but which is difficult, if not impossible, to achieve, as the final declaration of the conference tacitly acknowledged when, in the face of all these serious problems, it stated that only a few poor measures had been taken: *Education, dissemination of information and training have increased considerably*.

This last paragraph is a clear example of the UN's vagueness and limited executive capacity to address this issue. It should not be forgotten that this was the characteristic institution of the bipolar period in International Relations, and was therefore incapable of addressing a global issue, perhaps the first to deserve such a label. As a result, its decisions have been reduced, most of the time, to a repertoire of good intentions with a purpose that is more for publicity than effectiveness.

Therefore, the most significant aspect of the Conference was the creation, in 1983, of a commission to analyse the relationship between Environment and Development, chaired by the former Norwegian Prime Minister Gro Harlem Bruntland, which in 1987 published a report on the subject entitled *Our Common Future*, better known as the "Bruntland Report", which since then has been the essential manifesto on the issue that concerns us now: *environmental sustainability*.

In short, this document reverses the terms of the problem: development does not harm the environment, because if it harms the environment it is not development. In other words: "there can be no real economic development without a sustainable environment", which means that environmental protection must also be considered as a measure of economic development. A clever change of wording, with which he intended to overcome the resistance of underdeveloped countries to implement environmental measures that could harm their development. The report therefore defines sustainable development as development *that meets the needs of the present without compromising the ability of future generations to meet their own needs*, i.e. a kind of "commitment to intergenerational solidarity", in which there is room for many things, apart from the climate challenge (Bruntland 1988).

But the essential problem is that, no matter how much we change the statements, we are still faced with similar questions: is a development model that satisfies human needs possible without compromising the present and future stability of the natural environment Or in other words: is unlimited growth possible in a naturally limited world? Questions without answers, as we have already said, or rather with different answers, depending on the prior ideological commitment of the questioned subject. This is why, since the end of the last century, there has been a change of strategy and a search for formulas which, instead of opposing the two extremes, make them complementary. In other words, a development mechanism that, while remaining so, was also a mechanism for conservation, which since then has been called *Ecodevelopment* or *Sustainable Development*, incorporating the two terms of the problem in a single statement, one as an adjective and the other as a noun, and completing this proposal with a wide publicity campaign (Sanahuja, 2014).

In other words, a commitment to intergenerational solidarity, which the report makes explicit with regard to resources and pollution. Thus, with regard to renewable resources, sustainability implies that their rate of exploitation should be equal to or less than their rate of renewal. For non-renewable resources, their exploitation should be equal to or less than their replacement, and the generation of waste and pollutants should never exceed their recycling capacity or natural absorption. And so many other alternatives, although without assessing their costs and difficulties. A whole repertoire which, due to its theoretical coherence, ideological appeal and publicity, has since been incorporated into all the international community's environmental and social programmes, although perhaps for this very reason, most of them have not been fulfilled (Silverstein, 1991).



Fig. 2. Gro Harlem Bruntland at the time she chaired the commission that issued the report on sustainable development.

## 5. TWO REASONS FOR HOPE: OZONE LAYER AND POPULATION REGULATION

However, we cannot ignore some cases in which international efforts to protect the environment were successful, not only in terms of concrete progress, but also because they helped to foster the international mood of optimism that followed the fall of the Berlin Wall. Thus, in 1987, the same year in which the Brutland Report was published, the Protocol for the protection of the ozone layer was signed in Montreal, through the gradual elimination of certain products used in refrigeration processes and aerosols, whose destructive effects on the ozone layer had been warned of on several occasions since

1974<sup>1</sup> and which it was then intended to tackle through a process of sustainable substitution (Cacho and Sainz. 1989).

As the implementation of the Montreal Protocol had positive effects on the regeneration of the ozone layer, it was tacitly and sometimes explicitly thought that a similar process could be followed with greenhouse gases and the process of global warming, which was believed to respond to very similar processes. Such warming became more evident in that decade of the 1980s when so many environmental events took place. It was not only the comparison with earlier thermal observations, but also other obvious signs of warming such as the retreat of polar ice or continental glaciers<sup>2</sup>. The issue moved from observatories to newspapers and from there to non-governmental organisations and the boards of major oil companies, each moving their areas of influence.

But the pretence of fixing the global warming problem through similar sustainable substitution mechanisms soon proved ineffective. The success of the Montreal Protocol was an exception on the environmental issue. The destruction of the ozone layer is a very serious problem, to be sure, but due to specific causes: chlorofluorocarbons, gases that can be replaced relatively easily. Moreover, they affect one type of product: aerosols and refrigerants, which have industrial alternatives. This is quite the opposite of what happens with climate change and greenhouse gases, which are an essential product of the energy system inaugurated by the Industrial Revolution, making their substitution much more difficult and bringing us back to the basic dilemma of the question: "greenhouse effect or economic development", which was the essential theme of the Rio Conference, as we shall see later on.

Similarly, two years after that conference, the Cairo Conference on *Population and Development* took place, which also influenced the period of optimism and hope that was experienced in the Brazilian city. In a way, we could say that the evolution of environmental issues since 1970 has its antecedents in demographic issues, as they often use the same arguments and are influenced by similar ideological and political approaches, as can be seen in paragraph 5 of the Declaration of the Stockholm Conference, according to which: "*Natural population growth continually raises problems concerning the preservation of the environment and appropriate rules and measures must be adopted.*"

Likewise, population growth was one of the variables considered in the Meadows Report, due to the pressure that population exerts on resources and, consequently, on the natural environment, a dilemma that can be traced back to long ago, when Malthus considered it in his *First Essay on Population*.

1 In 1974, Frank S. Rowland and Mario Molina demonstrated the negative effects of chlorofluorocarbons on atmospheric ozone. In 1982, at Thessaloniki, Shigeru Chubachi reported a significant depletion of ozone in the upper atmosphere in the Antarctic. It took almost a year more for both observations to be confirmed, raising concerns about ozone for life on the planet.

2 Since the mid-19th century, thanks to the research of Eunice Foote and John Tyndall, it has been known that certain gases (carbon dioxide and methane) and water vapour block shortwave infrared radiation emitted by bodies into the atmosphere. In 1896, Svante Arrhenius suggested that the increase in fossil fuels could accelerate global warming. For more than half a century, these observations were ignored, as it was believed that the planet's ability to regulate its temperature was superior to man's ability to disrupt it.

But after the Second World War, the ideological confrontation between the two blocs had one of its most marked ideological differences in the demographic question, with notable repercussions on the recently decolonised countries where the population grew at a strong rate, much faster than the resources, giving rise to endemic hunger and claims against the former colonisers. This is why there was a return to talk of controlling population growth in relation to economic development and environmental protection.

This is what Edward Kormondy called the problem of the three "P's": *Pollution, Population* and *Poverty*, to define the three essential issues that threatened humanity (Arroyo and Pérez, 1997).

These positions were discussed and confronted in specific scenarios, such as the essentially scientific World Population Congresses in Rome (1954) and above all in Belgrade (1965). Ten years later, in Bucharest (1974), the scientific congress became the first conference of a political nature, aiming to approve an Action Plan for birth control (Arroyo, 2007).

But from the 1980s onwards, precisely when the contraceptive doctrine was gaining ground and birth control measures began to become widespread in many countries, a change in the demographic policies of the main international players took place which is noteworthy, as it constitutes an interesting precedent for the ideological changes that were to be experienced from then on in the environmental field. Thus, at the Mexico Conference in 1984, both the socialist and underdeveloped countries showed less resistance to applying birth control measures, while the USA and other capitalist countries played down the importance of the population issue, and even Reagan spoke of *exaggeration*, referring to the "population explosion".

This change in strategy was ideologically confirmed at the Cairo Conference in 1994 (Arroyo and Camarero: 1997), the last in the series which took place at the dawn of the global era and in the midst of the process of replacing demographic issues and population growth with environmental problems and global warming as the key issues for humanity. In the same way that in the demographic field the concept of "birth control" was replaced by the more transcendental and ambiguous concept of "reproductive health", in the environmental field the same was done by replacing the Meadows' "limits to growth" with Bruntland's "sustainable development", also more complex and ambiguous as in the previous case.

But it was rarely realised that the emission of these gases was a consequence of the economic system inaugurated by the Industrial Revolution, which was never based on sustainability, and that to eliminate the problem it was necessary to replace the conceptual and technical foundations of the system itself, even if this entailed very high costs.

## 6. THE ORIGIN OF THE PROBLEM. THE "UNSUSTAINABLE" CHARACTER OF THE INDUSTRIAL REVOLUTION

Both Watt's steam engine (1767) and Cartwright's power loom (1784), the two icons of industrialisation, represented a remarkable mechanical advance in themselves, but not to the point of justifying the revolutionary character of the period. Previously, there had been a preparatory phase, which Lewis Mumford (1982) called the *eotechnical* phase, with the generalisation of elementary machines, such as mills, fulling mills, forges, saws, already of a certain complexity and efficiency, but still subject to natural cycles. For this author, the Industrial Revolution, which he called the *Paleotechnical Complex*, was undoubtedly one of the essential stages of human history: coal and iron and other technological innovations considerably increased profits and capitalisation. The increased availability of capital fostered new inventions and constant social transformations. It is the golden age

of the bourgeoisie, of colonial expansion, of industrial capitalism, and so on. But it is also the golden age of the exploitation of the proletariat, of the unhealthy work of women and children, etc. And, above all, from the environmental

perspective that interests us here, industrialisation meant making the economic system independent of natural cycles and, above all, the possibility of separating production from consumption.

Both aspects were essential to ensure the economic take-off of developed countries, but also of their perverse effects on the environment. The main innovation that the steam engine represented with respect to water or windmills was not only its greater energy efficiency, but also its independence from the rhythm of natural agents. By not having to adapt to seasonal rhythms, nor to the regenerative capacity of the soil, the production of goods could be regulated only by the economic laws: supply and demand, profit optimisation, interest, yield, etc., which allowed the development of capitalism. We could almost say that the most *revolutionary aspect* of "industrialisation" was precisely its independence from natural conditions and constraints, i.e. its *environmental un-sustainability, which is why* it is now problematic to try to restore the pre-industrial balance, ignoring or concealing the costs involved.

## 7. RIO EARTH SUMMIT AND AGENDA 21

But let us return to the present day. From this dilemma between industrial economy and environmental sustainability, ten years after Nairobi and twenty years after Stockholm, the UN convened the third of the world conferences on environmental problems, in a city equidistant, in the scale of development, between the two previous ones and under a name that synthesised all the previous objectives: *The Earth Summit*.

The Conference took place between 3 and 14 June 1992 in Rio de Janeiro, convened by UNCED, and was undoubtedly a major event, bringing together, together with the official delegations of 179 countries, a diverse group of diplomats, scientists, journalists and, above all, a large representation of NGOs, who met simultaneously at the Global Forum. The essential aim of the Conference was to turn the general ideas of the Brundtland report into concrete provisions, which meant designing a new way of producing, consuming, relating, educating, etc. In short, a whole new way of life, expressed as a set of recommendations that, for the most part, remained on paper, however well-intentioned they may have been.

The outcome of the Conference was a series of documents and agreements of great symbolic, but much less practical, value. Three of them - the Rio Declaration, Agenda 21 and the Framework Convention on Climate Change - constitute an essential chapter in the environmental history of our time, but not in its solution.

The Rio 92 Conference has been compared to the process of drafting a World Constitution on the Environment. The dogmatic part would be the aforementioned final Declaration, consisting of the 27 essential principles that should govern and guide the policy of Humanity, while Agenda 21 would function as a kind of organic part of this supposed world constitution. In addition, a Convention on Biological Diversity and a Declaration of Forest Principles were also adopted.

But at the Rio Summit, a key event took place that highlights the heart of the environmental issue and the structural ineffectiveness of sustainability policies. As the environmental problems became better understood, it became clear that the core of these problems was the climate variations resulting from the mechanisms used for energy generation, which, as we have just mentioned, have been based on fossil fuels since the 19<sup>th</sup> century. Since then, the climate-energy binomial has been at the heart of sustainability policies, which move between a solution and an alibi, as Huntinton saw in 1942,

under the disjunctive Climate and Civilisation. Furthermore, the same Rio Conference approved the *United Nations Framework Convention on Climate Change* (UNFCCC), which agreed on a mechanism to reduce harmful emissions through a *market in emission rights*, whereby the less industrialised countries, which are theoretically considered to have room to emit more greenhouse gases, can cede these rights to the developed countries in exchange for financial compensation. This enshrined the greatest folly of environmental agreements, in that it seeks to solve the environmental problem by polluting in one place but not in another, ignoring the global nature of the problem. Thus, the rich countries continue to pollute the common environment, even if it costs them more, and the poor continue to do so despite the economic compensation they receive from the former. In the end, some remain rich and others poor, and the environment of both is becoming more and more polluted. The very name given to this economic compensation: emission rights, reveals the heart of the matter, because emitting greenhouse gases can never be considered a "right".

But at the time it was thought that a fair and effective mechanism had been reached. It was the famous "polluter pays", which meant trying to solve the problem by resorting to the same market mechanism that had caused it. All these contradictions became increasingly evident in the following two decades, in an atmosphere of uncertainty and contradictions that characterised the turn of the century (Menéndez. 2007). Ten years after the Earth Summit, another conference was held in Johannesburg (2002), under the same name of Environment and Development, which was an example of the rhetoric and ineffectiveness of the time. Ten years later, in 2012, the same discussions were repeated, only again in Rio de Janeiro, at another World Conference on Sustainable Development under the meaningful name of Rio+20. As in previous meetings, the aim was to analyse the state of affairs since the last conference, the progress made, the deficits still to be addressed and the new needs that have arisen in recent years. More of the same, which took the form of a new declaration under the name of "The future we want" and which, as in previous cases, moves between the statement of rather ambiguous general principles and their publicity, with some advances in the scientific field, such as a new environmental concept: the "green economy", as a mechanism for sustainable development or determining the amount of certain natural elements involved in the production of any good or service, such as the so-called "footprints" of carbon, water, etc. (Sotelo Navalpotro, J.A. Olcina Cantos *et al.* 2012).

## 8. CLIMATE SUMMITS: A REPERTOIRE OF NEW CONTRADICTIONS

At the same time as the Earth Summits were losing prominence as a reference point for international concern about environmental problems, other international conferences of a more monographic orientation were taking over, agreed at the aforementioned Rio Conference in 1992, specifically the aforementioned United Nations Framework Convention on Climate Change (UNFCCC), which officially recognised the existence of anthropogenic global warming, which since then has been the main environmental problem, even displacing interest in other, also critical, issues. There was undoubtedly an essential reason for this, such as the seriousness and importance of climate change in itself, but we must also bear in mind the important structural changes involved in dealing with its impact on the prevailing economic and social organisation. Indeed, replacing greenhouse gases implies, in practice, a profound transformation of the very structure of the global industrial production system, with all its geopolitical, economic, social and financial consequences. Moreover, it is claimed, at least in theory, that these objectives should be achieved within a reasonable timeframe, so as to allow the recovery of ecosystems disrupted by warming, while making all this compatible with the continuity of increasingly sustainable and equitable economic development. In other words, a true squaring of the circle which, from then on, will characterise the environmental problems of our times (Olcina, 2007).

Indeed, in order to deal with all this, a system of global control meetings and a mechanism for reducing emissions according to market criteria was established, which is an attempt to solve the problem by resorting to the same mechanism that had caused it. Moreover, the seriousness and importance of the issue has also favoured a greater presence of social organisations of all kinds in the environmental issue, which has undoubtedly led to a growing social visibility of the problem, but is also making it more difficult to address institutionally.

The annual monitoring meetings are known as the Conference of the Parties (COP), since the signatory countries are known as "Parties to the Convention". These Conferences, which have been functioning as the supreme body of the Convention, fulfil various functions, such as analysing compliance with the agreements, comparing the evolution of the concentration of greenhouse gases and whether their decrease is in line with what has been established, learning about new discoveries and the evolution of warming, all of this in contact with the Intergovernmental Panel, etc. The secretariat of the Convention was established in Bonn and to date there have been 26 Conferences of the Parties, also known as Climate Summits. Three of these played a key role in defining and addressing the problem: Kyoto in 1997, Copenhagen in 2009 and Paris in 2015.

Kyoto agreed on a reduction of greenhouse gases by 2012 of at least 5% of those emitted in 1990, which was taken as the reference date. However, as these emissions are very different in developed and undeveloped countries, a different reduction margin was established, as well as a system of penalties and incentives according to each case, for which an *emissions rights market* was created, to which we have already referred.

This situation became more complicated at successive conferences, notably Copenhagen in 2009 and Paris in 2015. Developed countries were forced to commit to a pace of emission reductions, which led to constant disagreements and withdrawals from the protocol or changes in their approach to it. The most significant case was that of the US, which alternated its withdrawals and acceptances of the protocol according to changes in the country's presidency. Thus, Bill Clinton signed the Kyoto agreement, but it was not ratified by the Republican-majority Congress, and when the Republicans became president with George Bush, the US withdrew from the agreement. Eight years later, when Barack Obama became president, history repeated itself, only in the opposite direction. The new president pledged to reduce emissions, thereby accepting the Kyoto Protocol, a situation that continued until Donald Trump came to power, who had already announced in his election campaign his intention to withdraw from the Paris Climate Agreement because, as he repeated on several occasions in his characteristic style, "climate change was a Chinese invention".

Other countries also withdrew from the agreement, such as Canada, to avoid sanctions for non-compliance with the agreements, although it later rejoined. On the other side, France regretted that a greater compromise had not been reached. Similar criticisms were voiced by other countries, especially the less industrialised ones for whom the main responsibility lay with the major developed powers. In this respect, the US position was compromised by its competition with China for world hegemony. The Chinese model of development is little or no respect for the climate, with Beijing's air pollution levels at the time exceeding those of London or Manchester in the middle of the last century. This absence of environmental control, together with a practically slave labour force, were the instruments that enabled the developed countries to obtain simple and cheap goods, thus favouring the rapid industrial development of the Asian giant (Max-Neef, 2006).

The least developed countries, on the other hand, denounce the contradiction of being forced to reduce their already comparatively low emissions, which are largely a consequence of demand from developed countries. In other words, it is a whiting that bites its own tail and always ends up in the same bottleneck: the pressure of the exaggerated consumerism that is characteristic of the developed model of our world (Silvertin, 1991).

As a result of all these contradictions, successive climate conferences have modified and made the emission reduction targets more flexible. Thus, at the 21st Climate Summit, held in Paris in 2015, it was agreed to achieve emissions neutrality between 2050 and 2100,

a sufficiently wide margin for the commitment to be totally irrelevant. Moreover, the agreements reached at the successive climate summits in Marrakech, Bonn, Katowice and Madrid were increasingly inconsistent, with sharp divergences between official representations and environmental and non-governmental organisations.

## 9. GOAL 2030: SDGS AND GREEN ADVERTISING

In addition to all this, international problems such as the crisis, pandemics, war and competition between the great powers have been delaying this longed-for date until it has become unattainable, due to the fact that today, the problem not only pits developed countries against underdeveloped ones, but also the former against the latter, whose competitiveness in a global market depends more and more on the predominant type of energy and the source of its generation. This translates into a dilemma: “greenhouse effect or economic development”, which everyone explicitly or implicitly resolves in favour of economic development. But while some do so by denying the greenhouse effect and its consequences, hence the name “denialists”, the majority prefer to disguise their position by ascribing to environmental sustainability or a supposed *energy transition* in which they do not believe or which they doubt in their hearts (Arroyo, 2021).



Fig. 3. Images identifying the SDGs and lapel emblem as an advertising reference.

Thus, in the face of international agreements to reduce the dreaded greenhouse gases, we are faced with the hypocrisy of companies and governments playing a double game. While most Western countries are implementing costly policies to decarbonise their economies, China, the country that in 2021 was responsible for 31% of global CO<sub>2</sub> emissions, continues to double its coal-fired power generation capacity. Another significant case is that of Germany, which, from being one of the leading European powers in the environmental struggle, changed its energy generation and supply policy when it was deprived of easy imports of Russian gas. But perhaps the most obvious case of environmental manipulation is the campaign against combustion vehicles and in favour of electric cars, not because they are not polluting, but because they are not the solution as it stands. This campaign is aimed more at promoting this branch of the automobile industry than at protecting the environment, even if it publicly claims the opposite.

All these issues have determined the latest orientation that sustainability has today and which is embodied in the *2030 Agenda* and the *Sustainable Development Goals*, specifically goal 7 *Ensure access to affordable, safe, sustainable and modern energy for all*, which are incompatible terms at the moment and will surely be so in 2030. In reality, this Agenda is much more than a simple environmental sustainability project, as it is a whole design programme for a future global society, a kind of *global code* to standardise the morals, ideas and behaviour of people, societies and nations (Sanahuja, 2016). Since tackling climate change directly would lead to a decline in development, an ‘adaptation plan’ to

the environmental consequences of climate change is preferred. Instead of drastically reducing emissions, the aim is to adapt to the consequences of not doing so, in order to make them as harmless as possible. At the same time, new sectors are encouraged to adapt and their development is promoted with constant environmental publicity. This is the aim, for example, of the so-called *Global Commission on Adaptation*, a non-governmental organisation, but closely linked to both national and international official institutions, headed by three international personalities, who clearly demonstrate the objectives and orientations of the institution: Ban Ki-Moon, Bill Gates and Kristalina Georgieva, an Asian, an American and a European, a diplomat who was the eighth secretary general of the UN, a businessman founder of Microsoft, of wide worldwide repercussion in the digital and globalisation field, and an economist who was executive director of the World Bank and later of the IMF.

The three aforementioned, who, as can be seen from their profiles, could very well represent the tensions and possibilities of a global world, plus representatives of various countries and international institutions, made a call in The Hague in October 2018 to study and carry out the necessary actions to prevent and adapt the structures of our planet to the inevitable transformations resulting from climate change. It is no longer a matter of avoiding or reducing such change, but of being prepared to face its effects, since such change, whether we want it or not, will eventually occur to one extent or another. This Commission presented its work and conclusions at the Climate Adaptation Summit organised by the Netherlands on 25 January 2021. Once the Commission was dissolved, its functions were taken over by the *Global Adaptation Centre*, which is tasked with taking its work forward through concrete programmes, which are intended to complement and even go beyond the commitments to reduce greenhouse gases.

Moreover, this plan has the growing support of large multinational corporations, the new global players that are displacing states and governments from world forums and centres of power. This is the case of the United Nations *Global Compact*, which aims to promote sustainable development in several business areas: human rights, labour and environmental standards and the fight against corruption in business activities and strategies on a global scale. With more than 12,000 companies worldwide, it can be considered the largest corporate social responsibility initiative. In its shadow we can find many other initiatives such as the so-called *SDG Ambition Accelerator Programme*, announced at the 2020 Davos Forum, which aims to boost the integration of the SDGs into business management.

In this way, the defence and identification with the 2030 Agenda has become, in most cases, the main sign of collective identity to define and recognise the new ruling classes of world society, a kind of global code to standardise the morals and behaviours of societies and nations, which is identified through behaviours, declarations, logos, icons, identifying images and extensive publicity, but which have little or nothing to do with the priority objective of conserving natural balances and maintaining the environment (Alfaro, Arias and Gamba, 2019). As has already been said, this is, in short, a concept of sustainability and sustainable development that is very different from the original Brutlandt report, as we will see later on. This is why the emission reductions of the largest global companies are lower than their advertising claims. For most of these companies, the corporate policy of reducing emissions is primarily a publicity mechanism to improve their image and increase their market share. It is the so-called "green propaganda", another form of misleading advertising, with which businessmen, politicians and managers of our society conceal their environmental inaction, since they are all convinced that there is no "development without growth", which is not possible in a world of limited resources, as the Meadows already saw in 1972.

A study by the *New Climate Institute*, an independent organisation of climate journalists, shows that the emissions reduction programmes of the major multinationals are lower than they claim and much lower than what is necessary to achieve the global targets of *climate neutrality and net zero*, which are advertised as the hallmark of corporate identity. It should therefore come as no surprise that, despite official declarations and advertising propaganda, the truth is that CO<sub>2</sub> emissions have tripled between 1965 and 2020, reaching atmospheric concentration levels unknown in the history of the planet, generating the much-feared greenhouse effect (Voigt, 1970).

## 10. ENVIRONMENTALISM AND SUSTAINABILITY AS ALIBIS

In other words, the Brutland Report's "sustainable development" was an attempt to resolve the dilemma between development and the environment, but on the contrary, the idea of "sustainability" as it is used today is more and more a publicity alibi which, faced with the objective difficulties of that solution, prefers only to reduce its impact and prepare us for its consequences. It is no longer a question, as in that famous report, of satisfying *the needs of the present without compromising the possibilities of future generations*, but only of satisfying the needs of the present, but "discreetly", since it is clear that the possibilities of the future are already being compromised, although we do not know to what extent.

Various mechanisms and procedures are used to achieve this "discreet sustainability", but with contradictory results. In addition to the wide publicity given to this sustainability by governments and corporations, to which we have just referred, we must recognise the efforts to save and improve energy efficiency, which, although insufficient, are nonetheless positive. This is the case of renewable energies, which represent an unquestionable advance, but which present technical difficulties for substitution that are often very costly. This leads to inflationary tendencies which, given the nature of the energy sector, quickly spread throughout the economic system. Furthermore, given the randomness of renewable energies due to their very nature, it is necessary to keep a parallel system of conventional generation in operation as back-up energy, which means that two forms of energy generation coincide in the same market: one renewable, expensive and sustainable, and the other cheaper but polluting. This overlapping of environmental and economic criteria leads to permanent instability, which translates into sharp variations in the final price, despite the paradoxical marginal mechanisms for setting the price and the permanent risk of crisis, despite the fact that the large production companies constantly advertise that all of this is necessary to achieve sustainable energy.

It is the magic word, which every day means less but is applied to more products: cars, bricks, clothes, furniture, holidays, waste, etc. all "sustainable" in order to soothe the environmental conscience and, above all, to maintain the same levels of consumption and waste, which requires a permanent and growing demand for resources and energy, which is unsustainable by definition. The "sustainability alibi", in its meaning as a pretext or excuse, is that it allows us to psychologically and socially save this problem, to excuse ourselves and "look the other way", in the belief that our actions and our consumption are "sustainable" (Naredo and Parra. 1993).

For all these reasons, we should not be surprised by the rejection that this idea of sustainability provokes in different environmental organisations that claim to represent civil society and which, as such, have been shaping an alternative and critical ideology to that of official bodies. The environmental movements began to take shape spontaneously in the sixties and seventies of the last century, parallel to the environmental history we have just seen. But, in the last decade, they have ended up becoming one of the social movements of our time, together with gender ideologies, illegal immigration or "historicist memorialism", which have become references of a new progressivism that, in the post-industrial societies of our time, have replaced the traditional class ideology and workers' demands.

The most mediatic example was represented, a few years ago, by a teenager who achieved international fame and personified the environmental resistance movement in the face of climate change and official sustainability. Greta Thunberg, a young Swedish girl who is a faithful representative of the *millennial generation*, but whose environmental argument is reduced to considering climate change as the sole responsibility of adults. Her most spectacular moment coincided with the 2018-2020 biennium, when she attended the Davos summit of the latter year, being received by the world leaders gathered there, as if she represented some phantom world organisation. In reality, all this is nothing more than a covert publicity stunt to evade the seriousness of the problem. As a result, Greta Thunberg's prominence gradually faded, eclipsed by other more traditional environmental organisations, which were simply seeking the much-desired sustainability and simply reminding us that time was running out, without the ineffectiveness of some and the hype of others doing any good.

## 11. A QUESTION OF TIME

Against this backdrop, the question is whether there is still time: will the policy of adapting to the effects of climate change and the gradual reduction of emissions be able to allow humankind to survive in a very different world and environment? In 1972, the authors of the famous Meadows Report on the Limits to Growth answered this question in the following terms:

*If current trends in global population growth, industrialisation, pollution, food production and resource exploitation continue unabated, the limits of growth on our planet will be reached sometime within the next hundred years.*

The problem is that, since then, we have already used up half of the century that Meadows pointed to as the possible date for a *sudden and uncontrollable decline in both population and industrial capacity*.

A year earlier, a Romanian economist and mathematician, Nicholas Georgescu-Roegen, in his most famous work (1996), had maintained the need to apply the laws of Thermodynamics to the study of the relationship between the environment and the economic environment. If the economic model followed since the Industrial Revolution is increasingly based on a mechanical and technological conception of Nature, it is necessary to take into account the laws of the latter in the study of the former. Until then, the laws of the market – supply and demand, profit optimisation, etc. – had been considered as if they were natural laws, but not the other way round, i.e. the consequences for the market economy of incorporating the workings of nature into the study of economics. The consequences of this approach could not be more revealing, as they lead to the conclusion that the economic subsystem cannot regulate the natural system that encompasses it, identifying energy degradation with environmental degradation.

*Demographic pressure and technological progress bring the human species closer to its end, only because both factors cause a more rapid deaccumulation of its endowment.*

Man's nature does not allow him to repress his present desires for the benefit of future needs. Growing entropy until the inevitable end. Let's see then how the problem is seen from the economic subsystem and its most evident disorder: the growing irrational and compulsive consumerism, which turn the famous *Sustainable Development Goals*, frontispiece of policies, and also emblem of the lapel of politicians of our time (Fig. 3<sup>a</sup>), into *Unsustainable Consumption Goals* (Arroyo. 2016).

## 12. GROWTH OR DEVELOPMENT; CONSUMERISM OR WELFARE

The model of industrial growth initiated in the United Kingdom at the end of the 18<sup>th</sup> century was undoubtedly one of the most splendid periods in the history of mankind, thanks to which extraordinary levels of well-being and development have been achieved. However, this should not lead us to ignore the fact that, in its current consumerist structure, this model, which is more about growth than development, has reached its limit and is impossible to apply in countries that are not very or not at all developed (Jackson and Marks. 1996). In other words, we are back to the beginning: environment or development, which forces us to look for another model in which the two variables are not alternatives, in which environmental protection is also a measure of development, in which development is not only understood as material growth, and in which sustainability is not an alibi for maintaining the same system, but includes the three basic dimensions of life: environmental, social and economic.

All these questions are not new, but have been repeated in other formats for more than two centuries. First came the demographic dimension and the controversy over the maximum uncontrolled population growth that the earth could support, with contributions as representative in the history of economic thought as those of Ricardo (Law of Diminishing Returns) and Stuart Mill (Steady State) or Malthus himself. Subsequently and in the opposite direction, the economic theories on the stages of economic development of W. W. Rostow (1993), whose last phase, or "High Mass Consumption" would be characterised by a largely urban society, with widespread and varied consumption, even of high-value goods, in which the laws of the market, as natural as those of Nature, would govern all the factors in action, thus achieving the much desired equilibrium (Arroyo. 2018).

But, as Pierre Vilar (1964, 23) has already said, these economists have used quantitative history and retrospective statistics as if they were automatic mechanisms that could be extrapolated to the past. Progress, which is more than growth, is only present when all the factors and all the risks are taken into account by science and the conscience of men. It is therefore essential that we know how to distinguish between growth and development, as in the aforementioned work by the famous French historian, and that we are clear about the basic equation between the two, which is that just as growth, especially if it is unlimited, is unsustainable by definition, development, in order to be sustainable, can occur without growth.

This last reflection also has a long tradition in environmental studies, since the need to use other indices to measure development, different from those used for growth. Thus, Net Economic Welfare (Samuelson and Nordhaus, 1996) instead of GDP, as well as the valuation of other non-material elements that produce social and personal satisfaction (Sumacher, 1988), to which we referred at the beginning. All of these alternatives are under constant discussion, as they seek to achieve development without growth, which for other economists of the stature of Keynes is impossible. In fact, all of these economists aim in one way or another to achieve a conservationist attitude towards nature, by means of low material consumption and encouraging savings. But, according to the aforementioned British economist, this would inevitably lead to stagnation and impoverishment, through what he called the "paradox of thrift", since reducing consumption reduces economic activity, development and, paradoxically, also savings (Riechmann. 1998).

It is therefore necessary to replace the economic model based on growth, consumerism and *aversion* to saving with one that seeks well-being in the satisfaction of non-consumable and non-consumptive goods, in the better distribution of these goods rather than in their accumulative and unlimited growth and, above all, in saving and conservation, as social, environmental and not only economic values. The exacerbated consumerism of our time discourages saving, prevents future prospects and leads to a dead end. In this situation, sustainability is an *alibi and not a solution*, a way of making *something change so that everything stays the same*, as Lampedusa said in *The Leopard*.

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# THEMATIC LINE 2

**TERRITORIAL,  
DEMOGRAPHIC  
AND SOCIAL  
CHANGES**

# Quality of life and place attachment

## PROPOSALS FOR ADDRESSING RURAL DEPOPULATION IN SPAIN

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### ABSTRACT

The depopulation phenomenon in Spain, well-known and academically defined since the 1980s, has become an effervescent issue in recent years thanks to the attention it has been paid by the media, civic organizations and public administrations. The change in scale of this phenomenon undoubtedly lies behind this renewed and growing interest. Demographic loss is no longer limited to small municipalities or micromunicipalities. Since the 2008 crisis, demographic loss has also significantly affected county seats and provincial capitals inland of the Iberian Peninsula. As a result, the traditional system of rural areas has undergone reconfiguration, if not disarticulation, by transforming depopulation into a territorial challenge. This fact requires a new set of policies and actions that seeks to maintain adequate and sustainable activities and services because their presence or their absence, their abandonment and consequent neglect, mark the extent to which the population decides to stay or relocate in a place. We are, thus, talking about offering resources to deal with undesired situations that hinder life projects and personal fulfillment; in short, acting at the well-being level by considering personal satisfaction; in other words, happiness. This work aims to determine: what rural municipalities should offer to guarantee the happiness and well-being of their resident populations; which factors will allow initiation, consolidation of life projects and will, therefore, favor permanent rooting in a place or, in the event of it disappearing, will force them to leave a place and relocate in the disappearing territory. To make progress with our objective, we worked with two different socio-demographic profiles according to their link with rural areas: the rural population and the neo-rural population. Fieldwork has been done in the Valencia province by taking the rural municipalities of the LEADER 14-20 program as a starting point. From June 2019 to March 2020, we organized eight discussion groups. At the end of discussion, the participants filled in a survey. The survey results showed the significant facilities and services capable of leading a population to not only remain or be attracted, but to also be rooted to rural areas. In particular, schools are meeting places that generate a social network capable of giving rise to values, such as trust, mutual help or belonging, which lead to residential satisfaction with the inhabited place. However, its presence is not necessarily required locally, but its proximity and accessibility are required. Rural areas' (self-)esteem also stands out as being essential for facilitating rootedness to a place in conjunction with school and other essential services. Although this is a value that should be promoted and consolidated among both rural and urban populations, several possibilities are proposed. In them all, the local society, the community level, plays a central role.

# 1. DEPOPULATION (IN SPAIN): WHY NOW?

## 1.1. RENEWED INTEREST IN AN OLD, WELL-KNOWN PHENOMENON: CAUSES AND MAIN COMPONENTS

One of the emerging issues over the last decade in Spain has undoubtedly been depopulation. However this is no new phenomenon, nor does it solely affect rural areas (Recaño, 2017; OECD, 2018; Camarero and Oliva, 2019), although it is true that awareness of its effects has grown significantly in the last two decades. The issue has gained visibility, and has been brought to public debate and addressed by public policy. Before the term “depopulation” became popular, which accounts for 60% of academic works in the last decade, the associated processes were present in the analyses of many social scientists who studied rural areas in, for example, discussions of “rural development” (Esparcia, 2021). Furthermore since the late 1980s, this phenomenon was not only well-defined, but also supported by regulatory and intervention instruments, primarily through financial (European policies and funds) and human resources (local stakeholders, from technical teams to a private sector and many local public officials committed to develop their territory).

Indeed rural scholars have extensively studied various aspects since at least the 1980s (Ceña and Fernández-Cavada, 1986), such as migratory flows between rural and urban-industrial areas (traditional rural exodus), effects and changes in natural dynamics (due to, among other factors, increasing socio-demographic modernization), impacts on demographic structures and the consequent emptying of many inner rural areas (Pérez and Leco, 2011; Collantes and Pinilla, 2019), or how the public perceives the problem, particularly through informative discourse (Gómez-Limón *et al.*, 2007; Saiz and Galletero, 2023). Likewise, the relative stagnation or slowdown in rural population losses in the 1990s has been analyzed, as has the arrival of certain contingents of immigrants to rural areas during the economic expansion from the late 1990s to the 2007 crisis (Green *et al.*, 2008; Camarero and Sampedro, 2009; Carvajal, 2009; Labrianidis and Sykas, 2009; Kasimis, 2010; Collantes *et al.*, 2014). Consequently, the return flows of many of these immigrants (or at least their migration from rural areas to urban or suburban zones) are also documented and analyzed, as is the (contested) flow of many city residents to rural areas following the COVID-19 pandemic (González-Leonardo *et al.*, 2022; Gutiérrez *et al.*, 2022).

Contributions to methodological and procedural content as to how to typify demographic dynamics (Ocaña, 1976, 1978; Vidal and Pujadas, 1983) by addressing demographic structures (Reques, 2011), analyzing settlements (Bosque, 1976; López, 2016; Pazo and Moragón, 2018), and incorporating aspects related to accessibility (Escalona and Díez, 2005; Goerlich *et al.*, 2015; Reig *et al.*, 2016; De Cos and Reques, 2019; Christiaanse, 2020) or place (Reques, 1997; Recaño, 2016, 2017; Bandrés and Azón, 2021), also stand out. Lastly, the extensive study of policies or initiatives that have more or less directly contributed to retain population in these inner rural areas should not be forgotten (Sáez *et al.*, 2016; Pinilla and Sáez, 2017; Molina, 2019; Esparcia 2021).

This academic contribution highlights a vibrant state of the art that showcases the complexity of a phenomenon like depopulation in general, and rural depopulation in particular, in which all explanations are complementary. It cannot be otherwise if we consider that depopulation is both a demographic phenomenon and a social, economic, cultural, environmental, etc., i.e., multidimensional phenomenon. This combination of interdisciplinary perspectives (agrarian history, rural sociology, anthropology, rural geography, among others) often resorts to numerous contexts and interpretations to explain interdependencies that institutions increasingly use to design and implement public policies that aim to address the consequences of depopulation or to at least mitigate its effects (Sánchez, 2020; Esparcia, 2021; Sáez, 2021).

Outside Spain, academic attention to depopulation is also growing, as noted by Delgado (2019), Corselli-Fordblad and Strandell (2020) and Cejudo and Valverde (2023). In the

European Union, many teams, also from complementary perspectives, have been analyzing rural dynamics, including population reduction. For instance, this is highlighted by research projects and seminars in Europe, such as: those sponsored by the ESPON Observatory that focus on both rural dynamics in Europe (ESPON, 2013) and depopulation; the H2020 program, which has mobilized a large number of scholars from all over Europe around these themes (Esparcia, 2021).

In Spain, what is truly new is the social, media and political projection that depopulation is experiencing thanks to its growing presence in not only academia, but especially in the realm of media, civic organizations and public administrations (Moyano, 2020, Esparcia, 2021), despite Spain not being, by far, the EU Member State that undergoes the severest demographic decline (European Commission, 2020). In the first case, media have played (and continue to play) a key role in bringing depopulation to public debate, but also in making the public aware of the rural world's values and problems, far beyond mere information about the consequences of depopulation or the multiple initiatives to confront it. This emerges from the studies, press articles, debates, etc., that have proliferated in recent years, as exemplified by the large number of news items that the Europa Press agency publishes in its daily newsletter "Depopulated Spain" (Europa Press, 2022).

The second case is civic organizations, which were initially involved in mitigating the consequences of population loss, sought to improve the rural population's expectations and living conditions, and are often the leading figures of many news items offered by the media. Specifically to the Spanish case however, they stand out for having suddenly emerged in the national political arena often after years, if not decades, of predominantly local activism. This is the case of, for example, "Teruel Existe" (Teruel, Aragón) and "Soria Ya" (Soria, Castile and León) (Esparcia, 2024).

In the third and last case, public administrations are central. Depopulation has long since been in the public mind as a political issue (i.e., Miguel Delibes' book "El Disputado Voto del Señor Cayo" (1978)). However the political class, with honorable exceptions (El Norte de Castilla, 05-10-2008), has not been clearly aware of the drama that it has entailed until almost halfway through the last decade. Hence the first reference, almost a precursor, can be found in the Commission of Local Entities of the Senate which, in 2015, drafted a report to take measures in relation to rural depopulation in Spain. Since then, but especially after the "National Strategy for Demographic Challenge" was approved, first the "Recovery Plan: 130 Measures Against Demographic Challenges", and later the recent "Plan for Recovery, Transformation, and Resilience," depopulation has held a prominent place on the political agenda.

It is, thus, complex differentiating among the nearly hundreds of events related to depopulation that are held monthly (MITECO, 2022) both nationally and locally. In fact it could be stated that there is no regional public institution whose president or councilor does not emphasize during various events the authorities' commitment to address depopulation. All this is reflected in vast normative deployment at different levels, which responds precisely to this commitment (Esparcia, 2021).

## **1.2. FROM DEPOPULATION CHALLENGE TO DEMOGRAPHIC AND TERRITORIAL CHALLENGE**

With the demographic challenge, depopulation takes on a new dimension for going far beyond simple demography, namely population loss and over-masculinization (and more pronounced as the size of municipalities diminishes). It reaches a territorial dimension by incorporating an analysis of (unequal) population distribution in space (AGE, 2018), by increasingly affecting territories that are not strictly rural, or where socio-economic decline is less intense (Esparcia, 2019a, b, c; Andrés, 2021). It is also linked with other aspects, such as aging and floating populations. Thus depopulation is understood as a territorial cohesion problem.

Although this territorial dimension is implicit, it is not always analyzed or sufficiently taken into account. This is especially important in the context of public policies to address depopulation, which require an integrated and articulated vision of the territorial support system, adapted to the diversity of different territorial environments by, for example: distinguishing gradients or levels of differentiated assistance; focusing on specific municipalities based on their characteristics or demographic thresholds (i.e., demographic resilience areas, rural emigration areas or rural areas at risk of irreversible depopulation) (Recaño, 2017); considering the territorial strategies defined by Spanish Autonomous Communities or regions.

Despite the quantity and variety of public depopulation interventions, there is still no true national cohesion policy (Collantes, 2020). As Sáez (2021) points out, politicians take advantage of the ease of reformulating any initiative as demographic because everything affects people in one way or another, and of displaying an integral approach to depopulation. It is, thus, understood that “from the government, successive versions of their plans are presented in encyclopedic mode, as a flood of ministerial initiatives whose rationale, application and sense within the overall strategy are not clarified, and an internal structure that provides coherence is lacking”. Incentives are directed toward achieving results, and narrowly linked with an increase in registered residents, and less in promoting the regeneration of rural communities, a challenging aspect to measure that can occur with or without demographic growth (Peón *et al.*, 2020). In this way, demographic factors are interpreted according to the principle by which more (inhabitants, migratory balance, births, density) is always better, and less is always worse (Sáez, 2019).

From this perspective, depopulation is also relatively easy to reverse through various types of incentives if we manage to get significant sectors of the now urban population to “return” to their rural places of origin. However, there is no “zero-sum” because depopulation is already a phenomenon that transcends rural areas, not only because of rural-urban migration, but mainly because of demographic dynamics, negative vegetative growth, from which it is difficult to escape without making profound changes in socio-economic dynamics and, if applicable, in the migratory variable. Once again, the territorial nature of depopulation becomes evident. However, the territorialization of these measures, desirable from a technical standpoint, may be inadvisable in political terms given that, if initiatives focus on the most fragile areas by addressing territorial equity criteria, then the government that favors them will incur a high electoral cost because voters are in urban areas and areas with higher density. Hence all administrations have rushed to design solutions, sometimes posed almost as being miraculous (laws, strategies, depopulation commissions, etc.), to face the enormous demographic challenge in our inner rural areas (Sáez, 2021; Esparcia 2022).

The emergence of depopulation as a topic of interest for public administrations, and as a recurring issue in public debate, is explained by economic, social and environmental reasons; that is, by the (un)sustainability of rural communities themselves. Population loss often leads, albeit not always, to the abandonment of activities that generate employment and income, the impoverishment of lifestyles and social cohesion, all types of heritage (historical, cultural, and even sentimental and personal), and land management uses and forms responsible for maintaining landscapes, biodiversity, environmental services, etc., which frustrate the initiatives taken from these areas to address global change. If depopulation is a concern for the political class, it is because demographic losses are no longer limited to small towns (due to the well-known aging-low fertility-low birth rate vicious cycle). They significantly affect inner county seats and provincial capitals in inner areas given migration to major cities in the Spanish urban system, particularly since the 2008 economic-financial crisis.

Mobility of non national residents from less dynamic rural areas (Abad, 2019), especially that of nationals, and even during years of recovery (Gil and Bayona, 2021), explains this “second depopulation wave”. Improved communications and accessibility from and to rural areas have allowed many Spanish families to relocate their residences in larger municipalities and become rural commuters (McDonagh *et al.*, 2016). It is true that the relatively short distances to travel (between 30 and 40 minutes on average) allow roots to be maintained, above all ownership of homes, and even a link with certain economic activities in some cases

(agriculture, tourism, etc.). However, these departures represent an addition: they reverse the rejuvenation of previous years and reactivate the classic vicious circle of depopulation in many Spanish rural areas. However, this rural decline has not been (nor is) only a demographic issue. This (new) departure has been led mainly by different professional profiles, more varied than those registered during, for example, the rural exodus halfway through the last century, including teachers, doctors, pharmacists, agro-industry workers, etc. Therefore, local population experiences an added psychological effect by feeling less protected. This decay spreads to the entire community which, faced with the expectations of sharp inevitable decline, reduces its investments, and seeks alternative places where they can be enterprising and live in the medium term. Individual migrations generate a depressive atmosphere that affects the whole and leads to greater propensity for emigration. Thus for certain families, the rural areas they leave no longer serve as a reference for their life project, their residence and their work.

This does not mean that processes of residential relocation from urban centers to rural areas have not simultaneously occurred, which are, however, exceptional movements that hardly reach remote areas seeing that migration tends to concentrate in larger villages. In other words, migration decreases as distance grows, and the good provision of services and accessibility to urban and metropolitan areas is relevant (Eliasson *et al.*, 2015). Consequently, regressive trends are consolidated in inner rural areas. As Moyano (2017) states: "there are many territories [where] the inexorable process of depopulation of their small municipalities continues with no chance of reversion. In these cases, it may make no sense to pour efforts and resources into reactivating something that is doomed to disappear"; these are "territories irremediably condemned to depopulation in which only palliative measures can be applied." These are the rural areas at risk of irreversible depopulation that Recaño (2017) differentiates, in which the task of reducing depopulation seems impossible, or to at least continues thinking of them as main permanent residences, and not to act as second homes and for "temporary" activities and uses related to leisure during festive or vacation periods (Esparcia, 2021, 2022, 2023).

Depopulation processes, especially those that take place in less dynamic inner rural areas, lead to a real reconfiguration of the urban spatial system, at least from a structural and medium/long-term perspective (Molinero and Alario, 2019, 2022). Thus municipalities with fewer than 20,000 inhabitants now have less weight than they did two decades ago. It is the towns with between 20,000 and 100,000 inhabitants that concentrate demographic growth, and also benefit from population loss occurring in the main urban and metropolitan areas. Consequently, the true recovery (and even the potential for it) of inner rural areas should be questioned. This reconfiguration undoubtedly requires making rapid decisions because it not only affects micromunicipalities (500 inhabitants or fewer), but is also increasingly present in municipalities of considerable size (from 2,000 to 10,000 inhabitants). These are the cities in the urban system that should perform territorial articulation functions, especially in areas with highly scattered rural settlements (Esparcia, 2023).

The "last line of defense" against depopulation should be the target of policies to maintain appropriate and sustainable productive activities, rather than to prevent the population from leaving and/or to attract new settlers. It is the presence or absence of these which fundamentally defines the extent to which more of the population decides to stay or relocate in rural territories. Rural villages can be sustainable with a smaller population, but not without productive activities, which renders it a different matter from depopulation. It involves "abandonment" (Ruiz Pulpón and Ruiz González, 2021), a concept that goes beyond the presence of activities and implies neglect; that is, deterioration in maintaining economic activities, essential services and traditional care (Moyano, 2020).

Another relevant topic is how the local population faces this abandonment when it considers that it occurs or what tolerance level it has before making the decision to change its living space. Similarly, it is also important to note how this (potential or real) abandonment is valued by the seasonal population because it is often the clearest beneficiary of any initiative against it. This approach connects individuals' aspirations and choices, and provides a practical contribution to assess the impact of the policies currently implemented

in numerous Spanish rural areas. It is linked with subjective efficiency and reveals whether something is suitable for society. As Sáez (2021) indicates, this is increasingly considered in public management because it allows an analysis to know whether citizens' desires have any connection with adopted political decisions. The relationship is clear: many political leaders constantly reiterate that public/social services and facilities should pursue the rural population reaching comparable quality of life levels to those enjoyed by the rest of citizens. Quite often in this discourse, equality is confused with accessibility and immediacy to certain public and private services; that is, fundamentally "having it in my village, or very close, in just minutes," and not the possibility of equal enjoyment of high quality and it being sustainable on all its dimensions, which empowers individuals as both humans and a community.

Attention should be paid to the possibility of personal fulfillment thanks to the available set of opportunities, which are objective and tangible in some cases, subjective and intangible in others, and the capacities to make them effective in an autonomous and conscious way (Nussbaum and Sen, 1993; Robeyns, 2020). It means offering resources that are public and/or private, productive and/or non productive, with which to face undesired situations that make personal fulfillment more difficult, such as lack of socializing opportunities, which are particularly felt by young people (Conejós, 2019; Escribano *et al.*, 2023), and loneliness, which is suffered mainly (but not only) by the older population (Hussain *et al.*, 2023). In short, this means acting in the well-being realm by considering personal satisfaction or, in other words, happiness (Layard, 2006, 2010). This change of paradigm would allow to complete traditional analyses about depopulation processes, and devitalization and territorial disarticulation in general (Molina, 2019). It would offer a much more suitable theoretical and practical tool, especially for small rural communities, where individuals' prominence and personal recognition are key (OECD, 2020).

## 2. PLACE SATISFACTION OR WHAT KEEPS AND ATTRACTS PEOPLE TO A PLACE

Individuals' happiness with or attachment to the place where they live, their satisfaction, and their well-being and quality of life, are subjects of the Geography of Happiness or Economics of Happiness. This is an extension of socio-psychological or socio-economic research into the determinants of people's affection for their living environment, including sense of community, available social capital, attachment to a place, etc. Such research often focuses on the geographical conditions that shape happiness, the personal, social or cultural framework of individual happiness, or the impact of urban planning and architecture on people's satisfaction. The geographical dimensions of happiness also interact with a wide range of economic (income, employment, type of work schedule, etc.), socio-demographic (age, family situation and composition, social capital, community networks, health, etc.), religious, cultural and political aspects (democracy, transparency, trust in public institutions, civic participation, etc.). Other conceptualizations are not directly related to people's feelings, but express perceived characteristics of the place lived in. We refer to expressions like place identity, sense of place, quality of life, place attractiveness, human scale of places, etc. (Kourtít *et al.*, 2020a, 2020b, 2021).

The spatial or geographical dimensions of happiness have been paid little explicit attention by either economics or psychology and sociology research. There are aggregate-level studies for certain countries, but research into happiness at the local level is still limited. Indeed conventional approaches to studies of specific places focus more on urban and metropolitan areas (Tov and Au, 2013; Veenhoven, 2014; Kourtít *et al.*, 2020b, 2021). These typically employ survey methods on subjective life satisfaction through perceptions or feelings of satisfaction that vary over time, and do samplings of personal experiences. In both cases, the spatial

context of analysis and the operational definition of the analyzed variables are crucial. Many studies often adopt a specific approach to happiness, quality of life or well-being, and then examine it from a multidisciplinary perspective.

Place identity is often addressed in environmental psychology, sociology, spatial planning, architecture, anthropology, geography or marketing. It helps to better understand the relationship between people and place. Its substantive meaning has been interpreted and defined in numerous ways; for example, in social identification terms (as an identifier of individual or group identity, or of a group in a specific territory), the profile of the place itself (as distinctive of its characteristics) or sense of place (emotional experience in a place). From various interpretations, place identity is understood as a set of physical attributes, functions, meanings and symbols, created both from an external image and an internal culture. These interpretations depend on physical and functional factors, and also on emotional ones. Thus identity or sense of place is combined with the idea of image from perceptions, emotions, culture and history, and with the natural and built environment, its typology, its materials, etc. This image can, in turn, generate a feeling of inhabitants' pride and attachment by presupposing a positive emotional, cultural or economic bond with it. The analysis of images, discourses and interpretations that rural inhabitants carry out of their daily lives makes it easier to understand rural place production (i.e., depopulation, counter-urbanization, gentrification, rural idyll, etc.).

Quality of life studies are primarily found in the economic and geography literature, whose main goal is to examine and unravel the attractiveness of a given territory, particularly in migratory influx terms (Morén-Alegret, 2008; Pérez and Sánchez-Oro, 2012; Collantes *et al.*, 2014; Sampedro and Camarero, 2018; Ruiz *et al.*, 2019; Rivera, 2020). It is often interpreted as a set of functional factors, such as employment opportunities, educational facilities, healthcare services, quantity and quality of social interactions, lower crime rates or land prices, and also with the services inherent to place, such as a unique, singular and "little" altered physical environment, the quality of environmental resources, the landscape or morphology, consumer services, lifestyle, etc. These are factors related to the intrinsic capacity of rural areas to attract (new) population, but they miss the fact that residential relocation in rural areas is also motivated by aspects related to repulsion/expulsion from cities.

Defining and quantifying quality of life, and by extension happiness in rural areas, is somewhat complex. There is no accepted and consensual definition of the concept. This notion generally differs from one individual or social group to another (as it can be the result of both an individual and collective vision). This makes it difficult to establish the variables to consider, their subjectivity and the variations they may present according to the profile being worked with (i.e., neo-rurals, returnees, retirement migration, labor migration, etc.), and even the considered spatial scale (the quality of life of a region may be considered relatively good in general, but not so particularly for one of its municipalities or several).

Most authors agree that quality of life is a concept that oscillates between a psychological or cultural dimension, and an environmental or material one. The former refers to a series of human psychological mechanisms that determine the degree of satisfaction with which each person or group rates their lived experiences (degree of freedom, trust, happiness, etc.). The latter refers to the external conditions that activate those internal mechanisms. This dimension is often associated with specific living spaces, such as the configuration of the place of residence, its environmental quality, etc. This is, in turn, related to the immediate environment; that is, the local territory. The higher or lower degree of satisfaction that each person or group feels also varies over time. So this is no static concept, but is continuously constructed for which comparisons can be made at different times. For example, the specific factors that can contribute to the maintenance of the local population, or can attract people to settle in rural areas, may lose or gain value depending on the opportunities or difficulties of various types that endanger the life project that links them with that space and, with it, the role they can play in the revitalization and (demographic) sustainability of rural areas.

### 3. OBJECTIVE, METHODOLOGY AND STUDY AREA

Maintaining intermediate population towns, given their role in articulating their surrounding rural environments (regardless of their identification with county seats), is essential for facing the extreme demographic weakening of the rural settlement system, particularly in micromunicipalities. These intermediate centers are the “last line of defense against depopulation” thanks to the services they still provide. So these are likely the municipalities that should concentrate the efforts of public strategies. However, it remains to be determined which services are considered important by rural communities because they are essential for their happiness and well-being; that is, those that will allow them to maintain their life projects, to promote permanent roots in the place or, if they disappear, those that will force them to leave and relocate elsewhere (to an urban place or another rural destination).

We distinguish two socio-demographic profiles. On the one hand, the “rural population”; that is, those with personal paths always linked with the rural environment due to their permanent residence there, their daily consumption, and even their incomes. However, these last aspects may no longer be exclusive to the rural itself over time; on the other hand, the neo-rural population; that is, those inhabitants whose permanent residence has recently occurred after previous life experiences in urban areas. This is generally a “distant” population from the daily dynamics of rural territories, but who value it the same as an integral part of their daily life, their well-being, based on emotional aspects, and on cultural, ecological and/or social roots.

Fieldwork was carried out in the Valencia province that spans 10,763 km<sup>2</sup> with a population of 2,684,403 inhabitants (INE, 2023). The organization of the territory is conditioned by the system of population centers, particularly the urban system, which channels the main territorial processes regardless of them being economic, demographic, social, cultural or environmental. The 266 municipalities in this region are characterized by their heterogeneity. The range of centers is very diverse in demographic size terms, and their territorial distribution is not uniform. The city of Valencia, the provincial capital, and its metropolitan surroundings comprise 44 municipalities and represent 60% of the total provincial population; that is, 1,599,656 inhabitants (INE, 2023). The rest of the territory is characterized by the predominance of very heterogeneous rural centers ranging from municipalities in clear demographic decline and at a high depopulation (and even a depopulating) risk, to other relatively stable ones that even report slight population growth, normally due to the role they play in their counties as market towns or their good connections with metropolitan transport infrastructures. This unique spatial population distribution creates a duality between inner and coastal areas.

To compile the list of rural municipalities from which to collect the necessary information, we used the delimitation provided by the Local Action Groups (LAG) of the LEADER 2014-2020 program (Table 1). All these territories exhibit common elements related to depopulation determinants. Lack of economic dynamism is one of them. In addition to a relative weight of the primary sector (in decline), issues like a small market size, particularly in terms of employment opportunities, promotion of new productive activities, lack of innovation, specific problems with housing and the supply of some basic services because they do not have minimum population levels, are pointed out. A second handicap is accessibility problems and connectivity issues in broadband connection and mobile coverage. The third constraining element is lack of some public facilities that allow adequate care levels.

The final information was obtained by simultaneously combining two research methods, one qualitative and another quantitative, which were conducted from June 2019 to March 2020. In the former, eight focus groups were set up, made up of the key stakeholders from each selected territory (two focus groups per Local Action Group, LAG). In all, there were 110 participants, and sessions included from six to 32 attendees. Access to participants was gained by contacting representatives of the local administrations belonging to LAGs

Local Action Group 14-20	Number of municipalities	Average distance in km to the main county's town	Average distance in minutes to the main county's town	Population in 2012	Population in 2021	Population evolution 2012-2021	Area in km <sup>2</sup>	Population density in 2012	Population density in 2021	Sex ratio (2021)	Aging index in 2012	Aging index in 2021	% employment in primary sector Dec 2014	% employment in primary sector Dec 2021
Turia - Calderona	44	18	19	42,872	42,149	-1.7 %	2,167.98	19.78	19.44	112.9 %	347.31	343.14	17.96 %	12.41 %
RURABLE	23	15	16	76,409	73,045	-4.4 %	3,495.71	21.86	20.90	110.4 %	305.57	318.2	19.09 %	16.96 %
Caroig, Serra Grossa & Riberes Xúquer	40	16	17	64,090	60,074	-6.3 %	1,459.58	43.91	41.16	102.5 %	187.48	204.7	21.74 %	12.41 %
Som Rurals	41	19	19	40,117	37,896	-5.5 %	650.98	61.63	58.21	104.6 %	213.2	217.3	14.14 %	9.22 %

Table 1. Socio-demographic indicators of LAGs 14-20 in the Valencia province

Source: the authors based on the socio-demographic indicators of the Statistical Portal of the Generalitat Valenciana. Most data correspond to 2021. The primary reason is that they were consolidated data (the data from 2022 were provisional at the time the database was updated). Additionally, the 2022 data could involve biases due to the provisional population relocation during the COVID-19 pandemic, especially in small municipalities.

where the research was conducted, and their managers. These contacts provided a list of potential participants interested in depopulation processes given their personal and/or professional connection to the selected areas. The invitation to participate considered certain factors: gender, age, job, residence and place of origin. The aim was to identify different ideas and behaviors based on the profile of the involved individuals, i.e., those who continuously lived in the rural environment and inhabitants with an urban residential lifestyle.

The average group discussion duration ranged between 2 and 3 hours, depending on the number of participants. All the sessions were recorded in audio. Each session started by organizing thematic working groups (formed only when the number of attendees was sufficient, and always starting from a minimum of five or six members). They ended with a plenary session, during which the main common points were presented and conclusions were drawn. To facilitate discussions, a script of the key points to address was prepared, along with the same points to be explored during a survey.

The purpose of the survey, like the focus groups, was to know different perspectives of the rural inhabitants of Valencia on depopulation and its related dynamics (employment, housing, social relationships, etc.), the motivations that led them (or not) to live in these territories, and the importance they attach to the presence (physical or accessible and in proximity) or absence of various services and facilities for remaining or moving to other areas (equally rural, but with more labor and social care offerings, or urban).

The survey was anonymous and included 18 questions that focused on aspects like: i) mobility within the territory; ii) importance of having various local facilities and their impact on perceived well-being; iii) their reasons for staying or leaving the territory. Basic demographic data were also requested to profile each respondent (level of education, gender, employment status, level of dependency, private car availability, etc.). Most questions were closed-ended to facilitate responses to a wide range of topics. Open-ended questions (with a limited response space) were also included to allow respondents to express themselves more freely and to, thus, offer nuances to extend and/or complete their previous responses. This approach ensured that all the participants' assessment of all aspects could be synthetically obtained in writing. In all, 110 surveys were collected for the non probabilistic sample.

## 4. RESULTS

### 4.1. CHARACTERISTICS OF THE SURVEYED RURAL POPULATION

The surveyed “rural population”, which comprised 62% of the participants in the group dynamics, showed slight differences in gender terms, but varied in age terms. Most of this group was aged between 40 and 64 years old. These data allowed us to identify the working adult population as those who, based on their participation in the activities that we organized, showed more interest in the issues related to the depopulation of the places they lived in, and in understanding and discussing its processes, stakeholders, consequences and possible actions. The sample displayed a high mobility level (all indicated having access to a private vehicle) and a high level of education for typically holding university degrees. This is somewhat related to the type of employment of most participants: local administration or education (high school teachers were common). However, workers from the private sector, primarily farmers, also attended. Regarding the declared family situation, most participants indicated that they lived with others, usually not dependents. In fact the few cases who reported having a dependent family member mainly involved children. This suggests that the sample represented relatively young families.

The second identified group, the neo-rural population, consisted of individuals who had mostly moved from the city of Valencia or its metropolitan area to rural municipalities in the province. With some exceptions, participants came from outside the Region of Valencia, but had roots in the territory. Due to its uniqueness, it is also noteworthy that retired attendees from Europe were present because this type of population usually settles in municipalities closer to the coast to seek a warm, sunny climate. Similarly to the rural population group, there was no significant gender differentiation in neo-rural attendees, but there was in age terms. The majority of this group was also aged between 40 and 64 years old and, once again, was an adult population also characterized by holding university degrees. This is a significant feature for showing the presence of highly qualified individuals who have chosen to move (or, in some cases, return to their family roots) to rural areas.

Regarding the neo-rural attendees’ occupation, the participation of people from both public and private sectors was significant, although the former was more prominent, with similar occupations to those identified in the rural population group (local administration, teaching, etc.). The main difference here lay in the type of private activities. Apart from individuals linked with the primary sector (agriculture and beekeeping), others were engaged in hospitality and were mostly self-employed. In any case, this profile also had no problems with spatial mobility because all the participants had access to a private car and with family responsibilities linked with the dependents in their care.

### 4.2. QUALITY OF LIFE AND PLACE ATTACHMENT

Regarding the most important reasons for continuing to reside in rural areas, differences were observed between the responses from both groups. Nearly 50% of the “rural population” considered attachment to their municipality as the most important factor for staying, i.e., the esteem and pride derived from living in the same place for a long time, often across generations. The second most important factor was established to be personal relationships, considered closer than those in urban areas. Job opportunities, rural lifestyle and other aspects like homeownership were less commonly cited.

The analysis of the neo-rural population’s survey responses showed that attachment had lost relative importance as attraction to place, but was still the commonest response of the people born in the city, but with family and/or property ties in rural areas (children and grandchildren of rural exodus migrants). Closely behind other motives emerged: rural lifestyle, understood as a slower pace of life compared to the city, and quality of life in these territories (tranquility,

landscape, environmental quality, feelings of greater security, etc.) were increasingly valued by neo-rurals, partly derived from the idealized rural environment seen from urban areas and which, as they acknowledged, have often led to unmet expectations. Other significant factors for neo-rurals included being in direct and continuous contact with nature, personal relationships established over time and, to a lesser extent, available or developed job opportunities.

As to the value placed by the rural population on the availability of certain local facilities, the most important one was the combination of schools and medical care (43%), closely followed by good public transport services (30%). These results were similar to those of the neo-rural population: school was considered key (31%), followed by public transport services (24%), although the difference being that other offers, such as the local presence of a social meeting space like a café and access to broadband Internet, were also valued (16% each). Undoubtedly, the respondents' age range somewhat explained the little importance attached to healthcare services. Employment availability (as both employees and the self-employed) explained lack of notable ratings for needing social services.

The importance of school was noted in both groups, as was quality public transport services to allow residents to move around the territory without relying on a private vehicle. This is interesting given that almost all the respondents had their own vehicle, but considered that such facilities would improve connections between municipalities and provide travel options.

Despite the importance that both groups attached to basic public facilities/services like schools, all the surveyed rural population and 75% of the neo-rural population would continue living in the same municipality if this provision disappeared, but was replaced with a mobile service. This result once again highlights the importance of public transport for assessing quality of life and, therefore, their willingness to stay. When asked about less frequently used facilities, for example a bank or savings bank, the response was similar: 100% of the rural population would remain in the municipality, compared to 86% of the neo-rural inhabitants, who would also continue living in the same place.

Territorial mobility was, thus, one of the basic issues that was recurrently reflected in many ways. The respondents of both types were willing to travel to continue accessing services if they were not locally available. Indeed both the rural and neo-rural populations who participated in the group dynamics acknowledged that they did trips covering distances between 5 km and 15 km, which can take up to 20 minutes depending on road conditions, to access basic services, such as schools, pharmacies and doctors, or to purchase essential goods. For other relatively more specialized and less frequently used services (i.e. ATMs, specialists, hairdressers, garages, etc.), responses showed that travel can take residents as far as 40 km away, and can take between 30 and 60 minutes. Although the respondents always mentioned that trips were made to the nearest municipality that offered the required service, they were also willing to travel longer distances without changing their residence when key facilities like schools were not available. This can be interpreted as a result of strong local attachment and extensive mobility.

Not having basic services or amenities in the same locality was not a problem for them, but not having easy access to them was because it requires proper infrastructure and a good transportation network. However, improvements in mobility services have led rural residents to spend more time outside the municipalities where they live. This has ultimately reduced social interaction opportunities by gradually eroding social relationships and activities that involve the shared enjoyment of spontaneous, safe, pleasant and desired interactions, all of which contribute to and define community well-being and, consequently, rural inhabitants' individual quality of life. Hence it is appropriate to not only improve these facilities, but to also provide activities that meet the local society's needs for community interaction.

On hobbies and leisure, the responses given by the differentiated groups were similar: about 60% enjoy activities related to nature or the outdoors, while 30% prefer spending time socializing. Ten percent prefer attending to and/or engaging in cultural activities. Opinions varied about the survival of these activities if depopulation increased. Eighty-four percent

of the rural population believed that these activities were not at risk, had always existed there and would continue to do so. Only 64% of neo-rurals thought this way, which showed that the latter took a relatively different socio-cultural attitude toward the environment, and to its enjoyment and conservation. However, 85% of the surveyed rural population would continue in the municipality even if their possibility to practice their hobbies disappeared, but only 50% of the neo-rurals would not. This indicates a relatively stronger attachment for those who had always lived in rural areas.

Almost all the respondents (100% of the rural population and 86% of the neo-rural) knew people who have had to migrate to urban areas, but the reasons that both groups provided differed. Both considered lack of qualified employment to be the main factor that drives out-migration. However, the rural population also cited other reasons, such as moving to study or socio-cultural issues (by referring to the fact that there were sometimes prejudices and discriminatory attitudes toward some groups in villages). Others pointed out issues that included detachment (a significant factor for the rural population), difficulty in accessing housing, and unequal opportunities compared to urban environments. The neo-rural population highlighted two factors other than unemployment: family matters and unequal opportunities compared to cities.

As in the previous case, the complete surveyed rural population was aware of the arrival of “new” inhabitants in their village, as was most of the neo-rural population (84%), who identified similar reasons, with employment being the most prominent. As many respondents noted, seeing that these jobs were sometimes precarious and seasonal, a significant part of the people who occupy them are foreign immigrants. Because of their temporality, these job opportunities were not seen as being capable of maintaining a population in the territory in the long term. Another factor that was repeatedly mentioned about attraction to rural areas was the higher quality of life that could be enjoyed there, followed by the existence of socio-family networks. Specifically, the rural population also differentiated the possibility of living near a high-quality natural environment.

Apart from loss of certain services, population decline, heritage abandonment, etc., one of the most relevant issues related to people staying in or leaving rural areas was lack of (self-) esteem by local society and its capacity to recognize the strengths and values of a rural area. This perception seemed to reproduce the association of characteristic ideas since halfway through the last century, the time when rural exodus peaked, and between failing to stay in the village given the possibility of (personal and economic) “modernization” and growth in cities. This narrative first overvalues the urban space over the rural by not having services and offerings in the same way. Second, it disregards the fact that there are also negative aspects in the city, such as stress, increased pollution, insecurity, overcrowding, negative effects on health, high cost of living, etc. Cities also contribute to this perception by constantly reproducing situations of servitude in the countryside; for example, the rural environment acting as a sink and a provider of resources or a source of recreation. These situations are sometimes reinforced by social media that project the urban lifestyle as a model to follow, and one synonymous with (social and professional) success, leadership, independence and freedom.

In this regard, the participants’ discourse was about two actions or strategies, and each one focused on a particular (urban or rural) territory, but both shared a common goal: to recover the rural population’s self-esteem. Regarding the strategies that focused on urban areas, our interviewees proposed co-creating awareness about rural areas not as a product to consume or “musealize”, but as territories in which to invest all kinds of resources (economic, familial, patrimonial, etc.). As they acknowledged, this is crucial to work decisively to retain (root) this population profile because it is often responsible for the most dynamic and regular socio-cultural activities over time, and is central to some villages’ survival.

This revaluation requires all the individuals and entities linked in one way or another with the rural environment to make a co-responsible effort. Our interviewees indicated that it should start with public administrations’ ability to develop and disseminate awareness and promotion campaigns to reveal the complete and complex reality of rural spaces. Besides, they should

provide truthful and up-to-date information for those interested in it, which should go beyond simple tourist marketing, and delve into the various types of cultural, social, and relational issues that organize the day-to-day of municipalities and inhabitants of rural areas. And all this without forgetting the important role of media in generating and transmitting the idea of rurality given their capacity to influence individual and, by extension, collective perceptions and behaviors, and to avoid undervaluing and hiding the negative externalities that exist in rural places. Hence the need to banish the romantic, bohemian and idyllic image of the countryside is reiterated. It often forges false expectations of what it really is by frequently generating frustrations of those who “come” to it after assuming that vision as completely valid.

As for the strategies that focus on improving and/or increasing the rural population’s self-esteem, the participants in the discussion groups suggested various proposals. There was the premise that if rural inhabitants do not feel proud about (and convinced) of living in the rural setting, then people from outside can hardly be expected to want to come and settle there definitively. For example, they emphasized the need to strengthen social, economic, patrimonial and emotional ties with the lived territory. In this sense, the advisability of promoting social relationships through relaxed and/or proactive meeting spaces, also endowed with satisfied and, therefore, capable of contributing to the realization of the various life projects hosted by the population living in these spaces, was pointed out. As our interlocutors recognized, this is the key. They mentioned issues related to leisure, sports and culture, or simple informal meetings. They also mentioned places and ways in which to start discussions about the design and execution of activities and projects to encourage widespread involvement and participation and, gradually, community management of the territory and its resources. This would support the local population to become more directly co-responsible for the decisions made and the initiatives taken in their territory.

This proposal also focuses on a fundamental profile for the demographic sustainability of rural areas: the young population, including teenagers and children. This population still hopes to shape its life space at the beginning of its life projects. Getting them to appreciate rural places is, *a priori*, relatively easier compared to other population profiles that may have already become dependent and/or have established complementarity relationships with other territories. This approach could be more effective if accompanied by processes of transmission and/or training in values, such as commitment to, interest in and respect for the environment and its society, and by showing, at the same time, the various possibilities for self-fulfillment and dignified life that rural places can offer.

## 5. DISCUSSION AND REFLECTIONS

### 5.1. QUALITY OF LIFE IN RURAL AREAS: DIRECTLY RELATED TO SERVICE PROVISION

In the 21st century, awareness about the serious demographic challenge that stems from the aging population in Western societies has grown. This awareness has occasionally focused on rural areas. In Spain, this awareness has particularly highlighted population loss. This loss also has historical roots, linked with the formation of national settlement distribution, economic modernization (including agricultural transformation), among others. However, Spanish society increasingly perceives it as a significant problem.

The duration and intensity of the depopulation process that Spain has undergone for years indicate that our settlement distribution is showing a marked weakening of less populated municipalities, or micromunicipalities. While many of these may have some vitality (and viability) as a non permanent residence for some people, these municipalities are generally in crisis and show no viability. However, depopulation effects also affect other segments of the settlement system that also present progressive weakening, particularly municipalities

with up to 2,000 inhabitants. This process, which affects these localities, can be problematic from the service provision perspective. Size does not necessarily and strictly determine the functions that population centers perform, but it is known that in inner rural areas, even small centers (of around 2,000 or 3,000 inhabitants) can host functions that are unthinkable in an urban environment.

Despite clear signs of weakening at medium and high urban system hierarchy levels, ranging from towns with certain central functions to proper county capitals and, in more exceptional cases, even provincial capitals (like Teruel or Soria in Spain), the extreme weakening of both micromunicipalities and a large part of the support system means that we face a reconfiguration process that, in some territories, may entail a growing disarticulation of the traditional rural system. In short, depopulation in Spain represents, in the words of some authors, a true territorial crisis (Molina, 2019).

To address this problem of the territorial disarticulation that arises from the depopulation process, it is necessary to overcome certain myths, such as the excessive confidence in infrastructure and facilities, given the assumption that these attract economic activity (and would, thus, help to retain population). This is a long outdated notion, but one yet still defended by the political class. The same applies to job creation as a remedy against depopulation, when it is known that many of the jobs created in rural areas are occupied by people who travel from non rural villages.

However, international institutions like the OECD (2016, 2018, 2020) explicitly highlight the need for policies in rural areas to support adaptation to demographic changes by paying particular attention to the quality of and access to services as an element to not only improve rural residents' quality of life, but also as a way to attract potential new settlers. Strategies for retaining and attracting, especially young people, are emphasized by service improvement in general, and by those related to health, education, and both physical and digital connectivity, in particular. These can address undesirable situations that make personal fulfillment challenging, such as lack of peers with whom to interact (Sáez, 2019).

Indeed the value of services is not enough. The development of life projects also requires other elements, such as housing, leisure, employment, work-life balance possibilities, support networks, transport (or mobility), etc. If only one or two of these factors are promoted in isolation, it will be difficult to fully achieve well-being and/or happiness in a place that allows population to root in the territory. Moreover, social reluctance to lose a class of services that has (to a greater or lesser extent) always been present in rural spaces and are not only the last available ones, but also almost the only means of social interaction, must not be overlooked. Educational and health services, along with others like local commerce, post offices, bars, etc., constitute the "glue" of rural life. Thus signs of a rural school or a health center closing are threats to rural communities and their way of life in general, and also to their well-being and happiness. Their disappearance not only means loss of key functions, but also entails the deterioration of one of the most important symbolic features of rural areas (Forsythe, 1984; Woods, 2006; Brereton, *et al.*, 2011).

As the largest population groups in rural spaces frequently neither have nor can use private transport means to move autonomously across the territory, their well-being level will significantly lower if these services end up being located outside the local area. This is mainly due to the need to rely on public (rural) transport characterized by its limited spatial layout and sparse temporal offering, which forces them to face longer access times to demanded services and, consequently, alters their consumption habits of these services and other aspects in general (leisure, shopping, etc.).

However, the accessibility and immediacy of certain public and private services are issues that should be debated more rigorously. As demonstrated by Goerlich *et al.* (2021), geographical accessibility is quite acceptable for most territories and people in Spain, including those in rural areas. This does not detract from the relevance or severity for those experiencing difficulties, which are particularly extensive in inner rural areas. As Sáez (2019) points out, one should consider the pros and cons of physically fragmented and dispersed

allocation, which is extremely questionable in efficiency, and even in equity, terms, and considers formulas that incorporate organizational, institutional and technological innovations in the provision of basic services. Cohesion depends not only or mainly on immediacy, but must be combined with other principles.

Most rural residents do not demand more educational and/or health services (they generally accept those that presently exist), but these services to be of quality, even if they concentrate in space (as long as they are accessible by public transport). It is more than demonstrated that the quality of the offer directly influences the population's use of these services. Thus having them in the same place of residence is of little importance if the provided service is perceived as insufficient and/or inadequate. It is necessary to seek other centers (further away), where one can access similar care, including that of higher and/or better quality.

## **5.2. LEADER AND ROOTEDNESS AMONG RURAL AND NEO-RURAL POPULATIONS**

Basic educational and health services are presented as one of the most important resources in the self-affirmation processes of local identity, in the search for roots and tangible references, of closeness and proximity, and against the advance of urban uniformity and homogeneity (Entrena, 2006; Bustos, 2009; Escribano, 2012). Indeed one of the most recognized potentialities of these services, specifically of the rural school, is its ability to offer local communities a range of strategies and resources to understand and respect their culture, and to value traditional festivals, the natural environment, their own history, etc. This implies providing open structures from which to jointly create, preserve and disseminate a series of local knowledge (Boix, 2003).

It is precisely around these open structures, such as schools or health centers, pubs and grocery stores, that a social fabric is built and shaped with the capacity and initiative to change lives. This occurs thanks to the social proximity that this class of basic services allows, and results from the daily encounter and the performance of a series of habitual tasks in a close spatial environment. These are settings in which establishing ties of trust and support is simpler than in dense spaces with more population to interact with, but paradoxically more elusive to it, due to the predominance of individual behaviors. When exchange occurs however, it enables the generation of a social fabric in which most people know one another, and where values like friendship, mutual aid or the idea of belonging are generated and, ultimately, influence residential satisfaction with the inhabited place (Auh & Cook, 2009). While having fewer residents may pose challenges in reaching certain local thresholds, it also provides a broader range of opportunities to engage in and to initiate creative and collaborative activities. In such settings, the community aspect becomes more significant and personal fulfillment is more attainable.

Once the local population is cohesive and rooted, it is relatively simple to support new residents' integration. They must often face various difficulties that endanger the life project and guide them toward rural areas, including the role they could play in their revitalization and sustainability. The success of their integration depends largely on the existence of a conducive and receptive environment; a welcoming atmosphere that does not often depend on strictly political elements, but on issues related to the values and daily social relationships that they find in their new destinations (Abraza la Tierra, 2006; Cruz Roja Española, 2006).

As Sáez (2019) highlights, a welcoming climate is crucially built on trust among neighbors and requires local civil society's active participation. Thus it falls on the residents of the community seeking repopulation to collaboratively manage new inhabitants' settlement and integration. Villages can only attract new residents if their current population is committed to embrace the shared challenges and to actively participate in welcoming initiatives. They must support the administrators of these policies, and contribute to build a social capital that reduces transaction costs and fosters trust both in the community and toward potential new residents. Without this communal effort, relying solely on attracting people from outside, without ties to the rural lifestyle or its socio-economic structures, poses a significant risk.

It is crucial to support rural communities so they can continue to be viable. To do so, development programs at the county level are needed, in which rural civil society plays a central role in defining the lines along which public-private collaboration is deployed. This involves relevant missions like promoting rural entrepreneurship, productive diversification, social revitalization (and training) and new settlers settling in. This approach is theoretically robust and constructed around, for example, LEADER (at the European level) and Law 45/2007 for Sustainable Development of Rural Environments (in Spain). Both examples are probably the most appropriate approach for sustainable territorial development in rural areas. They should be considered a reference framework for policies against depopulation.

Depopulation is a multifaceted phenomenon with numerous implications, and one that leads to political strategies that often amount to a mere collection of independent measures. Each measure might be justified as part of a strategy, and every outcome is attributed to these measures. However, such an approach simplifies the complex depopulation challenge and cannot replace a coherent, integrated strategy. Failure to implement territorial strategies that focus on rural areas as a whole, rather than just individual municipalities, can lead to significant losses: synergies, multiplier effects, valuable experience and expertise. The solution lies in the development processes of rural territories, which are inherently broader and more complex. This requires public policies that adopt a comprehensive and structured approach to the settlement system by embracing a vision that leverages synergies from local populations and stakeholders, and existing governance arrangements. It also requires place-based leadership that can effectively guide both strategic planning and the day-to-day management of policies at all the relevant levels. What is essential is establishing robust, proactive administrative units, which may be pre-existing or newly created ones that are well-coordinated, functional and equipped with management capabilities to effectively enable them to mobilize all forms of territorial capital.

However, it is crucial to not mistake the means with the end: neither LEADER rural development programs nor Zone Plans under the Rural Development Programs of Law 45/2007 are designed to directly tackle demographic decline in rural areas. These programs have specific goals which typically aim to either diversify rural economy or support sectors that face unique challenges, such as mountain agriculture and livestock. These measures essentially seek to enhance the rural population's income and economic levels. Although it is possible to anticipate that these efforts might indirectly influence demographic trends, it is also important to recognize that demographic phenomena have their own intrinsic dynamics. Recent experiences suggest that rural development policies and programs have had a limited impact on these dynamics. Expecting these initiatives to significantly affect demographic trends, particularly halting depopulation, would be misleading. There are two reasons for this: measures not specifically targeting these issues and demographic challenges being structurally complex.

### **5.3. FUTURE DIRECTIONS**

Attempting to restore the highest population ratios from decades past in contexts and dynamics that no longer exist is not merely a miscalculation or an idealization of the past, but can also lead to significant negative outcomes. These include frustration, inefficient and inequitable resource allocation, and the oversized construction of infrastructures and facilities, which do not necessarily enhance the local population's quality of life. Furthermore, having a smaller population can also offer unique advantages that lead to a more manageable community size (Sáez, 2019). In less populated areas, it is easier to initiate and engage in new activities, where the individuals who promote these activities can have a more significant impact, which leads to a more mindful living experience. This involvement enables them to play key roles by fostering "civic pride" through self-esteem, recognition and participation in community-enhancing activities that generate commitment. Hence the connection linking residents, well-being, development and dynamism is complex and not linear. Factors like cultural initiatives, social spaces, cooperative relationships, conflict management and diversity must also be considered indicators of community cohesion, equity, resilience, personal fulfillment, rootedness and autonomy.

In light of this, it is crucial for future analyses to progressively include references to intangible elements that add value to infrastructures (like telematics and communications) and facilities, such as: setting up professional teams; the presence of collaborative networks, regional projects and engagement in educational communities; the facilitation of research and innovation transfer in various creative processes. All this also involves creating welcoming environments and promoting open mindsets. Technologies like Big Data and Artificial Intelligence also present opportunities for studying the rural and urban populations' permanent, seasonal and daily mobility. Our findings and these prospective methodologies underscore the ongoing need to delve more deeply into phenomena like depopulation, attachment and sense of place to, thereby, enrich socio-relational and cultural discussions in the literature on demographic processes in rural settings.

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# Structural permanence of social and demographic change:

THEMATIC EMERGENCIES, SPATIAL SPECIALISATION  
AND MULTISCALARITY IN SPANISH GEOGRAPHICAL RESEARCH  
(2013-2023)

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## ABSTRACT

Social and demographic change is of crucial importance and involves issues of great impact for society. This is the basis for a systematic and holistic review of Spanish geographical contributions to the study of social and demographic change, and its territorial expressions from a multi-scale perspective, between 2013 and 2023. One hundred and thirty-five contributions – systematised using a Survey 123 form and a dashboard implemented by ArcGIS Dashboards (Esri), which is accessible to be consulted by the community – have been analysed. The results reveal the weight of the quantitative research, the contextual importance of the economic crisis and the COVID-19 pandemic, the spatial specialisation of geo-demographic studies from a bifocal approach to the urban and rural, and the thematic importance of ageing, migration, gentrification, touristification and the housing crisis. The studies put forward relevant proposals to contribute to decision making.

## KEY WORDS

Review; dashboard; geodemographics; thematic emergency.

## 1. INTRODUCTION

Social and demographic change is a crucial issue in the contributions of Spanish geography, and most specifically of human geography. Any attempt at summarising is a challenge that would greatly exceed the likelihood of faithfully expressing the solvency and interest of the contributions. Therefore, this paper mainly focuses on providing a systematic and holistic view of the vast bulk of the contributions of Spanish geography to the study of social and demographic change –and its territorial expressions from a multi-scale perspective– during the last decade.

The paper starts with a bibliographic selection of publications that meet three criteria – the thematic relevance, in other words, coincidence with the key search words (demographic change, social change, gentrification, ageing, etc.); a timeline between 2013 and 2023; and, finally, the authorship profile, obtained by filtering studies that have at least one author from the field of geography or institutionally attached to geography departments or units.

After the aforementioned criteria had been reviewed and the abstract and key words drafted, a total of 135 publications were selected and then reviewed in detail. A form was implemented in *ArcGIS Survey 123* and a dashboard designed using *ArcGIS Dashboards* of the Esri ecosystem in order to systematise the analysis. The use of these tools facilitated a quantitative and systematic interpretation of the publications reviewed, which are set out in Section 2 of this paper and are the basis for the subsequent theoretical-conceptual sections, aimed at providing a global and holistic view.

## 2. SOME FIGURES ON SOCIAL AND DEMOGRAPHIC CHANGE AS A RESEARCH TOPIC

The reviewed contributions on social and demographic change are mostly contextualised in research projects (Figure 1), which shows the importance and presence of this theme in the calls. In fact, 55% of the publications are part of a research project – fundamentally as part of national competitive calls, which account for two out of every three contributions – followed by projects funded by regional governments, and, finally, 11% of the contributions are linked to European projects.

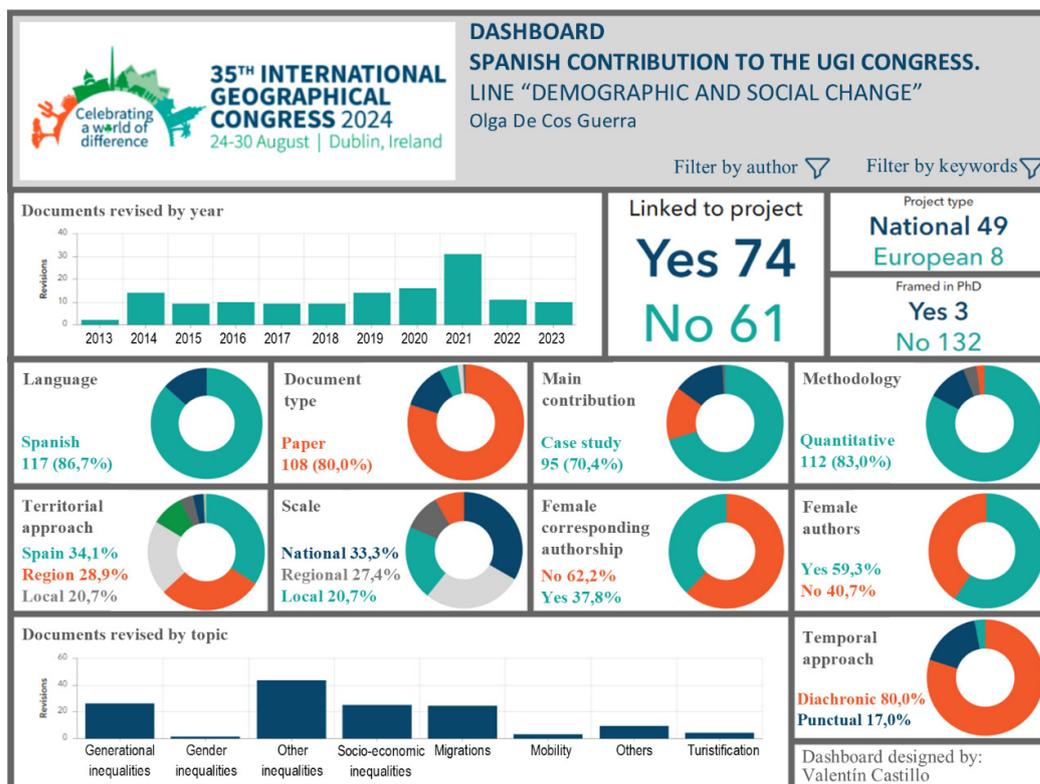


Figure 1. Dashboard<sup>1</sup> of the main characteristics of the reviewed publications. Own compilation.

1 Supplementary material. Interactive dashboard freely available to the community through the following link: [<https://unican.maps.arcgis.com/apps/dashboards/28c87fa4b51b405298374374dd7ab568>]. The dashboard includes identification details and interpretations fields of the 135 publications reviewed for this contribution. This tool allows queries and filtering in real time. The tool was designed by Valentín Castillo, a GIS and digital mapping technician at the Department of Geography, Urban and Regional Planning of the University of Cantabria. The logic design and content were provided by Olga De Cos.

Social and demographic change as a relevant and current topic on regional and national political agendas shows the need for the geographical contribution to move beyond its traditional link to the immediate local and regional territory, 'by territorialising research by academic fields', as pointed out by J. Gómez-Mendoza (2000: 7); the aim is for it to be positioned as playing an essential part in European and national calls as it studies the population and its present and future characteristics in the context of social and demographic change.

As regards the type of documents analysed, they are mainly journal articles (80%), followed by contributions to congresses (12.6%), and book chapters (5.6%). Most are publications written in Spanish (86.7%) and secondarily in English (13.3%). The prevailing methodology is quantitative, at the fore in 83% of the contributions, with a notable involvement of the Geographic Information Technologies, spatial analyses, and, even, spatial 'downscaling' estimates to disaggregate to building level the official data available for the census sections (De Cos & Usobiaga, 2019). This methodological profile is related to the use of open digital mapping sources as per the INSPIRE Directive (2007/2/EC), and the Spanish Ministry of Development's order FOM/958/2008, which involved the setting up of the Download Centre of the National Centre for Geographic Information (CNIG) and its amendment by Order FOM/2807/2015 to ensure greater accessibility. Furthermore, the download and consultation facilities of the statistical sources boost the repeated use of consolidated sources of the Spanish National Statistics Institute (INE) and of the regional statistics institutes. However, the qualitative methodology is only present in 2.2% of the contributions and a quantitative-qualitative mixed methodology in 3.7%.

On the other hand, special mention should be made of the strong territorial focus of the social and demographic change studies considered, with 70.4% of the publications analysing case studies, 14.8% reviews or further developing concepts, and 14.1% methodological contributions that would be replicable and, as applicable, scalable. The territorial approach is diverse and balanced; 34.1% are research for Spain overall, followed by studies on a specific autonomous community or region (28.9%), and 20.7% analyse local territories (municipalities, supramunicipalities, or similar). Secondarily, some studies address international scales (7.4%) and there are also publications where there is no territorial dimension (8.9%).

If we analyse the specific topics covered in the studies, there are certain differences of interest. Particularly noteworthy is the research that seeks to highlight inequalities with different matrices: territorial (43 contributions), generational (26), socioeconomic (25) and migration (24). There are two different contextual facts regarding the period in question that are often mentioned. First, the 2008 economic crisis is referred to in 51 contributions (37.8%) and, usually, as a context to interpret the changes that can be seen in time series of certain demographic variables, such as migration.

The COVID-19 pandemic is the other key event that emerged in geodemographic research. After its outbreak in 2020, an application of part of the methods and expertise was detected prior to the research progressing to the pandemic and its social and demographic impacts. A total of 23 publications (17%) includes COVID-19 in their key words. The modal year was 2021, with 11 publications on the pandemic. Part of the contributions addressed the transmission and distribution patterns, along with their relationship with the socioeconomic context and the social determinants of health (Miramontes & Balsa, 2021; Perles *et al.*, 2021; De Cos *et al.*, 2023; Esteban *et al.*, 2023). Other more demographic studies addressed key themes, such as age and the pandemic and its impact on the transmission, mortality and fatality rates (Acosta *et al.*, 2021; Rodríguez, 2021); the effects of the pandemic on the demographic dimensions of the natural dynamics and the demographic structure, insofar as the rise in deaths had repercussions on the mortality rate and life expectancy, or the conditions of the pandemic on fertility, and from there on the birth rate, by altering reproductive decisions (González-Leonardo & Spijker, 2022; Díaz-Hernández & Domínguez-Mujica, 2023). Moreover, insightful research was conducted into the pandemic urban exodus from the large cities and the possible resurgence of the rural areas as the preferred place of residence; the research showed that this trend was never consolidated and did not manage to modify the internal migratory patterns, as the profile by the end of 2020 was already converging with the pre-pandemic period (González-Leonardo *et al.*, 2022).

Finally, the gender dimension is usually referred to in some of the studies, but not monographically. As regards the authorship, only 37.8% of the publications had a woman as the corresponding author, even though nearly 60% of the articles overall had at least one woman among the authors.

This initial systematic analysis was the basis for the conceptual-theoretical development, with a holistic approach that is set out in the following sections.

### **3. THE BIFOCAL SPATIAL SPECIALISATION OF THE STUDIES ON DEMOGRAPHIC AND SOCIAL CHANGE: FROM THE UNIFORM TREATMENT OF THE RURAL TO THE DIVERSITY OF THE URBAN**

The entrenched population-territory duality underlies an important part of Spanish geographical research into social and demographic change. The spatial expression of demographic change specialised in the opposing poles of a unique system with intermediate matrices is addressed mainly from a national and regional approach (De Cos, 2023). Therefore, we find a bifocal and spatially specialised approach, with studies that analyse the effects of social and demographic change on urban areas, along with others that monographically focus on the demographic aspect of the population decline and the population drain in rural areas; however, both extremes (urban and rural) are part of a synchronic and systemic reality with opposite poles that interact to produce a series of intermediate mediation nuances, that are more territorial than demographic and social.

The bifocal spatial specialisation of the studies on social and demographic change – except for a regional approach in some cases – makes sense when taking into consideration the highly specialised groups and lines that research the effects of demographic change in rural or, as applicable, urban areas. The bifocal research by types of territory allows further study of the enlightening concept of the vicious circle of rural population decline in contrast with the urban virtuous circle (García-Marín & Espejo, 2019). However, and as will be seen, geodemographic research into urban areas based on Spanish geography raises disruptive discourses removed from the idealisation of the urban world.

On the other hand, the spatial demarcation of urban and rural study areas is not free of difficulties in Spain. After decades of references to the defining characteristics of the rural and the urban, as well as of the complex peri-urban areas (Obeso, 2019), the study areas continue to be at the discretion of the researcher in question, where the demographic size, or the administrative constraints, are usually demarcation criteria. This fact is important insofar as the demographic change is usually addressed from a diachronic perspective; therefore, it may show a certain basis inherent to a variant definition of the rural or of the urban area, where it would be fundamental to have a uniform and constant definition of the rural area, both in space and time (Collantes & Pinilla, 2019).

#### **3.1. SOCIAL AND DEMOGRAPHIC CHANGE IN RURAL AREAS REGARDING THE CHALLENGE OF TERRITORIAL, ECONOMIC AND SOCIAL COHESION FROM A MULTI-SCALAR PERSPECTIVE**

The contributions address both the social and demographic traits of rural areas – and their contribution to the population decline and the population drain – and the putting forth of proposals or, at least, views that can contribute to broader regional strategies to regenerate rural areas in decline.

### 3.1.1. The inertial contribution of demographic change to the vicious circle of depopulation

In Spain, the National Strategy for the Demographic Challenge provides society with robust lines of geographical and, particularly, geodemographic research. Furthermore, there is an increasing trend for demographic news items in the last five-year period, coinciding with the steps provided by the Spanish Government to follow the guidelines set by Europe, including creating the post of Commissioner for the Demographic Challenge (Cora *et al.*, 2023). Greater awareness and engagement by regional governments has also fostered the prominence of demographic change and its impact on rural areas. Thus, in 2013 the representatives of the autonomous regions of Asturias, Aragón, Castile and León and Galicia drafted the institutional declaration regarding the Demographic Crisis as the Forum of Spanish Regions with Demographic Challenges, an initiative to which Castile-La Mancha, Extremadura, Cantabria and La Rioja subsequently signed up (Delgado & Martínez, 2017).

As is well known, rural areas have long experienced a significant loss of population, which is most evident in emigration, which is a factor responsible for the demographic ageing of the middle and bottom of the pyramid, an example of a change that has already become a permanent trait (García-Marín & Espejo, 2019). On the other hand, demographic ageing has made way for a 'second depopulation pathway', where the loss of population is no longer explained by emigration, with a demographic structure of older ages less likely to change places of residence; the key factor is now the negative natural growth, as *'negative population growth has led, even where there is no significant outbound migration, to the population continue to fall in many rural areas'* (Pinilla & Sáez, 2017: 9). Accordingly, the negative natural dynamics highlights the demographic imbalances in the European and Spanish regions with demographic challenges; they are immersed in a structural demographic crisis – where population loss, demographic ageing and depopulation are inseparable – after their evolution of negative migratory balances from the mid-20th century, particularly among the ages of the support population (Delgado & Martínez, 2017). As has already been stated, they are areas in a vicious circle, where there is a clear demographic component in the population loss, but also in the loss of services, the shortfall in job opportunities, and urban lifestyles being considered more attractive. In fact, when managers demand effective solutions, regional or local studies are frequently overwhelmed by the existence of macro-factors that greatly exceed the possibilities of changing a consolidated cultural, social and demographic dynamics of inertia, which contributes to individual decisions (García-Marín & Espejo, 2019).

Assuming that the special impact of demographic change on rural territories is not exclusive to Spain, the search for cohesion and the fight against exclusion are of particular importance. In the framework of the territorial and sociodemographic cohesions indicated in Article 174 of the Treaty on the Functioning of the European Union (Royuela, 2022), many have been calling for an information plan and a specific demarcation for the disadvantaged rural area of Europe, as has been the case for the other end of the system, i.e., in the functional urban areas, defined according to the principles of L. Dijkstra and H. Poelman (2012). That would help to prepare standardised monitoring indicators from a multiscale perspective (Burillo-Cuadrado & Burillo-Mozota, 2018). On the other hand, the requirement for European Union member states to comply with the goals of fighting against poverty and social exclusion by means of a national social inclusion action plan – which, in Spain, lies in regional active plans – attaches particular value to research that sheds light on the vulnerabilities for social inclusion in rural areas as well (Escribano *et al.*, 2020).

From a critical approach, Spanish geography strives to break through the barrier to pursue contributions that help territorial planning by means of designing public policies that mitigate the effects of the demographic crisis (Vidal & Fernández, 2022; Aldrey & Constenla, 2023); however, there are no lack of obstacles rooted in demographic change, to the extent that much of the discourse considers the necessary *'mobilisation of the local demographic potential'* (García-Marín & Espejo, 2019) in line with the *'neo-endogenous rural development'* (Navarro *et al.*, 2021); we there encounter an absent, hollow support generation, and a weak *'demographic dividend'* with difficulties to support the weight of the imbalanced ratio between the potentially working and non-working population (Reques, 2012).

That being so, some studies propose social transfers as a path for the demographic stability of the demographically vulnerable rural communities, considering economic factors, such as unemployment benefits for the farming population and the pension system (Larrubia *et al.*, 2022).

Economic contributions, population ties, the tradition of 'village offspring' spending their leisure time back in the countryside (Alario *et al.*, 2018) or 'roots tourism' of emigrant descendants have helped the population decline not to lead to a population drain, despite the general demographic weakness in many of the territories (Delgado, 2018). Then there are other location variables, such as accessibility, with its proven direct correlation with steady annual real growth (Ruiz-Pulpón & Martínez, 2022).

Accessibility frequently appears in the research on vulnerability of rural areas. Furthermore, territorial vulnerability stemming from the accessibility or location places additional pressure on rural areas and their population, insofar as the territory is an active agent that provides more or less favourable location conditions, as has been indicated, but it is also a passive aspect as *'there is a real danger to the territorial sustainability due to the lack of generational handover'* (Jurado & Pazos, 2022: 80).

On the other hand, some studies focus on the demographic vulnerability as an expression of the overlapping multi-criteria condition of extreme demographic ageing, the low birth rate, the lack of support population, and the ongoing population loss (De Cos & Reques, 2019). Other research considers economic and social variables, (Rodríguez-Domenech, 2016), along with land for amenities, poverty factors, educational-occupational variables, human capital, agriculture, population, health personnel, public infrastructure, hospital beds per 100,000 inhabitants, presence of train station, digital divide according to population without broadband, etc. (Nieto-Masot *et al.*, 2020; Recaño, 2023).

Therefore, geographical research suggests that rural areas should be addressed in the plural. In contrast to rural municipalities influenced by peri-urban dynamics and which are 'demographically privileged', there is no shortage of municipalities with little or no chance of surviving the decline in population and eventually succumbing to population drain. Rural areas, in this regard, seem to be dual, divided between a category of the deep and stagnant rural, and another that is intermediate and dynamic; however, the reality is more complex, with hierarchical subtypes appearing in both realities (Molinero, 2019).

As regards dynamism, some authors identify processes of social change attributed to specialising in second homes, with a higher degree of housing refurbishment, despite the predominance of empty houses (Alario *et al.*, 2018). However, the glimmer of dynamism does not seem to be an indicator of the success of the rural renaissance, but rather evidence that a multifunctional rural world has not been achieved; the new rurality or rural renaissance seems to be exclusive to rural areas close to urban centres, benefiting from less aging structures and positive migratory balances (Alario *et al.*, 2018).

### **3.1.2. Searching for solutions: immigration as the only regenerative agent and demographic characteristics as an indicator of viability in a new territorial model**

There is no shortage of evolutionary studies looking to the past to learn from paths already taken; they even go as far as arguing that current research from a demographic perspective could be the *'epilogue of the depopulation process'* (Recaño, 2023: 1) with multiple lessons learnt, which would allow demographic resilience to be addressed as a focal point to face depopulation and the draining of life from rural areas.

The lessons learned from the past suggest that the survival of rural areas would necessarily involve immigration *'... There is no recovery of the birth rate on the horizon; On the other hand, the progressive ageing of the population in rural areas augurs an increasing weight*

*of mortality (...) and leaves immigration as the only realistic alternative to recover the depopulated territories...*' (Recaño, 2023: 3). Male-predominant and ageing rural area are in a situation of demographic depletion – of varying intensity depending on migration and natural increase of the population – where migration can be the true regenerative agent of the current weakened demographic structure (Niето & Capote, 2020; Niето, 2021).

Accordingly, it seems that the main challenge of depopulation policies as regards immigration would be to achieve permanence in the rural receptor areas, with labour measures to provide training to promote and transform the professional sector, with a far-reaching focus on integration in the host communities, and access to housing and services guaranteed (Collantes *et al.*, 2014). This approach adds a touch of reality to the generally pared down political pretensions with a blinkered focus on attracting population as the sole and priority objective, when – knowing the structural features – the objective should be to put the rural environment on a competitive footing with the urban one. It is a fundamental intermediate step in the search for the desired outcome: not only to attract population, but also – and most importantly – to establish one capable of vitalising the area and take up the reins of governance to drive neo-endogenous development.

In addition to the demographic orientation proposals, some interesting approaches are committed to redefining the territorial model to be multi-scalar and systemic in character and without the urban being decoupled from the rural; the model has a hierarchy of nuclei acting as service centres and, most particularly, areas with options for recovery (Gómez-Villarino and Gómez-Orea, 2021) differentiated from those will be left behind if they have a level of 'demographic non-return' due to family life cycles and the absence of population replacement by regressive natural dynamics (Cutillas *et al.*, 2022). To this end, settlement is considered a more appropriate scale than municipality; predictors of the vulnerability of nuclei to depopulation can even be identified using simplified models based on the population over 60 and the population volume of less than 10 inhabitants (López-Fernández, 2016).

Any action must be addressed both institutionally – coordinated, multi-scale, with support and political structures – and using social, specific and participatory initiatives at the local level (Plaza & Molina, 2019).

### **3.2. DEMOGRAPHIC AND SOCIAL CHANGE IN URBAN AREAS: URBAN CENTRES AS A FUNDAMENTAL FOCUS OF RESEARCH**

Urban areas are living, changing organisms, creating mosaics of different urban pieces and also of distinct demographic groups (Lardies & Rojo, 2021). Consequently, the geographical community in Spain – where 80% of the population lives in municipalities of more than 10,000 inhabitants – has devoted much of its research to analysing urban areas. This accounts for the complexity of processes and trends from integrating realities that go beyond the demographic, social and economic, within the framework of a non-binding Spanish Urban Agenda developed in harmony with the European one (De la Cruz, 2019).

Central urban areas account for much of the interest in the multiple overlapping housing processes (Fig. 2) – shifts in the type of tenure towards renting, gentrification, etc. (Lardies & Rojo, 2021) – while the peri-urban territory is at the fore of an unsustainable artificialisation process that has become detached from residential needs (De Cos, 2021). This is what some authors call the geographical dissociation between the life cycle – or the needs of the resident population – and the processes driven by urban dynamics (Salom & Fajardo, 2017).

The slowdown in the urban sprawl driven by demographic needs can be understood as metropolitan regions entering a stage of maturity characterised by a demographic structure and households demanding less housing. This 'urban paralysis' would not only have an economic, but also a demographic rationale (López-Gay, 2016).

The focus of interest of metropolitan studies ranges from previous residential expansion to internal sociodemographic processes, such as: regenerating very old areas; transforming certain areas where there is a high demand for housing; configuring localised poverty areas; the complexity of residential mobility patterns, which go beyond the centre-periphery model to generate a complex multi-directional network (López-Gay, 2016); geographical segregation of the immigrant population by origin; the increase in internal social contrasts (Salom & Fajardo, 2017); and the so-called 'demographic metabolism' due to the changing behaviour of generations in response to natural demographic phenomena and migration (Domingo & Bayona, 2021). In short, the socio-demographic impact of territorial dispersion towards low-density municipalities is confirmed, the repercussions of which are felt on the housing market, the rejuvenation of the peri-urban demographic structure and the social composition of the population, which undergoes peripheral gentrification processes in the face of residential choices to live in scattered areas, even in the case of those with medium and high income levels (García-Coll & López-Villanueva, 2017); there is even possible gentrification processes involving the regeneration of entire neighbourhoods of working-class origin (López-Gay, 2016). In fact, some authors point to a paradigm shift in metropolitan areas, which may entail a nuance of the centre-periphery socio-territorial differences, with aging metropolitan demographic structures, where larger numbers of baby-boomers predominate over younger generations, in a context of low fertility rates and lower growth (Bayonne and Pujadas, 2020).

Demographic and social change in urban areas			
 Type of territory	 Stage	<input checked="" type="checkbox"/> Priority	 Processes and concepts
Periurban and metropolitan areas	Maturity stage Slowing urban sprawl		<b>Paradigm change</b> 1. Decrease of socioterritorial centre-periphery differences; 2. Progressive ageing
 Type of territory	 Stage	<input checked="" type="checkbox"/> Priority	 Processes and concepts
Urban centres 	Urban regeneration Convergence of urban and touristic cycles		<b>Gentrification</b> Global, mutant, super-gentrification <b>Touristification</b> Unfair city, conflicts <b>Housing crisis</b> 

Figure 2. Main processes and concepts associated with the study of demographic and social change in urban areas. Icons source free to use Iconfinder. Own compilation.

### 3.2.1. Urban centres as a complex scenario of socio-demographic features and processes

In the last decade, gentrification has not only been consolidated as an area of study passed down from its first appearance in the 1960s and its extensive development in the 1990s, but it has also diversified its approaches, giving rise to a plural gentrification. Gentrification understood in this way has a global dimension, even though its manifestations are at the local, even intra-urban, level, where a mutant gentrification – or changing in time and space – has come to be interpreted as the dark side of urban regeneration; that reaches its maximum expression in what some studies call 'super-gentrification', when gentrification processes overlap in the same urban area at different times, that is, the gentrification of what has already been gentrified (Benach & Albet i Mas, 2018). Nuances of gentrification have emerged; thus, absolute gentrification is distinguished from relative gentrification, insofar as gentrification does not always produce expulsion (absolute gentrification), but in certain areas it occurs relatively, segregating without total expulsion (Salom & Pitarch, 2021).

On the other hand, gentrifying processes are also diverse in origin; gentrification is not always linked to urban renewal of residential space, but can be stem from changes in economic activities, such as traditional commerce being replaced by global companies that follow similar location patterns in different urban centres (Jover, 2019); or the widespread tourist gentrification that is interpreted as the 'third phase of gentrification', with a clearly global character (Benach & Albet i Mas, 2018: 19).

In fact, gentrification processes can enter into symbiosis with other aspects of urban centres – such as mobility, or more precisely sustainable mobility – insofar as gentrification can also promote social changes in the new inhabitants who acquire a more sustainable cosmopolitan way of life; however, some empirical studies on specific neighbourhoods conclude that sustainable mobility as an agent of social change responds more to the collective social imaginary than to verifiable facts at the socio-territorial level (Cebollada *et al.*, 2018).

Faced with this complex reality, some studies propose limited gentrification indices to analyse gentrification at the intra-urban level; they include everything from the socio-demographic characteristics of the population – demographic structure, level of education or income –, to the types of households and the characteristics of the dwellings – fundamentally, price and type of tenure –, as well as location variables, such as proximity to sought-after places, such as leisure or green areas (López-Gay *et al.*, 2021).

### **3.2.2. What happens in urban areas with great tourist appeal? The social effects of tourism gentrification and touristification in Spain**

There is an important area of specialisation in the study of demographic and social processes in urban areas with great tourist appeal. Conceptual clarifications between tourist gentrification and touristification are, in this regard, necessary. Both terms coincide in residents or activities being replaced or displaced; however, gentrification involves the residents being replaced by a permanent neighbourhood with greater purchasing power, while touristification replaces permanent neighbours with others of a temporary, sometimes fleeting nature, who stay in tourist accommodation and housing (Barrero & Jover, 2021). The reality is complex, as both processes are not mutually exclusive, they feed off each other and can even lead to problems of coexistence at neighbourhood level. Other authors consider touristification as a unique form of gentrification, particularly as the initial population is replaced, even though the replacement of these groups is not by a permanent population (De la Calle, 2019). In view of this, the conceptual framework is complex and varies from one study to another.

Indeed, cities tend to be dynamic tourist destinations; However, not all undergo the same processes. Some studies identify the factors that can turn a city into a tourist destination from an explosive dynamic, which include: being accessible, for example, if served by low-cost flights; being an established tourist destination; and having a port for cruise ships (De la Calle, 2019); However, the approach is necessarily multi-scalar and, therefore, these variables would change if the objective was to pinpoint the neighbourhoods of a city that are more prone to touristification.

The contribution of the case studies lies in the local and even intra-urban implementation of global gentrification processes. Such studies regularly use islands as the setting. According to J. M. Parreño *et al.* (2021), the city of Las Palmas de Gran Canaria is undergoing tourism gentrification processes leading to replacement of the residents; that is particularly affecting the non-EU foreign population, who are mainly immigrant workers and they cannot meet the increase in rental prices in an elitist global dynamic. The reality is even more complex in the tourist areas of the Canary Islands coast, as touristification there overlaps with residentialisation, where new residents settle in tourist areas and coexist with tourists, leading to important social, demographic and territorial changes; thus, the areas of greatest tourist appeal would be subject to the opposing forces of touristification and residentialisation, both responsible – along with other factors – for the increase in rental prices (Simancas *et al.*, 2018).

A. Blanco *et al.* (2018) use the approach of the 'touristification of the everyday' to identify a relationship between the rise in rental prices and the deterioration of social cohesion in the city of Barcelona, given a tourist gentrification that prevents the permanence of modest social classes. According to the aforementioned research, it is not only tourism that is responsible for the increase in rental prices, but also a combination of multiple factors, such as high indebtedness and increased demand.

We are witnessing a convergence of urban and tourism cycles that, according to J. Domínguez-Mujica *et al.* (2021), is the fourth tourism cycle in mature tourist areas; tourism gentrification is brought about by the abundance of holiday rentals and the arrival of a new foreign population to certain municipalities, as part of the transition from residential to holiday rentals. This reality creates an unequal city, with groups at a disadvantage, as are residents in the eyes of investors (Domínguez-Mujica *et al.*, 2021: 5).

### **3.2.3. From the bursting of the property bubble to the housing crisis: social vulnerability, evictions and foreclosures**

From the bursting of the property bubble and the ensuing housing crisis, outstanding contributions have considered housing to generate social inequality from the focus of the urbanisation of poverty and unequal geographical development (Vives & Rullan, 2020). This line of research is making headway despite the lack of available sources with a sufficient level of spatial disaggregation. Some studies are based on data on evictions by judicial district from the General Council of the Judiciary (Méndez & Plaza, 2016); others geocode judicial statistics on evictions and foreclosures (Obeso, 2014) or opt for unofficial sources, such as web portals, by means of web-scraping (Barrero & Jover, 2021).

In Spain, the property bubble evolved from the initial hypertrophy to the subsequent mortgage crisis, with evictions and foreclosures as the most dramatic consequence and with the greatest capacity for social mobilisation (Méndez & Plaza, 2016). Evictions are analysed from a territorial perspective, in mainly urban areas, and at detailed scales; 'Property Bubble Geography' has thus been consolidated and addresses the effects deriving from a property model that has allowed – and even encouraged – the use of housing as an economic instrument (Gutiérrez & Delclòs, 2017).

It is paradoxical that empty homes and evictions abound in the same territories, with many properties unfinished and others finished yet unsold; the latter are near medium-sized cities or areas with tourist appeal (Gutiérrez & Delclòs, 2017). Accordingly, some tourist areas are witnessing a major housing crisis, where high rental prices and evictions generate a double effect of fragmentation and socio-residential segregation-polarisation (Vives *et al.*, 2015).

In the near future, the effect of the Right to Housing Act 12/2023 (BOE-A-2023-12203, which came into force in May 2023, remains to be seen with the declaration of stressed market areas and the topping of the maximum rent increase allowed (Parreño *et al.*, 2021), in order to avoid the so-called invisible evictions when owners do not renew leases in order to rent out the property again at a much higher price (Barrero & Jover, 2021).

## **4. THE NEED TO LOOK TO THE FUTURE TO ADAPT A SOCIETY NOTED FOR DEMOGRAPHIC AGEING**

The ageing of the population is a constant of demographic change in Spain and explains the strong background of research on the factors of longevity (Lolo & Puga, 2014), the increase in life expectancy and disability-free years of life (Puga *et al.*, 2014), the relationship between ageing and over-ageing (Montoro & Pons, 2021), etc. The 'new old age' as a practically universal reality from demographic change makes the study of the state of health, its social determinants, health assets and the appearance of disability throughout life a priority (Pérez-Díaz & Abellán, 2020). Progress is also being made in research on the quality of life of older adults, active ageing, households, residential models and disability-free years of life. In short, the well-being of older adults is analysed as a multidimensional reality that depends not only on age and biological and genetic aspects, but also on socioeconomic conditions and social support networks, with unwanted loneliness being an essential issue as well (Rojo *et al.*, 2014).

Ageing as a social success and post-transitional older populations that go beyond the childhood-adulthood-old model demand changes in care models, which delay institutionalisation and adapt the lived space beyond the home, while also considering the neighbourhood as a necessarily friendly and collective care space (Puga, 2020). This, in turn, facilitates different residential contexts, such as family housing, collective housing, and ultimately residences (Rojo *et al.*, 2020). In addition, demographic change affects generational structures and potential support networks between generations. Thus, according to the study by D. Puga (2021), the increase in longevity modifies the generational structure of families; this favours the concurrence and availability of relatives throughout life, and increases the years of shared life with other generations, although, ultimately, the support depends on multiple factors. Accordingly, the existence of a strong family-based society in Spain, as in other Mediterranean European countries, makes it more prone to co-residence, solidarity and intergenerational relationships, compared to other weak family structures (Montoro & García-Vivar, 2019).

In the context of a 'restricted structural level' in the demographic demand for households due to the presence of fewer young people, more older people and less immigration after the economic crisis (Módenes, 2015), some research reveals an increase in the residential independence of older people at increasingly advanced ages, compared to intergenerational households; an aspect that is related not only to the state of health but also to economic circumstances (López-Villanueva *et al.*, 2021).

In terms of its spatial pattern, the elderly population has a predominantly urban profile, despite its high relative weight in rural areas (Montoro & Pons, 2021). Therefore, the urban environment, and not only urban centres, needs to be adapted for older people, as there are also many of them in some neighbourhoods in metropolitan municipalities that were urbanised several decades ago (García-Ballesteros & Jiménez-Blasco, 2016).

## **5. MIGRATION AND RESIDENTIAL MOBILITY: APPROACHES AND SCALES TO ANALYSE THE MOST VARIABLE COMPONENT OF DEMOGRAPHIC CHANGE**

Migration – the most variable component of demographic change – is established as a fundamental area of study in geography and has evolved to a phase of maturity in migration studies, which elevates the concepts of transnationalism and human mobility to the category of paradigms (Domínguez-Mujica, 2022: 277). In this sense, transnationalism contextualises geographical studies of social interrelations and interactions, while analysing patterns of human mobility.

Contemporary international migration is a complex multicentre network that shapes migratory regions through flow variables, with a bilateral mesh model from a transnational approach (Escolano *et al.*, 2020). Internationally, there are also relevant contributions on irregular immigration, using methodologies that overcome the limited available sources and reveal fundamental objective results for migration policies, such as the time/space patterns of accidents on the dangerous Canary Islands route (Mesa *et al.*, 2023).

Migration studies are diverse in their approaches (demographic, social, educational, etc.), dimensions (internal and international) and scales (local, regional, national, etc.). In addition, the evolutionary interpretation of migration in Spain is closely linked to a contextual event of significant importance, such as the economic crisis of 2008, which impacted migration for several years (García-Coll *et al.*, 2016). Not only was there a drastic reduction in the flow of international immigration (Gil-Alonso *et al.*, 2015; Recaño, 2016; Capote & Nieto, 2017), but also in interprovincial residential mobility patterns, leading to a greater concentration

of young adult migration flows in a few destinations, mainly Madrid and Barcelona (García-Coll & Pumares, 2014). The aftermath of the crisis was also felt in the subsequent suburbanisation due to immigration, particularly in the main functional urban areas during the post-crisis period (Thiers-Quintana & Gil-Alonso, 2019).

Following the economic crisis, some migration studies upheld the idea of a new phase that – despite not being on a large scale – is particularly relevant, due to its progressive trend and the number of highly educated young adults leaving to other European countries (Ortega *et al.*, 2016). This line of research on the so-called ‘brain drain’ addresses the emigration of human capital, which can lead to educational decapitalisation in certain areas (González-Leonardo & López-Gay, 2021). The brain drain and the circulation of talent are also present in the hypotheses to study internal (national) migration, which shows the high incidence of the occupational profile in emigration and the receptor role of the main metropolitan regions -Madrid and Barcelona- compared to regions from which people leave, such as Castile and León (González-Leonardo & López-Gay, 1999). 2019). Accordingly, imbalances due to educational selectivity in migration are identified in a context of internal migration that is not nuanced - quite the opposite- by foreign immigration; with part of the population with a higher level of education migrating to the main receptor regions, leaving behind the native population with a lower level of education; while the foreign population with a higher level of education that arrives in Spain also opts for the main receptor regions (González-Leonardo, 2020).

Special mention should also be made of residential mobility, understood as a specific type of internal migration, where there is a systemic criterion in its spatial demarcation (Bayona & Pujadas, 2014). In this vein, some studies focus on specific groups, such as the Spanish retired population and their biodemographic profiles of residential mobility subject to very different causes, including defensive aspects - particularly among the over 75s -, amenities, etc. (Parreño *et al.*, 2014).

In contrast, migration and residential mobility at the intra-urban level are indirectly present in the study of the sociodemographic characteristics of the foreign population and their residential strategies, which can lead to patterns of residential segregation where it is important to differentiate as to whether this segregation is voluntary or structurally forced (Galeano, 2017). The residential mobility networks of the Spanish and foreign population at neighbourhood level have different functional and spatial organisations; in this vein, S. Escolano *et al.* (2021) propose a predictive model capable of estimating future residence based on current residence.

## 6. FINAL THOUGHTS

The brief review of the robust and broad contributions of Spanish geography on demographic and social change highlights some aspects that are collected as a final reflection. On the one hand, it emphasises the quantitative approach that proposes interesting methods and models based on geotechnologies for case studies; the aim is not only to provide better knowledge of local and regional processes, but fundamentally to also generate knowledge about a reality that is being reproduced in other territories, and which is clearly affecting society and causing complex circumstances to which governments must respond. The geographical community is clear about its great social commitment to current issues and adapts its lines of research to emerging issues, as can be seen from the studies on the socio-demographic dimension of the pandemic; it also addressing thematic emergencies, such as the housing crisis; dangerous irregular migratory routes, etc.; the demographic challenge of the declining population in parts of Spain; the negative effects of the brain drain and the absence of job opportunities; and adapting to the needs of an ageing and ageing society.

Accordingly, the contributions could be structured in themes related to the growing 'geography of discontent', a term alluded to in the European Union's 8th Report on Economic, Social and Territorial Cohesion (Royuela, 2022). However, the lack of solutions is not only attributable to political inaction or budgetary constraints. There are some difficulties regarding the areas considered that make them difficult to address and make effective decisions using the current system of administrative and territorial management. Some of the difficulties have to do with the interrelation of some processes, the circular behaviour of the variables – where it is not clear which are causes and which are consequences – and the hybrid role of the population in that it can behave as a dependent and independent variable, which is also the case with the territory. On the other hand, although administrative management is divided horizontally and vertically, a good part of the processes referred to in this paper show a systemic behaviour, and are affected by macro-factors that cannot always be modelled in local, regional and even national equations. It is time to return to what has been contributed by the research teams, to look for channels for the real implementation of the proposals of academia, based on rigorous past, present and future analyses.

The time also seems right for a final conceptual reflection. I began this presentation by alluding to the context of demographic and social change; however, a good part of the aspects analysed are nowadays certainties and permanence that have become entrenched as a structural feature of the population. The question is whether we can continue to talk about change when change is already a permanence; The question is whether calling it change somehow diminishes the urgent need for adaptation and action... Change leads us to think that it is something in process, that it is a change at this time. However, the change is now stable and has transformed the demographic, social and territorial structures of the population, and as such has been treated and considered in the reviewed contributions.

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# Impacts of global change on the landscape

## THE ENERGY TRANSITION IN SPAIN: RENEWABLE ENERGIES AND LANDSCAPE. THE VIEW FROM SPANISH GEOGRAPHY

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### ABSTRACT

Electricity generation from renewable sources is one of the manifestations of the energy transition in Spain that has greatest impact in spatial and landscape terms. Despite this, the change towards a sustainable electricity production model, which allows more people to access energy and limits dependence on fossil fuels, is being marred by a lack of planning, social debate and citizen participation. This chapter analyses the technical dimensions of the change in the production model and its spatial imprint, and the different ways in which Spanish geographers have approached this question. It concludes with some reflections on the enormous challenge facing our discipline today, namely to demonstrate its capacity to provide useful responses to one of the problems of most interest to society.

### KEY WORDS

Energy transition; electricity generation; landscape; territory.

### 1. INTRODUCTION

Within the context of the ecological transition required today in the face of climate change, the energy transition (ET) is a process of structural transformation aimed at achieving a reliable, safe and sustainable energy model. This is a complex process which is still very much open to debate. It is of interest to a large section of society and can be approached from different angles depending on which of its many different components one chooses to focus on. As a spatial discipline, Geography is duty-bound to tackle an issue that directly affects its *raison d'être* in that a change of this magnitude enables us to directly investigate the relations between society and space. Within the context of decarbonization and electrification of the

economy, Spain stands out as a country that is fully committed to a transition model based on the efficient use of clean energies. The targets set out in the Integrated National Plan on Energy and Climate established that in 2030 renewable energies should account for 74% of power generation, and by 2023 this figure was already over 50%.

This shows that a new production model is rapidly taking shape, although it follows the same spatial pattern as its predecessor, based on the dissociation between production and consumption, making use of and extending existing energy transport infrastructures (power stations and lines). The result is a highly centralized model with which the government aims to achieve the targets promised at European level by implementing large-scale projects that harness scattered resources (wind, sun, water...) with a low energy density that require vast areas of land. This is radically altering the functions, character and perceptions of the territory and has a notable impact on the landscape. In spite of the magnitude and wide extent of these processes, spatial planning and citizen participation have been practically non-existent. With this in mind, this chapter aims, on the one hand, to clarify the direction being taken by the structural and territorial changes in electricity production linked to the energy transition in Spain, and on the other to explore the various approaches or perspectives from which it is being analysed within the field of Geography in Spain.

## 2. STRUCTURAL CHANGES IN THE SPANISH ELECTRICITY PRODUCTION SYSTEM

The ET refers to both the process of change in the structure of primary energy supply and the gradual transformation of a specific model of energy provision (Álvarez *et al.*, 2016:7). The aim is to achieve a model of energy supply using efficient systems which not only limit greenhouse gas emissions but are also respectful of biodiversity and sensitive to the territorial impact of the various forms of energy production, transport and distribution. This means that ET is a complex process that can be approached from many different angles: technical, political, economic, social, ethical, environmental or territorial. As regards this last aspect, the spatial and structural logics behind energy production and consumption are supported by well-structured theoretical formulations, in which it is assumed that these changes do not take final form until society as a whole, through important consensus-based political agreements, manages to interiorize the mechanics of the transition. In this sense, for Europe to become the first climate-neutral continent on the planet in 2050, various partial targets, such as those set out in the 2030 Climate and Energy Framework, must be met. Among other goals, this EU Framework has established that renewable energy should account for at least 32% of final energy consumption in 2030, at the same time as obliging each member state to adopt integrated National Energy and Climate Plans (NECP) and draw up National Strategies on this issue.

### 2.1. THE POLITICAL AND REGULATORY CONTEXT AFFECTING POWER GENERATION IN SPAIN

The Strategic Energy and Climate Framework in Spain (MEEC) is based on three main pillars. Firstly, the Law on Climate Change and Energy Transition passed in May 2021, which became the basic reference legislation covering a range of diverse measures such as mobility, changes in the electricity sector, consumption and use of fossil fuels, energy efficiency or respect for biodiversity. The second pillar is the Fair Transition Strategy (2020), whose main objective is to provide the instruments and tools required to mitigate the social and territorial impact of this transition. Finally, the PNIEC 2021-2030 sets a number of targets that the government aims to meet over the course of this decade: a 23% reduction in greenhouse gas emissions compared to 1990; 42% of renewable energies as a proportion of total final energy consumption (74% in the case of power generation) and a 39.5% improvement in energy efficiency.

After the COVID-19 pandemic, large funds were made available as part of the *NextGeneration EU* project. This coincided with the conflict in the Ukraine, which began in February 2022 and highlighted energy dependency as a vulnerability that was strategically unacceptable for Europe. The objective of the *REPowerEU* Plan was to break this dependency by saving energy, diversifying supply and accelerating the rollout of renewable energies. As a result of all this, in 2023, Spain announced an upward review of the targets for 2030. Should these be achieved, clean energies will cover 48% of final energy consumption and 81% of electricity consumption.

## 2.2. TECHNOLOGICAL DIMENSION OF THE ENERGY TRANSITION IN SPAIN

Since the 1990s, the installed power capacity in Spain has risen continually – from 43,551 MW in 1997 to 123,564 MW in 2023 –, and a much more diversified, better-balanced structure has been created (Figure 1)<sup>1</sup>.

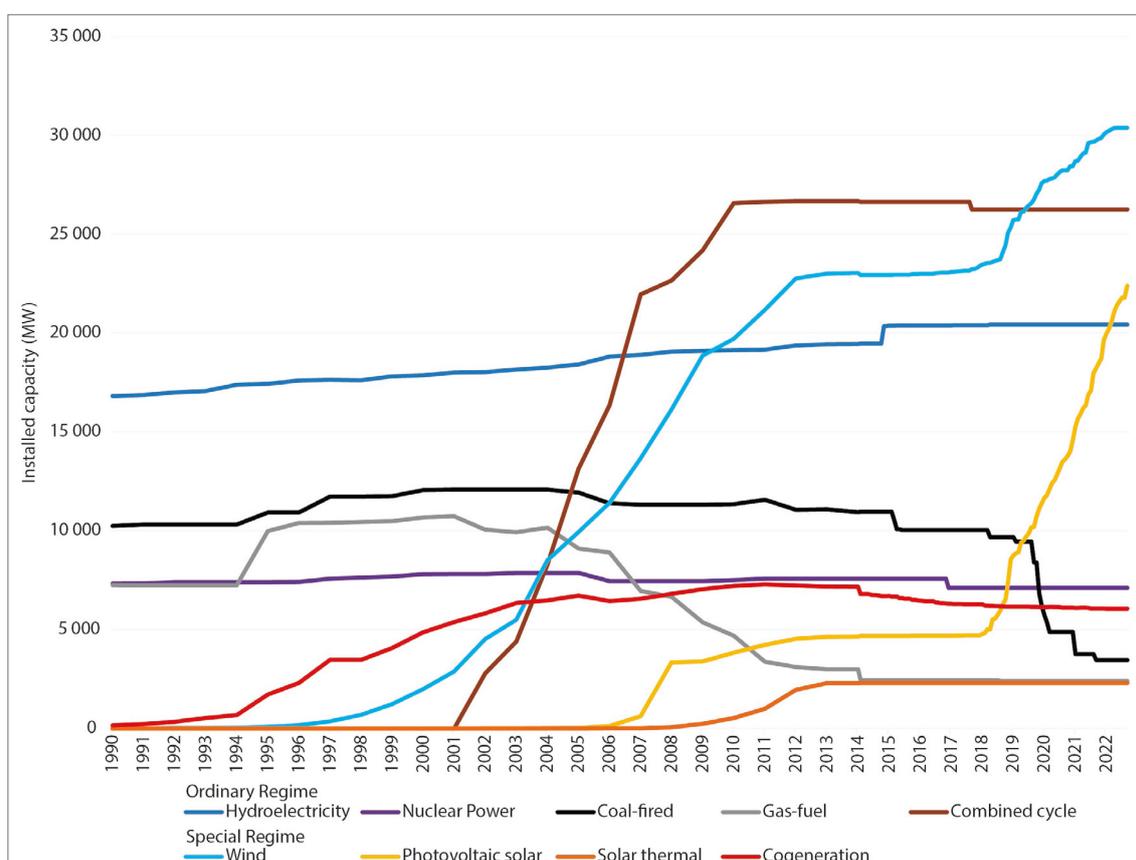


Figure 1. Changes in the installed power capacity in Spain over the period 1997-2023 and its distribution by sources. Source: Spanish Electricity Grid (REE).

The Law on the Electricity Sector 54/1997 was a milestone in the development of electricity generation in that it opened the door to free competition in the electricity market. Supplying an expanding economy would require a gradual increase in the installed capacity. This was achieved by expanding various nuclear (which produced 35.1% of electricity) and coal-fired (39.5%) power stations. In this way, they guaranteed a production capacity that was complemented by hydroelectricity (21.1%), a technology affected by the variations in rainfall from one water year to the next. At that time, the energy model was defined by two main

1 All the statistical data presented in this article come from the same source: Red Eléctrica Española (Spanish Electricity Grid), available at <https://www.ree.es/es/datos/generacion>

characteristics: the high levels of concentration in the electricity generation sector in both technical (large power stations) and business terms (the electricity production and distribution business was in the hands of just four companies: Endesa, Iberdrola, Unión Fenosa and Hidro-Cantábrico) and secondly the evident territorial dissociation between the areas in which electricity was produced and those in which it was consumed. This was possible thanks to the connectivity provided by a transport network in continuous expansion. All this gave rise to an industrial, unidirectional, centralized model, in which the market was controlled by a very small number of actors, and in which the energy consumed by the entire country was produced by a small number of centres with a high energy density.

Since then, the pattern of energy generation has changed substantially. Firstly, Spain's commitment to the EU to decarbonize its economy has led to a drastic reduction in conventional energy production, which with the closure of coal-fired power stations has led to a drop in the installed capacity from this source from 10,874 MW in 2011 to 2,061 in 2023. The second, and undoubtedly the most important, factor is the emergence and fast growth of renewable energies or their backups (combined-cycle gas-turbine plants) in order to obtain a more diversified combination with lower emissions. In the case of wind power, the capacity has increased to 30,732 MW at the end of 2023, making it the second most important energy source in the electricity mix in Spain. Solar power has undergone a similar process, in which solar thermal energy generation (2304 MW) has consolidated its position together with hydroelectric pumping as a renewable support or backup technology. For its part, photovoltaic energy is also growing very fast, reaching 24,931 MW in 2023.

Despite these dramatic changes, the spatial pattern that characterized the previous industrial model has been largely repeated in the new scenario: power generation remains concentrated in large plants, now powered by wind or photovoltaic energy, and is still promoted by large companies and investment funds. The main difference is that in the new scenario they are harnessing a much more dispersed resource and using traditional transport and distribution infrastructures to bring it to the end consumers.

### **2.3. THE SPATIAL DISTRIBUTION OF ENERGY PRODUCTION IN SPAIN**

If we look at the map of the spatial distribution of electricity generation in 1997 and we compare it with that for 2023, it is undeniable that the increase in the share of renewable energies in total power generation has been accompanied by large-scale dispersion across the territory. In 1997 (Figure 2), and as a consequence of the concentration in the forms of generation (large power stations), the 43,551 MW of installed capacity in the Spanish mainland electricity system were produced by a total of 1318 power plants situated in 559 municipalities. In reality however, most of the electricity was produced by around 100 plants, in line with distribution patterns linked either to a local resource or to the import of resources from overseas (ports). Electricity was also produced in certain spaces with low population density situated relatively close to consumption centres, which at some point were considered suitable sites for nuclear power stations.

By contrast the 123,564 MW installed in 2023 (Figure 3) were produced by a total of 67,460 plants shared between 4,687 municipalities. In the case of wind power, the principles governing its rollout are based on the presence of the resource at a particular site (in both mountain regions and high flat inland plateaus to take advantage of laminar winds) and the possibilities for transmission and distribution from this site (reinforcing the network nodes and the capacity of the lines), while in photovoltaic solar power, there is a preference for elevated plains in the south and certain solar "breadbaskets" on those further north.

As a result of this process, municipalities in deep rural areas are acquiring a more important role in power generation, in this case from renewable sources. These are spaces with a limited capacity for protest, in which the development of projects of this kind is seen as a source of additional income for local councils and certain private interests, even at the expense of jeopardizing landscape resources which in the medium to long term could play a key role in

their economic development. Until now, the ET has had an eminently technological dimension and its objectives, based on achieving ever higher levels of installation, have largely ignored the socio-territorial dimension associated with an impact of such magnitude.

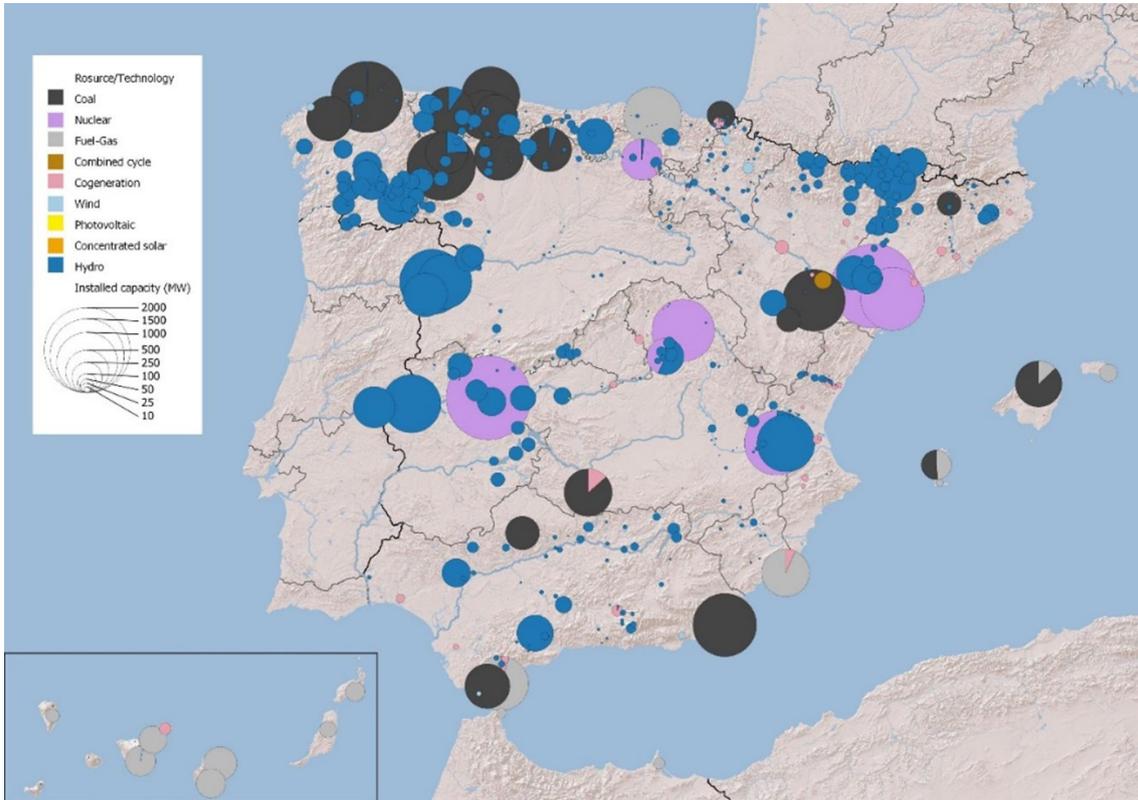


Figure 2. Installed capacity in Spain (1997) and its municipal distribution by type of source. Source: REE.

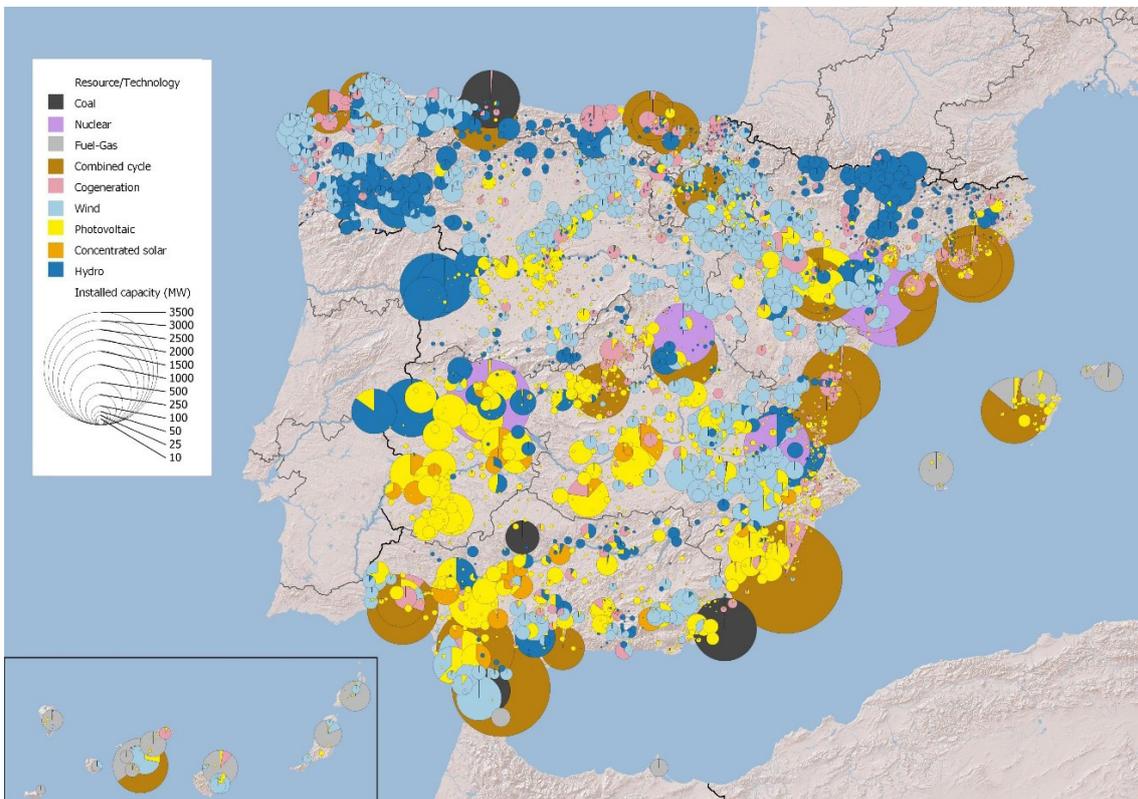


Figure 3. Installed capacity in Spain (2023) and its municipal distribution by type of source. Source: REE.

## 2.4. THE INTENSE IMPACT OF THE ROLLOUT OF RENEWABLE ENERGIES ON SOCIETY AND THE LANDSCAPE

The lack of planning inherent in the model for the rollout of renewable energies has made the developers the principal actors in the ET in Spain. To develop a project, all that is required are a series of permits from the relevant administrations. In such a decentralized country as Spain, these vary greatly from one region to another, giving rise to quite different situations. However, they all share a similar background: the lack of any debate on this issue and the urgent need to achieve the set targets has meant that the real, perhaps most complex impact, i.e. on the landscape, has not been properly addressed. Instead, discussions about impact have centred almost exclusively on the environmental and/or heritage dimensions. This explains why the mapping by the different administrations of exclusion zones for the installation of renewable energies (demanded urgently by the aforementioned REPowerEU Plan) largely follows the maps of the Natura 2000 Network and the sensitive areas from the perspective of flora and fauna. By contrast, in the “white zones” (those earmarked as suitable for renewables projects), nothing is said about how to install the plant as harmoniously as possible or at least about how to assess its impact on the landscape and on the cultural values of the affected area.

In addition, the ET proposed by the institutions has an unquestionable social component. In theory, the citizens have the chance to stop being mere consumers and become producers of their own energy. They become “prosumers” who opt for different methods of decentralized power generation, of self-generated electricity from nearby renewable sources, quite unlike the traditional, spatially centralized, unidirectional, industrial model controlled by a small number of large companies. Production can be individual or collective in the form of energy communities promoted by cooperatives, associations or local administrations. Since their regulation, photovoltaic installations of this kind, generally on roofs, have enjoyed spectacular growth. While the objective and high penetration scenarios set targets for 2030 of 9 and 14 GW respectively, by 2023 the installed capacity had already reached 6.95 GW. However, the social dimension of the transition also mentioned the need for public opinion to be taken into account. This would be expressed through participative processes in relation to projects that notably alter the spaces in which people live. It seems obvious that without this dialogue, it would be difficult to implement projects that meet the condition of bringing about a fair and democratic energy transition. It is precisely within this framework that the activation of a social consciousness of rejection of this kind of projects should be understood, rekindling the fight for the territory through the defence of its landscapes. This is an increasingly common situation nowadays, given the spatial expansion of transport infrastructures, the increase in the average size of projects and the greater spatial concentration of the installations.

As Mata and López (2022:92) made clear: “Geography forms part of the scientific consensus that endorses and confirms that an energy transition capable of tackling the challenges of the climate crisis cannot consist merely of a technological transition, as is happening to a large extent today, with little attention being paid to the base on which this technology is being installed: i.e. the territory and its landscape perception”. Perhaps this would be a good place to pause for a moment to assess the degree of involvement and the analytical orientation of the contributions being made to this debate by Spanish geographers.

## 3. METHODOLOGY

With this in mind, we conducted a review of a selection of articles from the databases on the Dialnet and Scopus websites for the dissemination of scientific research. Our analysis also included other important academic initiatives, such as the competitive projects financed by national and international calls for funding, which have contributed to the advance of research on this question. Even so, the scope of our investigation was relatively limited in that it did not cover books, book chapters or a range of different contributions made at congresses of various kinds. In this last case although some studies of the ET can be found under

the thematic umbrella of global processes of transition, they are relatively few in number. By way of example, in the dozen meetings organized by the Spanish Geography Association (Asociación Española de Geografía - AGE) in the first decades of the 21st Century, there has only been one line for discussion oriented specifically towards analysing the relationship between energy and territory. This was at a congress in 2011 organized by the University of Alicante entitled "Geography and Territorial Challenges in the 21st Century". One of the topics analysed was the Dynamics and Processes of Energy Change, about which 36 communications were presented. 20 of these analysed different aspects of the ET related with renewable energies and 5 referred specifically to landscape.

After setting out these initial reservations, we will now describe the procedure we used to select the articles. This was done using a search chain that focused specifically on two terms: "Energy and Landscape". The search was limited to entries in English and Spanish from 1997 onwards (the year in which the Law governing the Electricity Sector in Spain came into force). The ultimate goal was to identify different approaches and perspectives related with the landscape in the context of the development of renewable energies in Spain using a representative, manageable group of sources. This selection enabled us to carry out a more carefully focused analysis, whilst being aware that other important works such as PhD theses and articles in languages other than English and Spanish would remain beyond the scope of our study. The initial search returned 514 references, 17 of which were eliminated to avoid duplication, while a further 11 returned by other generic search engines were included.

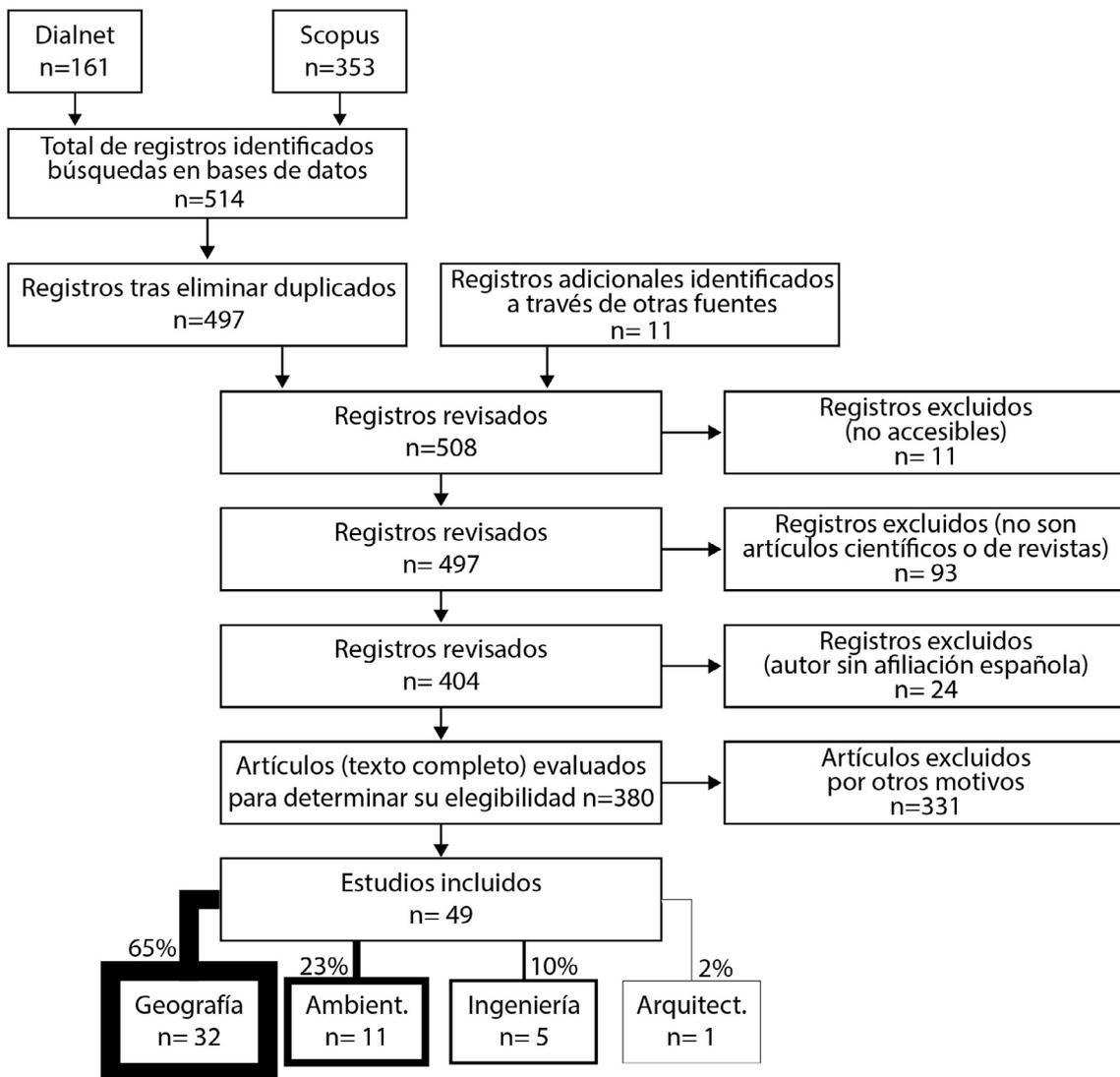


Figure 4. Flow chart describing the article selection process.

The sample group was subjected to a systematic filtration process to ensure the relevance of the articles finally selected for analysis (Figure 4). With this in mind, for example, we excluded articles in which an overly narrow definition of “landscape” was applied or in which the term “energy” was not used in relation to power generation. In this way, the list was reduced to 49 references. These were published from 2005 onwards and covered disciplines such as Geography (32, 65%), Environmental Sciences (11, 13%), Engineering (5) and Architecture (1). The reading and analysis of the content of these references highlights the wide variety of interests, spaces and methodological approaches adopted by Spanish Geography.

## 4. RESULTS. GEOGRAPHY AND THE DEVELOPMENT OF RENEWABLE ENERGIES IN SPAIN

Geography has traditionally addressed the landscape on the basis of its formal and functional principles, but also in terms of its subjective meanings and components. This enables geographers to develop combinative approaches that can be decisive for understanding the dynamics behind the relation between renewable energy development and the landscape, including aspects such as territorial planning, the visual impact, public opinion, heritage conservation and the socioeconomic implications of this development.

### 4.1. LANDSCAPE AND RENEWABLE ENERGIES, AN OVERVIEW OF APPROACHES AND METHODS

The bibliographic review enabled us, first of all, to obtain answers to questions such as: i) How do the authors of these papers define the concept of landscape? and ii) What methods do they apply to achieve their objectives? In this way we hoped to gain a deeper insight into the complexity of the idea of landscape in the field of renewable energy, highlighting how the different approaches are intertwined and mutually enriching. The authors do so above all from three main perspectives. Firstly, the idea of landscape as a space that has been altered by energy infrastructures is widely reflected in the selected articles. This approach centres around the objective changes and the new forms and functions that wind or solar power plants can impose on the landscape. In this sense, articles such as Díaz Cuevas *et al.* (2016), emphasize the importance of the planning and assessment of projects as essential tools for mitigating the adverse effects on the landscape, which is understood as a dynamic concept. Secondly, landscape is discussed within the broader context of the ET, initially approached in terms of change towards a “more sustainable model” (Domínguez *et al.*, 2010) and later more explicitly as the “energy transition” in articles such as Codemo *et al.* (2023) and Díaz Pacheco *et al.* (2018). In general, the studies of the energy transition underline the importance of territory not only as a (passive) receiver of changes but also as an (active) factor in the planning and acceptance of projects. In this way, Prados *et al.* (2021) discuss the energy transition in terms of the contribution that renewable energies make to rural development and adaptation to climate change, highlighting the need for a new form of governance to enhance this transition. Frolova *et al.* (2019a) mention the transition to more sustainable energy systems as part of the response to climate change and the need to improve national energy security, focusing on the EU strategy to increase the consumption of renewable energies. Thirdly, Rodríguez and Frolova (2021) analyse how this process is being carried out in Spain and Hungary, focusing on both the institutional context and the associated structural and social challenges. In general, the authors accept that the design and location of the energy infrastructures must consider their harmonious integration into the existing landscape, so as to facilitate a socially acceptable energy transition. Finally, various studies emphasize the role of the European Landscape Convention (ELC) in renewable energy planning, highlighting the framework it provides for making landscape a key aspect of energy policy (Frolova & Pérez, 2008), in that it promotes an approach that takes the opinions and needs of local communities into account (Frolova *et al.*, 2014). The reference to the ELC

in these articles is a sign of a growing recognition of the importance of tackling cultural and perceptual aspects of the landscape in the planning and development of renewable energy projects (Prados *et al.*, 2012)

With different approaches, we are offered, at the particular scale of each study, a rich and subtly nuanced understanding of the process we are studying that covers both the tangible changes in the new forms and functions of the landscape and the subjective perceptions. It also reveals the wide variety of methods used to analyse this question. These methods vary from the use of Geographic Information Systems (GIS) (Díaz *et al.*, 2016; Molina *et al.*, 2011; Tudela & Molina, 2005; Rodrigues *et al.* 2010), to qualitative research (Frolova *et al.*, 2022) and mixed methodologies (Frantál *et al.*, 2023; Frolova *et al.*, 2019; Pérez & Díaz, 2022; Prados, 2010a; Prados *et al.*, 2021; Rodríguez *et al.*, 2023; Rodríguez & Frolova, 2023). Other research studies analyse energy policies, legislation and other related documents, offering an institutional and legislative perspective on the development of alternative energy sources (Frolova & Pérez, 2008; Pérez, 2010; Prados *et al.*, 2012). Lastly, there is a group of studies based on a detailed description of the technologies, rollout models and specific cases studies, but without a clearly defined analytical or quantitative methodological approach (Baraja, 2010; Espejo, 2010; Prados *et al.*, 2012, among others).

## **4.2 THE DOMINANT ROLE OF CASE STUDIES IN GEOGRAPHIC RESEARCH INTO ENERGY**

Geographic research into renewable energies has applied a varied array of methods when studying the interaction between landscape and the rollout of energy technologies. In some cases, they focus on comparative analysis (Frolova *et al.* 2019a; Frolova *et al.* 2019b; Rodríguez & Frolova, 2023), while in others they look at the procedures followed to optimize the location of the plants. However, if there is one type of article that stands out above all others it is the case study. The most frequent scale of analysis is smaller than nationwide studies of Spain as a whole, and so provides a detailed understanding of how energy projects affect and are integrated into specific landscapes. Of these, Andalusia and other regions in the south of the Iberian Peninsula, such as Murcia and Southern Portugal, stand out with studies at a regional scale (Barral *et al.*, 2023; Díaz *et al.*, 2016, 2023; Mérida *et al.*, 2010; Prados, 2010b), at a provincial scale (case studies of Jaén, Rodríguez *et al.*, 2023; Rodríguez and Frolova, 2023), and at a sub-provincial or local scale (Codemo *et al.*, 2023; Frolova *et al.*, 2022; Prados, 2010; Prados *et al.*, 2021). Other territories which have also been the subject of case studies include Catalonia (Saladié, 2011, 2012, 2019; Saladié & Saladié, 2021; Zografos & Saladié, 2012), Castile and León (Baraja & Herrero, 2010), Castile-La Mancha (López, 2023), Aragon (Esteban *et al.*, 2023; Ibarra, 2023; Ibarra *et al.*, 2011, 2022) and Menorca (Silva & Fernández, 2020).

## **4.3. "RENEWABLES" AS A TYPE OF ENERGY OF INTEREST TO GEOGRAPHERS**

Of the 32 articles in our sample group, over 60% discuss renewable energies in general (and in particular wind and solar power), focusing on three aspects as regards landscape: i) the new forms and functions in the landscape (Frolova *et al.*, 2019); ii) public opinions regarding landscape (Frolova & Pérez, 2008; Prados *et al.*, 2012, 2021; Rodríguez *et al.*, 2023; Rodríguez & Frolova, 2023; Tudela & Molina, 2006); and iii) landscape within the framework of energy planning and policies (Barral *et al.*, 2023; Frolova *et al.*, 2019; Frolova *et al.*, 2014, 2019; Silva & Fernández, 2020).

In terms of the different types of renewables, most of the articles focus on wind energy, followed by solar power and lastly hydroelectricity. In these cases, the articles analyse two questions above all in relation with the landscape: i) the impact of renewables on the landscape and their integration into it and ii) social perceptions, showing that the interaction between renewable energies and the landscape is complex and multifaceted.

More specifically, the studies that centre on hydroelectricity (Frolova, 2010a; Pérez & Díaz, 2022) analyse how the different types of policies in energy, water, the environment and land use interact in the creation of Spanish landscapes (Frolova, 2010a) and public acceptance of this form of energy (Pérez & Díaz, 2022).

The studies of wind power revolve around the impact and integration of wind farms into the landscape and public perceptions of them. For example, Tudela & Molina (2005) emphasize the importance of assessing the landscape impact of wind farms, while Díaz *et al.* (2016) use GIS to quantify their landscape impact in Andalusia. Molina *et al.* (2011) introduce a GIS-assisted methodology to evaluate the impact of wind farms, highlighting the visual absorption capacity and the environmental impact. This enables a more detailed, more effective impact assessment when trying to identify the best possible locations for these infrastructures on the basis of legal considerations, and environmental and land use factors. Pérez (2010) discusses how offshore wind power can be integrated into the Spanish seascape.

Public perceptions of wind power are also a key issue in various studies. For her part, Frolova (2010b) analyses the social perception and management of these developments in Spain, while López (2023) focuses on how wind turbines affect the scenic beauty of the landscape, underlining the importance of understanding how different groups in the population perceive the visual impact of wind power. Frantál *et al.* (2023:7) propose a typology of conflicts related with the development of wind power, highlighting six problematic components: nature conservation, unfair distribution, effects on property and the quality of services, the size of the infrastructures, effects on health, landscape values and functional conflicts. They make clear that the visual impact is normally of secondary importance in decision-making, in which economic factors take priority over sociocultural concerns. Frolova *et al.* (2022) explore the varied responses of coastal communities in southern Spain to the development of offshore wind farms, highlighting the tensions between the perception of landscape, the conservation of marine resources and the socioeconomic benefits. This approach broadens our understanding of the impact of wind power above and beyond the onshore landscape, by focusing on offshore developments in the sea.

For its part, research into solar power emphasizes its impact on the landscape, land use changes and the public perception of these effects. For example, Díaz *et al.* (2023) analyse the distribution of solar energy in Andalusia, focusing on the types of surfaces in which solar plants are installed and their previous uses, the competition with agricultural land uses and the impact on the landscape. For their part, Mérida *et al.* (2010) focus on photovoltaic plants in Andalusia, examining their impact on the landscape. The study highlights the environmental paradox of these installations, which are generally perceived as positive but have significant impacts on the landscape, setting out a series of guidelines for their successful integration. Espejo (2010) examines the solar thermal energy (STE) plants in relation to technological aspects and rollout policies, underlining their visual impact and the vast tracts of land they occupy. Finally, Prados (2010a) explores public perceptions of solar power in the Protected Landscape of Guadiamar in Andalusia.

All these studies emphasize the need for careful assessment of the visual and environmental impact of solar and wind power and their proper integration into the landscape. Social perception and acceptance play a crucial role and it is essential to consider these aspects in territorial planning and management. Furthermore, comparative studies offer valuable perspectives about the energy transition in different geographical and cultural contexts as determined to a large extent by the intentions and objectives of the research projects within which many of these studies are conducted.

#### **4.4. RESEARCH PROJECTS ON RENEWABLE ENERGIES**

The initial phase of these projects began in 2005 and established the basis for a line of research that was consolidated from 2010 onwards. The projects mentioned in the papers published during this period include for example the ALTENER programme – by which the Murcia Region committed itself to promoting the development of the Renewable Energy

Plan (PER) drawn up by the Institute for Energy Diversification and Savings (IDEA) –, and the COMPLEX project of the Seventh Framework Programme of the European Commission. Perhaps more important for the field of geography was the creation and consolidation of the Spanish Network on Renewable Energies and Landscape (RESERP), which proved something of a watershed, facilitating fruitful collaborations between researchers and the publication of significant studies. These included the monographic issue of the NIMBUS journal with seven contributions from Spanish geographers, as well as the articles by Prados *et al.* (2012) and Frolova *et al.* (2014), and the book “Renewable Energies and European Landscapes” (Frolova, Prados, *et al.*, 2015) with nine chapters in which Spanish geographers took part.

With the consolidation of the RESERP in 2011, a second phase of expansion and the beginning of specialization were manifested in two research projects funded by the Spanish Ministry of Science and Innovation between 2012 and 2015. These projects were entitled: i) “Wind power and landscape: evaluation of the onshore and offshore landscape for sustainable planning (CSO2011-23670)”, which was led by a team from the University of Granada and ii) “Territories on the Frontier: Environmental Costs and Territorial Benefits of Naturbanization processes (CSO2011-28480)”, which was led by the University of Seville. Although the two projects applied different approaches, their objectives converged in the publication of the article by Frolova *et al.* (2014). The projects related with the RESERP and the CSO2011-23670 project marked the beginning of collaboration between Spanish and European researchers in multidisciplinary teams, a trend that was encouraged even further in the following years. This led to a project entitled “Ressources paysagères et ressources énergétiques dans le montagnes sud-européennes. Histoire, comparaison, expérimentation, 2012-2014”, which was part of the IMR Ignis Mutat Res Research Programme funded by the French Ministry of Culture and Communication, Directorate of Research and Innovation of France and the International Workshop of Greater Paris (Atelier international du Grand Paris AIGP), in which the team from the University of Granada were involved. After these projects came to an end, there was a regrouping of Spanish Geographers at an international level around a project entitled “COST Action TU1401 Renewable Energy and Landscape Quality”, whose aim was to find out how the protection and management of the European landscape could be harmonized with the rollout of renewable energy systems.

Specialization in the field of energy and landscape and its exploration in greater depth began again in 2018 with the projects entitled “Adaptation to the energy transition in Europe: environmental, socioeconomic and cultural aspects ADAPTAS (CSO2017-86975-R)”, “Planning and Engagement Arenas for Renewable Energy Landscapes PEARLS” (H2020 Research Innovation Staff Exchange (RISE) 778039) and “Obstacles and Dynamics of the Energy Transition in Mountain Regions: crossed views of the Alpes du Nord (France) and Sierra Nevada (Spain) VEDETTE”, part of the TESLA programme of the Labex ITEM of France, 2019-2020. The ADAPTAS interdisciplinary project, which was led by the University of Granada with the involvement of various different European teams, sought to gain a better understanding of the nature and dynamics of renewable energy development in Europe, tackling both the technical aspects and the social and visual impacts. For its part, the PEARLS project led by the University of Seville centred on spatial planning and social innovation within the context of “Renewable Energy Landscapes”.

These projects recently came to an end and we have now entered a new stage that combines geographical research interests and international projects such as “Socio-Territorial Innovation for the Energy Transition in the Iberian Peninsula (STEP)” and other projects with a regional impact such as the Map of the Potential for Renewable Energies in Andalusia. These projects reflect a wide range of approaches and interests, stressing the importance of combining renewable energy production with respect for and improvement of the landscape and the quality of life in local communities. The project “CO-SUSTAIN, Pathways for CO-creation between local authorities and collective actions for a SUSTAINable transition (ID: 101132467)” funded by Horizon-CL2-2023-Democracy-01-05), initiated a change in the focus of interest of Spanish geographers towards questions of social and environmental justice and democracy in the energy transition process: an important aspect of this justice was to reconcile the needs of the transition and the conservation of local landscape values.

These projects reflect a wide range of approaches and interests in the study of renewable energies and the landscape, from socioeconomic and cultural adaptation to specific planning of the landscape, the quality of the landscape and the importance of carrying out the energy transition in a democratic way. The funding of these studies by various different European and Spanish institutions is a sign that they recognize the importance of integrating renewable energy production with respect for and improvement in the landscape and the quality of life of local communities.

## 5. DISCUSSION AND CONCLUSIONS. LANDSCAPE PLANNING OF THE ENERGY TRANSITION ON THE BASIS OF A SOCIAL CONSENSUS

In the current scenario of the energy transition, the territory is taking the brunt of the rollout of renewable energy systems, while itself being just a secondary subject of discussion and debate. The rapid expansion of wind and solar power projects has had a particularly strong impact on rural areas, introducing new functional and landscape features with wide-reaching social repercussions in terms of both the impact on society and the response this generates. These issues and their different perspectives have strong, direct links to Geography which, as we have seen, focuses its research efforts not only on studying the effects and conflicts it gives rise to, but also on the search for criteria and proposals for good planning practices that can ensure a successful orderly rollout backed by a broad social consensus. What are the most acceptable locations? In addition to technical criteria, what other aspects must be taken into account in the planning of energy development? What is the hosting capacity of any given space taking into account its wide range of values and its right to non-saturation? What design patterns could be considered in each different project so as to ensure an acceptable – or perhaps on occasions even positive – impact on the landscape? At what scales should energy be planned? These questions are all lines of research that Geography, in its most applied version, is obliged to address at a time of new territorial configurations and profound changes in the landscape.

However, the academic discussion in general, and the geographic debate in particular, are not being taken into consideration in the decision-making for a strategic plan that weighs up all the different effects on the territory as a whole. One of the most direct impacts of these projects is on the landscape. They leave a clear mark, modifying the territory by introducing powerful visual references that tend to take over the scene, to the point of creating landscapes that are dominated by their energy components. However, in the development of wind and photovoltaic energy plants and their associated infrastructures, the landscape dimension is rarely taken into account and even less frequently in all its complexity, in the sense that landscape is a territorial attribute that is influenced by a whole compendium of different factors. In general, in studies of the impact of these projects, impacts on the landscape are normally treated as effects on the territory of an environmental nature, with a clear bias towards the alterations they may cause to the natural or heritage values of the sites, particularly in those in which these attributes are regarded as high-quality. In this way, rules and methods for the treatment and planning of new energy developments in heritage contexts have been established in guideline documents such as the ICOMOS Guide to good practices for the installation of infrastructures and facilities related with renewable energies and their potential effects on cultural heritage (Alonso *et al.*, 2022). This guide, which follows a similar methodology to “Guidance and Toolkit for Impact Assessments in a World Heritage Context” published in 2022 by UNESCO and its three consultative bodies (ICOMOS, IUCN, ICCROM), is offered to help ensure compatibility between renewable energy systems and the protection/conservation of cultural heritage values. However, restricting the effects of these infrastructures on the territory and the landscape solely to the most outstanding sites is a partial, incomplete way of proceeding that ignores the much more generalized approach enshrined in the European Landscape Convention (ELC). In this way, planning

is reduced to the vetoing of development in a few protected spaces, leaving the door open to a more opportunistic rollout dominated by the urgency to bring about the ET, taking decisions on the basis of exclusively technical criteria and on the availability of spaces for installation.

It is paradoxical that although the ELC has been in force in Spain since 2008, its impact on the management of an issue with such a severe impact on the landscape has been either very limited or practically non-existent in certain areas. This general statement regarding the treatment of landscape can be nuanced by analysing the differentiated treatment of the Convention in the legislation passed by Spain's 17 regional governments, given its highly decentralized approach to this particular issue. Indeed, the role of the ELC in the laws passed by the different regional governments has varied considerably in terms of commitment, repercussions and the time it was first mentioned. In some regions, landscape has been treated as an individual entity with the development of specific landscape laws, sometimes even prior to the ratification by the Spanish Government of the ELC. In others however, a multidisciplinary approach has been adopted, with varying impact, as a result of the partial incorporation of its principles into a range of other laws (Mata & López, 2022). Some of the more committed regions have finally issued their own guidelines for promoting the proper rollout of these new energy systems. This is the case for example of Catalonia with "Wind power and landscape. Guidelines for a successful rollout in Catalonia" (2013) and "Environmental criteria in Photovoltaic Solar Projects" (2022); and Andalusia with "Guide for the integration of wind parks into the landscape in Andalusia" (2014) and "Solar Landscapes. Integration of photovoltaic plants into the landscape in Andalusia" (2012). These documents are aimed at the main actors in these processes –technical experts, developers, communities, local entities– so as to promote the search for suitable sites and conditions for the installation of power plants that do not impair the quality of the landscape. Within the framework of the ecological transition and the challenges resulting from climate change, achieving a harmonious relationship between landscape and the expansion of renewable energies is a key goal in line with the objectives of the ELC, but the extent to which this is enforced in impact assessment studies remains limited. These guideline documents, which were drawn up with a favourable attitude to sustainable energies of this kind, place the emphasis on the search for territorial compatibility for actions which, although reversible, have an enormous visual impact, accepting the delicate balance that must be struck between the positive and negative effects.

In this way, landscape is being incorporated, to a greater or lesser extent, into the studies assessing the impact of these projects. Some of the Spanish regional governments that have shown greater commitment to the ELC have introduced a specific instrument to achieve this goal, namely a Landscape Integration Study (LIS). This is now part of the Environmental Impact Assessments to which these energy projects are subject pursuant to Law 21/2013 on Environmental Assessment. The objective of the LIS is to study the effects of the execution of the project on the landscape and, when applicable, establish the necessary corrective measures and criteria to bring about acceptable integration. Even so, the landscape is not always understood and analysed in all its manifold expressions. The LIS are often centred on the natural component of the landscape, measuring the impact and the measures that must be proposed to minimize it on the basis of this one single perspective. However, focusing exclusively on this one aspect is a partial approach that fails to encompass the complex nature of the landscape, which also has important cultural and identity-related attributes that must be taken into account in all forms of territorial planning that incorporate the objective of landscape quality. Public participation is also essential given the perceptive and emotional dimensions that landscape can have.

"No wind-power development is necessarily incompatible with the landscape, but equally that does not mean that any landscape can host any project" (Ghislanzoni & Romero, 2014: 5). This will depend on the characteristics of the installation and of the landscape that is hosting it, which is why the siting of the project and its integration into the landscape must necessarily give rise to a debate as to where – "not here" – and how – "not like that" –. As a result, the expansion of renewable energies finds itself in the paradoxical situation of being approved in general as an innovative and sustainable action that can help bring

about the objectives of ecological transition, alternative energy sources and making best use of renewable resources - while at the same time being questioned and sometimes directly rejected at a local level because of its impact on a specific area. These attitudes should not be viewed as opposition to renewable energy in general, but to the form it takes in a particular local area. This is a question of scale and degree that inevitably affects decision-making. While changes in the landscape have obvious local effects, the decisions regarding permits are often taken behind the backs of local people and without giving much consideration to the specific space involved. This is why in the processes for the planning and execution of projects, the principle of landscape quality and the consideration of the territories in all their rich diversity has proved to be an effective strategy for ensuring the social acceptance of energy projects, as demonstrated by the exemplary process of territorial planning and consensus carried out in the island of Menorca (Dubon & Mata, 2022). The energy transition is not just a technical process, it also has crucial territorial and social aspects, and its sustainability lies at the place where these three aspects converge.

Our review of the contributions made by Spanish geographers to the debate on landscape and its relationship with the expansion of renewable energies, suggests that it can be explored from two different perspectives in terms of approach and objectives. The first is the "Landscape and Energy" (or "Energy and Landscape") perspective. Coupled together in this way, the two terms create a prospective approach that aims towards reflection and the search for the right criteria and options for a correct, successful rollout of renewable energy projects in the territory. As an integrated entity, the territory is not a passive receiver at the mercy of unexpected actions and instead is normally well-structured and functionally active, even in areas suffering from abandonment and a loss of meaning. This means that any new addition is incorporated onto earlier pre-existing structures. Depending on their scale or dominant role in the landscape, these new additions can change the nature of the landscape. Given this situation, it is important to analyse how these changes are to be carried out, their repercussions, which also affect the landscape, and the mechanisms to ensure their social acceptance. Many of the aforementioned geographic research studies refer to the divorce between the modern, cutting-edge identity of the new energy plants and the defining features that identify the landscapes that host them. Conscious of this dilemma, the planning guidelines mentioned earlier propose a "clear and legible" integration into the landscape that springs from an action designed for the particular space in question and which safeguards its symbolic reference points. They mention the possibility of playing around with the distribution of the various elements on the dominant lines of the landscape (topography, field divisions, infrastructures, etc.) and prioritize the balance between compact plants, which reduce the total affected area, and installing excessive numbers of plants in certain landscapes (Mérida et al., 2012).

There is also a second approach aimed at "Energy Landscapes", which involves viewing this question from the perspective of its results, in other words, from the *fait accompli* on the ground of the transforming footprint of new energy models which have to be visible to work. We could also distinguish between "Landscapes with energy" (Landscapes with turbines, for example) and "Energy landscapes" (Wind-power landscapes), according to the dominant role played by these elements in the character of the new landscape. In the former, energy is just one more ingredient in the rich complexity of a landscape, while the latter stresses the dominant role played by energy in an area in which the large number of new elements gives rise to a new landscape category. In both cases, these installations cause brusque changes in the landscape compared to earlier more balanced panoramas, in the case of wind-farms also affecting night-time landscapes. However, their impact does not necessarily have to be considered as harmful for the qualities and values of the host territory. The change could even enhance the value of the landscape by helping create contemporary spaces that could be viewed positively within the objectives of the ecological transition. Here, the job of raising awareness as to the general good in relation to the cost/benefit is crucial for social acceptance and assimilation of the new landscapes. However, in many territories it is a non-existent, non-priority action in a process of expansion in which private interests tend to prevail, territorially fragmenting decisions that in fact should be combined in terms of their effects on the landscape.

This discussion of the two contrasting perspectives is useful when analysing the contributions to the debate entitled "Landscape and alternative energies" coordinated by Riesco Chueca in the PH journal published by the Andalusia Historic Heritage Institute. "The recent switch towards renewables is also a switch towards the visibility and omnipresence [of energy generation sources]: wind and photovoltaic plants spill across the territory, they become embedded within the framework within which people live [...] Comprehensive reintegration is required to adapt this widespread presence to the aspirations of quality and beauty that must preside over the conformation of the environment in which we live" (Riesco, 2023:86). This is a good starting point for a debate on a territorially extensive model that is imposed with very little prior discussion or criteria within a framework of territorial planning and environmental quality, which transcends the purely ecological to also encompass the landscape.

The first challenge lies in understanding the complexity of the rollout process. The decisions that measure the impact and the viability of each project in its specific site do not have a full view of the whole context, given that the nature of the artefacts and the spatial effects of these infrastructures are not confined to the boundaries of the installation itself. The benefits – normally economic profits made by the owners of the plants and the land – do not converge with the costs, which affect a much wider radius of territory. Managing the spatial transformations and their effects in a contextualized manner requires a compensatory overall view, within the context of a strategic rollout that includes social consensus and territorial planning with fairly shared costs and benefits.

The second critical point lies in the rollout models: either replicated over a large dispersed area or concentrated in degraded areas (quarries, old mines, dumps etc) or places whose landscapes are not highly valued (those with highly intensive agricultural uses or traversed by communication infrastructures, irrigation channels, etc.). The first model could potentially have a banalizing effect "given its repetitive nature, with long series of pieces of identical design, which are alien to the local landscape" (Riesco, 2023b); the second runs the risk of imposing a dominant subjective viewpoint which unfairly condemns the worst treated spaces, which are perhaps less appealing in terms of their bare, often treeless relief. Within the first, more scattered model, the impact could also be considered according to the type and scale of the installation: a large-scale business investment or a small-scale self-consumption project. The latter form of energy generation and distribution which benefits private individuals, residential communities and farms etc is widely accepted in that it fulfils the ecological transition and sustainability objectives. However, this model also requires some rethinking due to its disseminated effects on the landscape.

The third topic for debate centres around public attitudes to this question, which range from rejection to assimilation. Emphasis can be placed either on trying to hide or minimize the visual cost of these infrastructures or on trying to assimilate them and give meaning and new value to the landscapes created by a well-planned integration in line with the specific values and character of each landscape, in search of a discourse that socially reconciles the cost of the ecological transition with the benefits. In both cases, opposing positions can be observed. The most critical observers doubt whether it is possible for infrastructures with such a high visual impact to be rolled out in harmony with the landscape. The most optimistic talk of trying to give them an aesthetic meaning and opportunity by exploring their transformative capacity in a positive sense, occasionally becoming evocative or even inspiring landscapes for artistic creation; a good design for integration that encourages a favourable narrative and can transform energy artifacts into reference points in the landscape. If we take a longer historical perspective, it would not be the first time that society has come to appreciate the aesthetic appeal of infrastructures and their contribution to the creation of new landscapes, but this takes time. In this sense, the younger generations already accept renewables as everyday features of the landscape, and take their presence for granted without considering them to be a negative impact, viewing them instead as a present-day image of the territory produced by the cultural and technological development of society.

The general criteria in the planning of new energy developments cannot be applied in any standard, uniform way across a widely diverse territory with an equally wide range of different economic and social circumstances. As Alomar (2023) makes clear, there are no

objective best practices in this field, beyond what societies regard as good and are prepared to accept in terms of integration into the local landscape, heritage and identity. A change in the model of energy production and consumption is now regarded as a priority. This energy transition can best be achieved in a process in which public participation plays a key role. A favourable attitude towards the proposed changes is a good starting-point for the planning of this transition. This is where Geography, as the social science of space, faces two important challenges regarding how best to approach its contribution. Firstly, from an integrative perspective, it must contribute to the definition of the criteria and actions required in the design of planning tools, including the social considerations and the methods for citizen participation; secondly, the inclusion of landscape in the definition of the priority objectives in the energy field. Landscape is an expression of a territorial order whose quality and equilibrium cannot be disassociated from the concept of sustainability that is being sought with the changes being made in the energy model in line with the principles of the ELC: acceptable (integration) and accepted (social consensus) scenarios. As a result, landscape must not be seen as an uncomfortable issue for territorial management, but as a valuable criterion in the design of an energy transition with which society feels identified rather than under attack.

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# Global touristification: tourism reversal, management, recrectification or decrectification?

GASTRONOMIC TOURISM AS A DIVERSIFICATION STRATEGY  
OF MATURE COASTAL DESTINATIONS

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## ABSTRACT

In recent decades, a change has been observed in consumer preferences for tourism products, motivated by a more varied offer and more selective tastes. Among these tourist products, gastronomic products stand out. A tourism that has grown considerably and has become one of the most dynamic and creative segments of the tourism market. A gastronomic heritage that is part of the cultural identity of the different territories that make up the Galician coast, due to its marked fishing character. This work will analyze the use of gastronomy as an essential element in tourism promotion in tourist destinations on the Galician coast through both quantitative and qualitative analysis. Finally, we consider that gastronomy is currently one of the key elements for the diversification and empowerment of mature Galician coastal destinations in their promotion and marketing strategies.

## KEYWORDS

Gastronomic heritage, tourism management, diversification, governance.

# 1. INTRODUCTION

In Galicia's coastal destinations over the last few decades, territorial tourism development strategies have evolved from a vision based exclusively on "sun and beach" tourism to more lines of action centred on diversification and product quality. Among the new tourism products that have been promoted, gastronomic tourism stands out. Gastronomic tourism has grown considerably and has become one of the most dynamic and creative segments of the tourism market (Leal, 2013: 5). A tourism product that includes in its discourse sustainable values based on the territory, the landscape, the sea, local culture, local products, authenticity, which is something it has in common with current trends in cultural consumption (UNWTO, 2012: 5). The current tourist demand is largely characterised by the search for experiences; a field where gastronomy offers the possibility of developing a product based on the fact of tasting and savouring the agro- food wealth of a territory. In fact, gastronomy, as a tourist resource, is appreciated both for its own intrinsic value and for its symbolic character, "(...) insofar as it acts as an identifier of peoples and territories" (Armesto and Gómez, 2004: 84). In this sense, if the managers of tourist destinations are able to structure the offer into suitable tourism products, gastronomic resources not only increase the brand value of a destination, but also its own (Barrera and Bringas, 2008). Now, what should we understand by gastronomic tourism? Gastronomic tourism is defined as the desire to experience a particular type of gastronomy of a specific region (Hall and Sharples, 2003: 10). More specifically, gastronomic tourism should be assimilated to visits to primary and secondary food producers, food festivals, restaurants and specific places where tasting dishes and/or experiencing the attributes of a specialised food-producing region is the main reason for the trip (Hall and Sharples, 2003). Analysing the definitions used, we can conclude that the key to distinguishing this segment of demand within the shopping segment is their motivation for gastronomy; they are in fact knowledgeable travellers, or at least they try to stamp themselves as such, seeking to increase their knowledge through their trips and to make the most of what motivates them to travel. In fact, successful gastronomic destinations "(...) are (...) those that satisfy the appetite of gastronomic tourists for authenticity, offering products and experiences that faithfully communicate a close link between gastronomy, territory and community" (Hillel *et al.*, 2013: 202). In this sense, gastronomic tourism is considered a means to recover the traditional gastronomy of each area. Gastronomy is part of the cultural identification of a territory, given its historical and cultural character (Millán, 2011: 94). "It is also important to highlight that the set of resources, products and services articulated around gastronomy contribute to generating unique experiences for tourists, an activity that is fully aligned with the new expectations of the demand that currently seeks to experience experiences, to carry out memorable activities, much more than "passively visiting" a certain place" (Turgalicia, 2012: 7). Gastronomic tourism in Spain experienced significant development in the first decade of the 21st century. In 2010, it was estimated that around five and a half million people visited Spain "(...) mainly for this reason each year. Moreover, the vast majority of the fifty million foreign tourists who visited Spain in total highlighted the attractiveness of its gastronomy when asked about the most valued aspects of the country" (Flavián and Fandos, 2011: 12). In fact, "(...) the importance of gastronomy in Spain for tourism today is evident" (Leal, 2013, p. 25). In fact, the number of tourists in Spain who indicated "gastronomic tourism" as the main reason for their trip increased in absolute terms by 24% between 2016 and 2019. If we look at tourism expenditure, the expenditure on leisure and cultural activities generated by tourists who engaged in gastronomic activities<sup>10</sup> in 2019 rises to 3,527 million euros, 3.8% of total tourism expenditure. In 2021, the effects of the disruptive crisis of the COVID-19 pandemic are evident, with spending standing at €1.32 billion, close to the level reached in 2017 (€1.624 billion), remaining at 3.8% of the total (State Secretariat for Tourism, 2022:8). In this direction, the consultancy Dinamiza Asesores (2023: 16) points out that people who have made a gastronomic trip in Spain increased by about 10 percentage points in the last five years, with 86.4% in 2022 of travellers claiming to have made at least one trip or getaway of a gastronomic nature in the last two years. In Galicia, in 2019 AEITG

1 There is a wide variety of terms in the scientific literature used to establish the relationship between gastronomy and tourism: cuisine tourism, food tourism, gourmet tourism, gastronomy tourism, gastronomic tourism, culinary tourism, ... Without debating the most suitable of these, we are going to opt for gastronomic tourism.

(2020: 11 and 12), 49.9% of tourists visiting the destination did gastronomic tourism, the second most popular activity during the trip after visits to tourist attractions. Furthermore, gastronomy is the second most valued aspect of the destination, after landscape and nature, with a rating of 4.82 out of 5. Therefore, we find ourselves with a tourism product on the rise which has aroused the interest of both the central administration and all the autonomous Spanish administrations in the development of the gastronomic tourism product. The Autonomous Communities that are most committed to this tourist product are Asturias, the Basque Country, Aragon, Catalonia, Cantabria, Region of Valencia, Castile-La Mancha and Galicia. This commitment is reflected in the establishment of Strategic Competitiveness Plans or specific gastronomic tourism product clubs (Sánchez, 2012). In addition, due to its neighbourhood significance, we cannot fail to mention the importance that Portugal is gaining as a gastronomic destination within the European market. In the case of Galicia, where gastronomy enjoys considerable recognition, the administration has been promoting this sector in recent years through various policies and strategies, with the launch in 2012 of the Galicia Food and Wine Plan<sup>2</sup> and the Master Plan for Food and Wine Tourism in Galicia and Northern Portugal 2012-2014<sup>3</sup>. This plan aimed to strengthen this tourism model by implementing strategies and actions to boost the competitiveness of the gastronomic product and wine tourism in Galicia.

## 2. METHODOLOGY

The methodology of this work is based on the analysis of statistical data, the review of literature and the analysis of texts and images related to gastronomic tourism. Regarding this last point, the methodological development of this work has been based on the qualitative and quantitative analysis of the main official brochures on gastronomic tourism published by the regional (Xunta de Galicia) and provincial (Government of the Province of A Coruña, Lugo and Pontevedra) administrations. These are the brochures analysed:

- Gastronomic Carnival published by Xunta de Galicia
- Lugo Changes. Flavours of Lugo published by the Lugo Provincial Council.
- Buenos por naturaleza published by the Government of the Province of A Coruña
- Strolling among vineyards published by the Xunta de Galicia
- A mesa do Noroeste published by the A Coruña Provincial Council

This analysis considered aspects strictly related to the tourism sector, as well as others related to the surrounding landscape or specific descriptions of each place. The aim is to understand the resulting image of gastronomic tourism in Galicia. Specifically, two different types of analysis have been carried out:

**1– Analysis of descriptive texts of brochures:** In this process we follow the guidelines established by authors such as Pennebaker *et al.* For this analysis, the full texts of

2 Approved on 3 May 2012 by the Consello de la Xunta de Galicia.

3 This Plan is part of the ECA-IT Project, included in the Operational Programme for Cross-border Cooperation between Spain and Northern Portugal. Within this, five lines of action are foreseen: organisation and implementation of the plan, promotion of gastronomic destinations, development of gastronomic products, marketing and training and innovation in the sector. Another interesting project is CANTATA 2 (Celtic Authentic Niche Tourism in the Atlantic Area 2). This project was carried out between 2010-2012 and co-financed by the ERDF through the Atlantic Area Transnational Cooperation Operational Programme with the main objective of the integral development of the Galician rural environment through a greater use of its local agri-food and tourism potential. Within this operational framework, it developed the innovative tourism product "Agri-food routes of Galicia", consisting of various itineraries linking the agricultural and industrial production process and the tasting of local cuisine (Patiño Romarís, 2016b).

brochures and tourist guides were collected and the words included were counted. The total number of words analysed was 36,192. In order to extract data from such a large set of words, two post-filters were applied:

- A)** Elimination of words commonly used in the language, such as adverbs, pronouns, etc.
- B)** Once these types of words without added meaning were removed, words that were not repeated at least three times were removed.

After applying these filters, a final word count of 928 words was obtained. These words were ranked from most to least repeated and organised in a dynamic table to facilitate the analysis. This list of words has been represented by a word cloud with a specific size for each term according to the number of times it appears in the text.

- 2-** Analysis of images used in guides and brochures: Together with the texts, all the images in the guides were analysed to extract the territorial image, mainly using methodologies applied by Santomil (2011).

### 3. GASTRONOMIC OFFER IN THE GALICIAN COASTAL DESTINATIONS

Galicia has a wide variety of seafood products and is Spain's leading producer and consumer of fish. In fact, within the demand market, fish and seafood are the most valued food products of Galician cuisine. The Galician territory has a wide variety of seafood products as the leading producer in the Spanish fish market and a region that owns 40% of its fishing fleet (Piñeiro Antelo, 2014). Among the products, octopus stands out as a symbol and trademark character of traditional Galician cuisine.

On the other hand, the variety of climates and soils made it possible to create a wide range of land resources. Galician gastronomy has five wine Designations of Origin (Monterrei, Valdeorras, Ribeira Sacra, Ribeiro and Rías Baixas) and four other protected geographical wine indications (Table 1). Other Galician agri-food products are also included under specific designations (Galician beef, cheese, peppers, chestnuts, etc.). Galicia is the third Spanish Autonomous Community with the most certified quality products. There are 36 Protected Designation of Origin or Protected Geographical Indication labels (Table 2). On the other hand, Galicia has five Galician Wine Routes with a wide range of wineries that can be visited. In addition, there are numerous agri-food companies (canned fish and seafood, cheese production, wine, meat processing and dairy products, etc.) (Ministry of Agriculture, Fisheries and Food, 2023; Xunta de Galicia, Consellería do Medio Rural, 2023).

Designation of Origin (D.O.P.)	Province	Wine route <sup>4</sup>	Terra Vineyards (I.G.P.)
D.O. Monterrei	Ourense	Not certified	Barbanza and Iria Regional Wine
D.O. Ribeiro	Ourense	Non- certified	Viño da Terra Val do Miño Ourense
D.O. Rías Baixas	Pontevedra and A Coruña	Certified	Viño da Terra Betanzos
D.O. Ribeira Sacra	Ourense and Lugo	Not certified	Viño da Terra Ribeiras do Morrazo
D.O. Valdeorras	Ourense	Not certified	

Table 1. Designations of Origin and Viños da Terra in Galicia. Source: Own elaboration.

4 Wine Route certified by the Spanish Association of Wine Cities (ACEVIN).

Category	PDO	PGI
Fresh meat		Terneira galega Vaca galega/Boi galego
Meat products		Lacón Galego Chourizo Galego Xamón Galego Botelo Galego Androlla Galega Capón de Vilalba
Cheese	Arzúa-Ulloa San Simón da Costa Cebreiro Tetilla	
Other animal products		Mel de Galicia
Fruit, vegetables and cereals	Pemento de Herbón	Castaña de Galicia Faba de Lourenzá Grelas de Galicia Pataca de Galicia Pemento da Arnoia Pemento de Oímbra Pemento do Couto Pemento de Mougán
Fish and shellfish	Mexillón de Galicia	
Bakery products, I would bake and refuel		Pan de Cea Pan Galego Tarta de Santiago
Spirit drinks		Augardente de Galicia Orujo de Galicia Augardente de Herbas de Galicia Licor Café de Galicia Licor de Herbas de Galicia

Table 2. Galician Protected Designations of Origin (PDO) and Protected Geographical Indications (PGI) outside wine. Source: Consellería do Medio Rural e do Mar, Xunta de Galicia.

In Galicia, in 2023, according to the Directory of Tourism Businesses and Activities (DEAT) prepared by the Xunta de Galicia, there were a total of 5,707 catering establishments. The municipalities with the largest number of restaurants are the urban coastal towns of A Coruña (422 establishments, 7.39% of the total number of restaurants in Galicia) and Vigo (590 establishments, 10.34% of the total number of restaurants in Galicia). It is also worth highlighting the important weight achieved by this type of offer in Santiago de Compostela (404 establishments, 7.08% of the offer) and Sanxenxo (129 establishments, 2.26% of the offer), the two main tourist destinations in Galicia. In terms of the restaurant offer linked to quality labels, in 2023 there were 16 restaurants with a Michelin Star (out of a total of 95 recommended) (Figure 1) and 34 distinguished with Repsol Suns.

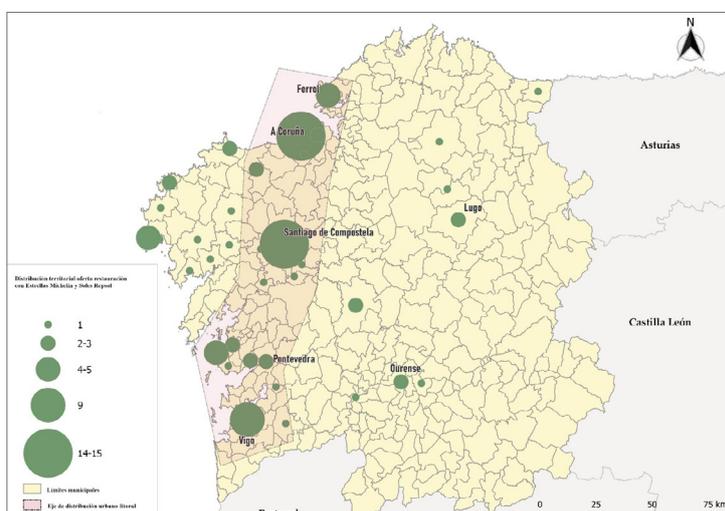


Figure 3. Territorial distribution of the catering supply recommended by the Michelin Guide in 2023. Source: Own elaboration.

A differentiating and not sufficiently known type of restaurant offer within the Spanish tourist market are the furanchos. Furanchos are "(...) premises used mainly as a private dwelling but where the owners sell the surplus wine from their own harvest produced in the house for private consumption, together with the tapas which, as food products regularly prepared by them, accompany it" (Art. 1.2, Decree 215/2012, of 31 October, which regulates the furanchos of the Autonomous Community of Galicia)<sup>5</sup>. The furanchos or loureiros are spread throughout the Rías Baixas and their number is difficult to quantify. In any case, the furanchos must meet specific requirements for their activity, where only a limited number of dishes (5) can be used with home-produced wine (Art. 4, Decree 215/2012) and they can only be open three months a year (Art. 8, Decree 215/2012). This is a catering offer that promotes the typical products of Galicia and their quality as a local product (Morón and Fusté, 2021: 153). Furanchos have become an important tourist attraction "(...) because visitors are increasingly attracted to try traditional home-cooked dishes, they want to be part of the local culture and live a different experience in a rural environment" (Morón and Fusté, 2021: 154).

Based on the above, we consider that the Galician gastronomic offer may constitute the main motivational attraction for a specific sector of demand (López Guzmán and Sánchez, 2008: 160). However, the cross-cutting nature of gastronomy as a tourism product means that it complements the offer of other products such as incentive and congress tourism, sun and beach, golf, health, religious, language and nature tourism (Table 3). Specifically, the combination of gastronomy with other tourism products has led to successful initiatives such as the *Bono Iacobus*, which combines gastronomy with the *Camino de Santiago*, and *Outono Gastronómico*, which combines gastronomy with rural tourism<sup>6</sup>.

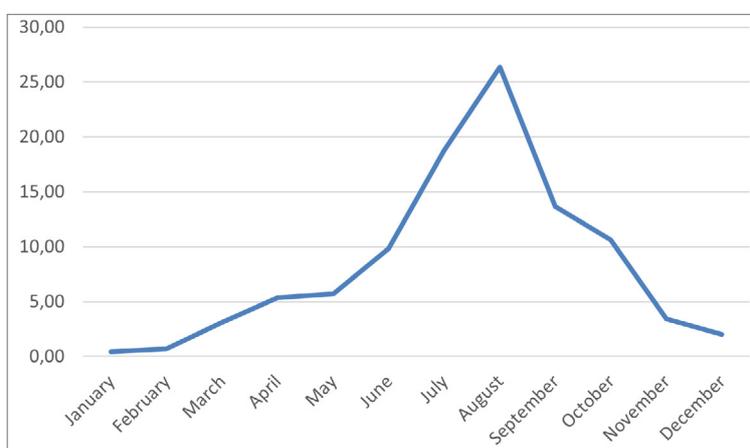
Product	Importance	Offer/ products of interest
Sun and beach	HIGH	Shopping, tastings, leisure activities...
Nature/Active	MEDIUM	Rural catering, visits to production companies...
Nautical	HIGH	Catering in nautical facilities, nautical charter with tasting on board, company events.
Cruises	HIGH	Excursions along wine routes, restaurants/tapas in port cities, shopping for <i>gourmet</i> products, ...
Mariner	VERY HIGH	Visits to fish markets, rafts, fish farms...; tasting on board fishing boats; shellfish trails on foot,...
The Way of Saint James	MEDIUM	<i>Iacobus voucher</i> , restaurants, gastronomic events, ...
Health	MEDIUM	Catering, events, tastings and samplings, leisure activities, Atlantic diet...
Rural	VERY HIGH	<i>Gastronomic Outono</i> , restaurants, ethnography, gastronomic festivals, organic products...
Golf	HIGH	Gastronomic walks, gastronomic shopping, haute cuisine restaurants...
Urban/Cultural	VERY HIGH	Catering, tasting, workshops, incentives, visits to production companies, ...
MICE	VERY HIGH	Catering, tasting, workshops, incentives, visits to production companies...
Religious	MEDIUM	Catering, events/gastronomic pilgrimages, ...
Idiomatic	MEDIUM	Catering, gastronomic events, gastronomic shopping...

Complementarity of the gastronomic tourism product with the main products of the Galician tourism offer.  
Source: Patiño Romarís (2016b: 717).

<sup>5</sup> DOG nº16, 13/11/2012.

<sup>6</sup> In the 17th edition of *Outono Gastronómico*, corresponding to the year 2023, a total of 79 rural tourism houses participated (14% of the Galician offer), distributed at provincial level as follows: 24 in A Coruña, 22 in Lugo, 17 in Ourense and 16 in Pontevedra.

Gastronomic festivals and fairs are first-rate promotional events with great potential for attracting tourists. In Galicia there are more than 300 gastronomic festivals and fairs, some of which are classified as Festivals of National or International Tourist Interest. They exalt the typical products of each territory and have a high potential for the use of brand value in the promotion of various food products (CLUSAGA/USC, 2013: 27). The origin of these festivals lies in local or regional celebrations commemorating local traditions or religious festivals, such as pilgrimages, in which the fulfilment of the promise to the saint was completed with a traditional meal. However, some of these gastronomic exaltations were already born with marked tourist intentions (*Festa do Marisco de O Grove*, *Festa do Viño Albariño de Cambados*, etc.). In fact, most of them are of recent creation, specifically from the late 1980s and 1990s. These festivals are tangible proof of the great Galician culinary tradition based on high quality raw materials, appreciated in Spain and abroad (Padín, 2009). Within this group of festivals, the Albariño Wine Festival in Cambados (1st Sunday in August) and the O Grove Seafood Festival (2nd week in October) stand out, with a clear tourist vocation. The latter is of particular interest due to its seasonal nature (Patiño Romarís, 2002) and its large number of visitors (Figure 2). Finally, it should be noted that the number of gastronomic events, pinchos competitions, forums, etc., has increased considerably in Galicia as a whole in recent years. These initiatives are effective in promoting and enhancing the value of a destination's gastronomic heritage.

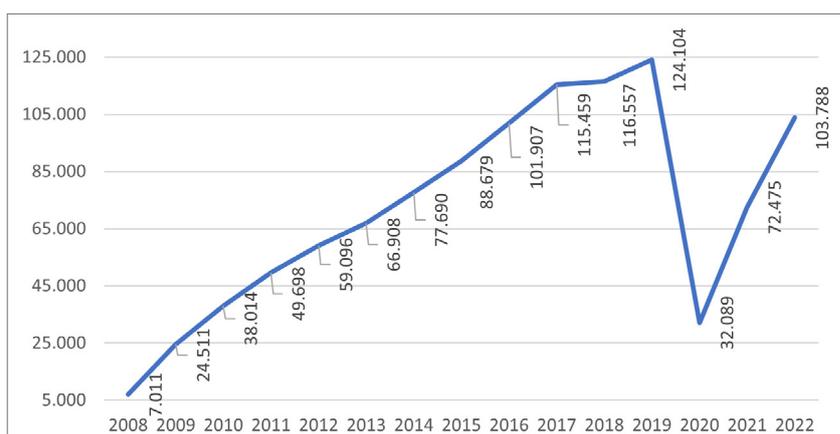


**Figure 2. Monthly evolution of the volume of overnight stays in hotel establishments in O Grove (Pontevedra).  $\Sigma$  Period 2005-2022. Unit: %.**  
Source: Own elaboration based on data from the Hotel Occupancy Survey (HOS) of the INE.

Gastronomic routes are an interesting instrument for positioning products and associating them with a geographical quality appellation; "(...) they are thematically formulated territorial articulations (...)" (Barrera, 2006: 84) around a gastronomic product. However, most of the initiatives of this type on the Galician coast do not constitute structured tourism products, as they are not subject to any plan or management, so that in most cases there is a lack of tourist signage, creation of specialised tourist services, enhancement of resources, lack of quality management, lack of cohesion of the offer, ... (Patiño Romarís, 2016b). Perhaps the only exception to this effective lack of planning both in Galicia and on the Galician coast are the wine routes. These routes are usually signposted and advertised with special panels on which natural, cultural and environmental values, vineyards and wineries are emphasised. These routes are the means by which the wine-growing territories and their related productions can be disseminated, marketed and enjoyed in the form of a tourist offer (Patiño Romarís, 2016b). A wine route consists of structuring a visit to all the places and resources that have to do with wine or its lifestyle in a given territory (Ravenscroft and Van Westering, 2001: 153). In other words, a wine route is "(...) a tourist route linking several wineries and vineyards in a given area" (Bruwer, 2003: 424). The Secretary of State for Tourism (2000: 15) defines the wine route as "(...) the integration under the same thematic concept of the resources and tourist services of interest, existing and potential, of a wine-growing area, formulated from the authenticity and the experiential vocation, in order to build a product from the identity of the destination, which facilitates the joint marketing of the whole area and guarantees the level of satisfaction of the demand, thus promoting the integral economic-social development of the area". Therefore, a wine tourism route is the result of the effort and the synergy that derive from the collaboration between public and private agents, based on an alliance and common objectives (Telfer, 2001: 21).

A Wine Route is an ideal tool for promoting a model of sustainable and integrating rural development, capable of boosting the competitiveness of a territory, increasing and improving wine production, respecting the environment and improving the living conditions of the citizens (Millán and Melián, 2008: 162). On the other hand, the wine tourism product has the potential to capture a segment of demand "(...) in search of new sensations, with longer leisure hours and a splitting of holidays that allows them to be deseasonalised" (Álvarez *et al.*, 2014: 707).

All the Galician wine-producing Denominations of Origin (D.O.) have their own wine routes<sup>7</sup>. Each of them is equipped with a wide range of tourist services, among which sectors and services such as wineries, accommodation and restaurants predominate (Turgalicia/Dinamiza Asesores, 2011: 41). In fact, all these routes present a high level of involvement and fostered public-private cooperation in the development of the tourism product of each appellation of origin (Turgalicia/Dinamiza Asesores, 2011: 137). The great challenge for tourism managers in these territories is to implement a more effective territorial marketing policy, where one of their target audiences is gastronomy and a basic strategic component is the implementation of continuous actions to dynamise the gastronomic product (Patiño Romarís, 2016b). Of the five existing wine routes in Galicia (Table 1), only one was certified in 2022 by the Spanish Association of Wine Cities (ACEVIN)<sup>8</sup>: the Rías Baixas Wine Route<sup>9</sup>, precisely the only one with a marked coastal character. In 2022, the Rías Baixas Wine Route was the seventh most visited of all the existing routes in Spain<sup>10</sup>, with a total of 103788 visitors. Figure 3 shows the effects of the disruptive crisis linked to the COVID-19 pandemic on the number of visitors: in 2020 the fall was -286.75%. In the year 2022, pre-crisis visitor numbers have not yet been recorded.



**Figure 3. Evolution of the number of visitors to the wineries and museums of the Rías Baixas Wine Route. Period 2008-2022. Unit: number of visitors. Source: Own elaboration based on ACEVIN data.**

- 7 An interesting product due to its link with the world of wine is the so-called Route of the Arrierios. A route that in the Middle Ages ran along a Royal Road, linking the wine production area of Ribadavia (Ourense) with Pontevedra. A route also known as the Wine Route, because on the way from Ourense to Pontevedra the muleteers transported mainly "bocois" of wine. On their way back to Ourense, the muleteers transported coastal products: octopus, dried or salted fish and seafood. Around this historic route, the Terras de Pontevedra Tourism Product Dynamisation Plan articulated a product consisting of a network of restaurants, shops, leisure activities, museums, hotels and rural accommodation, where you can enjoy typical Galician gastronomy paired with D.O. Ribeiro and Rías Baixas wines. In short, this is an interesting product that is in danger of no longer being revitalised after the expiry of the Terras de Pontevedra Tourism Product Revitalisation Plan in 2011 (Patiño Romarís, 2016b). See: [http://terrasdepontevedra.blogspot.com.es/2011\\_03\\_01\\_archive](http://terrasdepontevedra.blogspot.com.es/2011_03_01_archive).
- 8 The Spanish Association of Wine Cities (Acevin) and the General Secretariat of Tourism include in the Wine Routes of Spain Tourism Product Manual the methodology for the implementation of this tourism product and its subsequent certification by the Management and Certification Committee of the Wine Routes of Spain. This manual defines a set of requirements applicable to the managing entity of the route, such as its management system, signposting, promotional actions and marketing support, as well as those relating to the different types of establishments that can form part of it: restaurants, accommodation, wineries, shops, etc. In short, the Wine Routes of Spain brand establishes quality criteria to differentiate these routes from other wine tourism proposals (Patiño Romarís, 2016b). See: <http://www.wineroutesofspain.com/ver/2772/Tu-satisfacci%C3%B3n-garantizada.html>
- 9 The Rías Baixas Wine Route began its journey in 1996 and after a long process, in 2005 the Rías Baixas Wine Route joined the Wine Routes of Spain Product Club after passing an external certification process. At present, the Rías Baixas Wine Route is made up of six itineraries, four within the Salnés sub-area, one in O Rosal and another in Ribeira do Ulla (Patiño Romarís, 2016b).
- 10 Data extracted from the surveys carried out on real demand at the destination by the Tourism Observatory of the Wine Routes of Spain. A tool set up by the Spanish Wine Routes Tourism Product Club in 2008. This tool was the first initiative to measure data on the supply and demand of wine tourism in Spain (Patiño Romarís, 2016b).

## 4. QUALITATIVE ANALYSIS OF TEXTS IN TOURIST GUIDES AND BROCHURES PUBLISHED BY THE PUBLIC ADMINISTRATION

In this research we carried out a quantification of the most used words in tourist brochures. With this information, and after carrying out the processes indicated in the methodology, a total ranking of 928 positions was obtained. With this information, the word cloud (Figure 4) shown below was created, in which a word size directly proportional to the number of times each word was repeated was generated. This figure facilitates the detailed analysis of the different sections. The main analysis was carried out among the first 100 words of the ranking and especially among the first 10 words (Table 4) by number of repetitions. The first result is that the most used word is *party*. Thus, being an analysis of gastronomic tourism brochures, the clear association between event tourism or gastronomic festivals and the creation of a gastronomic image of Galicia is evident. Although it requires further analysis and study, this should be contrasted with another gastronomic strategy oriented towards high-level catering with more elaborate products. Thus, from the first word alone, a specific type of strategy focused on product and mass tourism as opposed to elaboration and specialisation is evident.



Figure 4. Word cloud of terms related to gastronomic heritage cited in tourism brochures published by the Galician public authorities. Source: Own elaboration.

Position in the ranking	Product name	Times repeated
1	Festa - Party	161
2	Bodega - Winery	141
3	Vino/viño - Wine/vintage	137
4	Galicia	115
5	Viñedo - Vineyard	111
6	Pazo (Traditional aristocratic house)	68
7	Agua - Water	66
8	Experiencia - Experience	64
9	Paseando - Walking	62
10	Río - River	61
		<b>986</b>

Table 4. Top 10 most repeated words in gastronomic brochures. Source: Own elaboration.

Focusing now exclusively on gastronomic products, when analysing the tourist brochures, we can see which ones are generating a greater tourist image related to gastronomy. Thus, the second most used word is *Bodega/Winery* with a total of 141 repetitions, which places it in first place in the ranking. This data alone indicates the great weight of the wine sector in gastronomy-related tourism. As an element of reinforcement of this analysis, we can use the use of other related terms only among the ten most used words. In this sense, among the top ten words in the ranking, in addition to “Bodega”, two other words refer to this product: “Vino/Wine” with 137 repetitions and “Viñedos/Vineyard” with 111 repetitions. This preponderance of one product over the whole is really significant. As we can see in table 4, if we exclude *water*, we can see that, among the top 10 in the ranking, wine (adding up all the words related to the term) is the most used gastronomic product. In quantitative terms, wine and its related terms account for nearly 40% (39.45%) of the total of the most repeated words among the top 10 in the ranking. This represents an enormous capacity to generate a territorial and tourist image.

We must also highlight, within this context, the use of terminology referring to the designations of origin of the wine itself. Among the top 100 most repeated words, we can find:

- Monterrei with 44 repetitions
- Albariño with 44 repetitions (DO Rías Baixas)
- Ribeiro with 39 repetitions
- Valdeorras with 35 repetitions

In addition to the administration's clear commitment to the creation of a tourist image using wine as a central element of attraction from a gastronomic point of view, this analysis shows the use of wine as a useful by-product in the promotion of other types of gastronomic elements. For example, as we can see in Figure 5<sup>11</sup>, which promotes a series of "typical" Galician products in the brochure: *Buenos por Naturaleza (Good by Nature)* published by the Deputación da Coruña, we can see that wine is positioned in the centre of the image. This iconographic selection, whether intentional or not, is no coincidence. The use of wine is a classic resource in tourism promotion with the aim of associating the powerful image of sophistication and culture with both products and territories. In the gastronomic promotion of Galicia, this is repeated in the creation of specific guides on the wine itself, vineyards and wine routes. Also, in using wine to add "value" to other gastronomic products.

Continuing with the rest of the gastronomic products, table 5 shows all the gastronomic products ranked in the first 100 positions. Thus, the first conclusion is that, despite analysing gastronomic brochures, the number of times that the products themselves are cited is low. Thus, if we add up all the repetitions of these products, we obtain a total of 557 repetitions among the first 100 positions in the ranking. This represents only 13.73% of the total number of repetitions of the words in the top 100. Moreover, adding up all the repetitions of all the other products barely exceeds the number of times wine-related terms are repeated (excluding the repetitions of the DOs). Among the 30 most repeated products, after wine, oil appears with a total of 53 repetitions and in 16th position in the ranking. After wine, the first dish in the ranking is *broth*. This is particularly significant in that it is far ahead of seafood products such as shellfish, mussels or perch. This is particularly significant for this research insofar as it shows a discourse that relegates the potential of coastal destinations to other areas and products. Finally, it is worth noting the high number of repetitions of simple products such as bread or peppers. Thus, in general, there is an image of simplicity and a preponderance of classic products with a lower presence of products related to the sea than would be expected.

On the other hand, it was considered particularly useful to analyse the territorial and geographical distribution. For this purpose, we analysed the number of times that the main places mentioned in the brochures are repeated. In table 6, we have analysed the words referring to a specific place name in Galicia, provided that they are among the first 100 positions. In this analysis we have included the naming of specific geographical elements. The analysis indicates that the main tourist destinations in Galicia (with the exception of the Rías Baixas) are also used in gastronomic promotion. Thus, in addition to the term Galicia, Santiago



Figure 5. Image from the brochure *Good by Nature* (2023; 2)<sup>11</sup> published by the Deputación da A Coruña.

11 See: [https://turismo.dacoruna.gal/es/descargas?field\\_categoria\\_tid=316](https://turismo.dacoruna.gal/es/descargas?field_categoria_tid=316)

Position in the ranking	Product name	Times repeated
16	Aceite - Oil	53
17	Caldo - Broth	52
27	Carne - Meat	45
28	Pimiento - Pepper	44
47	Pan - Bread	34
49	Pulpo - Octopus	34
50	Pollo - Chicken	34
55	Cocido - Stew	29
63	Percebe - Barnacle	28
64	Empanada - Pie	28
69	Sal - Salt	27
77	Ajo - Garlic	26
79	Lacón - Pork loin	25
81	Marisco - Seafood	25
83	Miel - Honey	25
90	Berberecho - Cockle	24
91	Mejillón - Mussel	24
		<b>557</b>

Table 5. Gastronomic products by number of repetitions among the 100 most used terms in gastronomic brochures. Source: Own elaboration.

Position in the ranking	Product name	Times repeated
4	Galicia	115
18	Santiago	52
21	Cambados	50
25	Ribeira	47
40	Sil	37
43	Miño	36
51	Ourense	32
58	Compostela	29
66	Monforte	27
70	Coruña	26
97	Lugo	23
		<b>474</b>

Table 6. Top place names by number of repetitions among the 100 most used terms in gastronomic brochures. Source: Own elaboration.

de Compostela would be at the top of the ranking (as long as we join the terms *Santiago* and *Compostela*, which can also refer to the cathedral). The presence of Monforte de Lemos also stands out above cities such as A Coruña or Lugo (also mentioned as provinces). Finally, the importance of wine is again noted in the presence of Cambados in position 21, as well as the terms *Ribeira* and *Sacra*, mostly used to refer to the Ribeira Sacra Designation of Origin.

Finally, as it could not be otherwise in a tourist brochure, we find words that refer to its own dynamics or to the overall image of the destination. Thus, we highlight the position of the term *experience* among the top 10 as a subjective element of leisure. With regard to the main iconographic elements of the destination, we note the presence, among the top positions, of terms such as *pazo*, *santo*, *monasterio*, *sacro*, *catedral* or *castro*. All of these terms are omnipresent in the tourist discourse of Galicia. Likewise, geography and especially water are a powerful set of iconographic elements. In addition to the term *water* (one of the most repeated terms), geographical elements such as *river*, *estuary*, *coast* or *sea* stand out. In this sense, the following image from the *Lugo Cambia* brochure (Figure 6)<sup>12</sup> is particularly significant. In it we observe not only a maritime landscape but also the selection of the main products related to the sea that appear in the ranking as well as the slogan: *From the sea and the rivers*.



Figure 6. Image extracted from the brochure *Lugo Cambia. Flavours of Lugo* (2024:3)<sup>12</sup> published by the Deputación de Lugo.

12 See: <https://turismo.deputacionlugo.gal/gl/planifica/descargas>

## 5. CONCLUSIONS

The gastronomic tourism product of the Galician coast is a key element of the image of its tourist destinations. A gastronomic tourism product that is presented to us as a unique, seasonal tourism product with a high cultural component. Gastronomy can be used to satisfy the traveller, to contribute to the authenticity of the destination and to increase the economic impact of tourism. A gastronomic product must be based on the definition of which are going to be the heritage resources, the resources that we are going to convert into tourist products that allow us to identify the destination within the market. Therefore, in order to be able to promote a destination through its own gastronomy, a series of basic characteristics must be present, including the fact that the tourist destination must present a clear differentiation of its endogenous gastronomic resources, that it must have a cuisine that is recognisable to travellers and that it must have a varied and important number of quality establishments where travellers can enjoy this gastronomy. At this point, we must also highlight the importance of improving the professionalism of the human resources in the whole value chain of gastronomic tourism on the Galician coast, through training and retraining. On the other hand, the next challenge to be faced by the managers of Galician coastal tourist destinations is to turn their territory into a culinary landscape.

In this direction, a basic territorial marketing strategy is to articulate gastronomic tourism routes, similar to the already existing wine routes, which allow us to take advantage of this comparative advantage to promote/structure the territory's tourism offer. A tourist offer articulated and interpreted through cuisine, local products and all the services and activities that surround them (Patiño Romarís, 2016b). Hence, the great challenge for managers of tourist destinations on the Galician coast to ensure that the public and private sectors work together, as well as the tourism sector transversally with other sectors (agribusiness, winemakers, shellfish farmers...). However, managers must be clear that it is not a question of creating indiscriminate pressure on the gastronomic heritage, but of exploiting it rationally in terms of sustainability. Finally, we believe that gastronomy is currently one of the key elements for the development and enhancement of the destination Galicia and the Galician coastline and, therefore, we advocate that the different public administrations and private companies should consider gastronomy as a differential element in their promotion and marketing strategies in order to increase the satisfaction of potential visitors (Patiño Romarís, 2016b).

As reflected in the analysis, the gastronomic tourism strategy is very much focused on mass tourism, with gastronomic festivals as the main element of attraction and image generation for gastronomic tourism. Although the importance and potential of this type of event should not be underestimated, a differentiated strategy should be developed to attract quality tourism with high added value. This is especially important in coastal tourist areas where sea-related products are the main attractions and elements of attraction for gastronomic tourists. However, this potential is scarcely exploited in tourist brochures where this type of product is relegated to secondary positions. It is essential for the public administration and the private sector to join forces and, in coastal destinations, this must be reinforced by promoting the gastronomic resources present without generating stereotypes. In short, it seems clear that there is a need to analyse the sector's past in order to build a more coordinated, resilient and high added value future.

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# Mobility between *Grandes Áreas Urbanas* and the *Metapolisation* of Land in Spain

METROPOLISATION, GENTRIFICATION,  
URBAN RESTRUCTURING

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## ABSTRACT

This study examines the functional structure and spatial organisation of interactions among Spanish *Grandes Áreas Urbanas* (GAU, Large Urban Areas) to identify potential *metapolisation* processes, that is, the formation of large functional urban regions. Mobility patterns of individuals, estimated from locationtracking records of mobile devices, serve as an indicator to measure interactions between GAUs. Using these data, a spatial network of travel flows was constructed and analysed by applying network analysis methods. The results reveal a hierarchical and multicentric structure within the network, characterised by a highly heterogeneous distribution of travel flows in terms of volume and distance. Functional clusters form compact territories influenced by infrastructure and transportation systems, though differences emerge between the central regions of the peninsula, where internal flows predominate, and coastal areas, which exhibit high inter-cluster connectivity. These findings suggest the presence of *metapolisation* processes in these areas.

## KEYWORDS

Mobility, Large Urban Areas, spatial networks, metapolisation, Spain.

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# 1. INTRODUCTION

Contemporary societies exhibit different dynamics and forms of spatial organisation than in previous periods of history. Technological innovations, improved infrastructure and means of transport and other factors have changed the physical, institutional, economic, technological and cultural contexts in which people and other social and economic actors pursue their activities.

These changes have had an impact on cities, which have undergone reconfiguration processes at various levels, affecting both their physical space and socioeconomic, functional, and spatial structures, due to the structural connections between cities and social organisation. Residential, productive and service-related suburban expansion has rippled outward in concentric circles, producing more complex and extensive new forms. The outskirts of large metropolitan areas have become diversified and fragmented, while urban centres are becoming more intensely specialised. These areas form large multicentric functional units connected by flows of people, information, finance, goods and services. To explain and describe these processes, authors have proposed concepts such as the “metropolisation of the territory” (Indovina, 2003) and, in major Latin American cities, the “post-suburbia” model (Borsdorf, 2004).

At the same time, inter-metropolitan relations are being reorganised in line with the transformation of metropolitan spaces. Ascher (2004) uses the term “metapolis” to describe large discontinuous urban regions connected in multipolar, disconnected and heterogeneous networks in the context of globalisation. Spatial dispersion, specialisation and the very nature of the activities carried out in these new urban environments lead to the multiplication of all kinds of flows to ensure cohesion and unitary functioning of urban networks. As such, the flows and infrastructure channelling them are key to creating these urban networks (Castells, 1995).

Urban areas in Spain have also been affected by this metropolisation (Archondo *et al.*, 2018; Cebrián-Abellán, 2018) and the reorganisation of interurban relations, supported by improvements to transport and communications infrastructure. Therefore, it seems appropriate to raise some questions about the interactions between *Grandes Áreas Urbanas* (GAU, Large Urban Areas) in Spain, and, particularly, about their spatial and functional structure. Specifically, this study aims to answer the following questions:

1. What is the functional and spatial structure of the connectivity of travel flows between GAUs?
2. Are there identifiable functional and spatial clusters of GAUs?
3. What is the relationship between the volume and length of travel flows?

Movements across geographical space entail increased costs (effort, energy) that depend on the distance covered, which implies that long trips must be compensated in some way (minimising costs and maximising utility). For this reason, relationships are more intense between close places than between distant ones (the first law of geography). However, improvements in transport and other factors may change the friction in geographical space (impedance) when travelling. Travel flows are therefore expected to show a solid spatial autocorrelation, but the friction in geographical space should be heterogeneous and specific to each GAU.

People’s physical mobility has been chosen to represent interactions between GAUs, as it has great social and spatial significance and promotes communication in business and personal environments. The research questions have been tackled through spatial network analysis. The results provide novel knowledge about relations between GAUs that is highly useful for designing land planning policies (Perrin, 2021). The results help to set limits for various levels of functional spaces rather than basing them on administrative areas (Ratti *et al.*, 2010). They also serve to identify the intensity of possible *metapolisation* processes.

This paper is organised as follows. Section 2 presents the concepts that form the basis for considering interactions as a spatial network. Section 3 describes the data and procedures used to analyse the interactions and model their relationship with the length of the trips. Section 4 includes the results of the analyses of hierarchy, connectivity, spatial clustering and distance of the interactions. Section 5 interprets the results in relation to the research questions. The study ends with section 6, which includes general thoughts on the findings and indicates some future lines of research.

## 2. INTERURBAN MOBILITY AS A SPATIAL NETWORK: CONTEXT AND THEORETICAL FRAMEWORK

### 2.1. THE CONTEXT OF INTERURBAN MOBILITY

Interurban mobility is a socio-spatial practice cutting across various socioeconomic and territorial dimensions, serving both as factor and product at the same time. Since the late 20th century, large metropolitan areas and other intermediate cities (Olazabal & Bellet, 2019) have generally grown demographically, economically and physically, while their sociodemographic, spatial and functional structures have changed at rates and intensities specific to each case. Other factors that have influenced the development and forms of urban mobility include transformations in the processes and location of productive activities (Escalona-Orcao & Climent-López, 2012) and in the distribution of goods and services –digitalisation, logistics platforms (Holl & Mariotti, 2018; Morales-Gil, 2010)– as well as the expansion and improvement of different types of transport and communication infrastructure networks (Holl, 2007; López-Escolano & Pueyo-Campos, 2018) and high-speed railways (Bellet & Ureña, 2016; Bellet-Sanfeliu *et al.*, 2010; Gutiérrez, 2001; Ureña, 2005).

Spanish cities, and especially GAUs, have also been affected by these changes. On one hand, the population and socioeconomic activities are becoming increasingly scattered and physical space more fragmented (Azcarate Luxána *et al.*, 2010; de Miguel González, 2001; Gil-Alonso *et al.*, 2020); on the other, activities in the peripheries are diversifying and urban centres are becoming more intensely specialised (Miralles-Guasch & Tulla-Puyol, 2012), particularly influenced by tertiary activities and tourism.

### 2.2. INTERURBAN MOBILITY AS A SOCIO-SPATIAL NETWORK

For the purposes of this study, interurban mobility refers to people's trips between their homes and the places where they pursue an activity, whether related to work, education or leisure. These trips may respond to different reasons, but someone's choice of a workplace, a place of study or a home influences their own mobility and the mobility of others. This interaction between actors and places is the foundation for viewing interurban mobility as a spatial (or geographical) network made up of nodes and connections (Andris *et al.*, 2018). Since individual trips are aggregated in GAUs, the network nodes correspond to the centroids of the GAUs and the connections represent the direction and volume of the flows of people between GAUs: the nodes, the connections and their characteristics form a directed and weighted network of interurban mobility.

Due to the geographical nature of interurban mobility, spatial networks –whose properties are different from those of social networks– are well-suited for modelling this type of mobility. The nodes, and occasionally the edges, of spatial networks are located in geographical space, which means that there is a cost involved in forming connections –whether in terms of time, resources, psychology or effort– that comes from spatial friction (Adams *et al.*, 2012; Barbosa *et al.*, 2018; Barthélemy, 2022). The restrictions imposed by the geographical space where

spatial networks operate also shape their connectivity, characterised by the excessive presence of short-distance connections compared to long-distance ones. The principle of spatial autocorrelation of geographical phenomena, expressed by the well-known first law of geography (“Everything is related to everything else, but near things are more related than distant things”) (Tobler, 1970, p. 236), is the basis for the large amount of short-distance connections compared to less frequent long-distance connections. Short-distance mobility is the most frequent kind, such as to GAUs close to the GAU where one lives. At the other extreme, long-distance trips are less frequent.

Different models have been used to estimate aggregate mobility between locations, whether viewed individually or organised in networks (Barbosa *et al.*, 2018). Gravity models are the most common and are based on distance as a key factor in mobility. However, intervening opportunity models (Stouffer, 1940) do not directly link mobility with distance, but with the *opportunities* provided by places of origin and destinations. Furthermore, the radiation model (Simini *et al.*, 2012) holds that people make decisions about mobility in two stages: first they select the opportunities (and places where they are located), then they order them according to their distance from the location of origin (Barbosa *et al.*, 2018).

Studies on interurban mobility conducted with spatial network methods have revealed some empirical regularities in their results. For example, the volume and length of travel flows fit a power law distribution with similar negative exponents, regardless of the distance travelled or the kind of transport used (by air, land or foot) (Barthélemy, 2011; De Montis *et al.*, 2007), which indicates the influence of distance over flow volume.

Studies on the morphology of weighted and directed spatial networks of interurban mobility have generally revealed the effects of distance (expressed in terms of separation between locations, travel costs or the effort exerted when travelling) and other factors that influence people’s mobility.

## 3. MATERIALS AND METHODS

### 3.1. INTERACTION BETWEEN LARGE URBAN AREAS (GAUS): TRIPS, GAUS AND DATA FOR ANALYSIS

We measured the interaction between GAUs by the number of *trips* entering or leaving each one. This data point has been selected because, overall, it represents the functional relationships between cities well. A trip is defined as “travel between the locations of two consecutive activities. The main purpose of a trip is determined by the activity performed at the place of origin, the activity at the destination or a combination of both. A trip may be monomodal or multimodal and be taken in one or various stages” (MITMS, 2023, p. 6).

This study only considers the total number of trips entering or leaving each GAU. Trips during a week of normal activity are used to capture the structure of the interactions (specifically from Monday, 17 April 2023 to Thursday, 20 April 2023). Flows between GAUs consisting of less than 20 trips per week are excluded. The data primarily reflect trips taken by workers and students. A total of 431.9 million trips were taken from origin to destination in the GAUs during the period of study, of which 395.7 million (91.6%) were internal, 8.6 million (2.6%) took place between two GAUs—subject to this study—and 27.5 million (6.4%) were from the GAUs to other areas.

The GAUs are the spatial units of this study and are composed of at least one city with 50,000 inhabitants or more or that is a provincial capital; they may also include adjacent municipalities of over 1,000 inhabitants (MITMS, 2022, p. 15). In 2023, GAUs were home to 68.2% of the Spanish population (32.3 million inhabitants) and accounted for 76.2% of all jobs, despite only covering 8.9% of the surface area of the country.

Collected by the Ministry of Transport, Mobility and Urban Agenda (MITMS, n.d.), the data have been represented through a directed and weighted geospatial network composed of 86 nodes, located in the centroids of each GAU, and 3,259 connections that represent the magnitude and direction of travel flows between each GAU.

### 3.2. METHODS FOR ANALYSING FUNCTIONAL AND SPATIAL INTERACTIONS

To achieve the aims of the study, we subjected the travel flow network to spatial network analysis methods to characterise the functional and spatial structure of the network. We conducted this analysis in two stages: a) calculation of global and local indicators of network hierarchy and connectivity; and b) modelling of the relationship between flows and distance between GAUs.

We used indicators weighing the connections by their volume of trips to measure and characterise the main functional aspects of the interactions, since they account for the heterogeneous nature of the flows between GAUs. To this end, we adapted the methodological framework proposed by Limtanakool *et al.* (2007), which distinguishes three dimensions in interaction networks (structure, strength and symmetry) and two levels of analysis (global and local). The *entropy* indicator was taken from the global level and the *total dominance* (strength) and *node symmetry* indicators were taken from the local level, which are standardised indicators of the strength and balance of travel from the nodes. The *symmetry* and *relative power* indicators of the connections were not used, since in this case there is a high degree of symmetry between the edges of two nodes. Instead, the *Y<sub>2</sub> inequality index* was used between the edges of each node (Barthélemy *et al.*, 2005; De Montis *et al.*, 2007) and the *relative power* indicator of each edge compared to the total travel entering or leaving each node (Table 1).

Level	Indicator	Equation	Maximum / Minimum	Observations
Global	*Entropy	$EI = - \sum_{i=1}^L (Z_i) \text{Ln}(Z_i) / \text{Ln}(L)$	$0 \leq EI \leq 1$	0: all the interactions are concentrated in one node; 1: with no hierarchical structure; (all the edges of the network have the same flow)
Local	*Total dominance (strength) (DIT <sub>i</sub> )	$DIT_i = \frac{T_i}{\sum_{j=1}^J T_j / J}$	$0 \leq DIT_i$ and $DII_i \leq \infty$	0: a node is isolated $\infty$ : a node dominates the network It is a standardised index of the strength of a node
	*Symmetry (gravitation) (node) (NSI <sub>i</sub> )	$NSI_i = \frac{\sum I_i - \sum O_i}{\sum I_i + \sum O_i}$	$-1 \leq NSI_i \leq 1$	-1: asymmetric node, with maximum net flow deficit; 0: fully symmetric node in its net flow; 1: asymmetric node with maximum net flow surplus
	**Inequality (of the distribution of trips between each node)	$Y_2(i) = \sum_{j \in V(i)} \left[ \frac{w_{ij}}{s_i} \right]^2$	$Y_2 \approx 1 / k$ if the weights are distributed uniformly between the edges (k)	If the weights are concentrated in a few edges, $Y_2$ approaches unity
	***Polarisation (of an edge) (PL <sub>ij</sub> )	$PL_{ij} = \frac{t_{ij}}{\sum_{j=1}^n t_{ij}}$	$0 \leq \leq 1$	Proportion of trips of each edge that enter or leave a node (GAU) compared to the total trips that enter or leave that node 0: an edge (link) does not exist 1: maximum polarisation

Table 1. Functional indicators of the interaction network.

Source: \*Limtanakool *et al.*, 2007; \*\*Barthelemy *et al.*, 2005; \*\*\* the authors.

- L Edge (link) of the network ( $l = 1, 2, 3, \dots, L$ ).
- $Z_l$  Proportion of trips from edge  $l$  compared to the total number of trips in the network.
- $I_i, I_j$  Number of trips to (in) from nodes  $i$  and  $j$ .
- $T_i, T_j$  Total number of trips associated with nodes  $i$  and  $j$ .
- $t_{ij}$  Number of trips from node  $i$  to  $j$ .
- $O_i$  Number of trips from (out) node  $i$ .
- $w_{ij}$  Weight (trips) of the edge between node  $i$  and node  $j$ .
- $s_i$  Strength (total number of trips from node  $i$ ).
- $i, j$   $i = 1, 2, 3, \dots, I; j = 1, 2, 3, \dots, J; \text{ for } i \neq j$ .

The study of the spatial organisation of the interaction network focused on two aspects. Firstly, we identified functional groupings (clusters, modules, communities) and their territorialisation. Secondly, we analysed the distribution of travel flows according to their length and the spatial scope of the mobility of each node.

We defined the functional groups with the *Infomap* node-clustering algorithm. This method reveals the structure of the network, considering the hierarchy and weight of the connections (Rosvall *et al.*, 2009). This is why it can be used with *directed networks*, such as mobility networks, where the flow between nodes is asymmetrical. We used the version implemented in the *Community Detection* module (Singhal *et al.*, 2020) of the *Cytoscape 3.9* programme (Shannon *et al.*, 2003). The *Markov time* parameter ( $0 < mt < 1$ ) scales the link flow to change the cost of moving between modules. A high value was assigned to this parameter (0.95) to prevent the formation of numerous small-sized modules.

Our analysis of the cluster structures raises the fundamental question of the extent to which mobility occurs between particularly cohesive nodes in the same cluster for reasons of accessibility or other reasons, and to what extent do long-distance connections make up the clusters in the same mobility space. To examine the issue, we used the external-internal index (Eli) (Krackhardt & Stern, 1988), as it is a standardised indicator of module cohesion. This index reflects the proportion between node mobility within the same cluster (internal connections: I) and mobility towards nodes outside the cluster (external connections: E). We calculated the index considering the weights ( $w$ ) of the connections. The value of the Eli index ranges between -1 and 1. A value of -1 indicates that all connections are internal (the nodes are part of an isolated group) and a value of 1 indicates that all connections are external, with a value of 0 expressing balance between internal and external connections or equality in mobility flows inside and outside the cluster (Table 2).

The length of the flows is the key variable to modelling human mobility, which in practice is expressed by the Euclidean distance between two locations (Barbosa *et al.*, 2018, p. 20; Barthélemy, 2011, p. 4). The distribution of the length of the mobility flows has been fitted with a potential function whose exponent expresses the spatial friction (Table 2).

The *radius of gyration of a place* (RGP) represents the typical distance of flows entering or leaving a GAU. Its meaning and construction is similar to the radius of gyration of a person (González *et al.*, 2008; Pappalardo *et al.*, 2015). The radius of gyration of a place (node) can be calculated for more frequented  $k$  locations (2, 5, 10, etc.) ( $RGP^{(k)}$ ) (see Table 2) using the same procedure.

Indicator	Equation	Observations
Clusters (Infomap)	$L(M) = q \sim H(Q) + \sum_{i=1}^m p_i^i H(p^i)$	Simplification of the structure of the flow network in node clusters.
EI index	$EI_i = (E_i - I_i) / (E_i + I_i)$	$E_i$ : internal edges (or flow) $I_i$ : external edges (or flow)
Distance (distance decay function)	$P = d^{-\gamma}$ $Ln(P) = -\gamma \ln(d)$	$P$ : cumulative distribution of trips $\gamma$ : Distance-decay coefficient (spatial friction) $d$ : trip length (distance)
Radius of gyration of place $i$	$RGP_i = \sqrt{\frac{\sum_{j=1}^n f_{ij} d_{ij}^2}{f_{ij}}}$	$f_{ij}$ : Travel flow between GAU $i$ and GAUs $j$ $d_{ij}$ : orthodromic distance between GAU $i$ and GAUs $j$
Radius of gyration $k$ of a place	$RGP_i = \sqrt{\frac{\sum_{j=1}^n f_{ij} d_{ij}^2}{f_{ij}}}$	$n$ : 1, 2, ... $n$ GAU from which flows enter or leave a GAU $i$ $k$ : 1, 2, ... $k$ with more frequent flows of GAU $i$

Table 2. Spatial indicators of the interaction network.

## 4. RESULTS

### 4.1. PREDOMINANCE OF SMALLER VOLUME FLOWS, MODERATE POLYCENTRISM AND GREAT DISPARITY BETWEEN FLOWS FROM THE ORIGIN AND THE DESTINATION OF THE NODES

According to size, travel flows are distributed asymmetrically, with a *long tail* showing the predominance of smaller volume flows. In fact, over 87% of the total flows accumulate in connections of fewer than 500 trips per week. This distribution indicates that the network of flows exhibit considerable diversity or entropy (0.66), indicating that flows do not accumulate in a few connections. The trips per week ( $w_{ij}$ ) range between 20 and 352,395 (Gran Canaria Sur to Las Palmas de Gran Canaria), with an average of 2,646. The probability distribution follows a potential function  $P(w) \approx w^{-\gamma(w)}$  with exponent  $\gamma(w) \approx -1.9$  (Figure 4, left). The largest flows are located between nearby GAUs, especially on the Mediterranean coast, around Madrid and in the GAUs of Galicia (Figure 2).

Total dominance expresses the strength of each node and may be interpreted as indicative of the central nature of the trips from each GAU; it varies between 0.03 (Arrecife) and 7.0 (Madrid), with an average of 1, well below the maximum value. The probability distribution of dominance  $P(DIT)$  is fitted to power law  $P(DIT) \approx DIT^{-\gamma(DIT)}$  with exponent  $\gamma(DIT) \approx -2.3$ . These indicators show that the interaction network presents a moderate level of polycentrism. The dominant GAUs are concentrated in three areas: on the Mediterranean coast, where there are several GAU clusters; on the Canary Islands, which has two dominant GAUs; and in the mainland interior, featuring the GAUs of Madrid and Seville and two smaller GAUs (Figure 1).

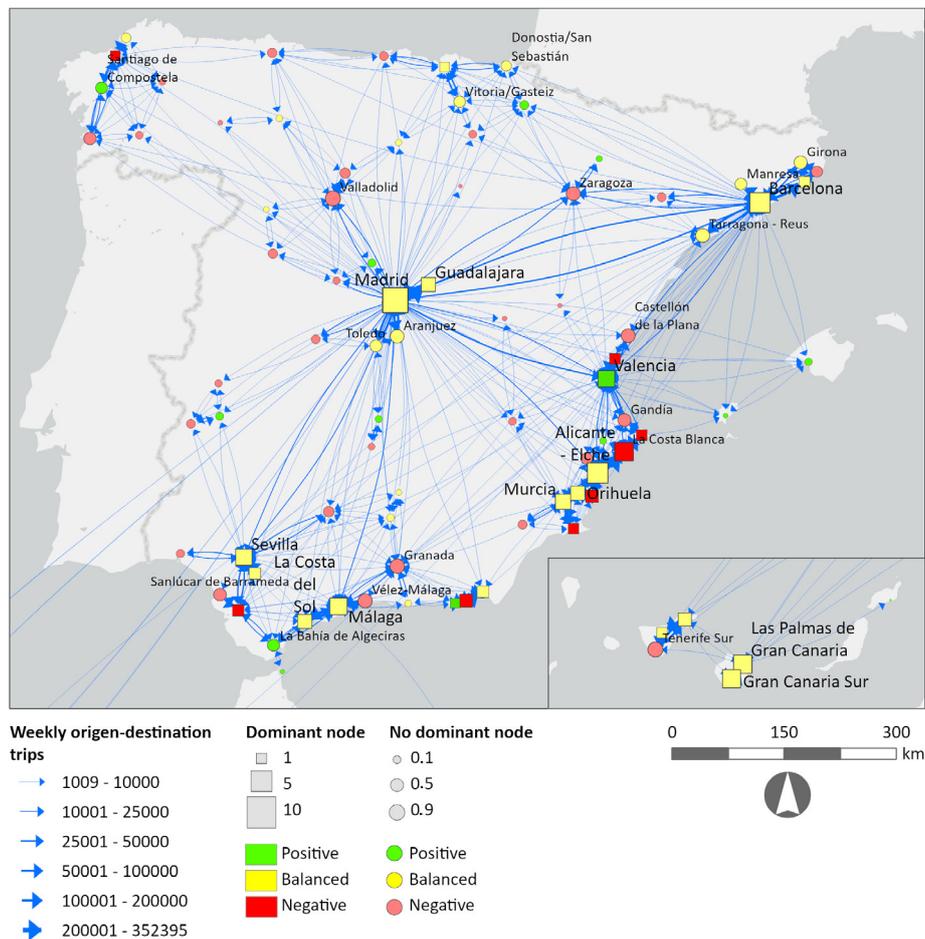


Figure 1. Dominance, symmetry and main travel flows.  
Source: MITMS (n.d.). Authors' own work.

Symmetry is an indicator of the degree of balance in trips entering and leaving each node. Symmetry values are moderate and range between  $-0.09$  and  $0.15$ , with an average of  $0.00$ . Most dominant centres have a high level of symmetry, which means that the number of trips entering and leaving is very similar. Valencia is the only dominant GAU with a positive balance; all other dominant centres have a negative one. Regional capitals that are not provincial capitals or major cities, such as Santiago and Mérida, stand out among the non-dominant GAUs with positive symmetry (Figure 2).

One more important aspect of these interactions is how flows are distributed across the connections entering or leaving a node. GAUs with the highest travel volume, like Madrid, Barcelona, Valencia and Saragossa, have a relatively low  $Y_2(i)$  index, showing a fairly homogeneous distribution of trips between connections, yet large isolated GAUs, such as Gran Canaria Sur and Las Palmas, present high disparity indices. The same pattern is observed in small or more isolated GAUs in the mainland interior or on the islands, like Burgos, Palencia, Soria and Ibiza. This indicator is high for less-travelled GAUs, reflecting the dominance of a few connections. GAUs nearby other large GAUs also exhibit high disparity, as the former concentrate travel flows entering and leaving the latter, like Guadalajara (with respect to Madrid) and Utrera (with respect to Seville). This indicator has similar values for flows entering and leaving (Figure 2).

Overall, the data exhibit a heterogeneous distribution of the dominance (strength) of the nodes, the volume of flows and their share of the connections entering or leaving each node, expressing a hierarchical functional structure.

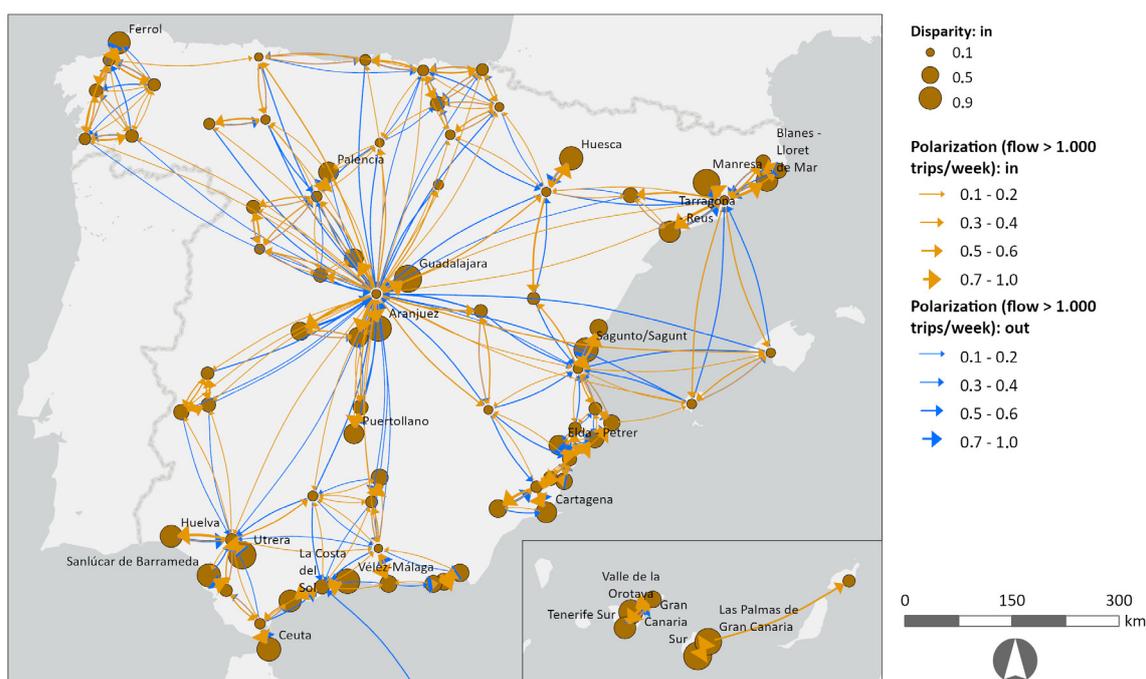


Figure 2. Disparity of flows in connections entering or leaving the GAUs. Source: MITMS (n.d.). Authors' own work.

## 4.2. PROXIMITY AS A FACTOR IN CLUSTER FORMATION: THE FIRST LAW OF GEOGRAPHY

The criteria used to identify clusters split the 86 GAUs in two levels, resulting in four level-1 clusters and 21 level-2 clusters. These clusters differ in size, shape and degree of interaction.

Level 2 reveals the local structures used in interactions between GAUs. The size of the clusters varies between two GAUs (Ciudad Real-Puertollano) and seven GAUs in the case of the clusters around Madrid and Barcelona. The total population and the number of trips in each cluster differ considerably: the smallest has just over 136,000 inhabitants and 81,000 trips,

while the largest has 6.7 million inhabitants and 2.3 million trips. One feature shared by all level-2 clusters is that the GAUs are close to each other, reflecting the influence of transport infrastructure that can also be appreciated in the linear configurations of some clusters (Figure 3).

The EI index measures the degree of isolation or extroversion of the clusters. Clusters with an EI value below 0 are the most isolated and are located on the Balearic and Canary Islands and in the mainland interior. These clusters are dominated by internal interaction and interaction with nearby clusters; interaction with more distant clusters is weaker. In contrast, the most extroverted clusters have an EI value above 0. Madrid stands out in this regard, as it connects robustly with all others, as do clusters in the Levante region, exchanging high-volume flows topping 100,000 trips per week (figure 3).

Level 1 shows the overall functional structure created by the long links between the GAUs. Four level-1 clusters have been identified, including the GAUs of the Canary Islands. The largest cluster encompasses 11 level-2 clusters and covers the northern half of Spain and the Balearic Islands. This functional cluster is mainly structured from Madrid, due to its large size and central geographical location, and, to a lesser extent, from Barcelona. The GAUs of Andalusia make up a functional level-1 cluster with Seville and Malaga as the main centres. Finally, the GAUs in the Levante region form a level 1 cluster characterised by its strong internal cohesion (Figure 3).

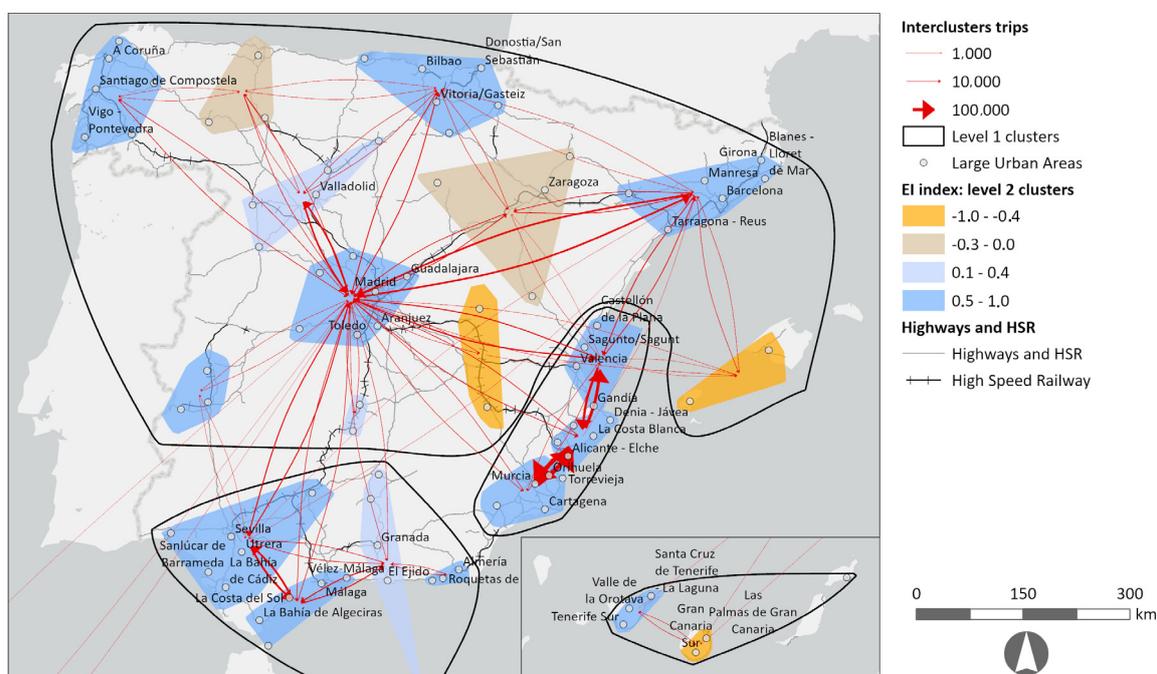


Figure 3. GAU clusters.  
Source: MITMS (n.d.). Authors' own work.

### 4.3. HETEROGENEITY OF SPATIAL FRICTION

The length of the trips, or rather the travel distance, is an essential variable for describing how interactions are organised in space. Overall, travel flows between the GAUs have a *long-tail* distribution dominated notably by shorter flows. Distances ( $d_{ij}$ ) range between 15 km and 2,350 km (GironaTenerife Sur), with an average of 484 km. The probability distribution follows a potential function  $P(d) \approx d^{-\gamma}(d)$  with exponent  $\gamma(d) \approx -1.9$  (Figure 4, right).

The gravity model is a good approximation for the spatial friction that affects the GAUs as a whole, since this friction increases close to the square of the travel distance ( $\gamma \approx -1.9$ ). However, each GAU has a specific friction exponent representing the spatial behaviour of the flows entering or leaving it. These exponents range between -0.23 and -3.13, indicating notable differences in impedance between the GAUs (Figure 4, right). The spatial distribution

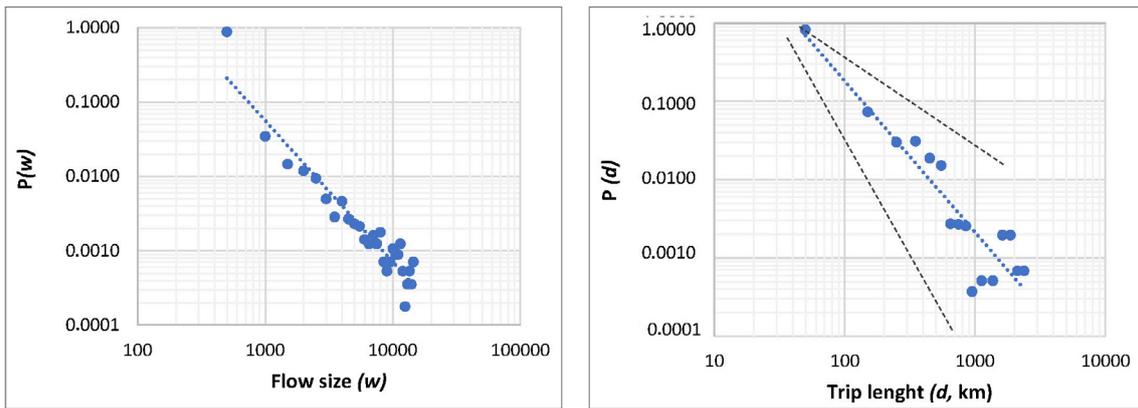


Figure 4. Left: Probability distribution of flow size (potential fit with exponent ( $\gamma_w \approx -1.9$ )). Right: Probability distribution of trip length (potential fit with exponent ( $\gamma_d \approx -1.9$ ); the dashed lines are a guide for exponents -1 and -3. Source: MITMS (n. d.). Authors' own work.

of the friction exponents shows a pattern that reproduces the locational and functional structure of the GAUs. GAUs with the highest impedance are located near other GAUs with which they exchange high travel flows, such as those on the Mediterranean coast and in the area around Madrid. Impedance is lower in most GAUs in the interior, since their distribution is more dispersed and their flows are more diversified. The lowest friction is found in the GAUs of the Canary Islands due to their isolation and distance from the GAUs on the mainland. Impedance is also relatively low in some peripheral GAUs, such as those in Galicia, on the Balearic Islands and in Madrid, which is connected to all other GAUs. The lowest impedance values are found on the islands and are related to the heavy share of air transport (Figure 5).

The radius of gyration represents the characteristic trip length of each GAU. The radius of gyration for trips entering or leaving each GAU varies from 48 to 1,116 km, with an average of 189 km. The radius of gyration is inversely related with the spatial friction exponent: the greater the radius of gyration, the less spatial friction. However, some cases deviate from this trend, such as the GAUs on the Canary Islands, whose exponent and radius of gyration values are the result of the combination of very long and short trips (figure 6). GAUs with a

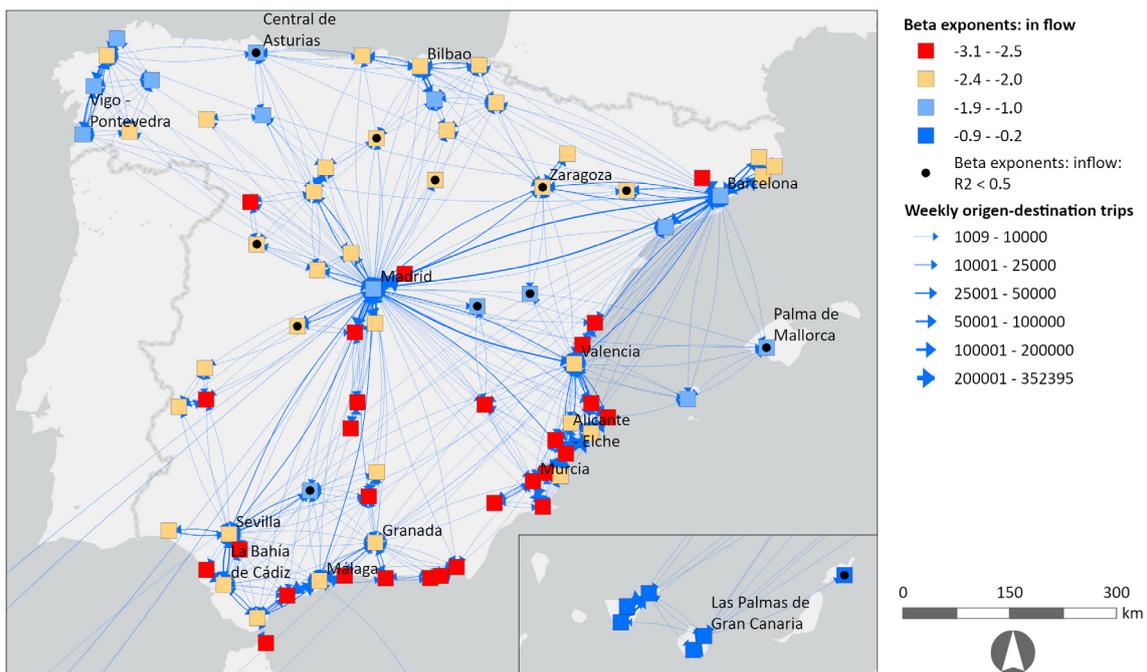


Figure 5. Distribution of exponents  $\gamma$  of the potential function fit to the probability distribution of trip length. Source: MITMS (n.d.). Authors' own work.

high-speed train station do not differ significantly from the others in terms of the radius of gyration and friction exponent. They do have a higher proportion of longer trips (over 50 km), however.

The relation of the total radius of gyration with radii of gyration 2 and 5 (the radius of gyration of the two and five most frequented GAUs) shows that for most GAUs, the total radius of gyration depends on the distance to a few GAUs. Figure 7 (left) shows that the total radius of gyration is roughly similar to the radius of gyration of the two most frequented GAUs, except the GAUs on the islands, which present larger differences. Figure 7 (right) reveals that the total radius of gyration is close to the radius of gyration of the five most frequented GAUs, which are also usually the closest to each other (the diagonal line in the graph represents the equality of the total radius of gyration and of radius of gyration  $k$ ).

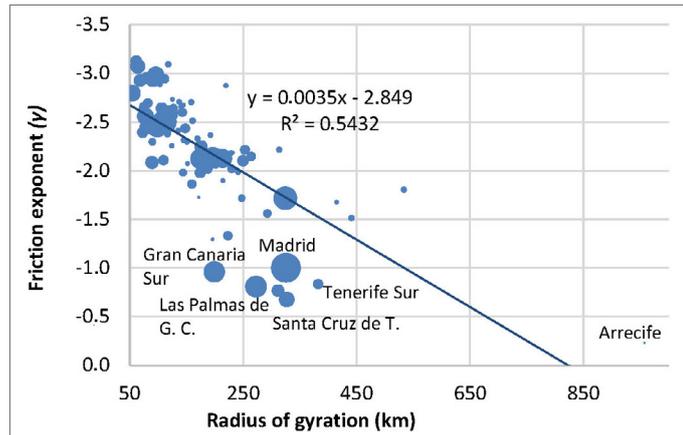


Figure 6. Relation between the radius of gyration and the spatial friction (circle size: trips entering each GAU). Source: MITMS (n.d.). Authors' own work.

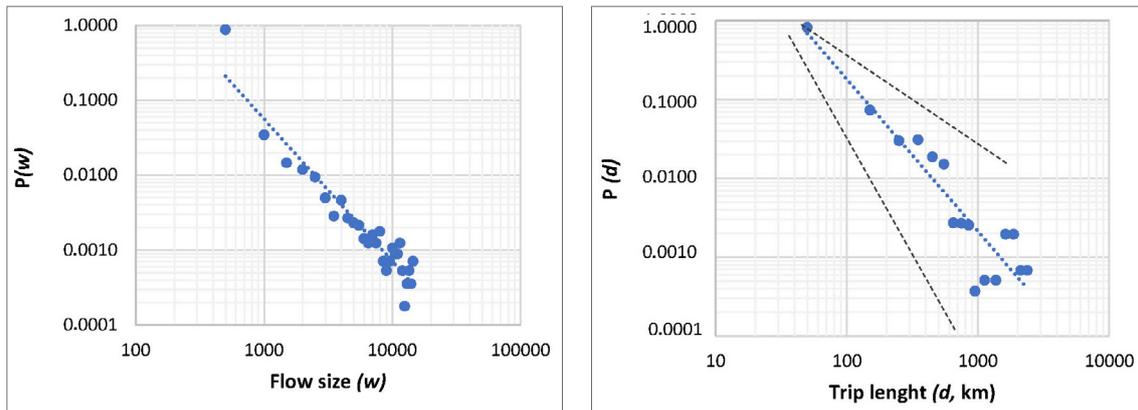


Figure 7. Relation between the total radius of gyration and radius of gyration 2 (left) and between the total radius of gyration and radius of gyration 5 (right). The diagonal line represents the equality of the total radius of gyration and of radius of gyration  $k$ . Source: MITMS (n.d.). Authors' own work.

## 5. DISCUSSION

The results indicate that interactions between GAUs form a spatially heterogeneous, hierarchical, multicentric network structured in functional modules that represents the historical, spatial and functional organisation of the Spanish urban system with numerical values.

### 5.1. RELATIONSHIP BETWEEN INTERACTION, DEMOGRAPHIC FACTORS AND SOCIOECONOMIC ACTIVITY

The demographic size of the GAUs influences the volume of trips entering and leaving them, but this relationship also hinges on other factors. Less populated medium and small GAUs tend to have a higher rate of trips per capita than the largest GAUs, revealing that larger GAUs are somewhat dependent on socioeconomic relations. The seven largest GAUs (over 750,000 inhabitants) contain 52% of the total population of all GAUs, but only account for just over one quarter of all trips taken (Table 3). This variation in per capita values reflects productive and residential specialisation.

GAU	Population (1k)	Population (%)	Trips per week (in + out) (1k)	Trips per week (%)	Strength ( <i>w</i> ) (total = 86; <i>x</i> =1) (strength)
Madrid	6,258	19.3	1,402	8.1	7.0
Barcelona	5,131	15.9	882	5.1	4.4
Valencia	1,573	4.8	602	3.5	3.0
Seville	1,312	4.1	571	3.3	2.8
Malaga	954	2.9	646	3.7	3.2
Bilbao	876	2.7	202	1.2	1.0
Central Asturias	787	2.4	63	0.4	0.3
7 GAUs	16,891	52.2	4,378	25.3	21.8
Rest (79 GAUs)	15,448	47.8	30,128	74.7	64.2

Table 3. General mobility indicators in GAUs with over 750,000 inhabitants.  
Source: MITMS (n.d.). Authors' own work.

The medium and small GAUs with the highest per capita travel rates are found primarily in two environments: close to large metropolitan areas (Madrid, Barcelona, Valencia, Seville) such as Aranjuez, Guadalajara, Utrera and Sagunto, or distributed along the Mediterranean coast, especially GAUs where tourism is very important, such as Blanes-Lloret de Mar, the Costa Blanca, Torre Vieja, Orihuela, Roquetas de Mar and the Costa del Sol, as well as islands such as Gran Canaria Sur (Figure 8). The per capita travel rates of the regional capitals (Santiago, Vitoria, Merida, Toledo) also stand out due to the density of services supporting the political and administrative activities there.

Tourist activity and residential specialisation are also key factors to generating trips, as seen in Table 4. In effect, the highest flows are found in mutual connections between GAUs with great tourist potential and between major GAUs, such as Madrid and Seville, and nearby GAUs.

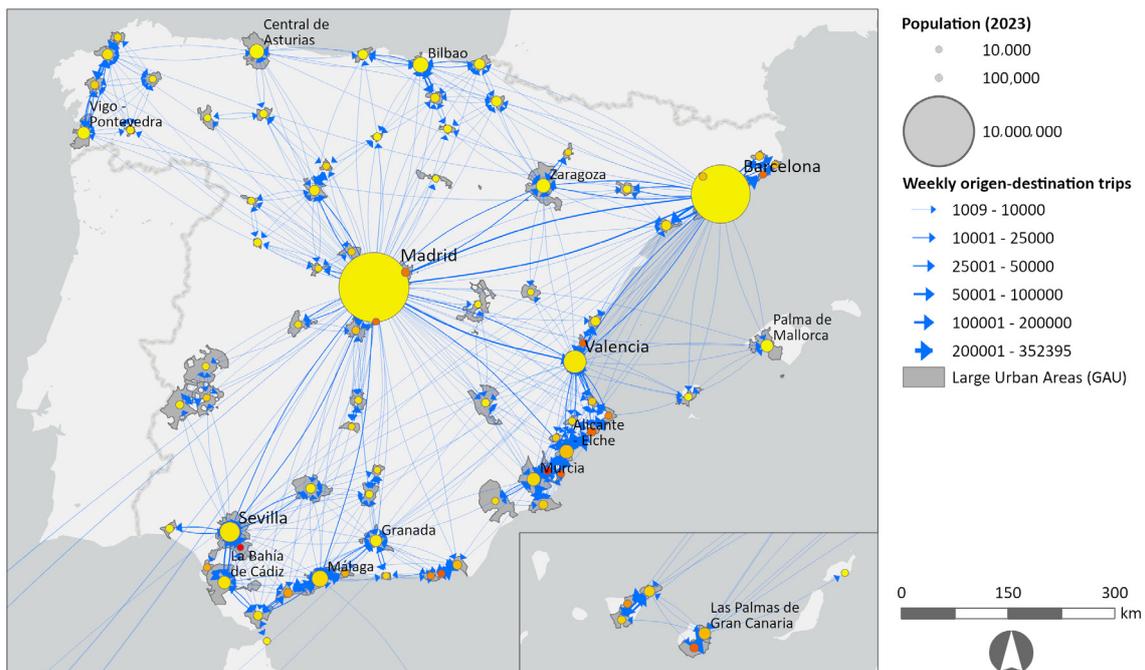


Figure 8. Population and per capita travel rate in the GAUs.  
Source: MITMS (n.d.). Authors' own work.

Origin-destination connections	Trips per week (s) (1k)
Gran Canaria Sur-Las Palmas de G. C.	352.4
Las Palmas de G. C.Gran Canaria Sur	349.9
The Costa Blanca-Alicante Elche	254.4
Alicante Elche- The Costa Blanca	253.8
Guadalajara-Madrid	213.8
Madrid-Guadalajara	212.4
The Costa del Sol-Malaga	183.3
Malaga-The Costa del Sol	182.8
Utrera-Seville	140.9
Seville-Utrera	140.3

Table 4. Main connections according to travel flow volume (s).  
Source: MITMS (n.d.). Authors' own work.

## 5.2. THE FORM AND SPATIAL ORGANISATION OF THE TRAVEL FLOW NETWORK IN RELATION TO THE LOCATIONAL STRUCTURE OF THE GAUS AND TRANSPORT INFRASTRUCTURE

Travel flows form a hierarchical structure of nodes and connections that is part of the transport infrastructure networks and is shaped by the spatial distribution of the GAUs.

The network of interactions extends in a radial field of action, with a large central hub that exchanges considerable travel flows with other important centres on the periphery, connected in turn with other GAUs in their area. These peripheral centres are found in concentrations on the Mediterranean coast. The network operates as an integrated system, composed of GAU clusters split into two functional levels.

This territorial organisation of the travel flow network is mainly based on the distance between urban areas and transport network possibilities. Formed by neighbouring GAUs, local functional subsystems (clusters) are powerfully cohesive and connected to one or several larger clusters. However, there are transitions: for example, the GAUs of Teruel, Cuenca and Albacete exchange significant flows with Madrid and the urban areas of the Levante coast. These local clusters are subsumed into larger ones and ultimately into a global one via far-reaching flows that connect the most important GAUs.

In some local clusters, most trips are internal due to transport limitations or the considerable distance to other GAUs, as is the case in the mainland interior. However, the main GAUs have multiple modes of transport (road, motorway, high-speed rail, air transport) that facilitate interaction with other GAUs. High-speed rail has strengthened direct connections between GAUs with stations equipped for high-speed trains and Madrid (Valladolid, Segovia, Saragossa, Barcelona, Valencia, Ciudad Real, Seville, Malaga, etc.) or Barcelona (Saragossa, Lleida, etc.). However, travel intensity or radius of gyration between other GAUs with high-speed station (between Saragossa and Valladolid or between Saragossa and Seville, for example) has not increased, possibly because the existence of the infrastructure does not imply the offer of direct train services along secondary routes, except in the case of Ciudad Real and Puertollano, which form a cluster and are connected by frequent low-cost rail services. GAUs with stations equipped for high-speed trains do have a higher proportion of longer trips than the rest.

The probability distributions of travel flows are similar to those of other types of movement, both in terms of volume and length. The exponent of the function fitting the probability of flows by volume ( $\gamma_{(w)} \approx -1.9$ ) is remarkably similar to that of movements like road traffic ( $\gamma_{(w)} \approx -1.8$ ) (De Montis *et al.*, 2007) and air transport (-1.7) (Barthélemy, 2011, p. 14). Furthermore, the global probability-fitting exponent of travel flows according to their length ( $\gamma_{(d)} \approx -1.9$ ) is comparable to that of movement in urban space (-1.8) (Chowell *et al.*, 2003; Escolano-Utrilla *et al.*, 2024; Yang *et al.*, 2019).

Each GAU's spatial friction or impedance reflects its spatial context, primarily the intensity of the relations with other GAUs, both near and far. The average values of exponent  $\gamma$  (approximately between -2.5 and -1.5) indicate moderate spatial friction, typical of peripheral or more isolated GAUs (Malaga, Saragossa, Burgos and others in the mainland interior) that have relatively large radii of gyration. GAUs with low exponents (less than -2.5) present very strong spatial friction, but it is caused by the proximity between GAUs rather than by any shortcomings in transport infrastructure, meaning that most travel is concentrated into a few GAUs close together. GAUs with high exponents (around -1) reflect weak spatial friction, as is the case of the GAUs on the Canary Islands, since air transport is required to travel to mainland cities.

### **5.3. COMPLEXITY OF INTERACTIONS AND POSSIBLE METAPOLISATION OF THE TERRITORY**

The intensity and complexity of interactions between GAUs exhibit considerable spatial differences, indicating the uneven development of possible *metapolisation* processes of the territory. A qualitative interpretation of the findings could be synthesised in the subsequent gradation of the intensity and scope of these *metapolisation* processes.

The level-1 cluster formed by 14 GAUs in the Levante region is the most complex. The GAUs have different-sized populations involved in a wide array of economic activities, though tourism carries significant weight. This cluster is a multicentric subsystem with great spatial continuity mainly centred around Alicante/Elche, the Costa Blanca and Valencia. Some GAUs exhibit considerably high proportions of travel outside their territory in relation to all travel, such as Orihuela (23.1%), Sagunto (17.1%), Torrevieja (13.9%) and the Costa Blanca (12%).

The GAUs of Madrid and Barcelona also have robust interaction with neighbouring GAUs. However, these clusters are monocentric and characterised by the importance of the core GAUs and the polarisation of flows (for example, over 90% of travel to the GAUs of Guadalajara and Aranjuez comes from the GAU of Madrid; more than 95% of travel entering the GAU of Manresa comes from the GAU of Barcelona), revealing the attractiveness of the main cities for generating flows.

The multicentric cluster made up of the GAUs of the Basque Country, Pamplona, Logroño and Santander/Torrelavega are characterised by very balanced exchanges of flows. The same is true in the Galicia GAU cluster, which also presents high internal cohesion. Both groups are part of the level 1 macrocluster.

The interactions of the GAUs of Andalusia are organised into four level-2 clusters that in turn form a level-1 cluster. The largest and most centralised structure is made up of the GAU of Seville and others nearby that extend to the Atlantic coast. The most complex cluster of those remaining is the one formed by the GAU of Malaga and other nearby GAUs, which is linear and somewhat polycentric and its structure is similar to the interactions seen on the Levante coast due to the impact of tourist activity.

The GAUs of the Canary Islands form a level-1 cluster composed of two level-2 clusters made up of the GAUs of Tenerife and Las Palmas de Gran Canaria, respectively. Both clusters have polycentric structures related to the islands' strong specialisation in tourism.

The remaining clusters have weaker flows between the GAUs that make them up and less complex structures. However, there are pairs of GAUs with quite intense interactions, such as Palencia-Valladolid, Saragossa-Huesca and Mérida-Badajoz.

The study suffers from some limitations related to the representativeness of the data –since the sampling excludes people without a mobile phone– and to its significance –since only the number of trips was considered and not the specific activity associated with each trip.

## 6. CONCLUSIONS

This study has examined the functional structure and spatial organisation of interactions between *Grandes Áreas Urbanas* (GAU, Large Urban Areas) in Spain through an analysis of people's mobility network. The results also provide indications of territorial *metapolisation*.

In relation to the objectives, we can conclude that mobility between GAUs forms a hierarchical network split into two functional levels and various well-connected centres, but it does not show scale-free behaviour, since the exponent of the probability distribution of centrality is  $\gamma \approx -1$ .

The modular functional organisation of the interactions is reflected in compact spatial groupings influenced by transport networks. The disparity between the flows that enter or leave each GAU shows that travel is concentrated in a few destinations or origins, generally the nearest, so most trips are bound for some GAU in the same cluster and will most likely return that same day. This functional and spatial pattern can be interpreted as a state of dynamic equilibrium consistent with the locational and productive model, that is, with the proximity or distance between the GAUs, with the location of economic activity and with the quality and capacity of infrastructure and means of transport. Overall, the network of interactions better reflects the "closer opportunity" model (Carra *et al.*, 2016) than the *intervening opportunity* model. The findings support the existence of *metapolisation* processes in certain parts of the territory.

Regarding the hypotheses, it has been confirmed that the dominant flows are small and short in length, with probability distributions that follow a scale-free power law, comparable to those of other modes of movement. This implies that there are long flows of a certain volume starting and ending in especially large GAUs. The similar distribution across different types of movement suggests that there are common principles operating consistently within each one.

Finally, the method used in this research provides statistical information on the characteristics of the structure of interactions between GAUs, making it easier to compare between different areas and monitor their development over time. We propose expanding the research by analysing other aspects, such as the temporal rhythm of the movements, the specific activity of the trips and the education and sex of the travellers, to the extent that the data allow it.

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# Geographies of Post-COVID Tourism in Spain

## ADJUSTMENTS AND DISPARITIES IN THE NEW DYNAMICS OF TOURIST SPACES

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### ABSTRACT

The post-COVID recovery is seen as an opportunity to transform tourism in Spain, led by an ecological and digital transition of destinations that is endorsed by the European Union and its financial programs for economic recovery. This study examines the evolution of post-COVID tourism in different territories (coastal, urban, and rural) and the applied tourism policies. The methodology relies on analysing indicators and statistical data for the selected territories, screening public plans and programs, and reviewing recent works on this topic from Geography in the national and international contexts. The findings evidence that, despite the debate on recovery versus transformation in tourism during the pandemic, the current trend favours the restoration of previous dynamics, with the risk of maintaining old imbalances or even the emergence of new ones due to the complex context of the current polycrisis.

### 1. SITUATION AND TOURIST FLOWS AFTER THE PANDEMIC CRISIS

Following the profound crisis caused by COVID-19, tourism in Spain is experiencing a peak moment, with international arrivals in 2023 recovering, and even surpassing, pre-pandemic levels, along with a surge in sector revenues. In 2023, Spain welcomed over 84 million foreign tourists, breaking the previous record set in 2019, and surpassing sector revenue figures records, which totaled over 108,000 million of euros (Ministry of Industry and Tourism, 2024).

According to data from the *Instituto Nacional de Estadística* (INE, 2023a), the main tourist markets sending visitors to Spain continue to be the United Kingdom, with 15,121,910 British arrivals until November 2023, followed by France, with 10,096,040, and Germany, with 9,768,600. These markets are followed, albeit with more modest numbers, by Italy, the Nordic countries, the United States, as well as the rest of Europe and America. The Asian market is still struggling to recover to pre-pandemic levels, as figures remain far from the approximately 600,000 to 700,000 tourists annually received from each of the three main Eastern markets: China, Japan, and South Korea (INE, 2023a). Another market that has not returned to pre-COVID-19 levels, but for very different reasons, is Russia. This is due to the long-standing restrictions imposed by their governments, and in the case of Russia, also due to international sanctions resulting from the invasion and war in Ukraine. These two regions have not yet returned to their positions of five years ago. European traditional markets have quickly regained their numbers and strength, while America is gaining ground as the second largest tourist sending region to Spain.

Looking at the territorial distribution of these arrivals, the map has changed little since 2019, with the two archipelagos and the Mediterranean regions still accumulating the most international arrivals. Catalonia, with 17 million international tourists until November 2023, is the most visited autonomous community, followed by the Balearic Islands with over 14 million, the Canary Islands with over 12 million, Andalusia with 11.5 million, and the Region of Valencia with almost 10 million. The Community of Madrid closes the group of autonomous communities most visited by foreigners, with just over 7 million awaiting the addition of international tourists from December 2023 (INE, 2023a). If we look at domestic tourist flows, the arrivals are distributed somewhat differently. According to available statistics, the most visited autonomous communities by Spaniards in 2022 were Andalusia (28,120,282 tourists), followed by Catalonia (24,161,771), the Region of Valencia (17,932,009), Madrid (10,969,654), and Galicia (9,450,082) (INE, 2023b). In this case, the archipelagos are not among the preferred destinations, while the rest of the communities, except for Galicia, do appear among the most popular destinations for both foreigners and nationals. This unequal distribution of tourism in our country is not new, as diversity in the intensity of the tourism phenomenon and its impact on the economic and social levels is the usual trend. These inequalities have even increased after the COVID-19 crisis (Martínez-Caldentey & Murray, 2023).

A notable change in recent years is the increase in total, average, and daily spending by foreign tourists in our country. Thus, in 2023, spending by foreign tourists in our country exceeded 108,000 million of euros, a figure much higher than the 86,901 million euros accumulated in 2019. The average spending per person has increased by almost €200 in this five-year period, reaching a total of €1,272, and €177 per day on average (Hosteltur, 2023). This is undoubtedly due to the increase in prices for transportation, accommodation, and catering services, as the sector has experienced a significant rise in costs, which has driven prices up without reducing the high demand. In the hotel sector, the increase in costs has been accompanied by an increase in revenues, which in the summer of 2023 grew by 23.3% compared to the same period in 2019 (Hosteltur, 2023). In some destinations such as Ibiza and Formentera, which suffer from significant tourist pressure, revenues have increased by 47.5%, but we also find rising prices in urban destinations such as San Sebastian (+35.3%) or Barcelona (+15.6%) (Exceltur, 2023a). This increase is remarkable as these are two of the cities with the greatest problems of overtourism, demonstrating that not even the saturation of certain areas and the measures taken to mitigate it are able to stop the escalation of prices. The price per room is on the rise in all Spanish destinations, especially in urban and coastal areas, without exception.

Therefore, it seems that neither political instability, marked by two wars in which Western countries are involved in one way or another, nor inflation in recent years, have affected the tourist flows experienced by our country. Behind this trend and visitor behavior may still lie the “revenge tourism” effect observed after the pandemic, as citizens seem willing to invest in services that provide them with immediate benefits amid potential future threats (Vogler, 2022).

## 2. POST-COVID TOURISM POLICIES IN SPAIN

The impact of COVID-19 has been profoundly unequal, as has the recovery and resilience of tourist territories in the face of the multiple harms generated by the polycrisis (health, climate, energy, migration, etc.) in which we are immersed (Blanco-Romero *et al.*, 2023). Each destination and territory have opted for a particular and different path in its adaptation to the new scenario, in which public policies around tourism promoted by public administrations play a fundamental role. The policies implemented in our country are largely a direct result of the changes and alterations caused by COVID-19, which activated various funding mechanisms to alleviate the effects on sector workers (PERTEs), companies, and tourist destinations.

Post-COVID tourism policy in our country has been mainly oriented towards the recovery and growth of the sector (Capdepón-Frías, 2023). Beyond the conjunctural measures applied in the early months of the pandemic, such as the “Impulse Plan for the tourism sector. Towards a safe and sustainable tourism”, the tourism policy has been deeply influenced by what was stipulated in the Recovery, Transformation and Resilience Plan, funded by the Next Generation EU financing instruments, which provide our country with €140,000 million between 2021 and 2026, with almost half of that amount dedicated to the plan (Government of Spain, 2021). Within the Recovery, Transformation, and Resilience Plan, component 14 is dedicated to the Modernization and Competitiveness Plan of the Tourism Sector (PMCST in its Spanish acronym), with a budget of €3,400 million. The PMCST defines its objective as “the modernization of the Spanish tourism sector from a comprehensive perspective” (Government of Spain, 2022) and stipulates three main lines of action: (i) Ecological Transition; (ii) Digital Transformation; (iii) Competitiveness. It is undoubtedly the most ambitious tourism plan with the highest funding in the history of the country, deserving a more detailed analysis.

As can be seen in Figure 1, the three axes designed in the plan are complemented by strategies specifically designed for extrapeninsular territories and are configured into a series of strategies, projects, and plans involving both the public sector (destinations) and the private sector.

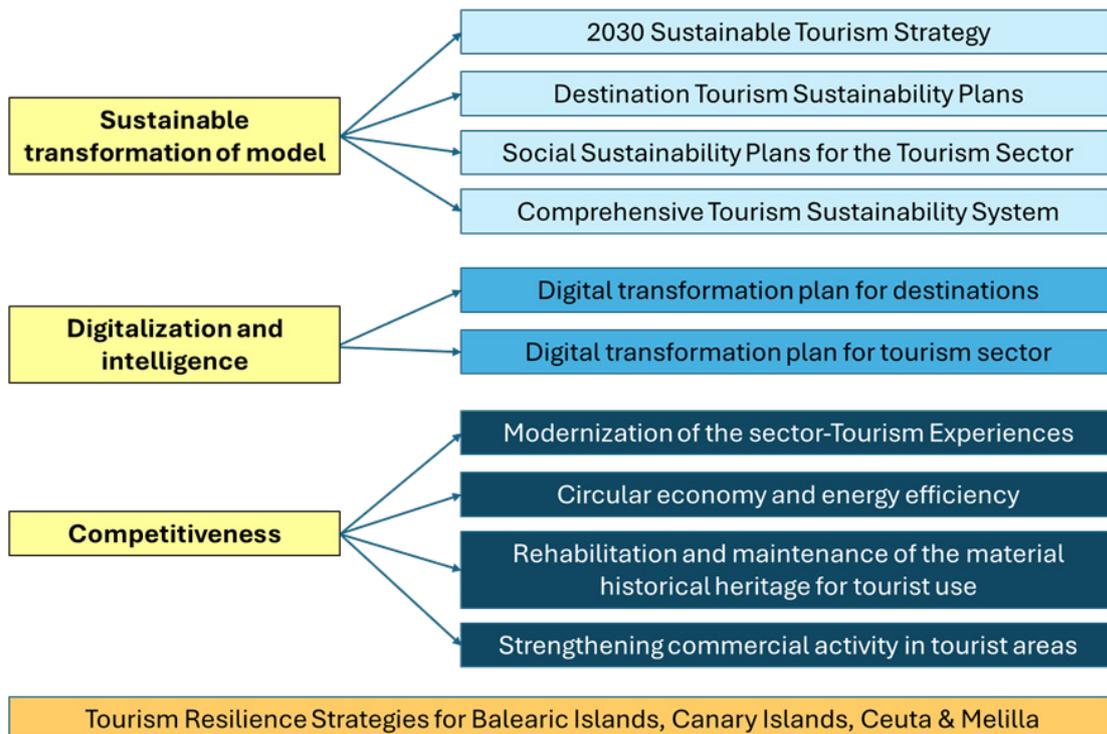


Figure 1. Axes and actions of the Modernization and Competitiveness Plan of the Tourism Sector. Source: Adapted from Velasco (2023).

Firstly, in the sustainability-focused axis, measures such as the development of the Spain 2030 Sustainable Tourism Strategy, Social Sustainability Plans for the Tourism Sector, the creation of the Comprehensive Tourism Sustainability System, and above all, Destination Tourism Sustainability Plans (PSTDs in its Spanish acronym), are articulated. The latter receives the largest share of the budget: €1,858 million, to be executed over three years. These plans have absorbed most of the efforts made by destinations that have applied for public calls and represent a significant incentive for numerous destinations in their efforts towards a tourism strategy that incorporates sustainability to a greater extent (Capdepón-Frías, 2023). The PSTDs include actions related to environmental restoration, adaptation to climate change, cycling infrastructure, energy efficiency, decarbonization, or sustainable mobility, among others. However, these plans can also include issues related to digitization (such as the development of digital tools for communication and marketing), deployment of telecommunications infrastructures, or development of intelligence systems, as well as other measures related to competitiveness. These include funding for tourist and resident awareness, promotion of tourism in sparsely populated areas, conversion of mature destinations, resource inventories, certifications, accessibility improvements, infrastructure creation, and product development (Government of Spain, 2022). In short, the PSTDs encompass actions that, while including the main axes of environmental sustainability, also address more conventional and continuous aspects.

Secondly, the axis dedicated to digitalization and intelligence for destinations and the tourism sector proposes a digital transformation plan for tourist destinations, oriented towards the network of Smart Tourist Destinations (DTI), and particularly, the development of an intelligent destination platform, endowed with a budget of €130 million and whose headquarters are located in Benidorm. This municipality has been chosen for its experience and trajectory in the field of DTI (Femenia-Serra & Ivars, 2021), and for being the location of the Valencian Institute of Tourism Technologies-INVAT.TUR. This boost for the DTIs complements the efforts that have been made since the publication of the National and Integral Tourism Plan 2012-2015, which already contemplated the development of DTIs by SEGITTUR. This project has had significant development through projects, regulations, and public funding aimed at local entities or associations implementing DTI projects (Ivars-Baidal *et al.*, 2023). Funding for the DTI network is complemented by funds for the Digital Transformation Plan of tourist companies through Artificial Intelligence and other enabling technologies, which includes the creation of an “industrial data space” (big data management), creation of an “app store”, and a “last mile” call program to finance innovative projects in sector companies (Government of Spain, 2022).

Thirdly, in the field dedicated to competitiveness, the PMCST includes funding for the development of new tourist products and innovative experiences with €100 million. On the other hand, it advocates for the circular economy with actions to improve energy efficiency, waste management, facility improvements, or efficient building management, among other aspects. This axis also includes a significant amount (€500 million) for the rehabilitation and maintenance of the material historical heritage for tourist use. Finally, this axis of the plan includes strengthening commercial activity in tourist areas with high traffic through actions of digitalization, modernization, and revitalization of these areas (Government of Spain, 2022).

Thus, as can be distilled from the analysis of the current situation and the policies implemented in recent years, Spain is committed to continuity in its international leadership in the tourism sector, while incorporating important nuances through the plans launched, such as a greater integration of the principles of digitalization and sustainability. Likewise, it seems that tourism in our country, despite suffering from the generalized inflationary spiral in the global economy, appears for the moment immune to geopolitical turbulence and economic uncertainty, which are configured as permanent factors of instability in the 21st century. Next, we will dedicate the rest of the chapter to analyzing how this post-pandemic tourism situation varies depending on the territorial context.

### 3. BETWEEN SUCCESS AND THE STRUCTURAL CRISIS OF COASTAL DESTINATIONS

The Mediterranean and island coastal areas have led Spain's tourism development since its inception and still today. Despite the COVID crisis, these are the environments that concentrate the largest volume of supply and demand in the country (López *et al.*, 2022). Before the pandemic, record figures were registered with an economic impact in 2019 of 108 billion euros (8.5% of the Spanish economy and 70.5% of the entire tourism GDP), and 1.6 million jobs (8.8% of employment in Spain and 62% of tourism employment) (Exceltur, 2021b). In that same year, 70% of foreign tourists were distributed in only 4 autonomous communities (23% Catalonia, 16% Balearic Islands, 16% Canary Islands, and 14% Andalusia), with a majority of them concentrated on the coast (López *et al.*, 2022). Nowadays, only 20 coastal tourist spots record 33% of all Spanish hotel beds (see Figure 2). Therefore, Spain presents a highly polarized distribution of tourism, where coastal areas play a key role in the country's economic development.

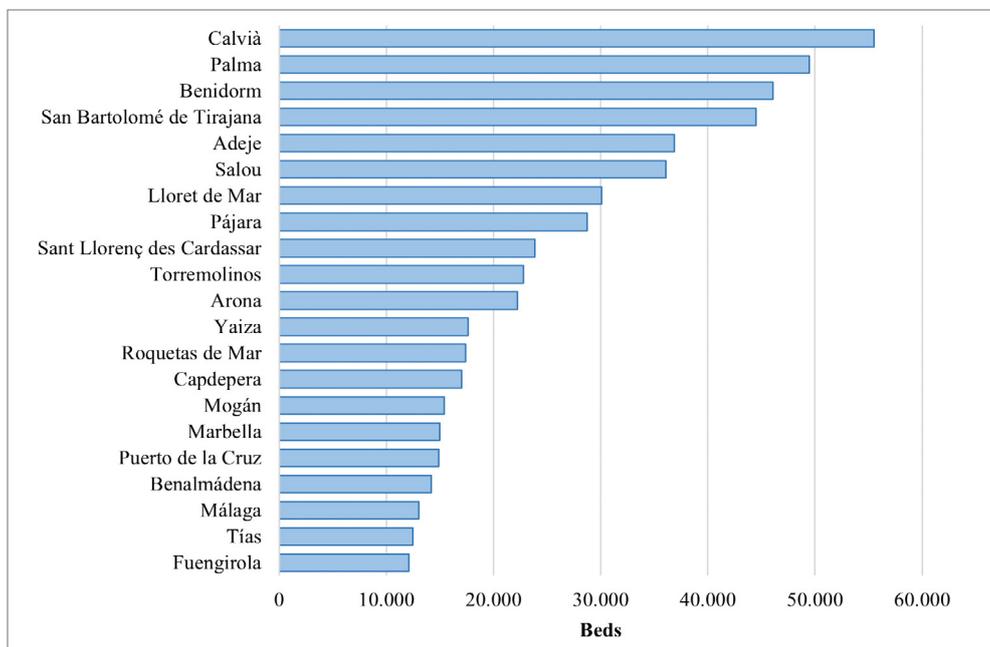


Figure 2. The 20 coastal tourist spots (vacation destinations) with more hotel beds in Spain, August 2022. Source: Hotel Occupancy Survey by Instituto Nacional de Estadística (2023b).

However, this success has also brought about negative impacts and significant environmental and social imbalances in coastal environments. Among these, the following stand out (Exceltur, 2021a): 1) strong construction pressure and territorial occupation; 2) high seasonality due to climate dependence and the vacation concentration of the work calendar; 3) a high floating population leading to resource overexploitation and congestion problems; 4) dependence on tour operators to ensure occupancy; and 5) a prioritization of mass markets with middle and low incomes. Thus, signs of obsolescence have been observed in consolidated coastal destinations for decades, especially regarding their adaptation to demand and the deterioration of resources and attractions that hinder sustainable development of tourism (Celdrán *et al.*, 2023).

The pandemic undoubtedly highlighted these contradictions and the susceptibility of monofunctional tourist spaces to crisis situations (Villar *et al.*, 2023). Thus, the high economic dependence of many coastal destinations resulted in significant impacts in terms of employment and the number of affected companies (Exceltur, 2021b). The direct impact of COVID management on mobility meant, during 2020, an average decrease of -84.7%

in foreign demand and -62.7% in domestic demand for Mediterranean coastal destinations, Balearic and Canary Islands, as well as a reduction of -77.2% in turnover. This historical setback was particularly dramatic for the hotel sector in the archipelagos, highly dependent on-air connectivity, where the drop in turnover reached around -90% (Exceltur, 2020). Thus, regional/local Spanish demand became the main source of income for these destinations, with a faster recovery of tourists in residential destinations, where second homes allowed for adequate sanitary conditions for long stays, albeit with lower spending (Martínez, 2020).

The COVID crisis was also understood as an opportunity for a new tourism model, based on value, proximity, and non-seasonal tourism (Villar *et al.*, 2023; Blanco *et al.*, 2023). In fact, several over-crowded destinations experienced social and environmental improvements due to the contraction of the sector. For example, in Mallorca, water consumption fell by 41.6% between March and July 2020 due to the decrease of tourist activity (Adrover, 2020); or the lack of tourists in the tourist districts of Barcelona resulted in an appropriation of public space by residents (Blanchar, 2020). This spurred social movements calling for a new tourism model, which was also supported by a large part of the sector as a measure to achieve more resilient and sustainable destinations. However, this claim seems to have remained theoretical or aspirational, as policies of growth have resurfaced as the pandemic has been overcome, both in terms of demand and supply. Tourism policies are reactivating real estate growth (Villar *et al.*, 2023), and pre-pandemic levels of tourist influx are quickly being recovered, once again reproducing saturation problems in coastal destinations (López *et al.*, 2022).

According to the profitability barometer of Spanish tourist destinations (Exceltur, 2022), coastal destinations recovered their pre-pandemic levels as early as spring 2022, and the summer of 2022 was a turning point in the normalization of tourist demand (see Figure 3).

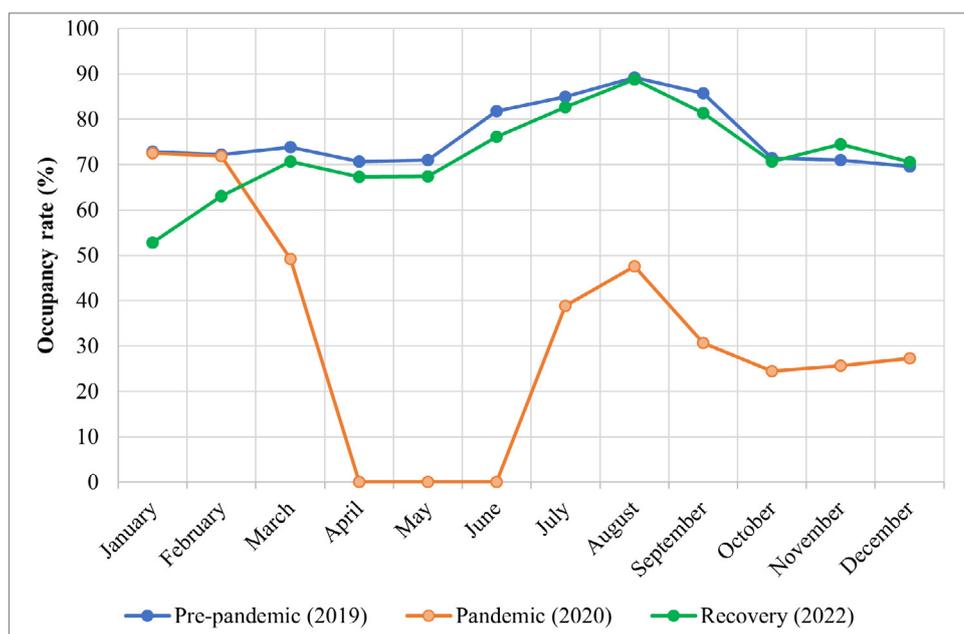


Figure 3. Evolution of hotel occupancy rate of vacation destinations in Spain, 2019-2022. Source: Own elaboration based on Exceltur (2022).

Although hotel occupancy rates remain below those of 2019, spending has increased significantly, indicating shorter trips (-4.2% occupancy vs. 2019) but higher expenditure (+12.8% income vs. 2019). Specifically, in 2022, the destinations with the highest incomes were the island of Ibiza and the Andalusian coast, with San José standing out followed by Ibiza, Estepona, Marbella, and Chiclana. However, it should be noted that the rise in operating costs for companies due to inflation and indebtedness and/or periods of closure experienced during the pandemic has led to an increase in prices (+17.7% vs. 2019) and a reduction in companies' profit margins.

## 4. OLD AND NEW CHALLENGES OF COASTAL DESTINATIONS

The progressive loss of competitiveness of “sun and beach” destinations compared to other more modern tourist destinations is not something new or a result of the COVID crisis. In fact, both the public and private sectors have shown interest in implementing renewal policies since the late 1980s (Ledesma *et al.*, 2023). This willingness has been articulated through restructuring or conversion plans, to reorient this situation and achieve tourism models more respectful of local society and the territory, that is, to advance towards territorial development guided by the principle of sustainability (Farinós & Olcina, 2022). See, for example, the pioneering Tourism Excellence Plans (PET) or the more recent PSTDs, which have focused particularly on mature coastal destinations with the aim of containing growth, diversifying products, improving quality, rehabilitating infrastructure, and promoting smart management (López *et al.*, 2022). Over the years, legal provisions and planning instruments aimed at limiting the emergence of new accommodations or qualifying tourist establishments and products have also proliferated (Corral & Hernández, 2011). See, for example, the “tourist moratoriums” proposed in the General Planning and Tourism Guidelines in the Canary Islands (Simancas, 2023; Ramos, 2023) or in the Tourism Area Intervention Plan in the Balearic Islands.

However, these policies have had a questionable (or at least dispersed) impact on the real transformation of the traditional tourism model, and as mentioned earlier, the COVID crisis does not seem to have led real change either. It is noted that mature coastal destinations continue to have a strong weight of real estate activity in their development (Celdrán *et al.*, 2023; López *et al.*, 2022). This is crystal clear in a favourable market context and also with the support of public administrations, which have relaxed measures to favour supply creation despite contradicting instruments committed to sustainability planning (Olcina & Vera, 2023; Gaja, 2008). Therefore, despite progress in territorial planning instruments and social and sectoral consensus on the need to rethink tourism development after the COVID crisis, there are still significant limitations in the implementation of sustainability principles to local urban planning (Villar *et al.*, 2023).

In addition to the difficulties in the post-COVID recovery and competitive transformation of coastal destinations, there is the already tangible impact of climate change on tourism performance. In fact, the coast is the geographical environment where the greatest risks from climate change effects are identified due to the high density of resident and floating populations, the presence of vulnerable ecosystems, and intense urbanization and artificialization of the coastline (Exceltur, 2021b). The effects of global warming are already evident in coastal destinations, and there is a growing negative impact on traditional tourism dynamics. Thus, the increase in loss of climatic comfort (rising temperatures in summer) and drought are two of the impacts that have been most intensely perceived in recent years, especially in the southern and eastern peninsular regions (Olcina & Vera, 2023). Furthermore, the rise in sea level and temperature, erosion caused by coastal dynamics, the limited sediment contribution from rivers, and storms threaten to make beaches disappear, as well as causing other impacts on ports and promenades in coastal destinations (López *et al.*, 2022).

The climate emergency is already one of the most important challenges for the competitiveness and viability of Spanish coastal destinations, urging the sector to actively engage in reducing greenhouse gas emissions and proposing adaptation and resilience strategies. In this regard, pandemic management has shown how, in crisis situations, and with the necessary political will and consensus, tourist flows can be regulated through sustainability standards (Romagosa, 2020). Additionally, the European Union, through the recent Glasgow Declaration on climate action in tourism, already urges the sector to halve emissions in the next decade and achieve net zero by 2050 (UNWTO and The Travel Foundation, 2021). It will be necessary, therefore, to address this decarbonization of tourism in a planned, consensual, and progressive manner, implementing actions aimed at achieving systemic change on a large scale that transforms traditional production and consumption models (Becken, 2019; The Travel Foundation, 2023).

## 5. URBAN TOURISM POST-COVID-19: A MISSED OPPORTUNITY?

In addition to the coastal destinations, the impact of COVID-19 has been particularly significant in urban areas. Following the end of the Great Recession (2008-2016), Spanish cities experienced a considerable growth in tourist flows, leading to a resurgence of urban tourism within the neoliberal parameters derived from the new economic framework (Colomb & Novy, 2016; De la Calle, 2019; Barrado & Hidalgo, 2019). In fact, in 2019, the municipality of Madrid reached 9.9 million travellers, followed by Barcelona with 8.5 million, while cities like Seville, Palma de Mallorca, or Granada exceeded 2 million travellers. Within this context of large magnitudes, the total closure of tourism and leisure activities during the more than three months of the state of alarm constituted a real shock not only for the sector but also for the residents themselves, who, for the first time in many decades, faced a city without tourists. The closure of tourist establishments (Order SND/258/2020) led to an unprecedented reduction in tourist flows in the urban destinations in 2020 (Table 1): for example, Palma de Mallorca experienced a decrease of 82%; Madrid and Barcelona saw reductions close to 75%; and medium-sized cities such as Burgos, Salamanca, or León experienced declines well above 60.

	2019	2020	2021	2022	2023*	2020%	2021%	2022%	2023%*
Madrid	9,963,195	2,593,111	4,650,729	8,668,684	9,051,472	-74.0	79.35	86.4	4.4
Barcelona	8,520,415	1,911,676	3,264,757	7,375,274	7,706,296	-77.6	70.78	125.9	4.5
Valencia	1,882,918	679,587	1,164,904	1,934,184	1,917,101	-63.9	71.41	66.0	-0.9
San Sebastián	s/d	s/d	503,875	780,462	843,721	s/d	s/d	54.9	8.1
Seville	2,811,351	876,414	1,463,983	2,640,728	2,776,119	-68.8	67.04	80.4	5.1
Palma	2,372,933	420,359	1,172,482	2,312,618	2,444,207	-82.3	178.92	97.2	5.7
Málaga	1,413,227	456,977	824,309	1,308,880	1,403,208	-67.7	80.38	58.8	7.2
Bilbao	962,974	339,584	619,036	1,024,953	1,041,820	-64.7	82.29	65.6	1.6
Santiago de Compostela	790,238	223,876	499,284	861,851	890,158	-71.7	123.02	72.6	3.3
Las Palmas de Gran Canaria	339,549	156,232	265,902	400,770	377,303	-54.0	70.20	50.7	-5.9
Valladolid	450,064	161,367	294,890	408,965	392,472	-64.1	82.74	38.7	-4.0
Gijón	418,368	157,895	238,171	319,461	371,114	-62.3	50.84	34.1	16.2
Córdoba	970,985	300,546	495,367	836,754	849,961	-69.0	64.82	68.9	1.6
Saragossa	1,176,981	380,482	672,536	1,007,846	1,041,560	-67.7	76.76	49.9	3.3
Santander	470,025	207,760	294,863	421,078	445,812	-55.8	41.92	42.8	5.9
Granada	2,001,464	596,052	872,772	1,573,190	1,594,148	-70.2	46.43	80.3	1.3
Salamanca	711,736	227,389	401,918	646,011	665,413	-68.1	76.75	60.7	3.0
A Coruña	457,503	173,145	308,497	437,539	428,595	-62.2	78.17	41.8	-2.0
Alicante	879,435	396,349	569,488	757,377	777,853	-54.9	43.68	33.0	2.7
Murcia	483,403	201,918	315,857	471,749	471,819	-58.2	56.43	49.4	0.0
Burgos	479,607	167,724	295,796	485,298	465,278	-65.0	76.36	64.1	-4.1
León	409,535	144,933	268,932	398,748	403,995	-64.6	85.56	48.3	1.3

Table 1. Evolution of total travellers in urban destinations (2019-2023)<sup>1</sup>.

Source: Hotel Occupancy Survey (Travelers entered by tourist points and months) by Instituto Nacional de Estadística (2023b).

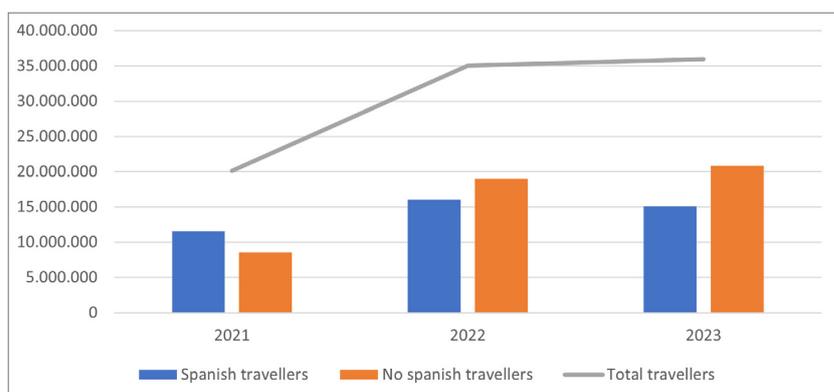
\*No data for December 2023.

1 The selection of cities has been carried out with reference to the third edition of the "Monitor of Tourist Competitiveness of Spanish Urban Destinations" (URBANTUR) conducted by Exceltur in 2023. These cities, in accordance with the methodological annotations of URBANTUR, approximately represent 87.2% of total urban tourism and 23% of total Spanish tourism (EXCELTUR, 2023a).

Considering the importance of tourism for the Spanish economy, whose contribution to GDP in 2019 was 12.6% (157.355 billion euros), generating a total of 2.6 million of direct jobs (Spain's Tourism Satellite Account, INE, 2019), a significant portion of public policies in the early months of the COVID-19 pandemic were directed to assistance the sector. The national government approved a package of measures which included, among other actions, a financing line from ICO endowed with 400 million euros or the extension of Social Security contribution discounts for fixed-term discontinuous workers. These aids were complemented by autonomous and municipal actions. For example, the "Department of Tourism, Culture, and Sports of the Andalusian Regional Government" launched aids for the Andalusian tourism sector aimed at those tourism companies (travel agencies, active tourism companies, and tourist accommodation) registered in the "Andalusian Tourism Registry" (RTA). Meanwhile, the Barcelona City Council established an extraordinary subsidy line to assist companies in the tourism and leisure sectors in mitigating the COVID-19 crisis.

In the academic field of Tourism Geography, the pandemic brought about a radical paradigm shift. The rich debate that had quickly emerged regarding the imbalances generated by the intensification of tourist flows in cities (overtourism, touristification, increase in tourist housing, tensions between tourists and residents, overcrowding of historic centers, deterioration of cultural heritage, etc.), which encompassed a considerable portion of publications on urban tourism, as seen in the XVII Colloquium of the Tourism Group of the AGE held in Maó (Menorca), in the same year as the pandemic, October 2020 (Pons, *et al.*, 2020), gave way to a period of reflection on tourism resilience in the face of the new health crisis situation (Bauzá *et al.*, 2020; Marchena, 2020; Simancas *et al.*, 2021; López *et al.*, 2022). In addition to the proposals aimed at redirecting the activation of urban tourism in a moment of significant mobility restrictions, discourses advocating for seizing the opportunity of deserted tourist cities to seriously consider new models of urban tourism emerged (Romero *et al.*, 2020; Fletcher *et al.*, 2021). Concepts such as quality tourist experience, urban tourism practices with added value, improvement of tourism employment conditions, promotion of interaction between tourists and residents, or greater regulation of tourism by public administrations, were just some of the ideas put forth from academia to redesign a more just, equitable, and ultimately more sustainable urban tourism planning.

Despite the moments of uncertainty experienced during 2020, the dystopia did not materialize. If in 2021 there was already a slight reactivation of tourism in all cities, regardless of persistent mobility restrictions, the period 2022-2023 has been characterized by the recovery of urban tourism (Figure 4). According to the "Hotel Occupancy Survey" by the INE, the number of travellers (residents and non-residents in Spain) increased from 20 million in 2021 to almost 36 million in 2023, representing an increase of approximately 80%. In fact, in this last year, the data indicates that 5 out of the 22 cities specialized in urban tourism (Valencia, Palma de Mallorca, Bilbao, Santiago de Compostela, and Las Palmas de Gran Canaria) already have higher travellers' numbers than in 2019, and possibly more cases will be added to this group when the INE publishes the data for December 2023. In this sense, the behaviour of international tourism has been key to the recovery of tourist flows in urban destinations, surpassing domestic tourism since 2022.



**Figure 4. Evolution of total travellers in urban destinations (2021-2023)<sup>2</sup>.** Source: Hotel Occupancy Survey (Travellers entering by tourist points and months) by Instituto Nacional de Estadística (2023b). \*No data available for December.

2 The data used for the graph corresponds to the same cities selected for Table 1.

The proposed change in the tourism model from the academic sphere during the pandemic has received a lukewarm response from stakeholders, especially from businesses. While it is true that they have shown more openness to dialogue, they have not made substantial changes to contribute to a rapid reorientation of urban tourism (Velasco, 2022). However, there is a greater awareness from the public administration for the implementation of more sustainable tourism planning and management models, in line with European policies and the Agenda 2030. For example, the Spanish Government, alongside the development of the Sustainable Tourism Strategy for Spain 2030, has launched the "Recovery, Transformation and Resilience Plan" through which European funds have been channelled to compensate for the losses caused by COVID-19. This includes the "Modernization and Competitiveness Plan for the Tourism Sector," within which operates the "Tourism Sustainability Strategy at Destination" that, for example, in the extraordinary call of 2023, proposes two strategic lines related to cities: "Major urban destination (Madrid and Barcelona)" and "Urban destinations."

On the other hand, at the local administration level, municipalities have also introduced various measures in their tourism plans to counteract tourist intensification, including strategies of deconcentrating (Tourism Action Plan 2019-2025 of Bilbao and Strategic Tourism Plan of Santiago de Compostela 2017-2022), seasonality reduction (campaign "Madrid embraces you all year round"), decentralization (Tourism Plan of Major Cities of Seville 2021), and diversification (Tourism Plan Donostia/San Sebastián 2017-2021) (Mendoza, *et al.*, 2023).

In the face of the renewed intensification of tourist flows, the response from Tourism Geography has been to continue highlighting the imbalances generated by touristification from various perspectives, such as commercial transformations in city centers (Palacios *et al.*, 2022); changes in the housing market and their repercussions on the local population (Díaz & Fernández, 2023; Crespi & López, 2023); shifts in tourism governance (Picó *et al.*, 2022; Arias & López, 2023; Almeida *et al.*, 2023); and tools for evaluating the intensification of tourist flows and strategies to counteract overtourism (De la Calle *et al.*, 2023; Mendoza *et al.*, 2023).

As noted in the latest UrbanTUR report (Exceltur, 2023b), the recovery of tourist flows "has once again brought to the forefront, with even greater intensity, many of the challenges already present in 2019" in the field of urban tourism, particularly those aspects linked to sustainability. Additionally, new realities have emerged that require attention, such as the disruption of artificial intelligence or the urgency of the climate crisis, which have forcefully entered the tourism context. All this, without forgetting the need to continue seeking strategies that promote a balance between the quality of life of residents and the implementation of tourist experiences closer to local values.

## **6. RURAL AND NATURE DESTINATIONS: LESS IMPACT OF THE PANDEMIC AND LIMITED EXPECTATIONS OF STRUCTURAL CHANGE**

Once the first wave of COVID-19 has ended in Spain, the end of confinement and the reduction of mobility restrictions will occur, a context that causes a significant increase in leisure and proximity tourism trips to rural and natural areas. The media echo this increase in mobility to rural and natural areas close to large cities in the summer of 2020, in many cases protected areas, with various implications (EUROPARC, 2021): traffic congestion due to the use of private transport in the face of the restrictions that still remain on public transport; concentration in visitor service infrastructures; changes in the profile due to the growth of people who had not previously visited protected areas; conflicts between residents and visitors; and a decrease in foreign visitors.

The variation in the volume of visits in the summer of 2020 with respect to 2019 are eloquent in national parks such as Cabañeros and Guadarrama, with increases of around 30%, in contrast to the decrease in the number of visitors to the Canary Islands parks, which have been notably affected by the decrease in arrivals to the archipelago. According to data from the National Parks Autonomous Service, the National Parks network reached its peak of visitors in 2018 (15.2 million) and presented a slightly decreasing trend, aggravated by the arrival of the pandemic, which marked the lowest record in recent years (9.3 million visitors in 2020), to rebound the number of visitors to 13.9 million in 2022.

From the point of view of rural tourist accommodation, the predominance of national demand as a structural characteristic mitigates the impact of the crisis compared to urban or coastal holiday destinations with a greater foreign presence (IGN, 2021). The survey conducted by Escapada Rural (2020) during the confinement reveals the substitution of trips abroad by domestic travel, the preference for rural destinations and safety and hygiene measures as a priority for booking accommodation.

Likewise, the pandemic intensifies the use of the voluminous stock of secondary residences located in rural municipalities and the emergence of new mobility flows such as professionals who establish their residence in rural areas, on a temporary or permanent basis, to work remotely, generally in environments close to large cities, due to their good physical and digital connectivity, lower housing prices and better quality of life in a context of health crisis (López Palomeque *et al.*, 2022). However, this trend, favoured by public policies to attract residents, seems to have attenuated after the end of the pandemic, although government measures with this approach persist, mainly at the local level.

Basic tourism indicators show a lower impact of the crisis on rural tourism and a faster recovery compared to coastal and urban destinations. However, the maintenance and intensity of this positive dynamic raise doubts.

Based on the INE rural tourism accommodation survey, the evolution of different variables can be analysed. Figure 5 shows the number of tourists and overnight stays of residents in Spain in the period 2019-2023 with a monthly breakdown. It clearly shows the three peaks of demand in normal years: Easter, summer, and December (Christmas), as well as the impact of confinement in 2020. Domestic demand recovers rapidly and even tourists and overnight stays in 2022 (excluding December to facilitate year-on-year comparison with available data) exceed overall those recorded in 2019, although both variables decrease slightly from January to November 2023 compared to the previous year. This evolution, with a positive variation in tourists of 0.5% and 5.8% in overnight stays in the period considered in 2023 compared to 2019, would therefore lower the growth expectations derived from the effects of the pandemic on the behaviour of demand.

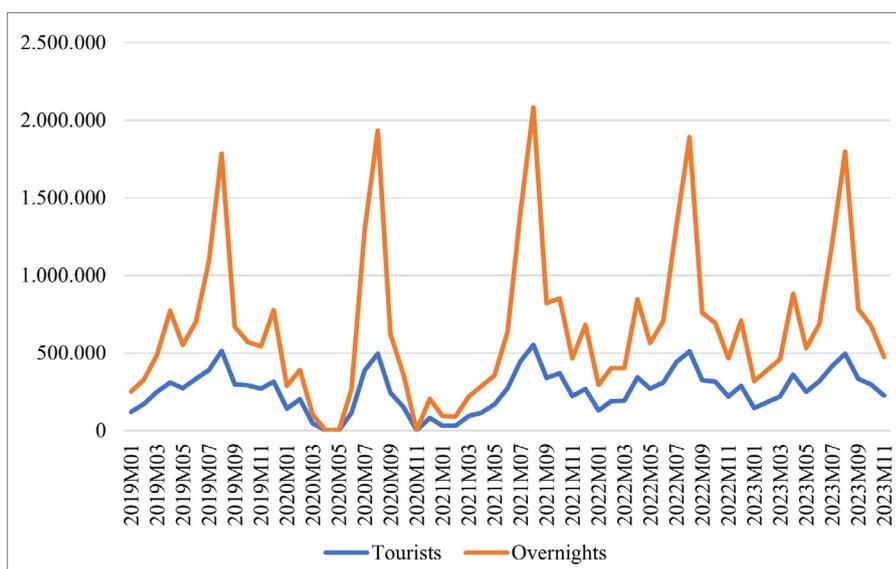
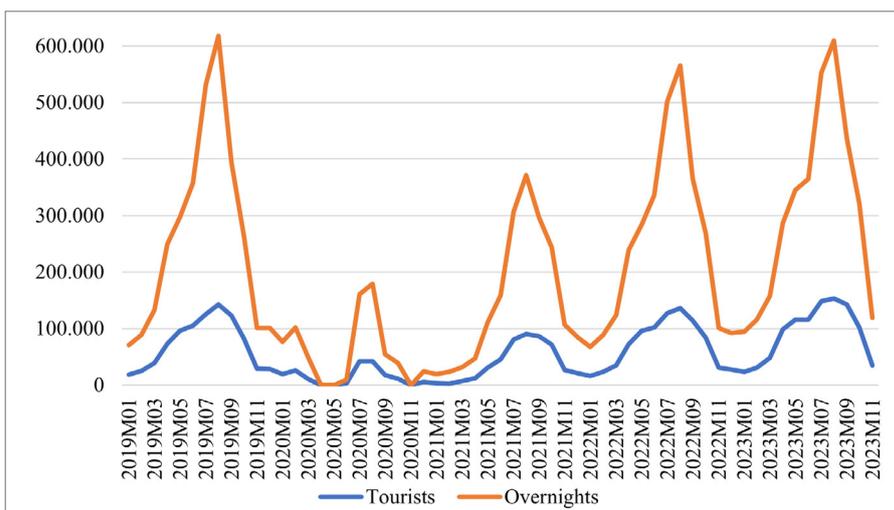


Figure 5. Tourists and total overnight stays. Residents in Spain. Source: Instituto Nacional de Estadística (provisional data).



**Figure 6. Tourists and total overnight stays. Residents abroad.**  
Source: Instituto Nacional de Estadística (provisional data).

Figure 6 shows the slower recovery of international demand, which traditionally only shows a peak in summer. Until 2023 the figures for both variables do not exceed those recorded in 2019, with an increase of 17.7% in tourists and 9.5% in overnight stays. The recovery of international demand, higher in relative terms than that of residents, means a readjustment of the shares of demand by origin, with the share of domestic demand falling slightly to 76% in tourists (79% in 2019) and 70.6% in overnight stays (71.3% in 2019), still with a marked predominance of domestic demand, a structural feature that has facilitated the better performance of rural tourism during the pandemic and in the years immediately afterwards.

Other variables also show a slight positive variation: the average stay has increased to 2.6 days in 2023 compared to 2.5 in 2019; the occupancy rate per bed places has risen by around 2 points each month, although with still very low values with the maximum in August (42.5%) and the minimum in January (9.7%). However, on the supply side, the average number of bed places open per month has decreased by 0.9% to 166,194 in 2023, although, on the other hand, the average number of staff employed per month has risen slightly to 25,702. Likewise, the price index for rural tourism accommodation has risen significantly, from a monthly average of 142 in 2019 to 163.3 in 2023.

These traditional indicators are complemented by other emerging indicators derived from other data sources. Caixabank's analysis (Cesar, 2023) of credit card spending by this financial institution in municipalities with more than 30,000 inhabitants or more than 100 inhabitants per square kilometre, reveals that rural tourism has gone from representing 10.9% of total tourist spending in Spain (2019) to 11.9% (2023), with a clear preponderance in inland provinces such as Segovia (79% of tourist spending), Huesca (74%) or Lleida (72%). This data integrates the expenditure of all visitors (tourists and excursionists) and, despite its methodological limitations (representativeness of the sample and the difficulty of fitting the different levels of rurality into the criteria used to delimit rural areas, above all), it provides useful information for understanding the new dynamics of leisure and tourism in rural environments.

## 7. THE INTERPRETATION OF POST-COVID DYNAMICS IN RURAL AND NATURE DESTINATIONS

The crisis caused by the pandemic has often been presented as an opportunity for rural and nature destinations, mainly those based on natural and cultural resources, as opposed to rural and mountain areas with overcrowded models (Pitarch, 2020), insofar as the effects of the pandemic can lead to changes in consumption patterns favourable to these destinations (Benítez, 2022). The new post-COVID dynamics in these areas pose two interrelated uncertainties: the quantitative evolution of tourism activity and the transformation of the development model from a qualitative point of view.

From the point of view of evolutionary dynamics, the analysis of rural accommodation indicators shows that the slight upturn in demand caused by the pandemic tends to stabilise and return to the patterns of pre-pandemic demand. No significant growth in rural tourism is therefore to be expected as a result of its improved performance during the pandemic. Positive trends include a slight increase in the share of international tourism, occupancy rates, average length of stay, employment and tourism expenditure in rural municipalities.

From the point of view of structural changes towards more sustainable and inclusive development models, different studies show no significant transformations but new research and management challenges in the face of the persistence of territorial and tourism imbalances at different scales (Blanco-Romero, Blázquez-Salom; Blanco-Romero *et al.*, 2023; Tirado *et al.*, 2022).

The persistence of the weaknesses of rural tourism in Spain (low occupancy rate, seasonality, risk of oversupply, limited associationism, low level of digitalisation, illegal supply, etc.) (Ivars, 2016) condition its economic and social profitability and its contribution to rural development. Although the contribution of tourism to local development is evident, the most eloquent figure being the 443,460 jobs in accommodation, catering and services in rural municipalities in June 2021 (Molinero and Alario, 2022), tourism activity is not enough to halt the regressive demographic processes that rural areas have been suffering for decades (Nieto, Ríos and Cárdenas, 2022). Soler and San Martín (2022) conclude that tourist overnight stays have little impact on the demographic evolution of rural municipalities compared to the existence of heritage, natural or cultural resources, which make a greater contribution to maintaining the population, so that policies should focus more on the conservation and enhancement of heritage than on the generation of accommodation supply.

Delgado's (2023) study on Cantabria contradicts optimistic approaches to the positive effect of the pandemic on depopulation, corroborating that its impact has been merely circumstantial. However, despite the fact that the administrative records do not reveal a sustained population growth, the pandemic caused an increase in the influx of people to rural Cantabrian municipalities to the point of generating social protest movements such as the one led by the group "Cantabria is not for sale" and its campaign "Cantabria Finita" against the official slogan "Cantabria Infinita", which denounce processes of rural gentrification which result, among other effects, in more difficulties in accessing housing.

The evolution of demand in the last four years ratifies the thesis of Somoza and Somoza (2023) of an attenuation of growth at the end of the restrictions of the pandemic and the recovery of consumer confidence. These authors also stress the need to recognise the importance of return tourism (former emigrants who maintain links with the rural municipality) for its contribution to maintaining the housing stock and employment, with the characteristic "floating overpopulation" that is generated during the summer season (Molinero and Alario, 2022). In addition to return flows, it is important to address the new residential demands in rural areas linked to teleworking and the impact of digital accommodation platforms on tourism supply and access to housing. The implementation of Airbnb Rural in Spain is illustrative in this respect. An aspect that refers to the need to reduce the digital divide between urban and rural spaces along the lines of projects such as SmartRural (Martínez-Puche *et al.*, 2022).

On the other hand, the context of crisis derived from the pandemic is perceived as an opportunity to reinforce proximity tourism to rural areas. Cañada and Izcara (2021) defend it as a fundamental element of a broader socio-ecological transition, while Romagosa (2020) stresses its contribution to a more sustainable and resilient tourism by reducing the impact of long-distance travel and better adapting to growing environmental awareness, while at the same time rediscovering the values of the territory at the regional level (Dot, Romagosa and Noguera, 2022). Díaz Soria *et al.* (2023) stress the importance of proximity tourism in the resilience of rural areas during the pandemic and question whether it will become a consolidated or passing trend. The authors warn that proximity travel is especially relevant in the environment of large cities and that its alternative character (linked to slow tourism or decrecentist or postdecentist approaches) does not make it an ecological or equitable modality, as shown by the episodes of congestion of rural spaces documented during the pandemic (Díaz Soria *et al.*, 2023).

The confinement and restrictions derived from COVID promoted a new relationship between citizens and natural areas. In this context, probably conjunctural, the contradictions of nature conservation policies and the promotion of tourism in natural areas become more relevant. Capdepón (2023) has studied the PSTDs affecting protected natural areas to demonstrate the prioritisation of the economic perspective (dynamisation of supply, creation of products, etc.) over the environmental dimension, an approach aggravated by the development of measures to promote tourism in areas which, on many occasions, lack approved master plans for public use and management. On the other hand, private protection areas are criticised as neoliberal conservation formulas that favour the commodification and privatisation of nature in order to propose post-capitalist conservation formulas such as convivial conservation, inspired by the theories of degrowth, the common good and good living (Müller and Blázquez, 2023; Müller *et al.* 2023).

## 8. CONCLUSIONS

Tourism demand in Spain has recovered relatively quickly after the shock of the pandemic. Firstly, domestic demand and, subsequently, international demand, which has already exceeded pre-pandemic figures in 2023 and is once again on the path to growth, which is expected to lead to continued annual records if the current tourism situation does not change. However, there have been slight readjustments in the composition of international demand, such as the slower recovery of Asian markets, which gives greater relative importance to tourists from American countries, and the fall in Russian demand as a result of the war in Ukraine.

After the policies aimed at managing the crisis (support for businesses and the maintenance of employment, health and hygiene guarantees, etc.), the pandemic has led to a significant public economic injection with European Union Funds for the modernisation of tourism through three basic pillars: ecological transition, digital transition and competitiveness. This economic support has been channelled, fundamentally, through the investments of the sustainability plans in destinations, with an extraordinary character for the period 2021-2023, and the financing of the Tourism Sector Modernisation and Competitiveness Plan.

This scheme largely reproduces the operation of the Excellence and Revitalisation Plans developed during the 1990s, which introduced improvements in destinations without achieving transformations of a truly structural nature (Ivars and Vera, 2019). A risk that can also be seen in the current sustainability plans, although their recent implementation prevents an evaluation of their true scope. On the other hand, these plans have also been criticised by tourism business associations, among which EXCELTUR stands out, for considering an excessive dispersion of funding among numerous projects and destinations, as opposed to the possibility of proposing a business support plan similar to the industrial sectors, as well as a greater concentration of investment in the most consolidated destinations.

Analysis by territorial environment reveals that the imbalances that existed prior to the COVID-19 crisis have been maintained. The pandemic has favoured a renewed academic interest in the resilience of destinations and questioned the continued growth of tourism activity. However, there has been no change in public policy priorities, beyond the implementation of the aforementioned sustainability plans aimed at improving the competitiveness of destinations, but without affecting their growth dynamics.

In coastal destinations, the limitations to the growth of supply are timid and located mainly in the Balearic and Canary Islands in the form of moratoriums. The recovery in demand is combined with the maintenance of real estate growth, despite the negative consequences of excessive real estate-tourism specialisation for the resilience of the destinations revealed by the pandemic, while at the same time there are no policies in place that are truly

committed to the necessary adaptation and mitigation of climate change. The main urban destinations have already exceeded their pre-pandemic influx figures, maintaining, or intensifying the pre-crisis imbalances, which has led to local policies aimed at deconcentration and diversification of supply, as well as exercising greater control over the tourist rental supply. The lesser impact of the crisis on rural areas as an opportunity to strengthen the role of tourism in local development seems to be diluted by the stabilisation of demand, while the positive effects of the upturn in local tourism, both on a regional and global scale due to its implications for favouring more sustainable tourism consumption patterns, are not guaranteed to continue.

In short, the debate opened during the pandemic between the recovery and/or transformation of the tourism sector is in favour of re-establishing the pre-crisis dynamics and, consequently, its imbalances. Tourism activity in Spain at the end of 2023 seems to have acquired a renewed dynamism, both in terms of demand and economic impact, which should not hide the need to carry out the structural transformations in destinations that have been suggested in the field of research, also taking into account the complex context of the current polycrisis.

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# The state of geopolitics in Spain

## A PERSPECTIVE FROM GEOGRAPHY

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### ABSTRACT

In recent years, the change of the strategic scene and, specifically, the European security framework, the COVID-19 pandemic and the migratory crises since 2015, among others, have relaunched interest in geopolitics and turned it into a field of relevance. Geography has a fundamental role in research on this subject. This contribution proposal seeks to collect the main contributions on geopolitics made by Geography in Spain in the last five years. In any case, and given that geopolitical studies are multidisciplinary in nature, works on this topic from related disciplines are included. Likewise, this contribution is contextualized with that made from the international level. Finally, a general diagnosis is made about the situation of geopolitical research in our country, providing ideas to contribute to the valorization of Geography as a pertinent science for the analysis of the current world.

### 1. INTRODUCTION: WHY THE INTEREST IN GEOPOLITICS

It is complex to pen in a text the interest in a discipline with tradition, and at the same time controversial; and the reasons that have motivated such a large number of authors to reflect, investigate and, ultimately, be charmed by it. Starting with the easy thing would be to make a juxtaposition of definitions – in some cases, ambiguous and diffuse – that would ultimately be reduced to the binomial of politics and territory. But, when delving into the concept of politics, it is impossible to separate it from that of the people: in essence, the *polis*, and the feeling of belonging to a collective identity. Researching on Geopolitics means love not only for one's own country, but for all the links in the international system. It is the passion for an extended homeland: it stands for truly opening the mind and crossing borders, it means studying the other, the different, the distant, the separated by a limit. Researching on geopolitical issues involves working to overcome those boundaries that reality imposes. It means entering another world where realities change, and always aiming to improve communication, the situation of well-being, security and stability, coexistence and peace between communities, ultimately it refers to cooperating and strengthening progress. All of these are reasons that (I humbly take the license to identify) have led geographers to become passionate about Geopolitics.

But, in addition, it is contagious: it is fascinating because society is passionate about it. The aim is to understand the world and current events, not to vaguely act as a judge in the middle of a war situation or other similar problems, but rather to know the causes and consequences, the implications and derivatives, to satisfy the interest and curiosity of learning about the world we live in. For this reason, blogs, social media channels, and other mainstream sources proliferate that inform about geopolitical issues to society. Furthermore, it is not only that mere curiosity to know how the world works – and the hackneyed expressions of the “chessboard”, “controlling the world” and the “economic substratum” – power has always fascinated... and in essence, Geopolitics is the geography of power.

The very etymology of “geopolitics” refers to the “government of the polis [of cities]”, so we could speak of the study of governments linked to the place, and that link is reflected in the definition of what a State and its Administration are. It is that expression of power over the territory, of control of space by a determined society that permeates the physical environment with its development, technology, culture and values. The figure of the State emerges as the unification of political power, and is the pillar of the international system. Today’s world is a world built by sovereign and independent States, despite the existence of other non-state actors, such as companies, organizations or companies, which were cornerstones in other times of History, or the future. It was at the Montevideo Convention (1933) when it was debated what a State was and the conditions it had to meet to be considered as such, which is statehood. As a summary, the conditions of statehood include a defined territory; a permanent population; an independent administration capable of exercising its control and organization functions; and the ability to establish relationships in the international arena (Grant, 1999; Ker-Lindsay, 2012).

Geopolitical issues affect the economy of different countries, cultural manifestations in their broadest spectrum, institutions and government systems, values and currents of thought, people’s identity and the perception of all of these. It could be said, in this sense, that *everything is Geopolitics*, because truly, everything is impregnated with it. From the increase in the price of food, the ease or impossibility of crossing a border, the creation or regulation of an infrastructure, the election of political representatives, or even the promulgation of any policy. But, at the same time, the rule of “everything is” implies that “in reality, nothing is”, and it is necessary to define what genuinely constitutes the object of Geopolitics. And this is where Geography must lead this definition and include it as one of its most successful, popular and acclaimed subdisciplines both by society that wants to satisfy its concerns, and by professionals who want to have the most privileged information to anticipate and predict sociopolitical behaviour.

If we understand Geography as the science that studies the relationship between the human being and the physical environment, and from the most classic geographical thought the term “geographic space” was coined as that space of contact between the physical environment and the human environment, where both are interrelated, Geopolitics should coincide with the territorialization of the political system, and the interrelations with it. As with other social sciences, the broad and holistic nature of Geography makes its delimitation diffuse, since social phenomena are linked to a territory in their applied nature. However, the virtue of Geopolitics lies here: to single out studies that involve the notion of territory and that involve the relationships between different political systems, more specifically between States, between them and non-state actors that dispute power, or in the own political organization of a territory. Frequently, some authors include other relationships that, in the author’s opinion, could rather be included within Social Geography, such as, for example, the relationships of different social movements with the State – without including a dispute over power or statehood, the condition of being a State –, or different sectoral policies that, in essence, are regulations and responses to those sectoral decisions: conflicts, as such, cannot be considered “geopolitics” *per se*. There are conflicts of all kinds, urban conflicts, conflicts over housing, conflicts over infrastructure, conflicts over local resources... and many others, which do not represent a loss of statehood, or an impact on interstate relations. Not everything is Geopolitics and this discipline must strengthen its object of study, and at the same time, leave room for other disciplines to include different policies and their sectoral conflicts. There are many policy studies on specific topics: financing policies, service

provision, economic policies, water policies, fishing policies, demographic policies, perception studies, territorial policies... that do not necessarily have to be synonymous with Geopolitics. Finally, it is worth mentioning that a geographical substrate is necessary to conceptualize and develop the different geopolitical issues on it, otherwise, we would be faced with essentially historiographic studies, migrations, or other new currents such as the geographies of well-being and terror.

## 2. AS A KIND OF INTRODUCTION: POLITICAL GEOGRAPHY, GEOPOLITICS AND THEIR EVOLUTION

Within Geography, geopolitical issues have traditionally been one of the fundamental ones in the study and development of Geography, since it spatializes power relations. From classical antiquity, with Aristotle and his *Politics*, or the travels of Strabo, the close links between this knowledge can be glimpsed. Their institutionalization crystallized in the 19<sup>th</sup> century in Political Geography, whose object of study focused on nation-states. The context of the rise of imperialism and the enterprise of geographical societies meant that it was seen as a weapon for colonialism, with a strong deterministic character, as can be seen in the works of Ratzel, Ritter or Mackinder, which influenced so much, even shaping the European political reality. The term Geopolitics arrived with Kjellen in 1916, and its subsequent development with the thesis of Nazi expansionism led to this discipline being reviled, which seemed to be relegated to a kind of Darwinian natural selection practiced on States. However, renowned authors continued with important treatises such as Cohen, Taylor, Huntington or Mearsheimer. Likewise, Geopolitics has received great contributions from military science, with Clausewitz and *On War* (1832), or Jomini, Hart and Moltke, among others, all of them authors in the field of strategic studies, to the more recent contributions typical of a reality in continuous change, and concepts such as "hybrid war", "grey zone" or "cybersecurity" whose initiators are usually the armies themselves, defence departments or intelligence centres. Currently, the topics of Geopolitics are varied: the perception of the "other", the values of society, feelings of threat, belonging or identity; in addition to strategy analyses that include military equipment, doctrines and precepts; the conception and regulation of security architectures and their dialogue channels, etc.

As it can be guessed, the difference between Political Geography and Geopolitics lies in the ontological basis and the approach applied. The first is widely associated with static and descriptive research, which analyses a specific spatial situation at a specific time, while the second has a dynamic and evolutionary character, studying the relationship of States with their environment (Hennig and Körholz, 1931). From this is derived the practicality of Geopolitics which, without ignoring its own epistemology, develops its vocation of being applied to case studies and aims to resolve the dilemmas that States face. Therefore, the strategic and military connotation of Geopolitics is unavoidable, since it is oriented towards rivalries caused by factors of a very diverse nature. In this line, it is closely coordinated with Intelligence, when evaluating scenarios and offering solutions to dilemmas and conflicts that have occurred.

The multidisciplinary nature of geopolitical studies means that, at times, they are disputed by related disciplines such as Political Science, Sociology, Military Sciences and Strategic Studies, International Relations, Law, Economics, Psychology... although Geography has a fundamental role in the research on this matter. This contribution seeks to collect the main contributions in the field of Geopolitics made from Geography in Spain in the last five years. For this review, I start from personal knowledge of the subject, as it is one of the main lines of work developed by the author; in addition, an exhaustive search has been carried out for articles related to this topic published in all journals with the quality seal of the Spanish Foundation for Science and Technology (FECYT, in Spanish) in the Geography category, for the period 2019-2023. Likewise, this contribution is contextualized with that made with other search engines, also from the international

level. Finally, a general diagnosis is made about the situation of geopolitical research in our country, providing ideas to contribute to the valorisation of Geography as a pertinent science for the analysis of the current world.

After these initial considerations, the following section indicates the main lines of work identified, which include publications of a multidisciplinary nature. Finally, a section of final reflections is prepared trying to make proposals to strengthen research on this subject in Spanish Geography.

### 3. GEOPOLITICAL STUDIES IN SPAIN: A VIEW FROM GEOGRAPHY

Among the Geography journals with the FECYT quality seal, based on the volume of articles on this topic analyzed, *Geopolíticas(s) Journal of Studies on Space and Power*, stands out, published by the Complutense University of Madrid, with a clear vocation towards these geopolitical issues, and where there is a notable contribution from geographers, as well as political scientists, sociologists, economists, historians, experts in International Relations or Law. It has numerous publications by Spanish geographers, and a large number of Latin American, as well as North American and European authors. *Scripta Nova, Electronic Journal of Geography and Social Sciences*, edited by the University of Barcelona, also includes a high number of publications related to this topic, mostly from geographers. In addition, in 2022 it published a specific dossier on "Critical geopolitics and borders". Journals such as the *Bulletin of the Association of Spanish Geographers* and *Documents d'Anàlisi Geogràfica* (Universitat Autònoma de Barcelona and Universitat de Girona) also tend to collect various contributions from geopolitical geographers. The magazine *Investigaciones Regionales - Journal of Regional Research* (Spanish Association of Regional Science) also brings together some articles on this topic, although economists and political scientists predominate. Other journals such as *Investigaciones Geográficas* (University of Alicante), *Anales de Geografía* (Complutense University of Madrid), *Espacio, Tiempo y Forma. Series VI, Geography* (UNED University) and *Estudios Geográficos* (Institute of Economics, Geography and Demography, CSIC) also publish some articles of a geopolitical nature written by geographers.

Likewise, it is worth highlighting other Spanish journals that deal with Geopolitics topics, such as *Política y Sociedad* (Complutense University of Madrid), with contributions from political scientists, sociologists, and specialists in Law and International Relations, mainly from Spain; the journal *Relaciones Internacionales* (Autonomous University of Madrid), which collects contributions from experts in International Relations and Politics, with a large number of Latin American and Spanish experts; and the *Journal of International Security Studies - Revista de Estudios en Seguridad Internacional* (Global Strategy), which publishes articles of multidisciplinary origin: from International Security, Law, Sociology, Politics, International Relations, Philosophy, etc.

To all of them we should add other publications from prestigious centres such as the *Journal of the Spanish Institute of Strategic Studies* (IEEE), or the *Working Documents of the Royal Elcano Institute of International and Strategic Studies*, which include current geopolitical issues. Linked to the latter, it is necessary to mention the *Publications of the CIDOB* (Barcelona Centre for International Affairs) and the editions of the magazines *Política Exterior* and *Revista Ejército*, which deal with issues of international and military relations, respectively.

Once a framework was made of the main repositories of geopolitical research in Spain, the main publication topics in these have been selected, prioritizing: 1) the contributions made from Geography –regardless of the country of origin–, and 2) other multidisciplinary fields from Spanish institutions. In this way, it is possible to obtain a vision of the state of geopolitical production published in Spain, by geographers and by the Spanish academy. In addition, other works are pointed out that complement this vision and that provide important influences on the authors of Geopolitics in Spain.

### **3.1. EPISTEMOLOGY, ONTOLOGY AND WORKS OF CLASSICAL GEOPOLITICS**

This first identified line of work includes conceptual works and critical reflections on the discipline, as well as basic manuals for the teaching and academic dissemination of geopolitical topics. Thus, the manual by López-Davalillo and Martín-Roda (2012) offers a basis for the studies of Geopolitics as a subject in the Spanish field of Geography. The majority of contributions that deal with ontology or conceptual issues come from related sciences such as Political Science: Cairo (1993 and 1997) already reflected in the 1990s on critical Geopolitics and its approaches; from the Global Strategy group, formed at the University of Granada, more innovative concepts are provided that include the latest advances in defence and international security studies (Jordán, 2018; Bueno, 2016), in addition to offering balances of the strategic studies themselves (Bueno, 2019). Among the contributions of geographers published in Spain on this line of work, the reflections of Raffestin (2020) and Claval (2020) stand out. Reference manuals on Geopolitics applied to study regions are also included in this line of research. In this sense, the Síntesis publishing house offers its Geopolitics collection with the works of geographers such as Plaza *et al.* (2021), about the European Union; Marcu (2021) about Russia and Eastern Europe; or Urdiales (2021) about the Mediterranean. In addition, another issue is dedicated to the Asia-Pacific region, carried out by Pérez Gil (2020) from the field of International Relations, from which Tovar (2021) also provides a study on the international system, including spaces in conflict.

The so-called superpowers dominate the interest in research in this line on world power competition, in the broadest sense of classical Geopolitics and from a Western perspective. The European Union is a space that has received considerable attention, e.g. Plaza (2004) or Marcu (2005) reasoned about the challenges of this organisation. In light of the new climate reality, the Arctic has become a space of competition (Madueño, 2023). China - and its surroundings - has also received interest, as it is considered an emerging superpower (Baqueés, 2019; Pareja-Alcaraz, 2021) but, without a doubt, Russia is the actor that attracts the most attention in Spanish scientific production. As a result of geographical proximity, or due to various cultural, political and economic issues, the works that have the Russian Federation, the post-Soviet space and the Russian area of influence as their object of study are abundant and have even dedicated monographic issues such as the one coordinated by López Jiménez (2023) on Russian interventionism in his neighbourhood. Morales (2019) offers a conceptual vision of Russian international relations, Marcu (2007) deals with the evolution of post-Soviet Russia; and González (2021) provides, from a strategic vision, the Russian position vis-à-vis the international community. In a more applied aspect, Ruiz-Ramas *et al.* (2020) collect in their book various considerations on the relations between Russia and the European Union; Marcu (2009) transfers it to Romania, Moldova and Ukraine.

### **3.2. TERRITORIAL CONFLICTS AND STRATEGIC SPACES**

What is expressed in the previous line of research leads to considering a second field, more specific, applied and concrete on disputed spaces. They are strategic spaces contested by different actors, which are implicitly related to conflict situations: conventional wars, hybrid wars, instability or conflict prevention. Unlike the previous one, the majority are case studies in which these dynamics are noted and characterized, and perhaps it is because of this perspective applied to a specific territory that the contribution of geographers is notable. In this way, Plaza (2011) reviews contemporary geopolitical conflicts; Bernabé-Crespo (2020) identifies potential spaces of tension in Eastern Europe. Precisely, and as previously mentioned, it is the Russian and post-Soviet space that receives a prominent analysis, as a result of its instability and the processes of ambiguity and reconfiguration that take place in the present. Thus, Marcu (2004 and 2011a) and Morales and López-Jiménez (2017) relate the tensions in it, as well as the origin and persistence of frozen conflicts.

As is currently being observed, the freezing condition does not appear to be perennial and its reactivation is due to the dominant geopolitical context (De Waal, 2018a). The ongoing conflict

on Ukrainian soil has encouraged investigations into this case, which are analysed, among others, by Ruiz-Ramas (2016), Megoran (2022), Taibo (2022) and Pardo (2023). Born from this instability, the cases of their neighbours who find themselves in circumstances of tension are also the subject of attention, trying to prevent conflicts in the face of fear of contagion and extension of escalation, as is happening in Moldova (Bernabé-Crespo, 2021a) and Belarus (Bernabé-Crespo, 2021b). Other territories in conflict on European soil are the Balkan or Caucasian, with contributions such as those of De Waal (2018b) and Ferrero-Turrión (2021). Continuing towards Asia, China -despite maintaining a low profile- is also present in contested spaces such as Africa (Esteban, 2010). Interest has also been directed towards the so-called "corridors", strategic connection spaces that generate high value and are highly monitored (Esteban, 2016; Bernabé-Crespo and Vallina, 2023). Other spaces such as the Arctic are also defined as a space of collision, where cartography plays a special role of friction (Arrieta, 2020), or the Sahel, where phenomena that also affect Spain converge (Anguita and González, 2019). Finally, in the Spanish case, it is worth highlighting the contributions made by the Elcano Royal Institute, such as that of Arteaga *et al.*, (2021), as well as other publications by geographers such as García *et al.* (2021) who highlight the strategic value of the Balearic Islands.

### **3.3. COMPETITION FOR NATURAL RESOURCES AND ENERGY**

Territorial conflicts and the competition for strategic spaces can be motivated by a multitude of factors: cultural and identity (often referred to as ethnic), political (freedoms and rights), purely geopolitical due to the conservation of a privileged position, and economic. The latter are the ones that have traditionally received the most attention, giving rise to their own lines of work embodied in the name "Geopolitics of natural resources", since they are mostly based on the acquisition of high-value spaces due to the unequal distribution of these resources, with economic benefits from their exploitation. In this sense, the book by Martín-Roda (2021) is remarkable, specifically on energy resources. Indeed, the energy issue has become a cornerstone of relations between different international actors, and has been widely studied from Economics (Escribano *et al.*, 2013; Lucas *et al.*, 2016). Furthermore, the development of the concept "energy security" implies the dependence on these resources and the volatility of the civil and political security situation that their shortage could cause. In this way, various studies have aimed to offer a vision of the implications and guarantees of the sector, in the face of a geopolitical space of confrontation (Marquina, 2008). Other natural resources involve elements of friction, such as water (Medina, 2020; Batista and Costa, 2021), the sea and fishing (Crespo *et al.*, 2019) or rare earths, considered one of the most important resources in the technology of the future (Santos-Fuser, 2023).

### **3.4. BORDERS AND CROSS-BORDER COOPERATION**

The study of borders has been closely linked to Geography from its very conception since, by meaning, they demarcate and describe the territory. A state of the art on this topic was carried out by Trillo (2022) in the previous Spanish contribution to the IGU. In this text, studies on borders are included as one of the lines within Geopolitics, since their symbiosis is evident as it implies, in most cases, power competitions and rivalries over space. However, in this section, as mentioned above, a selection of works recently published in Spanish magazines and/or by Spanish researchers, and with an evident influence of Geopolitics, are reviewed. In this regard, it is worth highlighting the dossier coordinated by Lois (2022), which includes important texts on critical geopolitics and borders.

From a theoretical perspective on the nature of borders and, above all, their evolution in the historical context, it is necessary to highlight the works of Cairo (2001), Lois and Cairo (2011). Coca and Baltos (2020) also characterize the most recent border dynamics from this perspective, and Cairo and Lois (2014) provide a vision from the geopolitical discourse. The demarcation of the border, its establishment and possible changes in its layout are also a field

of great academic interest to understand the meaning and practicality of borders. Thus, Trillo and Paül (2014) reflect on the nature and evolution of the Spanish-Portuguese border; in this same space, Cairo *et al.* (2022) review the political discourse that motivated the milestones of its demarcation. For his part, García-Álvarez (2019) provides a vision more linked to the Historical Geography of the bordering space. In another context of equal interest, Bernabé-Crespo (2021c) discusses the convenience of redrawing the border in the Kosovo case, subject to claims and in a situation of absence of complete international recognition. Perhaps one of the fields that offer the greatest perspectives of depth in the analysis, helped by the territorial policies of the European Union, is that of cross-border cooperation. This matter is an imperative in the 21st century, where borders change their meaning and conflicting processes of deborderization and reborderization are noted (Giband and Vicente, 2018). In this way, recent studies on the construction of cross-border spaces include those of García-Álvarez and Trillo (2013) and Trillo (2014) for the Spanish case; Camonita *et al.* (2020) in a broader European perspective; or Marcu (2011b) for Romania and Moldova. Finally, studies on borders stand out for their versatility by framing various phenomena in this kind of areas, such as mobility (Prokkola and Ridanpää, 2022) or heritage and tourist attractions (Prokkola and Lois, 2016).

### **3.5. ELECTORAL GEOGRAPHY**

Electoral geography has been one of the branches of Political Geography that has attracted the most attention since the development of democracy, basing its study on the distribution of the vote and on the analysis of the electoral behaviour of different political parties. This branch should not be limited to serving as a description of suffrage, but rather to understand and recognize spatial patterns and their relationship with geographical characteristics, particularly those linked to demographic and socioeconomic ones. The lack of explanatory analysis and the interrelation with these variables from a geographical approach has meant that it has been mostly covered by publications from Political Science, such as the interpretations of Crespo and Mora (2022), Ortiz *et al.* (2022) and Moreno (2023), all of them trying to explain the growth of the far right in Spain and Europe. However, Geography has contributed with important works such as those of Bosque (1982 and 1988), and other studies of a similar nature such as that of Hernández and De Haro (2020). More recently, the original line of work by Rodríguez-Pose (2018) has been added, which combines the explanation of electoral performance with the processes of contestation and multi-causal rebellion, with significance in geopolitical movements, generating a “geography of discontent” (Dijkstra *et al.*, 2020). Despite these important contributions, spaces of opportunity are detected to expand production in this line of work.

### **3.6. POPULATION: MINORITIES, IDENTITIES AND MIGRATIONS**

In this line of research, those fields have been selected in which demographic characteristics and their phenomena have special significance in terms of Geopolitics. On the one hand, the very distribution of the different communities that make up the entire population, differentiated by subgroups that cause tensions linked to movements of identity claims, potentially linked to the emergence of centrifugal or centripetal nationalisms; on the other hand, the mobility of the populations of a world that, in the 21st century, has become a world in transit, and which gives rise to inequalities and conflicts, in addition to being susceptible to being used as a geopolitical weapon, as shown by the present.

Beginning with studies on “ethnic” minorities, as they have traditionally been called, the works carried out by Ferrero-Turrión (2001 and 2004) and González (2004) stand out. From Political Science, it addresses the difficulties and problems faced by these communities, their rights, claims and conflicts, in the study space of Eastern Europe combined with the European enlargement process. From Geography, Marcu (2014) analysed the feeling of belonging of the Romanian community in Spain; Ejupi and Bernabé-Crespo (2022) link the identity of the Kosovo Albanian community with the geopolitical dispute in Serbia. Certainly,

it would often be better to talk about identities rather than ethnicities, depending on the case applied. These different questions crystallize in other studies such as that of Royuela and López-Bazo (2020), on the creation of the European identity; or that of Pérez del Pozo (2020), about the Muslim community in Russia and geopolitical conflicts intrinsic to security. This last appreciation is linked to studies of nationalism, having as one of its mentors Bieber (2018), who discusses the rise of these movements today, also relating it to the pandemic (Bieber, 2022). Finally, the study of migrations in a geopolitical key has been carried out both from Geography (Marcu, 2007 and 2011) and from Political Science (Ferrero-Turrión, 2005; Zapata and Ferrer, 2012), linking it with security. Finally, a current example of these issues is the migration caused by ongoing war conflicts, such as the one in Ukraine (Kostadinov, 2023).

### **3.7. DIPLOMACY AND POLITICAL ORGANIZATIONS**

This broad line of work includes research referring to the foreign policy of States, as they involve changes in the spatial nature of supranational organizations such as enlargements or withdrawals of members, strategies for conflict resolution, or geopolitical actions that impact the diplomacy of very varied events. It is, therefore, a field of work that is closely linked to International Relations, and that has a wide presence in journals such as *Política Exterior*, or publications derived from centres such as the CIDOB, the IEEA or the Real Instituto Elcano. For example, the consolidation of the European Union as an international geopolitical power is a topic of analysis, in which Molina and Benedicto (2020) claim strategic autonomy as a key point. The study of the enlargement of the EU is a recurring topic that gathers several scholars such as Plaza (2003), and with ramifications of this policy towards the Balkans (Ferrero-Turrión, 2015), or the same community action in endeavours such as competition for the Arctic (López-Tárraga, 2022) or the confrontation with Russia (Ferrero-Turrión, 2020), in addition to the withdrawal of members such as the United Kingdom (Navarro, 2021). The expansion of NATO and relations in terms of cooperation and security with Spain have also been widely studied from International Relations and Law (Gordillo, 2022; Testoni and Bueno, 2022; Tovar, 2022), also including relations with Russia (Morales, 2018; Moreno and Priego, 2022). Chinese foreign policy has also been studied by Zhou and Esteban (2020), in relation to the Belt and Road Initiative and the improvement of trade and transport connections and a rise in Chinese influence. In this aspect, diplomacy plays a transcendental role and is reflected in documents such as those by Fernández (2022) and Bueno and Gallego (2021) that analyse the Spanish position in its main spaces of influence. Furthermore, geopolitical issues are of great importance in the organization and development of very diverse international events: Magalhães *et al.* (2023) reflected these circumstances in the case of the Olympic Games.

### **3.8. POLITICAL-ADMINISTRATIVE ORGANIZATION**

The study of the political-administrative organisation has been one of the classic work objects of Political Geography: the division of the territory and the characterization of the Institutions and Government. The presence of geographers is notable in this field, who discuss the nature of States and the scales of organisation and power structures. A specific line would be precisely this, the study of political-administrative divisions and their scales of analysis and territorial organization. In this way, Albet i Mas (2019) writes about the structure and evolution of Spanish municipalities, and Morales *et al.* (2022) consider the reorganization of this map, proposing the scale of the regions in the case of Castile and León. Continuing with the trend towards reorganization and configuration of the State, the productions of Farinós *et al.* (2019) are remarkable, who reflect on the articulation of the Spanish territorial model; Plaza y Lois (2023) pay tribute to the writings of Juan Romero that deal with this topic; and Paül *et al.* (2021) discuss the demands for Leonese autonomy. Moreover, it is also necessary to point out the consequences of the territorial model on regional inequalities (Rodríguez-Pose and Ezcurra, 2010). A third line of work in this field would be the construction of the State itself. Some of these investigations are those of Romero (2020), for the cases of Yemen and Myanmar; or that of Benedetti and Salizzi (2023) for Argentina.

### 3.9. OTHER TOPICS: TERRORISM AND PANDEMIC

In this last section, two different lines are included: on the one hand, issues linked to terrorism, which are preferably studied from International Security and Psychology; on the other hand, a line of study that responds to the situation of the COVID-19 pandemic. The first has a great influence on the relations between different States and war situations. The link with Geography is questionable, but they provide very valuable nuances that have a special impact on the processes studied by Geopolitics. In this regard, Martini (2020) analyses how they impact the international system; Jordán and Horsburgh (2005) map the events of jihadist terrorism in Spain; Torres *et al.* (2006) reflect the evolution of this threat worldwide. It is worth highlighting two productions that help to understand these processes of jihadist radicalization, with special interest in the Spanish case (De la Corte and Jordán, 2007; Jordán, 2009).

For its part, the second line has received multidisciplinary attention taking into account different considerations. The impact of the pandemic was so disruptive that practically all sciences directed their studies, even if only punctually, towards the most immediate needs. Geopolitics was an exception, and proof of this is the publication of the special issue in the 11th volume of the journal *Geopolíticas(s)* in the same 2020, called "Geopolitics of the COVID-19 pandemic", or the number 52<sup>nd</sup> from the journal *Relaciones Internacionales*, titled "COVID-19: Re-reading International Relations in light of the pandemic." Among the articles highlighted outside of these two monographs, we can highlight the one on the management of this crisis mediated by the confrontation between the administrations of Catalonia and Spain (Paül and Trillo, 2022).

## 4. FINAL REFLECTIONS AND FUTURE LINES OF WORK

Geopolitics cannot be understood without Geography. Geography permeates, serves as a substrate and motivates political actions, turning them into geopolitics. In the control of the territory, it is necessary to consider not only purely geographical variables such as the physical environment, the distribution of the population or economic resources, but also political and cultural factors that take on special relevance. In all of this, Geography can and should contribute from its different approaches, objects of study and analysis.

In this brief state of the art, the main lines of work in Geopolitics in the Spanish context have been identified, privileging research published in Spanish journals and those carried out by geographers, highlighting the most relevant of the last five years (2019-2023). It is necessary to clarify two limitations of the present study, mainly due to the multidisciplinary nature of this subject: 1) the impossibility of collecting all the production, so other research has most likely been missed; 2) the difficulty of listing contributions from other related disciplines is also a limitation, their number is extensive and of a very varied nature, which is why an attempt has been made to bring together in this text the most relevant and those with the clearest connection with a geopolitical and geographical perspective. Despite this, this text should be understood as one more link in the consolidation of Geopolitics as a field of interest within Geography and Spanish academia in general, and should be completed with subsequent studies and compilations that delve into the framework. theoretical and fundamental bases of the discipline, and a greater extension and scope of this type of studies, given the demands and concerns of society.

Among the highlighted lines, some of them have a wide presence in Spanish Geography, such as border issues or the political-administrative organization of the State. Others are of growing interest, such as territorial conflicts and strategic studies, classical geopolitics treaties (due to the return of these issues to the international level), diplomacy, supranational architectures of regional integration and their foreign policy, the construction of identities, and other cases derived from the migratory reality that has gone from crisis to continuous

tensions. Others, although they have traditionally been studied by geographers, have a growing presence of researchers from other disciplines, such as electoral geography or competition for natural and energy resources. In any case, most of them respond to demands from society in a context of challenges regarding uncertainty and instability. The return of Geopolitics to the world stage is an opportunity for this discipline to establish itself, and to contribute to the academic debate and decision-making of the different socio-political actors. Specifically, the challenges facing our society are multiple and multifactorial. To begin with, the crisis of democracies and their fragility, and the need to strengthen institutions, promote good governance, transparency and representativeness. This is followed by confrontation between geopolitical rivals and the spread of territorial conflicts; the opening of border revisionism, the emergence of nationalisms and the reactivation of hostilities that were apparently stabilized. Likewise, the confluence of communities in altered spaces that pose a challenge to coexistence; and everything immediately mentioned, mediated by the palpable influence of climate change, which accentuates competition for natural resources and compromises international security in energy matters, among others.

Cooperation with the related disciplines of Political Science, International Relations, Sociology, Psychology, Economics, Law and Military Science would be very positive to strengthen these lines and develop geographical research. Furthermore, the virtue would be reciprocal: 1) Geography offers these sciences complementary visions articulated around territorial notions, with the ability to interrelate physical and human factors; 2) Geography benefits from importing new concepts and methodologies, and offering a renewal of content and research that increases the motivation of the new generations who decide to choose our discipline.

Strengthening scientific production on Geopolitics is a task not without difficulties. First, dissemination with rigor and objectivity is necessary, in the face of the proliferation of non-academic channels, and disinformation itself, one of the most used geopolitical strategies for destabilization. Furthermore, to reinforce this research it would be very positive to establish stable cooperation networks between researchers from different fields and even investigate coordination, with the aim of stabilizing it and preventing it from being relegated to cycles of greater or lesser interest. Particularly, Spain is a country with outstanding strategic depth: a) a European country, one of the driving forces of the European Union, b) a Mediterranean country, a meeting point with the Global South and with potential ties with the southern and eastern shores of the Mediterranean, c) a country in the Hispanic American sphere, with powerful ties that make Spain the bridge between the American and European continents, and d) the exploitation of a growing soft power that positions it as one of the countries with the most prominent influence. All of this makes Spain a key actor in the global geopolitical panorama, whose study of Geopolitics must be up to the task and must be helped by Spanish Geography, both in the support and collaboration from the different institutions, as well as the visibility of the organizations, editorials and the promotion of this discipline in their curricula.

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# The recent economic transformation in the rural world

MOVING TOWARDS SMART, SUSTAINABLE, RESILIENT, DIVERSIFIED AND MULTIFUNCTIONAL TERRITORIES

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## INTRODUCTION

The different events occurring over the last five years have led to talk about certain economic transformations in Spain's rural world, which have accelerated or given rise to territorial processes. Just before the pandemic at the beginning of 2020, the rural world and agricultural activities were prominent in the media, which reported the mass protests of farmers and cattle breeders related to the value chain of their products, sustainability, marketing channels, the competitive working conditions and also the new CAP reform which was highly controversial in certain aspects. The geographical research on *Smart* Agriculture is still only tentative although abundant studies have been conducted on depopulation and the ageing of the rural society and the role of the European LEADER rural development programmes, which, in 2021, had been running for 30 years. Little research has been conducted on rural industry and local production systems (LPS). Perhaps somewhat more has been carried out on agri-foods with a designation of origin, but practically none exists on the industrial districts, which were hit hard by the deindustrialisation processes after the economic crisis of 2008.

During the different waves of COVID-19, the rural spaces gained prominence for several reasons. They had a low demographic density; they were far from large urban conurbations with no "social distancing"; and they also filled our supermarkets with agricultural products during the lockdown. However, also noteworthy was their capacity to organise themselves and redirect their industrial activities towards the much needed medical and healthcare textiles. The rural LPS of footwear, clothing, alcoholic drinks and textiles, in general, were able to mass produce healthcare textiles (particularly masks) and hand sanitiser in record time, thanks to the collaboration networks and their adaptation and reconversion capacity. The necessary rural reindustrialisation was knocking on Europe's door. Furthermore, some

studies reflect the timid urban exodus to the rural villages, driven by remote working and the *boom* in rural tourism during the two following summers. All of this was accompanied by the spectacular step forward made by the logistics sector towards the peri-urban and rural-urban space, driven by the boom of leading e-commerce companies during the pandemic, such as Amazon. The growth of the large areas of reclassified land on which the logistics platforms have established themselves in many corridors of peri-urban rural spaces is an emerging research topic related to the international rural-urban continuum.

Within the post-pandemic context, from the end of February 2022, the war in Ukraine (the “granary of Europe”) and the European Union sanctions imposed on Russia have further increased the prominence of rural spaces as the territories for the mass implementation of renewable energy infrastructures, mainly wind and solar, within the broader framework of the energy transition and the 2030 Agenda. The concepts of “solar farms” and “wind parks” are now used in the media and environmental impact and territorial development studies, and there is no doubt that they constitute or will constitute an enormous economic transformation in many rural areas. On the other hand, climate change and the problems of the agricultural sector related to water scarcity emphasise the importance of new, more sustainable and smart agricultures that can adapt to the situation.

At the beginning of 2024, the problems of the farmers and rural territories in Europe resurfaced and erupted with the French and Germans taking the initiative, followed by the Spanish and Portuguese. All of the effects generated by the accumulation of systemic crises (Méndez, 2023), that have led to talk of a permacrisis and polycrisis, impact the European agricultural products that can no longer compete with those that are imported from outside of the EU, which do not have to fulfil the environmental sustainability and labour requirements. The consequence, in the same way as the beginning of the year 2020, was the tractor blockades that collapsed European roads in January 2024.

Therefore, within this critical global and European geopolitical and economic context, there are many Economic Geography topics being researched today in rural spaces that require a preliminary in-depth differentiation due to the wide heterogeneity of types of rural environment according to their current economic activities, their proximity to or remoteness from large cities and the social groups of which they are composed. The dynamic, intermediate, stagnated and profound rural area categories should be borne in mind so as to avoid generalisations (Molinero and Alario, 2022). Rural multifunctionality is reflected in studies related to the “Smart Rural” concept, which is giving rise to the new European programmes that will perhaps replace LEADER for rural economic development. They incorporate the search for solutions to all of the socio-economic and geographical problems of these spaces, based on their strengths and opportunities within the global economic framework. These new times for global capitalism have given rise to new ruralities in Spain over the last five years. The multifunctionality and economic diversification of rural areas are becoming increasingly more urgent and evident and go hand in hand with the new technologies (smart). The question that should be clarified by the academic field is whether we are really witnessing a rural rebirth, which was the title of the Colloquium of Rural Geography of AGE (Spanish Geographical Association), held in 2022 after the Colloquium of 2020 focused on the problem of depopulation and the demographic challenges in rural spaces.

We will now give a brief description and a more detailed academic state of the question considering five relevant geographical thematic blocks that reflect the recent economic transformation in the rural world in Spain, based on a selection of noteworthy case studies over the last five years. Some of these rural economic transformation processes are referred to in the manual published in 2022 by the Economic Geography Group of AGE with the title “Geografía económica. Fundamentos, agentes y procesos” (Economic Geography. Foundations, agents and processes” (Alonso, Del Pozo, Pallarés-Barberá and Sánchez, coord. 2022), and have been reflected in recent years in the articles published on Spain, mainly in the journals AGER (<https://ruralager.org/es/>) and TERRA (<https://ojs.uv.es/index.php/TERRA/index>), and also BAGE (<https://bage.age-geografia.es/ojs/index.php/bage>).

# 1. THE “SMART” DIMENSION MARKS THE ROAD MAP IN THE NEW STRATEGIES FOR THE SMART AND SUSTAINABLE ECONOMIC-TERRITORIAL DEVELOPMENT OF CURRENT RURAL SPACES

## FROM THE 30 YEARS OF THE EUROPEAN LEADER PROGRAMMES TO THE *SMART RURAL 21 AND 27* PILOT PROJECT AND THE EMERGING SUSTAINABLE SMART VILLAGES

Pilot projects for rural development related to the *Smart* concept, similarly to the previous and more prominent process of the *Smart Cities*, began to be implemented before the COVID-19 pandemic but were revived and accelerated by it. From 2020, although only tentatively, research projects began on the concept of *Smart Villages* and are still ongoing. The majority of the studies still focus on the LEADER project case studies. There are very few publications on the smart and sustainable solutions that are being proposed based on the new *Smart Rural* initiatives.

March 2021 marked the thirtieth anniversary of the European LEADER initiative for the progress of rural territories. However, Spain's rural interior is immersed in a severe depopulation and ageing process. What has happened? What has been done wrong? Learning from mistakes is fundamental for a Sustainable Territorial Planning of Spain's rural environment within the 2030 Agenda. Within the context of the Recovery, Transformation and Resilience Plan 2021-2023, the Spanish Government Delegate Committee for the Demographic Challenge has designed a programme with 130 measures to implement in rural depopulated territories, divided into 10 fields of action and with funding of over 10,000 million euros. However, if we consider that the objective of the LEADER programmes in Europe for all of these years has been the development of rural territories, perhaps we should first analyse what we have done wrong over the last three decades to correct the errors and stop rowing against the tide.

Although the repercussion of this initiative for Spain's rural environment is unquestionable (there are 264 LAGs, representing 6,200 municipalities that had a budget for rural development programmes in the period 2014-2020 of almost 8,300 million euros), it is clear that it has not been able to slow down the depopulation of the rural territories in interior Spain, where the inequality is not only manifested in the low demographic density with respect to urban and peri-urban spaces, but there is also an enormous population ageing problem. Just before the thirtieth anniversary, Esparcia and Mesa (2020) reviewed its application in Spain in a book titled “LEADER en España. Cambios recientes, situación actual y orientaciones para su mejora”, which, based on a qualitative methodology, considers thirty key ideas.

What has failed in these 30 years of LEADER programmes in Spain? It seems that this initiative has been applied within a national context in which territorial processes were fostered that have generated the contrary of what was sought, even though this seems inexplicable. We are referring to the policies of a concentration and polarisation of economic activities in the cities, supported by a radial model of transport infrastructures. Any development actions taken in rural spaces that are not within the radiuses of the model have been insufficient to counterbalance the supply of jobs and services in metropolitan areas. Acknowledging this mistake and attempting to correct it will form the base of the future success of any rural development initiative or the curbing of depopulation. However, this is not the only solution to such a complex problem. In addition to transport infrastructures with a grid design, the provision of social and internet services to all of these spaces will also be essential. The European funds for territorial cohesion do not seem to be allocated to this purpose, making it increasingly difficult to obtain polycentric territorial development. In short, we have learned (finally) that swimming against the current is difficult, even impossible and gets us nowhere (Mecha, 2021; Molina, Hernando and Pérez, 2022).

There has been much talk in the media about digitalisation as an innovative solution of the twenty-first century, both in cities and rural territories. Yes, villages also wish to become smart like the *Smart Cities*. The concept of territorial smartness seems to be measured today by Internet access or digital connectivity, a basic requirement for digitalising any economic activity that is sought as an alternative for depopulated rural spaces. If the inhabitants of rural areas pay the same taxes as those of urban spaces (for now proposals for a differential taxation system are only tentative), they will also want access to the basic twenty-first century services in order to be competitive. Who wants to go and live and work in a village with their family if they have no Wifi access or are unable to reach schools or healthcare facilities in less than 30 minutes? We are hearing a lot about the 15 minute city as an example of sustainability. However, we do not hear much about the 30-20 minute (or maximum of 30 kilometres) districts or villages, which is an interesting and essential initiative to encourage an urban exodus and the sustainability of rural territories. However, evidently, the ageing of the rural population makes the digitalisation of its economic activities and services complicated, as illustrated by the European pilot initiative *Smart Rural 2021* (<https://www.smartrural21.eu/>), in which only the Spanish municipality of Ansó (Huesca) took part despite the more than 200 applications from Spain to participate.

The project “Preparatory Action on Smart Rural Areas in the 21st Century” (*Smart Rural 21*) was a project lasting two and a half years supported by the European Commission (DG AGRI), with the overall objective of promoting and inspiring villages to develop and implement smart village approaches and strategies throughout Europe and draw conclusions and support future policy interventions in smart village initiatives. The project began in December 2019 and concluded in November 2022. After the enormous success in the number of applications to participate, it was deemed necessary to give a new opportunity to those countries that wished to participate, giving rise to *Come Along!* In Spain, together with Ansó, other municipalities joined the initiative, such as Añora, Candeleda, Elvillar / Bilar, Sierra de Montánchez y Tamuja and Vega de Valcarce. As a result of this pilot project, an inventory was made of smart solutions for rural spaces, giving rise to a wide range of innovative practices adaptable to different local contexts in different thematic areas (*people, economy, living, environment, governance, connectivity & mobility*) (<https://www.smartrural21.eu/smart-solutions/>), of which six have been implemented in Spain as a pilot project. This database is being used and updated by the subsequent project *Smart Rural 27* (<https://www.smartrural27.eu/>).

This second pilot action was launched by the European Commission in December 2020 with the objective of “preparing the member States and rural communities for implementing the post-20 Common Agricultural Policy (CAP) and other EU policies and initiatives that could potentially foster the emergence of more *Smart Villages* throughout Europe. In Spain, the villages of Kuartango, Ansó, Oliete, Baix Solsonès, Saldes, Sant Pere de Torelló and Mengíbar are participating. Smart Rural 27 held its final conference in March 2024, having created knowledge groups for the rural communities on renewable energies and digitalisation, which seem to be the factors that will lead to the recovery and development of the territories that have been experiencing depopulation processes for decades (Palma and Mecha, 2022).

As well as the 130 measures, the ten lines of action and more than 10 billion euros of funding, strategies are also needed in which universities and the transfer of research and knowledge can greatly contribute. In the minutes of the 20th Colloquium on Rural Geography held in 2020 under the slogan “Rural spaces and demographic challenges: from the perspective of the depopulated territories”, we can find many research projects on this topic. The success or failure of the economic and social policy measures depends on many factors and needs to be studied in depth. As well as maintaining a territorial approach and taking urgent structural action in terms of infrastructures, which we have previously referred to in order to put an end to the economic models of urban concentration, other actions are proposed to help slow down the process of depopulation.

- Creating the necessary working conditions to include highly qualified personnel in the Local Action Groups and the Local Development Agencies.

- Applying a reduced tax rate in rural spaces until they have the same services as the cities.
- Promoting employment creation initiatives related to renewable energies or remote working, but always respecting the landscape and natural heritage.
- Demanding a price of electrical energy in accordance with the proximity to the places of generation, eliminating distribution and marketing costs.
- Maintaining a stable funding mechanism over time, without depending on political changes, as it will take more than a decade to revert the current situation.
- Supporting local specialised “know-how” (agricultural, industrial and agro-industrial), that knows a lot about cooperation, innovation, networking and resilience, as demonstrated during the hardest months of the lockdown, providing our markets with foods and our hospitals with masks.

If we combine these strategies with the 2030 Agenda and the fulfilment of the 17 Sustainable Development Goals, there may be a hopeful outcome in terms of the Sustainable Territorial Planning of Depopulated Rural Spain. The time has come to change the direction of the current of the water in which we are rowing and to put an engine on our boat in order to urgently move towards the sustainability (environmental and social, of course) of the depopulated rural territories and true territorial cohesion. There will still be time to do this if we have learned from our mistakes. We should fully exploit the lessons learned and the funding for the post pandemic recovery in the short, medium and long term. There is just a little over five years until 2030.

## 2. THE ROLE OF RURAL TERRITORIES ON THE PATH TOWARDS THE GREEN AND ENERGY TRANSITION OF THE 2030 AGENDA

### **RENEWABLE ENERGIES AND SHORT FOOD SUPPLY CHAINS IN THE CONTEXT OF THE NEW COMMON AGRICULTURAL POLICY (CAP) AND THE SUSTAINABLE DEVELOPMENT GOALS (SDGS)**

Rural territories are defined as fundamental actors in the transition towards a more sustainable energy production system and in the promotion of agricultural practices that are respectful of the environment. Within this context, the convergence in rural spaces of the implementation of renewable energy infrastructures and short food supply chains emerge as key elements for addressing the environmental, social and economic challenges faced by contemporary society. Rural areas constitute the ideal location for developing the diversification of the energy matrix towards renewable sources such as solar, wind, hydroelectric and biomass, due to the availability of resources (mainly land). Furthermore, short food supply chains, which promote local production and the direct distribution of fresh and high-quality food, not only reduce the carbon footprint associated with the transport of goods, but also reinforce the ties between producers and consumers, boosting the local economy and promoting social cohesion in rural communities (Palma and Mecha, 2023).

Within the context of the new Common Agricultural Policy (CAP), it is imperative to redirect the incentives and support measures towards the promotion of sustainable agricultural and energy practices in rural territories. The CAP should encourage the adoption of clean and efficient technologies and the creation of infrastructures appropriate for the production and distribution of renewable energy, while guaranteeing an environment that fosters the development of organic farming and local markets. The financing programmes and support instruments should be aimed at training, innovation and investment in projects that drive the transition towards a more resilient, equal and sustainable agricultural and energy model.

Ultimately, the reinforcement of the role of the rural territories in the energy and agricultural transition represents a unique opportunity to revive the rural communities, promote the creation of local employment, conserve the biodiversity and natural resources and construct a fairer, more inclusive and environmentally aware society. The convergence between the 2030 Agenda and the new CAP and the local efforts to attain sustainability provide a framework for addressing the global challenges from a holistic and territorially rooted perspective, driving a transforming change in rural spaces towards a more prosperous and balanced future for the coming generations. The development of renewable energies in the Spanish rural spaces has experienced considerable growth in recent decades, converting Spain into one of the European leaders in the production of clean energy. The country's rural areas offer optimal conditions for the implementation of different renewable energy sources, taking advantage of their abundance of natural resources and extensive area.

Photovoltaic solar energy and solar thermal energy constitute the most noteworthy technologies developed in Spain over the last five years (Espejo & Aparicio, 2020), thanks to the country's high levels of solar irradiation and the availability of large areas of land for installing solar panels and solar thermal plants. The region of Andalusia, in particular, has been a pioneer in promoting large-scale solar projects, significantly contributing to the generation of clean energy and local economic development. On the other hand, wind energy has also experienced considerable growth in the Spanish rural space, particularly in regions such as Galicia, Castile and León and Aragón, where the wind is constant and strong. The installation of wind parks has generated employment and economic activity in these areas, as well as contributing to the diversification of the energy matrix and the reduction in greenhouse gas emissions. In addition to solar and wind energy, other renewable sources such as biomass, hydroelectric energy and geothermal energy are also being explored in the Spanish rural environment. Forest and agriculture biomass is being increasingly used for generating heat and electricity, using the organic waste available in rural areas. Furthermore, hydroelectric energy, although to a lesser extent, still constitutes an important renewable energy source in areas with suitable rivers and reservoirs.

In short, the development of renewable energies in Spain's rural areas not only contributes to the mitigation of climate change and the reduction of the dependence on fossil fuels but also represents an opportunity to revive the local economies, create employment and promote environmental sustainability. However, it is important to address the associated challenges, such as the integration of renewable energies in the electricity network, an adequate territorial planning and the active participation of the local communities in energy projects to guarantee a sustainable and equitable development in the Spanish rural environment.

One of the main controversies of the CAP reform for the period 2023-2027 in Spain and the whole of Europe resides in the distribution of the agricultural funds and the impact on rural areas. The new CAP proposes changes in the distribution of direct payments to farmers, introducing a more equitable system based on objectives such as the protection of the environment, the mitigation of climate change and the promotion of sustainable farming practices. However, this redistribution of payments has generated concern among farmers and the rural communities, particularly in regions that depend on agriculture as in the case of many areas in Spain. Some fear that the new measures could reduce the income of the farmers and negatively affect the economic feasibility of the farms. Another point

of controversy in the reform of the CAP is the implementation of eco-schemes and sustainable agricultural practices. Although the introduction of the eco-schemes seeks to promote practices that are respectful of the environment and biodiversity, their application and the criteria for allocating them has generated debates on their effectiveness and feasibility in the Spanish rural context. Some farmers express concern about the administrative complexity and additional requirements that participating in eco-schemes implies and the lack of clarity in the objectives and associated financial incentives.

Furthermore, the reform of the CAP has also generated controversy in relation to the contribution to rural development and territorial cohesion. Despite the efforts to reinforce the rural development programmes and support the economic diversification in rural areas, some critics argue that the proposed measures are not sufficient to address the structural challenges and development in many rural areas of Spain. There is worry that the lack of resources and the administrative complexity will hinder the effective implementation of programmes and projects of rural development, which could exacerbate the territorial disparities and undermine the viability of rural communities.

In short, the 2023-2027 CAP reform contemplates a series of controversies and challenges for European rural spaces, including Spain. Although it seeks to promote agricultural sustainability and rural development, it is necessary to address the concerns and guarantee the active participation of the farmers, the rural communities and other relevant actors in the implementation and review of the agricultural and rural policies to ensure a sustainable and equitable future in the European countryside.

Short food supply chains have become an increasingly relevant element in the context of the new Common Agriculture Policy (CAP). This food production and distribution model is characterised by the proximity between producers and consumers and by the use of sustainable agricultural practices that respect the environment. Within the framework of the CAP, short food supply chains are considered as a fundamental tool for promoting sustainability, food safety and rural development. The new CAP acknowledges the importance of this model and has introduced a series of measures and programmes aimed at fostering its adoption and expansion. One of the principal initiatives of the CAP in relation to short food supply chains is the promotion of local produce and the direct sale of agricultural products. Through support and finance programmes, the CAP seeks to facilitate the access of farmers to local and regional markets, promoting the marketing of fresh and highly quality food without intermediaries. This not only benefits the farmers by guaranteeing a better economic return for their products, but it also reinforces the ties between producers and consumers, fostering trust and transparency in the food chain.

Furthermore, the CAP offers incentives for the conversion to organic farming and the maintenance of sustainable practices through direct payments and specific subsidy schemes. These incentives help to compensate the additional costs and possible losses of income associated with the transition to organic production, while fostering the adoption of agricultural practices that are respectful of the environment and biodiversity. Another important measure of the CAP related to short food supply chains is the support given to the creation and development of local markets and direct sales platforms. This includes financing the infrastructures and equipment necessary for marketing local products and the promotion of labelling systems and certifications that guarantee the quality and authenticity of the food produced through the short supply chains.

In short, the new CAP acknowledges the fundamental role of short food supply chains in the construction of more sustainable and resilient food systems. By providing financial support, incentives and specific programmes, the CAP seeks to drive the development of this agricultural model, promoting local production, the protection of the environment and the revival of rural economies throughout the European Union.

### 3. WINDS OF REINDUSTRIALISATION IN RURAL SPACES

#### **THE EMERGENCE OF FACTORS OF PROXIMITY TO THE CONSUMERS, THE REDUCTION OF RISKS IN THE TRANSPORT OF GOODS AND THE RESILIENT AND INNOVATIVE CAPACITY OF THE TRADITIONAL INDUSTRIAL AND AGRO-INDUSTRIAL DISTRICTS**

During the health crisis and the subsequent economic, industrial, social and geopolitical crises generated by the “glocal” COVID-19 pandemic, the LPS of footwear, textiles-clothing, the car sector and the production of alcoholic drinks had the opportunity to demonstrate against the clock (to society and the public institutions) their capacity within a context of closed trade borders on all geographical scales, even local, and the enormous competitiveness on markets of these healthcare products in question. The dependency on an industry that provided essential equipment and clothing for hospitals and had offshored its production due to the globalisation of the economic activity in preceding decades was an enormous problem in the short term. Geographical proximity had become an enormous advantage overnight as municipalities were practically besieged due to the forced lockdown of the population. Within this urgent context, the industrial and organisational conditions of the LPS proved to be enormously efficient (experience in flexibility and constant adaptation to the customer, cooperation between manufacturing and auxiliary companies as a principle, network-based organisational structure), with their openness to constant technological and organisational innovation, together with the spirit of solidarity of entrepreneurs and workers and whole villages: they reinvented themselves with ingenuity and their charitable spirit.

Within the theoretical context of smart innovation, the smart society and smart territories (Spanish National Plan for Smart Territories, 2017), going beyond digitalisations, contemplates the concept of smartness as the capacity of organisation, collaboration and cooperative resilience between companies and public and private actors, together with social participation. In light of the situation of collapse generated by the COVID-19 pandemic in March 2020, the LPS located in dynamic rural spaces constituted nodes of solidarity, cooperation, ingenuity and adaptation to the crisis situation, in short, nodes of smart, social, organisational, technological and productive innovation.

The LPS of the footwear and textile-clothing sectors became manufacturers of masks and other clothing products for healthcare workers or for hospital use (gowns, boot swabs, blankets, sheets,...). Similarly, the alcoholic drinks sector adapted itself to produce hand sanitiser. Specific companies stood out, becoming highly visible in the media due to having relevant brands in the market but transforming with the support of auxiliary companies in their industrial or agro-industrial districts, such as the territorial development and innovation agents (mainly town councils, business associations and technological institutes). The LPS in dynamic rural territories were able to adapt extremely quickly to a crisis situation thanks to the following factors: the geographical proximity between manufacturing companies and the actors and agents involved in production, within a context in which proximity is fundamental; the inter-enterprise relationships between manufacturers and nearby auxiliary companies as a way to continue usual activity; the production flexibility of their manufacturing systems; the socio-business relations of regional collaboration and cooperation as a principle of action; the existence of business associations and sectoral institutes in the region; and the fluid relationship with specialised technological centres to guarantee the design and quality of their products.

Emerging from this “glocal” context (global and local at the same time), is the idea that the LPS have an enormous capacity to rapidly adapt to all types of urgent, production flexibility and innovation situations, thanks to their network organisation based on cooperation and geographical proximity. Many case studies analysed in different coordinated research projects carried out by different teams of the Economic Geography Group of the Spanish

Geographical Association (AGE) in previous decades have shown this. The industrial and organisational conditions of the LPS have shown their enormous efficiency, together with their charitable and voluntary spirit, which was displayed by entrepreneurs, workers and whole municipalities (rural villages or small towns): they reinvented themselves with true ingenuity, innovation and business and territorial intelligence. In less than a month, Spain witnessed what we could call the fastest “industrial reconversion” in the history of certain LPS (Mecha, 2020).

In response to the collapse, the entrepreneurs and workers became drivers of innovation with the collaboration of support agents and entities in the local and regional environment. Thanks to them, they were able to quickly reinvent themselves and guarantee the quality of their products. During the health crisis and the subsequent economic, industrial, social and geopolitical crises generated by the “glocal” COVID-19 pandemic, the LPS of footwear, textiles-clothing, the car sector and the production of alcoholic drinks had the opportunity to demonstrate against the clock (to society and the public institutions) their capacity within a context of closed trade borders on all geographical scales, even local, and the enormous competitiveness on markets of these healthcare products in question.

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In the industrial footwear districts, the companies of seven autonomous regions mobilised and, from the first wave of the pandemic, rapidly transformed: in Arnedo (La Rioja) we can highlight the companies Callahan and Pitillos, in Elda, Petrer and Elche (Alicante) the “*aparadoras*” of the footwear manufacturing companies (Susy Shoes, Magrit, Desiree Shoes) sewed masks even from their homes; in Almansa (Albacete) the Asociación de Fabricantes de Calzado (Footwear Manufacturers Association) lent the sewing machinery of its affiliated companies; in Valverde del Camino (Huelva), the company Calzados Herce, whose CEO is the president of the Provincial Association of Footwear Industries (APICAL), was the first in the province to manufacture masks, sterilising them at 170 degrees by ironing them; five factories in Murcia (Maypol, Manuel Lopez Caro, Alhego Shoes, Clara Durán and Calzados Picón), four in Caravaca and one in Cehegín, which are usually engaged in the manufacture of espadrilles, interrupted their production to make masks for healthcare centres; in Menorca, the companies Pons Quintana, Mascaró (century-old footwear company) and Homers manufactured masks, aprons and gowns for the Balearic Islands; and finally in Monforte de Lemos (Lugo), the workers of the company Losal (more than a century old), made masks with fabric supplied by INESCOP and with the collaboration of the residents of the municipality.

In the traditional industrial districts of the textile-clothing sector, companies in the regions of Galicia and Valencia particularly stood out: in Arteixo (A Coruña) the head office of the company Inditex (Zara) obtained the special health and medical textiles and around 25 companies of the textile cluster in Galicia (Cointega) and the textile giant of the region Jevaso began to manufacture masks, robes and boot swabs for hospital workers in the region; in Manises (Valencia), the young fashion firm THE-ARE began to manufacture fabric masks with 100% cotton; in Villafranca del Cid (Castellón), the well-known century-old tights and socks company Marie Claire rapidly transformed itself to manufacture fabric masks and medical robes certified through the Instituto Tecnológico Textil (Textile Technological Institute) (AITEX) of the region; and in the district of Ontinyent (Valencia), the home textile companies urgently began to manufacture healthcare and medical fabrics and masks with their own brand “Textil Ontinyent”.

The emergency products manufactured by both the footwear and textile-clothing LPS were masks and other medical products such as gowns, aprons and boot swabs for hospital use. It is evident that many of these products did not fully comply with the protection regulations at first, but it should be taken into account that they were manufactured within a context of a health emergency with a shortage and absence of strategic resources of these products. In all cases, the initiatives were highly visible in the media, television, radio and the printed press, particularly the local and regional media. However, among these initiatives was the exceptional case of the creation in mid-2020 of the Medical Textile Cluster of Ontinyent, a dynamic rural space.

Before the beginning of the pandemic, the textile industrial agglomeration of Ontinyent included more than 25 companies specialised in the manufacture of home textile products, which, together with many auxiliary companies, had formed an LSP which had been referred to in different publications on a national level. However, from the beginning of the twenty-first century, this industrial district had been suffering from a severe decline, due to the competition from textile manufactures in Asian countries, which led to the disappearance of some emblematic brands such as the Paduana blankets. This situation gave rise to the creation of the Territorial Reindustrialisation Platform in 2014, made up of several local, district and regional business associations. Despite having become a resilient LPS, Ontinyent had a series of latent preconditions that gave it enormous capacity to adapt to a crisis situation: a manufacturing tradition and know-how transmitted through the generations; a large business fabric; a large capacity for social venture, cooperation and innovation; a strong business associationism; the existence of specialised technological institutes; and a municipal public policy that is highly committed to economic, industrial and territorial development.

The strong specialised territorial identity of Ontinyent is supported by many social actors and agents and entrepreneurs from the municipality, whose governance is coordinated by a local council that is actively committed to sustainable territorial development. Together with the mayor's office as a promoter and financier of the initiative, the principal agents involved in reconverting the textile LPS into a medical textile cluster included the Association of Textile Businesses of the Region of Valencia (ATEVAL), which has its head office in Ontinyent and the Technological Textile Institute of the Region of Valencia (AITEX) with its headquarters in the nearby municipality of Alcoi. On 6 July 2020, the town council and ATEVAL signed the agreement that created the "Clúster Textil Sanitario" (Medical Textile Cluster). Both institutions immediately sought the support of AITEX so that it could help the companies reach the necessary medical textile quality in order to obtain the certification from the Spanish Agency for Medication and Healthcare Products (AEMPS). In November 2020, the brand "Tèxtil Ontinyent" was registered and technical workshops were organised for entrepreneurs and workers of the cluster in which many technical and commercial agents and even university researchers were invited to speak.

With the support of the local council, the district and regional business associations and the nearby Textile Technological Institute, the pre-existing companies of the textile sector and other auxiliary sectors (packaging, machinery, screens, partitions, etc.) adapted their facilities in record time, acquiring machinery with state-of-the-art technology, managed their licenses, certifications and approvals and trained their workforce to initiate a new line of business focused on medical textiles. Their new high quality products (masks, gowns, overalls, caps, cuffs) and other hospital products such as new blankets or sheets (such as the innovative and successful "manta-escola" of Textils Mora or the Ecodry biocidal mask of Atenzza) became highly visible in the national market with a territorial and sectoral brand image represented by the new logo. In a very short space of time, more than 40 companies from the municipality and district formed a cluster with a production capacity by mid-July 2020 of 15 million masks per month, which were sold through a collaborative website created for the cluster. Without a doubt, this is a one-time success story, that unfortunately has not been maintained over time and disappeared at the end of the pandemic, despite attempts to maintain it as a strategic cluster on a national level.

## 4. THE BOOM IN E-COMMERCE AND THE GLOBALISATION OF GOODS TRANSPORTS EXPANDING ACROSS THE RURAL SPACE

### LOGISTICS SPREADING ACROSS THE RURAL-URBAN CONTINUUM CORRIDORS, CREATING NEW LINEAR LOGISTICS DISTRICTS

The globalisation of e-commerce, driven by the pandemic, has accelerated the development of the logistics industry which is necessarily expanding across peri-urban territories and the rural spaces close to the cities where land is available. The boom in e-commerce and the internationalisation of goods transportation is significantly transforming the peri-urban rural space, giving rise to the expansion of logistics as an economic activity and the creation of new linear logistics districts along the rural-urban continuum corridors. This phenomenon is the result of the growing demand for products and services by consumers and the need for efficiency in the supply chain and goods distribution.

E-commerce has experienced exponential growth in recent years, driven by the increase in online sales prompted by the lockdown during the first wave of the COVID-19 pandemic and still persists. This has led to an increase in the demand for goods transportation in both urban and rural areas, as companies seek to satisfy the needs of the customers in all geographical locations. In response to this demand, the logistics activities have expanded beyond the initial first-mile metropolitan locations and have extended along the rural-urban corridors, creating new linear logistics districts between cities. These districts are characterised by the concentration of storage facilities (logistics platforms), distribution centres and delivery points (*counter or locker*) along the principal transport routes, such as roads and railways and around the dry ports.

The creation of these logistics districts in the rural space has both positive and negative implications. On the one hand, it can generate economic opportunities for the rural communities as it provides employment and economic activity related to storage, order preparations and goods transportation, contributing to the revival of rural areas that have experienced the loss of traditional industries. However, it also poses challenges and concerns, such as the increase in traffic and congestion on rural roads, environmental pollution, the fragmentation of the landscape and the pressure on the natural resources and local infrastructure. Therefore, the reclassification of land uses for real estate logistics requires a careful planning of the intermodal transport infrastructure (road and rail that connect with seaports and airports), environmental management and the active participation of local communities in decision making.

In 2021, the logistics sector in Spain transported around 725 million shipments, which is 6% more than in 2020 and a historical figure according to the estimates of UNO (Spanish logistics and transport business association). The latest report of the Spanish Transport and Logistics Observatory (<https://observatoriotransporte.mitma.gob.es/logistica>) states that in 2019, there were already almost 140,000 companies in the logistics sector employing around 700,000 workers. In 2021, there were 34.4 million m<sup>2</sup> of covered storage for road transport, 7.3 million of logistics areas in railway terminals, 222,263 m<sup>2</sup> of airport cargo areas and 91.8 million m<sup>2</sup> in State ports. One of the linear logistics districts that has grown the most is the Corredor del Henares, located to the east of the Region of Madrid and border area with the province of Guadalajara.

The logistics deployment of Amazon in the eastern municipalities of the metropolitan area of Madrid (Coslada, San Fernando, Torrejón de Ardoz, Alcalá de Henares) has led to the overspilling to rural municipalities such as Meco, Azuqueca de Henares, Alovera, Cabanillas del Campo or Chiloeches. The economic activities of these villages has transformed with the construction of large distribution centres and warehouses, taking advantage of the strategic

space close to the city of Madrid and important transport infrastructures, such as the A2, the dry ports of Axuqueca and Coslada and the Adolfo Suárez-Barajas airport. These logistics centres constitute key nodes in the supply chain of companies such as Amazon, Inditex, Carrefour or Alcampo, facilitating the receipt of goods from the ports of Barcelona and Valencia, their storage, classification and shipment to the whole of the national and European territory. Auxiliary transport companies are proliferating in the surrounding area. A similar logistics development is occurring on the border of the province of Toledo and Madrid, where Amazon installed a large robotic logistics platform in Illescas in 2021.

This logistics development has attracted investment, generated employment, contributed to the transformation of the landscape, increased the traffic and congestion on the local roads and increased the demand for public services and housing in the surrounding areas. Although this development can drive economic growth and rural territorial growth, it is essential that we address the environmental, social and territorial impacts to guarantee a sustainable and balanced development in the area and promote the harmonious coexistence between logistics activities and the rest of the economic activities.

## 5. COMBINED ECONOMIC DIVERSIFICATION IN RURAL SPACES

### FROM WINE TOURISM AND OLIVE OIL TOURISM TO FLOWERING TOURISM AND THE MUSEUMALISATION OF RURAL HERITAGE

The relationship between the so-called Local Production Systems (LPS) with a long historical tradition in rural spaces and tourism is based on identifying the cultural heritage associated with the recreational and informational activity referring to the high-quality products elaborated and their production process throughout history. The LPS (agro-industrial), tourism and cultural heritage triomial is reflected in the agricultural and industrial museums, which are also the starting or finishing point of tourist and agro-industrial trade routes in the territories in which the specialised economic activity is carried out. In parallel, within the current framework of the smart and sustainable territories, tourism visibility through digitalisation related to the museums, routes and commercial activity of the companies forming part of the LPS constitutes an interesting perspective of analysis when searching for territorial development strategies. The relationship between these components affects all of the interrelated economic sectors in the afore-mentioned trinomial, provided that a context of interinstitutional and inter-company systematic collaboration prevails. The analysis of these tourism, commercial and LPS-related components provides an innovative perspective in the scientific context, based on a growing number of case studies on agritourism and industrial tourism.

Therefore, the relationship between the LPS, smart, agri and industrial tourism, based on the museumalisation and enhancement of the territorial cultural heritage is consolidated as a new paradigm of pluri-activity, economic diversification and the smart development of territories in every sense, not only technological but also in terms of organisation and collaboration. It should be pointed out that some of the agritourism and industrial tourism initiatives analysed in the research matured during the first waves of the COVID-19 pandemic and were implemented during the first months after the lockdown and post-pandemic context, which seems to have benefited smart national tourism somewhat.

The most traditional studies on wine tourism or olive oil tourism have been updated with the new possibilities created by digital tourism. Furthermore, other new forms of rural tourism have also emerged related to agri-industrial museums (Mecha, 2024) or flowering tourism related to cherry blossom, almond blossom, lavender (Ramírez, Gago, Serrano, Babinger & Santander, 2023) or saffron (Martínez, Cañizares, Ruiz & Ramírez, 2023).

## CONCLUSIONS

Over the last five years, rural spaces in Spain have experienced a series of major events that have significantly affected their economies and the life of their inhabitants. These events have ranged from economic and geopolitical crises to natural and health phenomena and have had an impact on the economic dynamics of the Spanish rural areas.

One of the main events that has affected rural spaces in Spain is the global economic crisis caused by the COVID-19 pandemic. The restrictions on movement, the closure of establishments and the fall in tourism particularly affected the economic activities related to the tourism and hospitality sector in rural areas, which began to seek other alternatives based on new technologies. In parallel, the increase in environmental awareness and the transition towards a more sustainable economy have also influenced the rural spaces in Spain in recent years. The interest in organic farming, agritourism and renewable energies has generated new economic opportunities in rural territories, driving the necessary diversification of the economic activity and the creation of employment in new sectors, such as biorecycling and the generation of clean energy.

On the other hand, the changes in agricultural and rural development policies, both on a national and European level, have had an impact on Spanish rural spaces. The reform of the Common Agricultural Policy (CAP) and the distribution of agricultural funds have been topics of debate and controversy in the Spanish rural environment, as they have raised concerns about the economic feasibility of farms and the continuance of the agricultural activity in some rural areas. Finally, extreme climate events, such as long droughts, the many forest fires and floods in certain regions have also negatively affected the Spanish rural economy over the last five years, generating significant economic and social costs for the rural communities. The vindications of protesting farmers at the beginning of 2024 are a good example of this.

In short, the major events occurring over the last five years have had a profound effect on the economy and the development of the rural spaces in Spain. Although some events have posed challenges and difficulties, opportunities have also emerged for innovation, economic diversification and sustainability in rural areas, which underlines the importance of forming rural societies able to adapt to change and promote a balanced, sustainable and resilient development in the rural environment. The new technologies can evidently constitute a support, but without a real territorial development project based on governance on different geographical scales of action, the policies will not be effective. The identification of global, regional and local problems and the search for innovative, sustainable and fair solutions should be the path to follow in the short, medium and long term.

The 22<sup>nd</sup> National Colloquium - 5<sup>th</sup> International Colloquium of Rural Geography in October 2024 will on the long term and the search for solutions for rural territories under the slogan "Contributions of (rural) geography to the "long-term view" of rural areas". Its main themes are related to the different fields of intervention that will guide the policies and plans of the European Union until 2040. In the coming years, from the academic world, we will have to work on establishing rural areas and communities that are (i) stronger (ii) more connected (iii) more resilient and (iv) more prosperous, by supporting the Rural Action Plan of the EU and the Rural Pact through the transfer of research. The research will most probably revolve around the five topics of interest analysed in this chapter.

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# The urban network and spatial interaction in the Spanish Region of Murcia

## A SPACE MOVING TOWARDS TERRITORIAL IMBALANCE?

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### ABSTRACT

Cities are not detached in national territories but are related to each other through exchange activities. The relationships that are created between them means that cities acquire complementarity and differentiation of functions, generating a set of hierarchical centres that comprise an urban network.

This paper will show how, from the theoretical basis of the rank-size rule, central places and areas of influence in the urban spaces of the Spanish Region of Murcia have undergone significant transformations and changes, which far from structuring the space have further unbalanced it. In fact, the regional capital's dominance in functional endowment and population weight has generated an urban macrocephaly that will be very difficult to correct in the coming decades. This situation leads us to propose actions that seek both territorial balance and much-needed land planning.

### KEY WORDS

Rank-size; Murcia; Territory; Centrality; Functionality; Primacy.

### 1. INTRODUCTION

The network of cities in the Region of Murcia was studied closely in Professor Serrano's doctoral thesis and subsequent publications (1984, 2003, 2004, 2006 and 2007). These works characterised the Region's structure, functioning, dynamics, and interactions. Spatial interaction models were applied, in which the hierarchy and functioning of human settlements were established, using data on the exchange of goods, services and information, as well as the mobility of people. Four decades after Serrano's studies, we argue that this content needs updating to identify the most recent developments in a changing context replete with conundrums.

We define an urban network as 'a set of cities that relate to each other through flows of people, goods, services and information' (Godoy, 2003). These relationships can be cooperative or competitive (Gutiérrez and Roberto, 2023) and have different degrees of intensity and scope (Alfonso, 2018). Urban networks are formed by the complementarity

and specialisation of urban functions, as well as by accessibility and connectivity between cities (Del Pino, 2001) and the attraction of talent (Puebla, 2021). Some aspects that are often addressed in this framework are shown below (Table 1).

Criteria for classifying cities according to their size, function, influence, and level of service. For example, one can speak of global cities, metropolitan cities, regional cities, intermediate cities, etc.
Models and theories that describe the structure and dynamics of urban systems, i.e. the set of cities that interact with each other. For example, one can apply the theory of central places, the theory of development poles, the theory of urban life cycles, etc.
Internal and external factors that condition the growth, distribution, and hierarchy of cities. For example, one can consider history, geography, economics, politics, culture, technology, etc.
The effects and challenges posed by urban networks and the hierarchy of cities for sustainable development, social cohesion, governance, innovation, etc.

Table 1. Basic ideas for a theoretical framework of urban networks.  
Source: own elaboration.

Racionero (1981) defined the urban network as *the set of central elements or places with different typologies, according to their size and functions, which also have zones or areas of influence*; areas that are structured hierarchically (Zárate, 2012a) Sánchez (1989) added, drawing on the case of Extremadura, that the network hierarchy is determined according to the nature and structure of the services, assuming a factor of demographic and economic change which, in turn, transforms the tertiary as indicated by Arnáez, Díez and Muga (1985), in the case of La Rioja. The urban system constitutes a densely populated society integrated in a system of interdependent cities (Zárate, 2012b) acting as centres of production, distribution, and consumption, which organise the territory (Sánchez, Llorente, Rodero and Alonso, 2015) and create flows of people and goods (García and Segado, 2015).

To identify a network, it is necessary to place the main cities on a map and represent them by a symbol proportional to their place in the hierarchy (León and Ruiz, 2006). This place is primarily a function of population size (Neal, 2011), but other criteria can be chosen (production, administrative status, etc.). Links between cities correspond to the directions of the dominant exchanges, which are often the axes of communication and represent, in fact, relations of interdependence between two cities and the re-territorialisation of cities as studied in the case of Castile-La Mancha by Ondoño and Cebrián (2022), and other medium-sized cities such as Castellón de la Plana (Ortells, 1983).

The size of the agglomerations, the unequal importance of their area of influence and the variety of services offered by one or the other, means that there are cities that are dominated, and others that dominate the territory (González, 2007).

In the case of the Region of Murcia, the 45 municipalities that comprise the Region have a hierarchical arrangement that is due to functional endowment and specialisation, a reality that has changed in recent decades for various reasons, such as the role played by the development of the Statute of Autonomy and the socio-economic dynamics of the different municipalities. These changes have highlighted improvements in agricultural productivity, industrialisation, the increase in tourism and the inclusion of tertiary services as varied as health and education.

In 2023, 43% of the total population of the Autonomous Community of Murcia and its metropolitan area lived in the capital and its metropolitan area, which included most of the basic services, such as highly specialised hospital complexes, universities, state administration offices and the headquarters of the regional ministries of the Autonomous Community, without forgetting the large commercial areas or headquarters of the main sports facilities, as well as the essential communication hubs, such as the railway, international airport and motorways. Other important nuclei are Cartagena and Lorca, as they have created their own area of influence and regional relevance, positioning themselves as important spaces in socio-economic and population development, although they are losing strategic value in the face

of the progressive advance of Murcia as the city with most regional protagonism. Therefore, we can affirm that there is an urgent need for sustainable territorial balance, especially for the regions furthest from the regional capital, with a large surface area and demographic 'weakness', such as the Northwest (NW) with five municipalities (21.04% regional surface area and 4.7% of the population) and the Altiplano with two (13.92% regional surface area and 4.15% population); areas that continue to lose their appeal – to the regional capital's benefit. In some cases, regions such as the NW or the Ricote Valley are suffering significant depopulation, which has become alarming in municipalities such as Moratalla, Ojos, Ulea and Ricote (figure 2).



Figure 1. Location of the municipalities in the Region of Murcia (2023).  
Source: <https://www.pinterest.es/pin/555139091550246901/>



Figure 2. Boroughs of the Region of Murcia (2023).  
Source: [https://laquiaw.com/murcia\\_por\\_comarcas](https://laquiaw.com/murcia_por_comarcas)

## 2. METHODOLOGY

Our main sources of information to justify and explain the changes that have taken place in Murcia have been digital cartography provided through GIS (Geographic Information Systems) and statistical data from official bodies. Additionally, we have drawn on graphic documentation, among which we highlight: comparative charts, graphs, tables, and cartographic material; all with the idea of supporting the objectives of this work, which are to illustrate the urban hierarchy and degree of balance of the cities in this urban system (Pillet and Cañizares, 2007).

For the development of this research, we have used both traditional primary sources that give access to real and specific data, such as the Urban Cadastre and extensive cartography available to urban planning management, as well as other current tools based on the Region of Murcia's GIS (known as Cartomur and the Cadastre of the Ministry of Finance and Public Administration), as well as use of the IGN-Iberpix and Arcgisonline's GIS.

## 3. RESEARCH RESULTS

### 3.1. INDICES OF THE SPATIAL ORGANISATION OF CITIES

The first index employed is the rank-size rule, which is based on the inverse relationship between the order of the cities in the network and their demographic weight: the second city has half the population of the first, the third a third, the fourth a fourth and so on. The second index is the primacy index, which measures the dominance of the main city over other cities in the autonomous community.

### 3.1.1. Application of the rank-size rule

Having considered the rank-size relationship of Auerbach's urban nuclei system (1913), verified by Zipf (1949), the cities are represented cartographically by means of a Cartesian coordinate axis: the orders or positions that the cities occupy in their ranking by population volume are placed on the x-axis, and their respective demographic numbers on the y-axis.

To identify any significant evolution over time, we have established a time sequence over the last forty years (1982-2022). Through analysis of figures 3 and 4 presented below together with the data in tables 2 and 3, we find that three of the fifteen most populated municipalities in the Region of Murcia in 1982 have disappeared: specifically, Mula, La Unión and Cehegín, were replaced by: Mazarrón, S. Javier, and S. Pedro, with Mazarrón moving from 21st to 11th place in 1982, and San Javier from 17th to 10th place, while others fall in the rankings (Cieza moves from 5th to 8th place and Yecla from 6th to 9th place).

In relation to the interior in recent decades, the two fundamental causes being the importance of intensive agriculture and tourism. The former activity faces challenges such as water supply and an often poorly paid and overexploited immigrant workforce; while for the latter, seasonality represents the greatest challenge in ensuring the loyalty of this activity, which brings such wide-ranging benefits to the region as a whole.

City	Rank	Real and observed population (Op)	Expected population (Ep)	Difference between Op and Ep	Op x 100 /Ep
Murcia	1	284,585	284,585	0	1.0
Cartagena	2	167,936	142,292	25.644	1.18
Lorca	3	61,879	94,861	-32.982	0.65
Molina de Segura	4	31,515	71,146	-39.631	0.44
Cieza	5	30,327	56,917	-26.590	0.53
Yecla	6	25,307	47,430	-22.123	0.53
Alcantarilla	7	24,617	40,655	-16.038	0.60
Águilas	8	20,809	35,573	-14.764	0.58
Jumilla	9	20,663	31,620	-10.957	0.65
Caravaca	10	20,445	28,458	-8.013	0.71
Totana	11	18,537	25,871	-7.334	0.71
Torre Pacheco	12	15,654	23,715	-8.061	0.66
Mula	13	14,738	21,891	-7.153	0.67
La Unión	14	12,262	20,327	-8.065	0.60
Cehegín	15	13,648	18,972	-5.324	0.71

Table 2. Rank-Size Rule of the 15 main municipalities of the Region of Murcia (1982).  
Source: Own elaboration based on La Caixa yearbook.

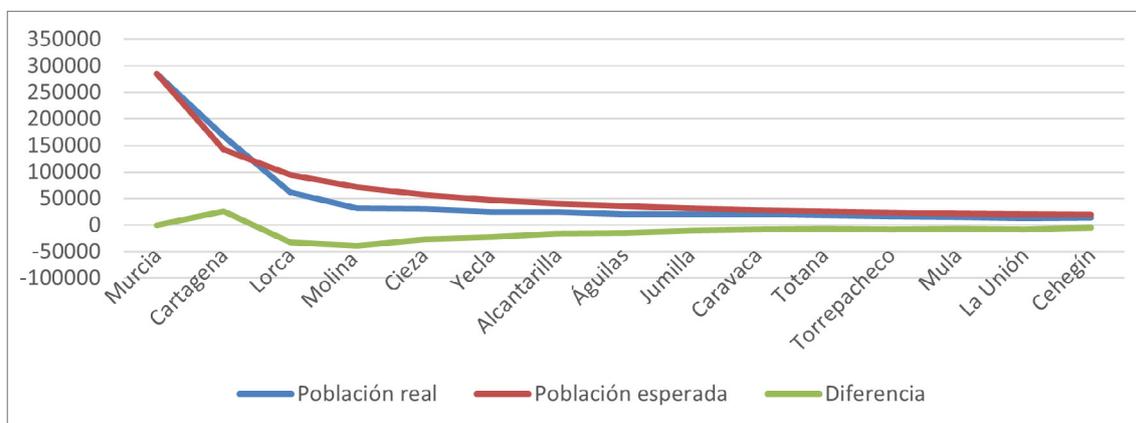


Figure 3. Rank-Size Rule of the 15 most populated municipalities in the Region of Murcia (1982).  
Source: Own elaboration based on La Caixa yearbook.

The first four – Murcia, Cartagena, Lorca and Molina de Segura - remain in the same positions, although with substantial changes: in 1982 Murcia was unable to double the population of Cartagena, while in 2023 it does. In fact, for Cartagena to reach half the population that lives in the municipality of Murcia it should have 230,349, while in reality it has 216,365. The same is true of the municipality of Lorca with respect to Murcia, as this population is far from the 1/3 that would correspond to it – it should have 153,449 inhabitants (i.e., the expected population), while it only registers 96,238.

The capital of Murcia has undergone spectacular development in many areas: urban, health, commercial, cultural, the university, and the consolidation of land transport infrastructures that have made it a communications hub and motorway junction, creating a centralism or star shape that even surpasses regional boundaries (Morales, 2015).

As seen in Table 3 and Figure 4, of the cities in the Region that occupy positions 2-14, none in 2022 was able to reach their expected population in relation to the regional capital, with Cartagena (0.93), Totana (0.84) and Caravaca de la Cruz (0.83) coming closest; while Alcantarilla (0.46), Torre Pacheco (0.48), and Águilas (0.54) were the furthest away. Torre Pacheco has risen from 12th place in 1982 to sixth place in 2023.

City	Rank	Real and observed population (Op)	Expected population (Ep)	Difference between Op and Ep	Op x 100 /Ep
Murcia	1	460,349	460,349	0	1.0
Cartagena	2	216,365	230,349	-13.984	0.93
Lorca	3	96,238	153,449	-57.211	0.62
Molina de Segura	4	73,498	115,087	-41.589	0.63
Alcantarilla	5	42,559	92,069	-49.510	0.46
Torre-Pacheco	6	37,299	76,724	-39.425	0.48
Águilas	7	35,956	65,764	-29.808	0.54
Cieza	8	35,301	57,543	-22.242	0.61
Yecla	9	35,083	51,149	-16.066	0.68
San Javier	10	33,645	46,034	-12.389	0.73
Mazarrón	11	32,988	41,849	-8.861	0.78
Totana	12	32,316	38,362	-6.046	0.84
San Pedro del Pinatar	13	26,320	35,411	-9.091	0.74
Jumilla	14	26,234	32,882	-6.648	0.79
Caravaca de la Cruz	15	25,611	30,689	-5.078	0.83

Table 3. Rank-Size Rule of the 15 most populated municipalities in the Region of Murcia (2022). Source: Own elaboration based on CREM.

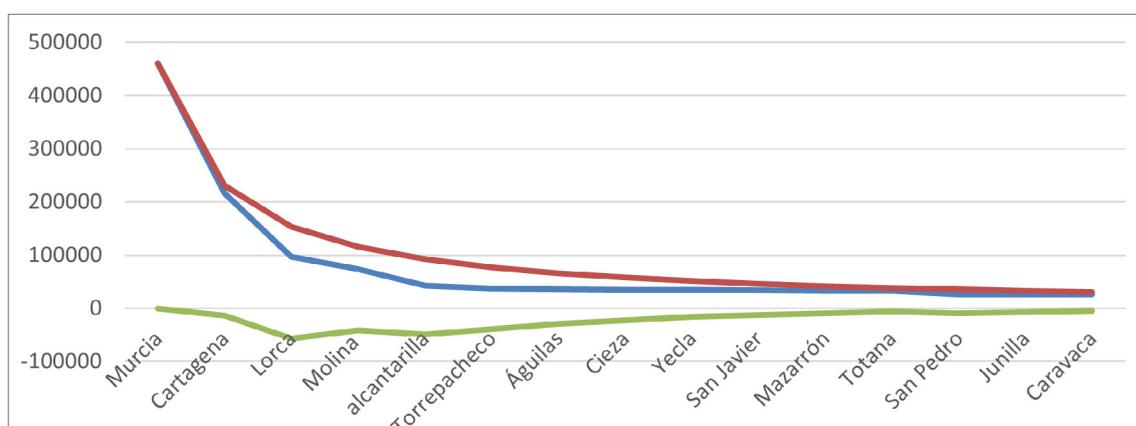


Figure 4. Rank-Size Rule of the 15 most populated municipalities in the Region of Murcia (2022). Source: Own elaboration based on the CREM yearbook.

### 3.1.2. Primacy in the network of cities

This is expressed through the quantitative relationship between the largest city in the urban system and the next three in the population hierarchy. It is formulated as follows:

$$I_p = \frac{P_1}{\sum_{i=1}^4 P_i} \times 100$$

This index provides percentage magnitudes ranging from 25 to 100. High values show macrocephalic networks and low values indicate bicephalic or tri-cephalic networks, with a more regular hierarchical distribution of cities.

After the appropriate calculations between these four municipalities, which occupied the same position in 1982 and 2022, we obtain very significant data on the primacy and organisational form of the network of cities in the Murcian community. In 1982 the index reached 52.12, rising to 54.38 in 2022, which shows a balanced network of cities, with a tendency towards tricephaly in the so-called 'Murcian triangle' (Capel, 1968): Murcia-Cartagena-Lorca, having been influenced by both historical evolution and heritage. These cities have always played a fundamental role in the territorial balance due to their geographical location in a strategic place: Murcia, on the axis of the Segura-Guadalentín rivers and centre of the vegetable garden, Cartagena, with its strategic sea exit and port and significant mineral resources, and Lorca as a communications axis in the Guadalentín valley and therefore, control of the route between Andalusia and the Mediterranean arc. All constitute large territories with their own spaces, which, over time, have been gaining or losing influence based on the level of competitiveness and attraction of each.

## 3.2. ANALYSIS OF ECONOMIC SECTORS CONDITIONING THE ORGANISATION OF THE NETWORK OF CITIES

This analysis is carried out with the aim of grouping together various sectors that condition the network of cities' structure, according to their economic and social weight, generating greater or lesser attraction and competing for a position in the regional space.

### 3.2.1. An industry concentrated in a few municipalities

In overall terms, Murcia is a region with a moderate degree of industrialisation and some polarisation, as agriculture and tourism have been imposed in many municipalities that have not had access to industrialisation as a complementary source of work and wealth creation. In the analysis of the ten most industrialised municipalities, four are above average in terms of population, with Cartagena doubling this weight, representing 14.61% of the population and 35.08% of industry; followed by Yecla, which has gone from 2.26% of the population to 4.54% of industry; Lorca from 5.41% to 7.19%, and Molina de Segura from 3.52% to 4.8%. The regional capital maintains a 'tight balance' as it represents 30.08% population and 29.22% industry. The remaining municipalities, due in many cases to their agricultural-tourist nature, have values below the average.

Cartagena is the most industrialised centre in the region. The facilities in the Escombreras Valley, the Navantia shipyard and the Cabezo-Beaza and Los Camachos industrial estates are examples of the great potential of this port city, which maintains its industrial tradition. It has, however, undergone periods of serious radical industrial change in recent decades, particularly due to the great industrial crisis of the 1980s, when a large part of the chemical industries dedicated to nitrogenous fertilisers were dismantled, and the shipyards restructured. Molina de Segura, a traditional manufacturer of canned vegetables, has also

suffered serious setbacks due to a lack of competitiveness in national and foreign markets, although its municipal area has been used for installations from Murcia, which has given rise to industrial estates such as La Polvorista and Base 2000, where various industries and cargo warehouses have been installed to supply the regional capital and road trade (Transports El Mosca, etc.). Lorca has benefitted from significant public policies implemented in relation to industrial land. The creation of Saprelorca, for example, was implemented through SEPES (a state company), which has developed industrial land next to the national road from Lorca to Puerto Lumbreras-Andalucía. Finally, it is worth highlighting the industrial areas in Murcia and its metropolitan area, such as the West-San Ginés industrial estate between Murcia itself and Alcantarilla-Molina de Segura, where the flow of people and goods is very intense. Other 'isolated' industrial areas appear in Caravaca (footwear), Cieza and Jumilla (agro-industry), and Yecla (furniture and furnishings).

Table 4 shows quantitatively the different indices applicable to these municipalities, followed by a graph to make the data more visual.

Municipality	Total population, of the municipality	% over the Regional total	Comercial Index	% over the Regional total	Index of Industrial Activity	% over the Regional total
Murcia	460,349	30.06	1,153	40.25	772	29.22
Cartagena	216,365	14.13	512	17.87	927	35.08
Lorca	96,238	6.28	208	7.26	190	7.19
Molina de Segura	73,498	4.80	154	5.37	127	4.8
Alcantarilla	42,559	2.77	99	3.45	66	2.49
Torre Pacheco	37,299	2.43	36	1.25	17	0.64
Águilas	35,956	2.34	52	1.81	22	0.83
Cieza	35,301	2.30	54	1.88	16	0.60
Yecla	35,083	2.29	62	2.16	120	4.54
San Javier	33,365	2.17	48	1.67	25	0.94
Rest of the Autonomous Community	501,084	30.43	486	17.03	360	13.62
Total 10 munic.	1,003,057	69.57	2,378	83.03	2,282	86.37
<b>Total, Region</b>	<b>1,531,141</b>	<b>100.00</b>	<b>2,864</b>	<b>100.0</b>	<b>2,642</b>	<b>100.0</b>

Table 4. Commercial and Industrial Index of Murcia's 10 most populated municipalities (2022).  
Source: Own elaboration based on CREM.

### 3.2.2. Commercial spaces located in the most densely populated areas

The region's commercial activity represents a dynamic sector that has changed a lot in recent decades, as small businesses have been unable to compete with the opening of large shopping centres in cities' peripheral areas. We can see how the top five municipalities: Murcia, Cartagena, Lorca, Molina and Alcantarilla have a higher commercial index percentage in relation to their number of inhabitants: Murcia is the municipality with the highest index and difference between the population index (30.08%) and commercial index (40.25%), which is more than ten points. In the case of Cartagena, it is above three points (14.61%-population) and (17.87%-commercial); while in the cases of Lorca, Molina and Alcantarilla the difference is around one point: Lorca (6.31% - 7.26%), Molina (4.54% - 5.37%) and Alcantarilla (2.82% - 3.45%). The municipalities occupying levels six to ten, on the other

hand, all have a higher percentage of population than the corresponding commercial index, Mazarrón (2.41% - 1.45%), Cieza (2.4% - 1.81%), Águilas (2.38% - 1.88%), Yecla (2.36% - 2.16%) and Torre-Pacheco (2.25% - 1.67%).

Together the municipalities of Murcia and Cartagena practically occupy almost 60% of the commercial index of the whole region (40.25%+17.87% = 58.12%). In the Region of Murcia there are a total of 23 shopping centres, of which 10 are located in Murcia municipality and 6 in Cartagena, representing 69.56% of the total; which translated into metres of surface area represents 73.24% of the regional total, with the capital of Murcia standing out with 46.74% of the regional total. This indicates a degree of 'attractiveness' that covers the entire regional area and even extends to neighbouring provinces, predominantly to the municipalities of the Vega Baja, such as Orihuela, the south of the province of Albacete, such as Hellín, and the east of Almeria, such as the Sierra de María and Huerca-Overa. Lorca occupies third place and the coastal tourist municipalities of San Javier, Los Alcázares and Águilas a fourth commercial level; although the draw of Murcia and Cartagena for all is very high.

Municipality	Number of commercial centres	Surface area	% of the total surface area of the Region
Águilas	1	29,082	4.84
Alcázares (Los)	1	5,920	0.98
Cartagena	6	156,212	26.04
Lorca	2	80,363	13.37
Molina de Segura	2	23,485	3.90
Murcia	10	280,770	46.74
San Javier	1	24,813	4.13
<b>Total</b>	<b>23</b>	<b>600,645</b>	<b>100.00</b>

Tabla 5. Commercial centres in Murcia (2023).  
Source: Own elaboration.

### 3.2.3. A radial communications network around Murcia

In a globalised society, mobility means the opening of new business channels and the arrival of goods and services to a specific area. In the Region of Murcia, the greatest effort to increase and improve communications has been made in the road network and, from 2022 onwards, the arrival of the High-Speed Train to the city of Murcia. Air space has also improved with the opening of the international airport of Corvera in 2019, however, it is necessary to bear in mind that the nearby airport of El Altet-Elche, given its proximity and range of options, has been a reference point for all Murcians when they have had to make international flights, since its offer is broader and more competitive than the airport of Corvera. Maritime passenger traffic is irrelevant due to the proximity of the ports of Alicante and Almeria, which have a long tradition of passenger traffic. Cartagena is more dedicated to industrial activities and, in recent years, to the arrival of cruise ships that often call at the city, bringing it significant benefits.

The road network has a radial configuration, the central axis of which is the city of Murcia, where the Mediterranean axis of the A-7, which runs from the French border to Algeciras, and the A-30, which runs from Madrid to Cartagena, converge. Other motorways built in the last two decades, which have a more secondary character, are the RM-15 from Murcia to Caravaca, which has dynamised the northwest of Murcia in relation to the regional capital, including the cities of Cehegín, Bullas and Mula, the RM-11 from Lorca to Águilas, and the RM-3 from Totana and Alhama to Mazarrón, both opening up the Guadalentín corridor to the coast of Murcia. The AP-7 motorway along the Murcian coast towards Almería has been a major investment that has been very difficult to make profitable due to a lack of traffic. In 2024, the section of the A-33 from the M-30 at Puerto de La Losilla to Fuente la Higuera (Valencia Province), linking up with the motorway from Albacete-Valencia, came into operation. This inland axis has provided great relief to the heavily transited Murcia-Valencia motorway via Elche-Monforte del Cid.

From the point of view of greater territorial structuring, the dual carriageway from San Javier-Yecla (RM-1) and the Northwest axis from Andalusia-Caravaca-Calasparra-Jumilla and Yecla (RM-730) are yet to be completed. This dual carriageway would generate a more reticular network, since Murcia is a central location and the backbone of most of the regional road traffic, a circumstance which generates regular traffic jams on the Murcia ring road.



Figure 5. The Autonomous Community of Murcia's motorway network. Source: [www.murciaturistica.es](http://www.murciaturistica.es)

### 3.2.4. Health care in proportion to population weight

Healthcare is a basic need for citizens' welfare. The Region, based on the order of 24 April 2009 of the Regional Ministry of Health and Consumer Affairs, established a healthcare organisation of public hospitals based on nine areas, although three of them are part of Murcia capital and its metropolitan area with three reference hospitals (Figure 6).

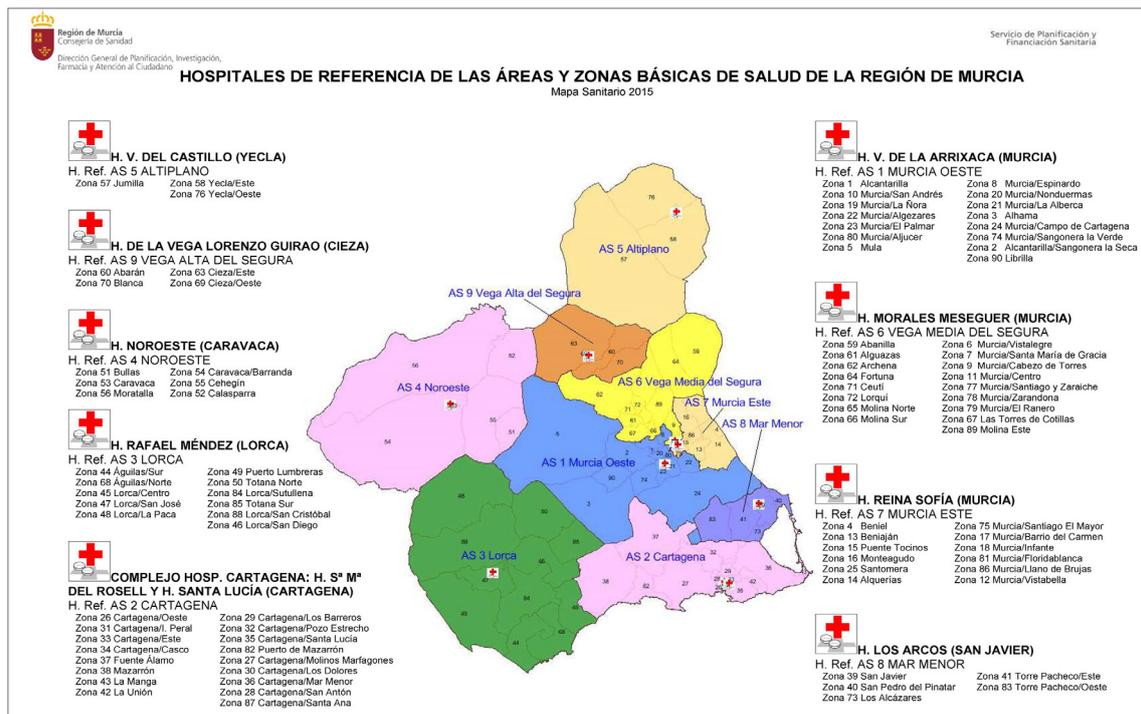


Figure 6. Health areas and reference hospitals in the Murcia Region. Source: Murcia Health Service (2023).

There are large differences between the surface areas that these areas occupy territorially and the number of inhabitants that live in them. 53.1% of the inhabitants of the region live among the three areas of Murcia, where we find 49.9% of the total number of beds available in the Region, which indicates 431 inhabitants per bed. In terms of the number of beds available, the area of Cartagena stands out with 300 beds/per capita, while Yecla with 638 and Lorca with 624 are the areas with the greatest deficit, the regional average being 458 beds/per capita. Table 6 highlights the most important data.

Name of area	Inhabitants	Number of hospitals	Number of beds	Number of inhabitants/beds
Murcia Oeste, Este and Vega Media	813,074	3	1,665	431
Cartagena	237,114	2	788	300
Lorca	180,570	1	289	624
San Javier	114,199	1	255	447
Caravaca	69,938	1	113	618
Yecla	61,317	1	96	638
Cieza	54,936	1	124	443
Total	1,531,148	10	3,330	459

Table 6. Distribution of hospital beds per inhabitant ratio by health area.  
Source: Murcia Health Service (2023) and own elaboration.

In relation to the private hospital supply, there are 751 beds across seven hospitals, one in Cartagena with 214 beds and the other six in Murcia: four in the capital and two in the metropolitan area - one in Alcantarilla and the other in Molina de Segura. There is a clear absence of private hospitals in most of the Region, only the area of Murcia, and to a lesser extent Cartagena, have these types of establishments, which also provide public services through agreements with the Regional Ministry of Health. There are seven geriatric hospitals, all privately owned, with a total of 628 places; it is striking that none of them are located in Murcia, not even in its metropolitan area (table 7).

City	Number of beds	Care purpose
Alcantarilla	139	Medical-surgical
Cartagena (2 centres)	234	Medical-surgical
Molina de Segura	83	Medical-surgical
Murcia (3 centres)	349	Medical-surgical
Lorca	175	Geriatrics
Caravaca de la Cruz	39	Geriatrics
Cartagena (2 centres)	247	Geriatrics
Cehegín	28	Geriatrics
Cieza	40	Geriatrics
San Pedro del Pinatar	99	Geriatrics

Table 7. Distribution of the private supply of hospital beds in surgical and geriatric centres.  
Source: Murcia Health Service (2023) and own elaboration.

Finally, there is a scarce supply of psychiatric centres: three for the entire Region of Murcia. In total there are 206 places, all in Murcia: one of which is public, with 94 places, and the other two private, with 50 and 62 places. This clearly shows the primacy of Murcia over the rest of the Autonomous Region of Murcia.

### 3.2.5. Concentration of higher education in Murcia

There are three universities that form part of the university district of the Region, two of which are public (University of Murcia and Polytechnic University of Cartagena) and one private (Catholic University Sant Anthony). The University of Murcia offers the widest range of bachelor's and master's degrees. Most of its facilities are located in the municipality of Murcia; although it also has branches in Lorca, Cartagena and San Javier. The Catholic University Sant Anthony is located in the Murcian district of La Ñora and has a branch in Cartagena. Finally, the Polytechnic University of Cartagena is in the city itself, on two nearby campuses: La Muralla and Alfonso XIII. The centrality of Murcia is once again evident, as it is home to more than 81% of university students between the two universities: Cartagena has around 17%, and Lorca and San Javier around 1% of students. Murcia is the university capital of the Region largely because of its international projection, due to the arrival of students from European Erasmus and Mundus programmes.

### 3.2.6. Proportionality of the cultural offer

Theatres and museums are spaces of great cultural attraction, which attract thousands each year to enjoy their various programmes. The Region of Murcia is home to 27 publicly owned theatres, with seven in the municipality of Murcia, which represents an attraction that goes beyond the municipal limits. This is a differentiating element, since in the other cities the audience comes from the local area. Additionally, there is a network of 49 public museums: Murcia (with thirteen) and Cartagena (with seven) have the greatest offer and attract international tourism; in the other cities there are notable museums, but their draw is more limited.

City	Theatres	Museums
Abarán	1	1
Águilas	1	1
Aledo	1	
Alcantarilla	1	2
Alhama de Murcia		1
Archena		1
Blanca	1	1
Bullas	1	1
Calasparra		1
Caravaca	1	3
Cartagena	2	7
Cehegín		1
Cieza	1	1
Jumilla	1	2

City	Theatres	Museums
Lorca	1	3
Lorquí	1	
Mazarrón		1
Molina	2	1
Mula	1	2
Murcia	7	13
Puerto Lumbreras		1
San Pedro Pinatar		1
San Javier	1	
Santomera	1	
Torre Pacheco	1	
La Unión		1
Yecla	1	3
Total	27	49

Table 8. List of theatres and museums forming the public network in the Region of Murcia (2023).  
Source: Autonomous Community and own elaboration.

## 3.3. THE CENTRALITY OF MURCIA IN THE CURRENT MODEL OF SPATIAL RELATIONS

To elaborate on the urban centrality of Murcia we have taken into account certain indices, such as the Calculation of the Centre of Gravity (Rn) by Carrera (1988) and other classical theories, such as the work of Reilly (1931), which relates the area of influence of the city to the gravitational field, stating that: *“The flow of people, goods, ideas and information between cities is directly proportional to the product of their population and inversely*

*proportional to the distance between them*". We have also applied Converse's method (1949) which, based on a modification of Reilly, allows us to identify the territorial 'break point' that marks the theoretical limit of cities' areas of influence; enabling us to carry out a cartography that we present in the figure and which in our opinion is significant. We highlight that the commercial space of Murcia, as a capital city, encompasses the whole of the region and greatly restricts the influence of the two other large commercial areas: Cartagena and Lorca. The good infrastructure, proximity and large offer make Murcia a significant commercial area that leaves very little margin to the other centres, which are barely circumscribed to its municipal district and in part to the bordering municipalities.

Applying these indices and the municipalities' geographical position, we could establish the location of the three main commercial areas (Murcia, Cartagena and Lorca), with a nuance in the case of Murcia - the capital - which could be configured in three areas, or 'crowns'. The table below summarises these results.

Municipality	Crown	Number	Name of the municipalities
Murcia	Crown 1	9	Albudeite, Alcantarilla, Alguazas, Campos del Río, Ceutí, Las Torres de Cotillas, Lorquí, Murcia, Molina del Segura
	Crown 2	28	Abarán, Abanilla, Aledo, Alhama, Archena, Beniel, Blanca, Bullas, Campos del Río, Cartagena, Cieza, Fortuna, Fuente, Álamo La Unión, Librilla, Lorca, Los Alcázares, Mazarrón, Mula, Ojós, Pliego, Ricote. Santomera, San Javier, San Pedro del Pinatar, Torre Pacheco, Totana, Ulea, Villanueva del Segura.
	Crown 3	8	Águilas, Calasparra, Caravaca de la Cruz, Cehegín, Jumilla, Moratalla, Puerto Lumbreras, Yecla
Cartagena		8	Cartagena, Fuente Álamo, La Unión, Los Alcázares, Mazarrón, San Javier, San, Pedro del Pinatar, Torre Pacheco
Lorca		5	Águilas, Aledo, Lorca, Puerto Lumbreras, Totana

Table 9. Relationship of areas of influence through 'proximity crowns'.  
Source: Own elaboration.

Murcia's primacy over the other cities in the Autonomous Community of Murcia's urban network indicates an area of influence that occupies the entire regional territory and even surpasses it, attracting other localities in neighbouring Autonomous Communities, such as municipalities in the south of Albacete (Hellín and Tobarra), Vega Baja del Segura in the province of Alicante (Orihuela, Crevillente, Albaterra, Cox, Catral and Callosa de Segura) and municipalities in the east of Almería (Vélez-Rubio, Almanzora and Huércal-Overa).



Figure 7 shows Murcia's area of influence and the secondary sub-areas of Cartagena (Fuente Álamo, La Unión, Los Alcázares, San Pedro del Pinatar, San Javier and Torre Pacheco) and Lorca (Puerto Lumbreras, Aledo, Totana and Águilas).

Figure 7. Determination of areas of commercial influence by crowns.  
Source: own elaboration.

## 4. CONCLUSIONS

The Autonomous Region of Murcia is an urban region with characteristics that individualise it and generate a singular morphology. We have shown that its evolution over the last forty years, as indicated by various indicators, shows a preponderance of the regional capital over the rest of the territory, due to its outstanding position in economic activity and demographic weight. As Sassen (2007) points out, in a globalised economy, Murcia has an intense development of communications and access to facilities and services.

Murcia –the capital– is configured within the regional space as a reference in terms of commercial, health, administrative, cultural and university facilities, receiving the greatest flows and mobility of the region's inhabitants, and it is also the headquarters of all the departments of the regional government of Murcia, which has resulted in a civil service city with a variety of facilities. Its area of influence exceeds the regional boundaries, encompassing other areas of the Vega Baja del Segura in the province of Alicante, east of Almeria and south of Albacete.

Cartagena, as the second regional city, has an extensive industrial complex and has created its own sub-area of commercial, health and university influence. It is well communicated by motorway with the regional capital, which is some 50km away. The Murcia-Cartagena axis constitutes the economic and service and population engine (44%) of the whole region, forming a leading crown, around which the rest of the Murcia region revolves.

The triangle formed by the cities of Murcia-Cartagena-Lorca has continued to bring together the majority of regional activities and a large proportion of the population in the region as a whole (50%), although the former two cities have a significant weight in most services generated in the Autonomous Community. For all these reasons, it would be necessary, although complicated, for the more peripheral areas to gain greater specific weight despite the growing trend of losing it, as is happening with negative growth in the municipalities of the Northwest and Ricote Valley. For all these reasons, it is necessary to review the improvement of the internal communication axes, as well as the demographic recovery, which is increasingly unbalanced in favour of the large metropolitan areas of Murcia and Cartagena, which have generated the most job opportunities. Proof of this has been that the majority of immigrants arriving in the Region have settled in metropolitan Murcia, due to the proliferation of tertiary services, and in Cartagena (and its area of influence), where municipalities such as Torre Pacheco, San Javier or Cartagena itself have offered increasing employment in agricultural work and the hotel and catering trade.

Regarding communications, the regions of Valle del Guadalentín, Vega media del Segura and Cartagena are much denser and more efficient than the inland areas, which adds to the imbalance between the historically more depressed inland municipalities and those mentioned above, making it difficult to achieve a harmonious development of the entire regional area.

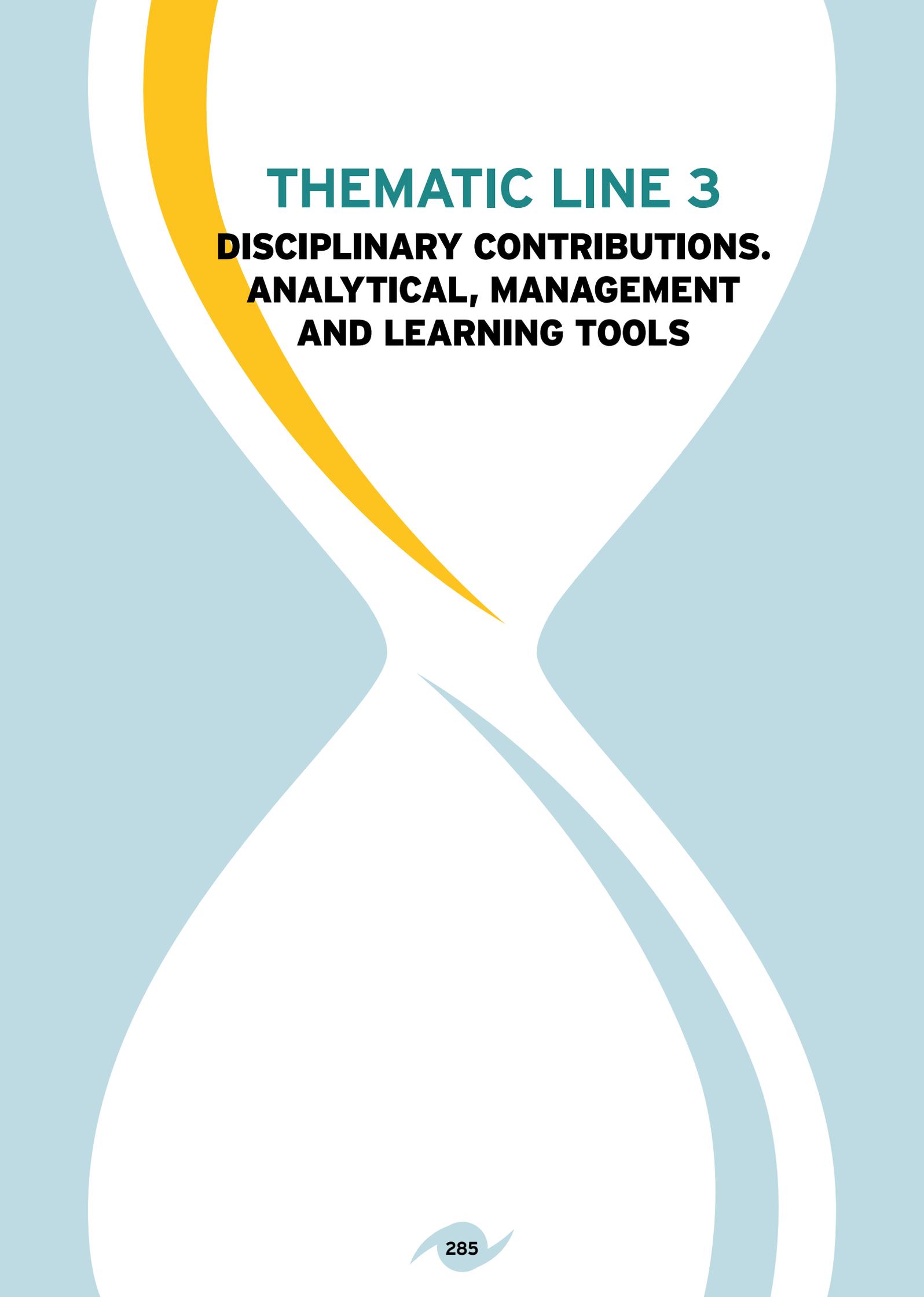
The regional identity and the socio-economic advances experienced over the last four decades have shaped a very dynamic space, and in fact the opportunities and strengths have counteracted endemic weaknesses, although we must not forget the threats could slow progress and even initiate a harmful regressive path for this geographic space. Specifically, these threats include, for example, Murcian products' lack of competitiveness in the face of globalisation and the European Union's agricultural agreements with third countries, such as those with North Africa, the partial or definitive closure of external water reserves, and the uncertainty surrounding the Tagus-Segura water transfer. On the other hand, the High-Speed Railway to Cartagena and Lorca, with continuity towards Andalusia, and the construction of the trans-European freight corridor are pending, as well as greater promotion of agro-industrial products and tourism as key elements in a region that forms part of the 'Mediterranean arc', and whose development expectations are high.

After forty years of autonomy, the Region of Murcia has improved its indices of economic and social well-being. The municipalities of Murcia and Cartagena have played the most important role, and in the future this trend will continue, which will have to be considered when applying territorial planning policies and spatial rebalancing. This approach should help create an area with equitable growth among its different regions, and boost citizen solidarity.

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**THEMATIC LINE 3**  
**DISCIPLINARY CONTRIBUTIONS.**  
**ANALYTICAL, MANAGEMENT**  
**AND LEARNING TOOLS**

# The scientific and social responsibility of geography for eco-social sustainability

## THE ROLE OF EDUCATION

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## ABSTRACT

There is a close epistemological relationship between advances in geographical knowledge and sustainability, which includes theoretical and methodological aspects. This leads to an ethical relationship that gives geography a scientific and social responsibility to ensure eco-social sustainability, as well as an opportunity, by providing current geography with its own contemporary discourse and adapting it to social needs. For the latter, education for sustainable development (ESD) is an essential tool. This contribution reflects on this epistemological relationship and the relevance of geographic education while presenting an analysis of trends in Spain. To this end, the contributions to the biennial congresses organized by the Spanish Geography Association (AGE) and the Geography Didactics Group over the last ten years are analyzed. These reflect that the Spanish geographic community shows a growing concern for education in sustainable development and sustainability.

## KEYWORDS

Global change, SDGs, Agenda 2030, Geographical education, Spain.

## 1. INTRODUCTION

The current moment is strongly characterized by human action, which has a series of effects that have been considered under the term “global change.” This mode of occupation is associated with devastating and unequal exploitation that leads to continuous degradation of natural resources, with significant eco-social impacts worldwide (Kerr *et al.*, 2007; Steffen *et al.*, 2011, among others).

The main international organizations have expressed their concern and interest in this situation by designing measures based on the principles of sustainability (Stoll-Kleemann and O'Riordan, 2017). The most well-known are those developed by the United Nations (UN), whose members established the "Millennium Development Goals" for the period 2000–2015 and, in 2017, the "Sustainable Development Goals (SDGs)" with a target year of 2030. These latter goals describe the main challenges facing development and seek to ensure "a sustainable, peaceful, prosperous, and just life on Earth for all, now and in the future" (United Nations, 2017), establishing environmental limits and thresholds for the use of natural resources. To achieve these goals, governments, businesses, and civil society must be involved at any scale, although some warn that the SDGs may have been designed without considering local realities (Brandner and Cummings, 2017).

Meanwhile, numerous academics from various disciplines have addressed in their research the effects of global change, especially regarding the impacts of climate change and mitigation and adaptation actions and recommendations. Other authors go further and reflect on a model called "degrowth," which advocates aspects based on sustainability and social well-being (Holmberg and Sandbrook, 2019; Fletcher *et al.*, 2019; Hummels and Argyrou, 2021).

All these initiatives demonstrate the need to ensure sustainability is understood in eco-social terms and underscore the urgency of implementing measures that should not be limited to the scientific and administrative spheres but should be conveyed and embraced responsibly by the citizenry. To this end, UNESCO, as the organization responsible for education on the UN's goals, has designed strategies to implement the SDGs in education (Murga-Menoyo, 2015). These should be considered without falling into the risk of being included as a result of a trend imposed by international organizations or as a fad, while assuming and transmitting, critically, the principles addressed (Alonso-Sainz, 2021).

In this context, geography emerges as a fundamental discipline, as it enables a holistic understanding of global challenges by integrating environmental and human aspects while providing knowledge and skills to address future challenges (Meadows, 2020; Lin *et al.*, 2022). Thus, current geographical education presents a significant opportunity for sustainability education at all academic levels, although particular emphasis may be placed on the university level. Here, the training of specialists should not be limited to the identification and analysis of problems, theoretically and in isolation, but also to the search for and application of solutions for a citizenship that transcends territorial conceptions through a "glocal" dynamic (Sklad *et al.*, 2016). Globally, the literature on geographic education for sustainable development (GESD) already shows a certain trajectory. However, in the case of higher education in geography in Spain, there has been a systemic lack of sustainability education, although, as noted by Martínez-Hernández and Mínguez, 2023, experiences are being developed thanks to the individual and voluntary efforts of numerous professionals who incorporate sustainability aspects into their teaching and research how to proceed didactically to achieve adequate and rigorous learning.

## 2. APPROACH, OBJECTIVES, AND METHODS

The previous considerations highlight the existence of a close epistemological relationship between advancing geographical knowledge and achieving sustainability. This relationship includes, on the one hand, theoretical aspects, since the basic object of study in geography is the eco-social relationship of the territory, which constitutes an integral system with interconnected elements and processes at multiple and inter-scalar levels (from local to global, considering the "glocal" aspect). The behavior of territorial elements conditions different states of equilibrium or sustainability. On the other hand, the geography-sustainability relationship also includes methodological aspects, as geographical tools for territorial information, such as Geographic Information Technologies (GIT), and the methods requiring

their use allow for achieving very complex and precise spatial analysis results, thereby optimizing the diagnosis, prediction, and management of the eco-social balance of the territory and conditioning its degree of sustainability.

We start with the hypothesis that this observable epistemological relationship between geography and sustainability leads to the formation of an ethical relationship. If geography provides the knowledge and means to ensure sustainability, and assuming that this is unavoidable in an anthropogenic context of global change, it is a moral duty that geographical action always consists of a sustainability approach. Thus, geographical action materializes in scientific research in the academic field (generation of eco-social knowledge), in technical advice and social transfer in the institutional and activist political sphere (generation of viable eco-social management alternatives), and in social transfer in the educational sphere (training in knowledge, methods, and duties of sustainable management of the eco-social reality of the territory).

In summary, it is argued that the epistemological relationship between geography and sustainability leads to an ethical relationship that confers scientific, and social responsibility on geography to ensure a sustainable eco-social system. Within this responsibility, geographical education is essential as a tool to transcend the scientific world and achieve genuine social transfer. In relation to the above, in this work, we set the following primary objectives:

1. To confirm the epistemological relationship between geography and sustainability at a conceptual and methodological level.
2. To justify the importance of geographical education in the ethical responsibility of the discipline to achieve social transfer with a sustainability focus.
3. To understand the trends in Spain regarding geographical education for sustainability.

The first objective will require a qualitative literature review methodology. The second and third objectives will combine qualitative review with a more quantitative approach, as there will be a non-exhaustive compilation of educational initiatives developed in Spain, focusing on higher education, where the first and most direct contact between the scientific and social worlds occurs. In this regard, trends in research will be analyzed through contributions published in the proceedings of the five most recent congresses of the Spanish Geography Association (AGE) (2015-2023)<sup>1</sup> and the five most recent congresses organized by the AGE Didactics Group (2014-2023)<sup>2</sup>. Contributions containing the following terms in the title or among their keywords will be considered: "sustainability," "education for sustainable development" (ESD), "Agenda 2030," "Agenda 21," and "Sustainable Development Goals" (SDGs).

### 3. EPISTEMOLOGICAL AND ETHICAL RELATIONSHIPS BETWEEN GEOGRAPHY AND SUSTAINABILITY

Some authors define geography as the science or discipline of sustainability (Aleniene and Pereira, 2021; Lin *et al.*, 2022; Olcina Cantos, 2022). This is due to several reasons. The first reason is the holistic approach it offers (Pitman, 2005; Meadows, 2020); the second is its synthesis capacity (Demerit, 2009; Maude, 2022); and the third is its long tradition of studying and teaching the relationships between society and the environment (Maude, 2022; Mitchell, 2022). Precisely, these studies have allowed us to make sense of the challenges of sustainability (Bednarz 2006; Huckle 2002).

1 <https://www.age-geografia.es/site/publicaciones-no-periodicas/>

2 <https://didactica.age-geografia.es/publicaciones/>

To these three well-known and addressed reasons, it should be added that currently, the challenges facing geography as a discipline are multi-scalar and related to sustainability. Thus, sustainability is not only understood in environmental or climatic terms but also socially, linked to aspects of justice and inequality. This fact generates diverse and transdisciplinary discourses that are highly topical, highlighting the emergence of sustainability (Grindsted Nielsen, 2022).

Contemporary geography reinforces its traditional applied character and offers, compared to other disciplines, the advantage of a territorial approach and the capacity to incorporate spatial technologies, such as Geographic Information Systems, to enhance measurement and observation (Demerit, 2009). Thus, geography is oriented towards finding solutions (Bailly and Gibson, 2004) and is consolidated as an applied discipline. Precisely, this aspect brings geography closer to politics and decision-making (Griggs *et al.*, 2013; Sheppard, 2011), allowing for the establishment of action steps currently related to the SDGs, such as the 2030 Agenda. This is, so far, the only international tool available to administrations to advance sustainability criteria. The SDGs currently provide a framework for geography due to their strong relationship with social commitment and spatial impact (Patel *et al.*, 2017; Cañizares Ruiz *et al.*, 2020; Croese *et al.*, 2021), although they have been strongly criticized by some geographers for legitimizing neoliberal processes and policies (Liverman, 2018; Nightingale, 2018, among others).

Another characteristic of contemporary geography, in addition to its applicability, is that it is an adaptive discipline relevant to society and based on the knowledge of global-scale spatial phenomena, which must anticipate changes (Harden, 2012; Moss *et al.*, 2013). This anticipatory nature is fundamental and is essentially based on research, which provides knowledge that, besides being used in education, allows for scientific advancement and transfer to society. Research also proposes narratives adapted to current issues that are non-conformist and, sometimes, provide alternatives to hegemonic discourse. However, there seems to be a gap between research and teaching, as the knowledge acquired in research is not fully transferred to teaching, thus wasting this potential (Castree, 2015). Advances in research and generated knowledge should be included in teaching to ensure anticipation and, consequently, to equip future professionals by providing them with theoretical content and fostering certain skills, methodologies, and competencies (Meadows, 2020). This is one of the main challenges of geographical education, representing a significant opportunity cost for curricula (Harden, 2012).

## 4. THE ROLE OF GEOGRAPHICAL EDUCATION IN SUSTAINABILITY

The “Decade of Education for Sustainable Development 2005-2014” initiative, promoted by the United Nations Education for Sustainable Development, aims to empower citizens to address present and future challenges and leaders to make appropriate decisions for a viable world. Thus, UNESCO emphasizes the value of education as a driver of change to adapt to complexity and growing environmental challenges, along with the need to make adaptations in education without which a sustainable future cannot be achieved (Lin *et al.*, 2022), including non-formal education institutions, which can be well-prepared and provide significant complementary value (Reinke, 2014).

This UNESCO initiative provides a good reference framework for geographical education, recently updated with the SDGs (De Miguel González and Sebastián-López, 2022). The global research network “Future Earth,” whose goal is to increase the impact of scientific research on sustainable development, highlights the significant contributions made by geographers. However, some authors like Grindsted and Nielsen (2022) call for additional steps and even addressing the treatment of the SDGs in an interdisciplinary manner, due to the importance for curricula of associating diverse theoretical knowledge with sustainability competencies

defined by UNESCO in 2014, shaped by the following skills: i) Critical thinking; ii) Ethical and intellectual commitment; iii) Relational and holistic thinking; iv) Sense of community belonging; v) Argumentative skills; vi) Participatory skills; vii) Democratic commitment; and viii) Commitment to universal human rights (Murga-Menoyo, 2015).

Geographical competencies are in line with the skills that ensure good sustainability education (García Pérez, 2015). For example, critical, relational, and holistic thinking can be provided by the ability to work with different scales as well as the knowledge of the interconnected processes between nature and society. Another example is learning about territorial management, which can promote attitudes toward social intervention in line with participatory skills and democratic commitment and in defense of human rights. Key geographical concepts, integrative and contextualizing, can facilitate the understanding of complex realities and focus theoretical and procedural teaching from different disciplines or sub-disciplines towards sustainability. Some examples are "social space," "territory," "landscape," "glocality," etc.

The incorporation of sustainability-related aspects into curricula helps improve the quality of university studies (Collado *et al.*, 2022) and the image of degrees (Aleniene and Pereira, 2021). In 2016, the International Year of Global Understanding provided an opportunity for geographers to learn about other educational practices and reinforce the role of geography as "the science for sustainability" (Meadows, 2020). However, despite the efforts made by the UGI in its Lucerne Declaration (Haubrich *et al.*, 2007) and some reference authors in geographical education for sustainability (Pretorius, 2018, 2022), as well as the demand from students themselves (Grindsted Nielsen, 2022; Martínez-Hernández and Mínguez, 2023), there has been limited discussion about the role of geographical education in the competencies required under an ethical framework of sustainability and the unstable job market (Widener *et al.*, 2016).

This limitation starts in the configuration of current geography curricula (Grindsted, 2023), as sustainability is often seen as a complement rather than a core element (Lin *et al.*, 2022). According to the extensive study by Leal Filho *et al.* (2023), conducted in 40 different countries, there is no detectable pattern of institutional application in university education, and initiatives end up being mostly individual and covering a wide range of topics. Martínez-Hernández and Mínguez (2023) observed this same reality in the specific case of higher education in geography in Spain.

Even within geographical education itself, sustainability education is unevenly represented across areas of knowledge. Yli-Panula *et al.* (2020) indicate that 42% of sustainability teaching focuses on physical geography and is related to SDGs 12 (responsible consumption and production), 13 (climate action), 14 (life below water), and 15 (life on land). Cultural knowledge is predominantly related to SDGs 10 (reduced inequalities), 11 (sustainable cities and communities), 16 (peace, justice, and strong institutions), and 17 (partnerships for the goals), but is less mentioned (14%). Additionally, the connections between the SDGs are underexplored. A widespread global trend is the greater predominance of environmental content in sustainable geographical education compared to social content (Crespo *et al.*, 2023).

In a study by Martínez-Hernández and Mínguez (2023), focused on the Spanish case, it was discovered that students and teachers are aware of this situation and demand greater attention to the SDGs in social education, specifically in human geography, economic geography, and spatial planning. The need for a good geographical education to develop sustainability competencies is also considered in other university degrees in related fields, such as tourism (Mínguez *et al.*, 2021), due to the comprehensive territorial knowledge expected from geography. Geographical knowledge, as concluded by Mínguez *et al.* (2021), can help convey the ethical responsibility of pursuing the SDGs in territorial areas, at both academic and professional levels, by providing a holistic approach to eco-social learning and having analytical tools related to geotechnologies, with which to significantly visualize the relationships between natural and human elements in sustainable development.

Indeed, methodologically, geography can also play a crucial role in sustainability education, yet this avenue has not been systematically maximized in higher education either. Spatial representation allows for the visualization of the eco-social interrelationships of the planet. Currently, the cartographic technical level has reached such a high level that geotechnologies, like Geographic Information Systems (GIS), facilitate an interactive representation that can be accompanied by spatial analysis of present situations or possible scenarios according to different eco-social dynamics. Geotechnologies, therefore, can be great allies for geographical education in sustainability, but the epistemological barriers of traditional teaching must be overcome, which is often less receptive to the interdisciplinarity required in eco-social training. The work of Martínez-Hernández and Mínguez (2023) reveals that 34% of students and teachers in geography degrees demand a greater presence of procedural or methodological contents related to the SDGs, such as a greater emphasis on geotechnologies from the perspective of these objectives.

Sebastián López *et al.* (2023) demonstrate that geotechnologies (particularly GIS, digital atlases, remote sensing, geolocation-based mobile applications, etc.) has had a significant impact on innovative learning and educational benefits through new and effective teaching resources and methods such as problem-based learning or service-learning. They conduct an experience of collaborative digital mapping with future teachers in which they confirm the acquisition of skills specific to geodigital competence at an instrumental, cognitive-intellectual, socio-communicative, axiological, and emotional level.

Among geotechnologies, a tool that is frequently used in geographical education to promote a sustainability approach is “digital storytelling” through narrative maps (“story maps”), thanks to the potential of web GIS, which allows handling large amounts of data from various topics stored in the cloud (Buzo-Sánchez *et al.*, 2022). This technology enables sustainability issues to be visualized, empowering students to go beyond the theoretical knowledge of SDG indicators and achieve transformative action based on critical thinking (Lázaro-Torres *et al.*, 2023).

Paradoxically, the didactic strategy of using geotechnologies to facilitate the approach of sustainability to geographical education seems to be observed with greater aspiration in the higher education of primary and secondary school teachers, while higher education in geography remains more tied to traditional disciplinary separation dynamics (Martínez-Hernández and Mínguez, 2023). The transfer of geographical education in sustainability to teacher training is excellent news for the eco-social education of citizens, ensuring their ethical activism, but it remains a challenge not to neglect explicit sustainability training for geography professionals.

## 5. TRENDS IN SPAIN REGARDING GEOGRAPHICAL EDUCATION FOR SUSTAINABILITY

The geography degree, first as a bachelor's and then as a bachelor's degree, with different denominations, has considered, with varying intensity, aspects associated with sustainability. The regulatory change approved in 1990 led the geography bachelor's degree to have a structure based on the fundamental subjects of physical geography, human geography, and regional geography, as well as on instrumental techniques and the application of knowledge in the fields of spatial planning and natural resource management. This compartmentalized structure by areas reduces the holistic perception characteristic of geography, and the didactic interest runs the risk of being subordinated to the interest of faculty distribution and its difficult balance between areas (Martínez-Hernández and Mínguez, 2024). The subsequent adaptation of geography studies to the European Higher Education Area, following the model of the current Spanish 4+1 bachelor's degree, allowed for the maintenance of general education in geography and adaptation to the demands of the labor market (Tulla, 2010; De Miguel and De Lázaro, 2016; Gallego, 2023).

Since the approval of the White Paper on Geography and Spatial Planning (ANECA, 2004), the programs of different degrees, recognized under various denominations, have occasionally been modified, but they have not been adapted to the new framework of the main global challenges, which are largely of ecosocial nature and are becoming increasingly powerful, requiring a thematic, philosophical, and methodological adaptation of higher education (Castree, 2015a; Gallego, 2023). Within the context of global changes, a significant portion of job opportunities for geography students are related to the 2030 Agenda, and education is fundamental to achieving it. Geographers can establish networks with administration professionals by applying sustainability competencies to interdisciplinary spatial thinking, making them more competitive in the job market, which traditionally is difficult to access (De Cos and Reques, 2010), and providing them with an ethical framework adapted to the current territorial reality.

The success of geographers, therefore, hinges on education for sustainable development (ESD), which in the Spanish context is a relatively recent approach, with little more than fifteen years strictly speaking and somewhat more than thirty in a broader sense (Crespo *et al.*, 2021).

The educational curriculum of geography in primary and secondary education began to consider environmental awareness in the 1990s with the reform of the LOGSE (1991). However, the focus was too environmentalist, giving little prominence to human activity. The curricular development of the subsequent legislative reform (LOE, 2006) explicitly incorporated social responsibility in the transformation and deterioration of nature through education on landscape. But it was not until the latest educational law (LOMLOE, 2020) that the curricular development of geography introduced clear references to eco-social challenges and the need for sustainability education (Crespo *et al.*, 2023).

In university geography programs, there is no specific curricular development of sustainability, and ESD (Education for Sustainable Development) has appeared recently through general or cross-cutting competencies (Martínez-Hernández and Mínguez, 2023). Geographical training with a sustainability focus seems to be limited to particular initiatives, which are often disseminated at scientific events of the AGE (Spanish Geographers Association), whether general or educational in theme. In the last decade, five congresses of each type have been held. Below are the general congresses:

- XXIV Congress of the Spanish Geographers Association: *Spatial analysis and geographical representation: Innovation and application*, held in Saragossa in 2015. A total of 244 contributions were presented in communication and poster formats. Of these, only three include the concept of sustainability in the title or keywords, and none of the other selected words for analysis. Of the three communications, two were assigned to the "territorial planning and management" line, and the other was linked to the "economic activity and society" line. In two of the three cases, sustainability is understood in social terms, and in the third, it is related to environmental factors on an urban scale, specifically waste management. There are more texts that capture ideas associated with territorial and environmental sustainability, but the specified terms are not included in the title.
- XXV Congress of the Spanish Geographers Association: *Nature, territory, and city in a global world*, held in Madrid in 2017. It featured 283 contributions, including 9 presentations, 244 communications, and 30 posters. None of them consider the Sustainable Development Goals or the agendas or Education for Sustainable Development; however, there are seven communications that consider sustainability as the main theme. On this occasion, the three communications and the poster included in Line 1 "Nature and Global Change" associate sustainability with environmental and landscape aspects, derived from economic exploitation of space or climate change, in environments of special fragility. The two communications included in Line 2 "Sustainable, smart, and inclusive cities" address urban aspects and understand sustainability in social and economic terms, relating it to equity and resilience. Additionally, there is another poster related to Line 3, "Territory and organizational factors and geographic dimensions," that analyzes the social perception of national parks.

- XXVI Congress of the Spanish Geographers Association: *Crisis and Spaces of Opportunity Challenges for geography* were held in Valencia in 2019. 130 contributions were received, of which 95 were in communication format and 35 in poster format. Sustainability was considered in the congress's own design, defining an axis on "global change and sustainability" composed of three lines: 1 Natural environment and the Anthropocene: Physical alterations, social repercussions, and territorial restorations; 2 Climate change: Resources and risks; and 3 The challenges of water, receiving two communications related to this block. In them, environmental sustainability is addressed, related to food sovereignty and water supply. Additionally, another communication is identified, already belonging to the axis of the "productive model," in which sustainability is understood globally (environmental, social, economic, and political) and is associated with tourism. In general, sustainability is more present in all communications than in previous editions, but no contribution includes the rest of the selected words for analysis, although one of them references Agenda 2030, linked to a case study of rural areas.
- XXVII Congress of the Spanish Geographers Association: *Geography, Global Change, and Sustainability*, which took place in La Laguna in 2021. It featured 178 contributions. As in previous congresses, some communications make specific reference to Agenda 2030 and the SDGs without including them in the titles or keywords; however, none of them deal with the teaching of sustainable education. Social, economic, and environmental sustainability, along with governance, is one of the pillars of territorial development and therefore one of the fundamental themes of the Congress, as reflected in its name and in some of the axes, such as "Territorial Development, Sustainability, and Quality of Life." Three communications have been counted containing the word sustainability in the title, understanding it in an integral key, that is, as a result of combining social and environmental aspects while associating it with governance models.
- XXVIII Congress of the Spanish Geographers Association: *Geography, change, challenges, and adaptation*, held in La Rioja in 2023, received 178 contributions. For the first time, the concept of "education for sustainability" appears as an essential educational tool in raising awareness and training students. In one of the two communications, it is related to sustainable consumption, and in the other, it is linked to the utility of GIS (Geographic Information Systems) and the SDGs as a framework for raising awareness about the responsible use of natural resources by certain economic activities. Sustainability is the central theme of numerous contributions, but the word only appears explicitly in the two previous communications related to education, and in a third one on sustainability indicators, a recurring topic. Unlike what happened in previous congresses, on this occasion, it is common for the term "sustainability" to appear among the keywords. This occurs on six occasions, where sustainability is understood in a generic way and applied especially to urban areas.

The presence of Education for Sustainable Development (ESD) in scientific events within the Spanish geographical community may have found a higher thematic precision in the congresses of the Didactics Group of the Spanish Geographical Association (AGE). Below are the five most recent ones, covering the last decade:

- X National Congress of Geography Didactics: *New conceptual and methodological perspectives for geographical education*, held in Córdoba in 2014. 73 communications were presented, with only one of them acknowledging the concept of sustainability in the title. On this occasion, it was related to its role in the geography curriculum in Germany and professional knowledge. This communication also includes a section on Education for Sustainable Development and its role in teaching geography.
- XI National Congress of Geography Didactics: *Digital Natives and Geography in the 21st Century: Geographical Education and Learning Styles*, held in Seville in 2016. It featured 54 communications, none of which addressed Education for Sustainable Development or issues related to SDGs, Agendas, or sustainability.

- XII National Congress of Geography Didactics: *One landscape, multiple perspectives on geography learning*, held in Madrid in 2018. Out of the 73 contributions, none addressed sustainability issues, Agendas, or SDGs, and only one focused on Education for Sustainable Development. This one centered on the conceptualization of future primary school teachers.
- XIII National Congress of Geography Didactics: *Teaching and learning geography for a sustainable world*, held in Girona in 2021. Sustainability was one of the central themes of the congress, emphasizing that both the 2030 Agenda and the SDGs are internationally launched initiatives to protect the planet, highlighting their importance. Of the two volumes composing the congress proceedings, only the first one is currently published, featuring 28 communications, of which 6 directly address the SDGs as a teaching framework and 2 address sustainability, understood as a way of acting. However, none of the communications refer to Education for Sustainable Development in the title, although several do so inside, emphasizing its importance for citizenship education and critical thinking. A similar situation occurs with the 2030 Agenda, which is not referred to in the titles but is mentioned in numerous texts as a reference tool for the development of the SDGs.
- XIV National Congress of Geography Didactics: *The place of geography, the geography of the place*, held in Albacete in 2023. The proceedings book contains 55 contributions, and many of them, more than a dozen, are linked to the mentioned topics. In the titles, concepts such as Agenda 2030 (one communication), E(D)S and SDGs (two communications), and Sustainability (three communications) were found. The predominant ideas consist of: i) Considering the Agenda 2030 as a tool related to SDGs and ESD, as well as geographical processes and even political conflicts; ii) Valuing education to provide knowledge, skills, and values required in sustainable development, taking the SDGs as a geographical framework to solve socio-territorial problems; and iii) Highlighting the contribution of geotechnologies in integral sustainability learning.

Additionally, although not a direct result of a congress, one cannot overlook the recent monograph *Teaching Geography in the 21st Century: Challenges, Resources, and Teaching Proposals for New Global Challenges*, published in 2022 by the University of Alicante. This university press publication complements other works with very similar titles (Sebastiá and Tonda, 2016, 2017), which focus on aspects derived from the implementation of the European Higher Education Area (EHEA) and technological advancement. Among the sixteen chapters, two contributions stand out, focusing on ESD with a transdisciplinary approach to addressing sustainability. They also consider ESD as service-learning based on critical reflection and dialogue between individual and collective experience in a context of collaborative work. Current geography must respond to the SDGs to deepen understanding of two key aspects: The environmental crisis and the economic, social, and cultural crisis (Granados, 2022; Rodríguez-Domenech, 2022). Meanwhile, the chapter presented by the editors of the work proposes including climate change and the effects of the pandemic in secondary education and baccalaureate through curriculum elements (Morote and Olcina, 2022). This contribution adds to the line of work presented by these authors, with the most recent one linked to natural hazards (Morote and Olcina, 2024). Another significant contribution addresses the study of rural areas in non-university education, which continues to be associated with depopulation and decline, neglecting the reality of an active, rich in values, and sustainable rural environment (Armas *et al.*, 2022).

In conclusion, when analyzing the evolution of research related to geographical education, especially evident in the recent scientific events of the AGE and its didactics group, it can be observed that the Spanish geographical community shows a growing concern for education in sustainable development and sustainability. There is an increasingly frequent trend to explicitly consider aspects and elements associated with eco-social sustainability as a central theme. The recent work of Mateo Girona and Rodríguez Domenech (2023), which reviewed the relationship between sustainability and geotechnologies in national

and Iberian didactic congresses from several years before, provides results in the same direction. It is noteworthy how a milestone was identified in 2021 when both types of congresses introduced sustainability as a central theme for the first time, even reflected in the names assigned to them ("Geography, Global Change, and Sustainability" and "Teaching and Learning Geography for a Sustainable World," respectively). It can be asserted that university research on ESD in Spain is recent but growing and seems persistent, starting from a post-pandemic threshold after the reconfiguration of academic and social priorities due to COVID-19 (Mecha, 2021).

## 6. CONCLUSIONS

In a context of global change driven by climate crises and social conflicts, the paradigm of sustainability, with a focus on sustainable development or degrowth depending on ideological considerations, is well established in current scientific, political, and social communities. Under the leadership of the UN, which has capitalized on the sustainable development approach, significant global consensuses have been reached on the global challenges that humanity must collectively address. The latest of these is the 2030 Agenda, comprising 17 SDGs and their corresponding targets, which have become the reference for scientific research, political action, and social advocacy.

Geography, as a discipline whose object of study is the territory where the SDGs, whether more environmental, social, or combined, are concretized and converge, has enormous potential to contribute to the development of the 2030 Agenda. This potential is manifested in the interrelationship of the eco-social elements and processes studied by geography, from a multi- and interdisciplinary perspective, and in the spatial analysis methods inherent to the discipline, recently revalued through geotechnologies, as an essential part of big data, thanks to the geolocation of data, which allows for mathematical and visual spatial variable cross-referencing. Geography has the tradition, purpose, and methodology to study the degree of balance of territories in the world system, or, in other words, to analyze eco-social sustainability. Consequently, it is a discipline with a great deal of ethical responsibility on the path to a sustainable world.

This manuscript has reviewed the relationship between geographical advancement and sustainability at an epistemological and methodological level. It is derived that future lines of geographic research, some of which already have a certain trajectory, should tend towards comprehensive topics with an eco-social approach, such as sustainable development, natural and anthropogenic risks, transportation systems, migrations, landscapes, ecosystem services, tourism growth, global change, climate crises, land use, etc.

The responsibility that the study of sustainability confers on geography increases the importance and necessity of social transfer, which finds a systemic channel, although not exclusive, in formal education. Many authors, especially those following the Lucerne Declaration of the IGU in 2007, speak of "Geographical Education for Sustainable Development." The manuscript has reviewed the role that geographical education can play in sustainability under the framework of ESD. UNESCO defines a series of skills to develop sustainability competencies. Geography can contribute to their acquisition, as the relationship of its theoretical and procedural postulates with sustainability has been seen, and there are strategies to facilitate learning, such as the use of key geographical concepts. However, there are studies showing an excessive tilt of teaching towards environmental sustainability compared to the study of the social dimension and the inherent interrelationship of elements and processes. Geography students themselves in higher education demand more emphasis on the social and cultural aspects and focus on procedural deficiencies, for example, in the use of geotechnologies, which would allow them to update professionally and better understand eco-social interrelations. Perhaps a more explicit presence of ESD in curricula is lacking, as the current widespread situation internationally is a complementary presence,

often dependent on individual initiatives. For example, there has been an increase in didactic practices around "story maps," which develop geographical and often sustainability competencies.

The manuscript concludes with a preliminary study of ESD trends in Spain, and the results do not differ from the general characterization. There has been significant progress in primary and secondary education, where the latest curriculum development includes explicit mentions of ESD and eco-social training in geography/geographic areas, as well as the development of geo-technological competencies. But in universities, ESD is diluted. It may even be more active in teacher training, associated with curricular change in basic education, than in the training of geography professionals themselves. A vision of study plans that is excessively compartmentalized into exclusive areas is of no help. Even specialties such as territorial planning, which, by definition, are holistic and could more easily foster ESD, are sometimes epistemologically fragmented to satisfy a teaching distribution among the three classic areas of Spanish geography.

Reviewing the presence of ESD in contributions to general and didactic congresses of the AGE over the past decade, it is observed how interest was barely noticeable until 2021, coinciding with the academic and scientific experience of the global COVID-19 pandemic, which perhaps placed sustainability at the center of the debate, and geography was no exception. Congresses have begun to include references to sustainability in their themes, and the number of contributions is on the rise. The interest in ESD in Spain is recent but seems to be progressive.

There is no doubt that eco-social knowledge, with a focus on sustainability, is key to endowing geography with its own current discourse and adapting it to social needs. The AGE itself adopted, in 2019, a motto that is in clear harmony with the current territorial moment and reflects the concern of the Spanish geographical community, in line with the international community, for sustainability based on genuine scientific and social responsibility. This motto is: "Geography, the science of global change, environmental sustainability, and territorial information." Perhaps the adjective "environmental" to refer to sustainability is not the most appropriate, as it places more emphasis on natural phenomena than on social and interrelated ones when precisely one of the main challenges to be overcome by ESD lies in this conception, which should shift towards the idea of eco-social sustainability. But with the contribution of that nuance, the motto can be applauded for highlighting global change as the object of geographical research, sustainability (eco-social) as the focus, and territorial information as the method. It is up to geographical education to transmit this relationship between geographical concepts and methods and the necessary eco-social sustainability, which implies ethical responsibility. Making this relationship explicit in study plans, even in university education itself and not only in basic education, can help systematize genuine ESD and prevent it from being diluted in the individual initiatives of willing teachers and researchers.

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# Geographic education and global change

## TOWARDS A NEW CURRICULUM PARADIGM<sup>1</sup>

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### ABSTRACT

The limited incorporation in recent school curricula in Spain of geography-related content such as sustainable development, land use planning, globalization, geospatial information technologies, geopolitics, and even the climate emergency demonstrates that there are still significant gaps in geographic content and themes. These include those related to postmodern and cultural geography, urban and territorial agendas, the emergence of neo-geographies, the conceptual relevance of the Anthropocene, or the link between geographic discipline and global change.

This need has driven the design and experimentation of curricular frameworks and innovative practices, as highlighted in the recent GeoDem reference declaration by the European Association of Geographers (EUROGEO). This new paradigm is applied, among others, in two European projects focused on global change: Teaching the Future and V-Global, both are involved in teaching geography and training teachers.

### KEYWORDS

Geographic education, global change, curriculum, EUROGEO.

<sup>1</sup> This contribution is made in the framework of the European projects in which the authors participate or coordinate, representing EUROGEO or their respective universities (Saragossa, UNED), as well as in their collaborations with other international geographical entities with the IGU Commission on Geographical Education, with the Geography Education Specialty Group of the American Association of Geographers, and with the British Geographical Association, and in particular the projects Teaching the Future (2021-1-BE02-KA220-SCH-000034478), Virtual Field Work in the context of Global Change: a blended learning approach for higher education (V-GLOBAL) (2021-1-FR01-KA220- HED-000023242), as well as the Jean Monet Geography, democracy, European citizenship and the digital age (GeoDem) action (619917-EPP-1-2020-1-BE-EPPJMO-SUPPA), which can be consulted <https://www.eurogeography.eu/projects/>

# 1. WHY TEACH GEOGRAPHY AFTER THE END OF HISTORY?

Fukuyama's well-known book on the end of history is becoming more controversial every day in its thesis that liberal democracy has imposed itself as an ideology after the fall of the Berlin Wall, and that the end of the great world confrontations has arrived. The internal problems within the European Union after Brexit, the internal conflicts in Latin American and African countries, the Arab-Israeli conflict and its extension to the Middle East region, the war in Ukraine, but above all a new scenario of growing rivalry between China and the United States at all levels (political, economic, financial, monetary, industrial, commercial, technological and energy) have elevated geopolitics as an indispensable knowledge for analyzing, understanding and acting in the contemporary world. Thus, the geographical dimension of geopolitics is acquiring an importance it has never had before, not even at the height of the colonial conflicts of the nineteenth century, or in the two world wars or the Cold War of the twentieth century, to explain and condition international relations, global diplomacy, but also the very future of history and of humanity itself.

Added to this are challenges as universal as they are geographical, such as globalization itself, sustainable development, climate change, energy transition, global terrorism and drug trafficking, the geography of arms and defense, international financial flows, the impact of new technologies (and artificial intelligence) on the economy, society and territory (and especially on cities), gender equality, global health, international migration, refugees and, last but not least, human rights. All these are the central themes that in one way or another vertebrate and appear explicitly cited in the strategic documents of the main players on the global geopolitical chessboard: the European Commission's Agenda (2019-2024), NATO's Strategic Concept (presented at the Madrid Summit in 2022), the US National Security Strategy (of 2022) or the 2035 Development Goals for China (expressed by Xi Jinping at the 20th Congress of the Chinese Communist Party in 2022).

## 1.1. TEACHING GEOGRAPHY IN SPAIN

Why is almost none of this taught in secondary education, baccalaureate, nor in teacher training in Spain? Is it perhaps in the interest of "distracting the student" with knowledge of a past that cannot be changed and whose basic conceptual categories in the curriculum (Eurocentrism-colonialism-industrialization, conflicts between European powers that drag the world down, civil war) have less and less importance in the global context described? Why is the teaching of a global citizenship and global understanding (Demirci, De Miguel and Bednarz, 2018) not articulated around disciplinary contents, essentially geographical, i.e. political, economic, social, and cultural in their spatial dimension? Why is the curriculum deconstructed by means of transversal contents or by means of successive neologisms and pedagogical fashions that focus on how to teach undervaluing and even despising what to teach? -The eternal debate on the balance between conceptual, procedural, and attitudinal contents that form the backbone, with some other additions, of competencies.

Why does the European framework of competences identify some disciplinary competences, for example, mathematical competence or linguistic competence, and not geographic competence? Why in that same European framework is history expressly cited and not geography, when developing citizenship competence? Why in the PISA tests is geography not considered in the scientific competences? Is it that spatial and geospatial thinking is not considered another competence despite all the scientific literature on it? (Carbonell-Carrera *et al.*, 2020; Lee and Bednarz, 2012; Kim and Bednarz, 2013; Rodán *et al.*, 2016).

Why were the joint allegations of the expert entities (Spanish Association of Geography-Royal Geographical Society-*Colegio de Geógrafos*) ignored during the public information period of the new LOMLOE curricula for primary, compulsory secondary and high school

education, especially with the contribution of geographic competences for global change? Why do we continue to claim the role of geography in the formation of citizens with the same or even greater intensity than 32 years ago, when the International Declaration on Geographical Education was proclaimed at the 27th IGU Congress?

These and other questions lead to only one answer: perhaps it is not interesting to teach geography because it is probably the knowledge that most enables and empowers citizens in the present and for the future (De Miguel, 2024). Geography also provides students with well-founded critical thinking in the face of global change, which cannot be predicted, but can be influenced and conditioned. The data are devastating in this regard. The official statistics of the Ministries of Education and Universities show that in 2022 the number of students who started 1st ESO (K7 stage) in Spain was 536,000. In that same year, 210,000 students took the A level test in History of Spain (core subject of *Bachillerato*, senior high school), while only 31,000 did so in the optional subject of Geography (in the Humanities and Social Sciences modality).

In other words, only 5.8% of the national total of students beginning secondary education have a basic geographic training in scientific content related to the challenges of today's world. And we say basic because of the scale of Geography of Spain, not Geography of the Contemporary World, since this regional approach persists in the successive curricula of the second year of baccalaureate, from the initial one approved in 1992 after the implementation of the LOGSE. Or what is worse: almost 95% of the students in this country lack a full geographic education, relative to the questions that really interest them in the world as a spatial whole, from the age of fifteen, once they finish the third year of ESO. This fact, in turn, is conditioning the teacher training provided by universities to prepare future teachers for their professional performance.

## 1.2. TEACHING GEOGRAPHY FOR THE ELITES OR FOR GLOBAL CITIZENSHIP

In these exciting times we live in 2024, the well-known words of Gilbert Grosvenor in 2010 (Editor and President of National Geographic for decades) take on more meaning: "In a democracy, if you don't understand Geography, you're going to make some bad decisions. This can happen at the highest level of government, or at the local level..."<sup>2</sup>. He exemplified this when he asserted that 75% of Americans did not know the borders of Afghanistan, in the face of various polls conducted by the Obama administration to find out whether American taxpayers and voters preferred to send more troops to the Afghan War or to withdraw from the conflict. Conversely, the existence of the Office of the Geographer and Global Affairs in the influential Bureau of Intelligence and Research (INR), the only intelligence agency owned by the U.S. State Department, the power of the National Geospatial-Intelligence Agency (NGA, in the Defense Dept.), coupled with the growing demand for students taking the Advanced Placement in Human Geography exam (Solem, Bohem, and Zadrozny, 2021), make geography a strategic, geo-strategic, or even "meta-geo-strategic" discipline for those studying or working to maintain U.S. global leadership.

In the United Kingdom, Geography has become the sixth most chosen subject in GCSE examinations (equivalent to 4th ESO or K10), which is impressive considering the three compulsory subjects of English, mathematics, and science (Parkinson, 2020). The Geographical Association corroborates this data for A level exams when it reports that the choice of Geography exam in 2021 was the highest increase over those in 2020. In China, Geography is, together with History and Political Science, one of the three compulsory subjects of the demanding *gaokao* exam, in its social sciences modality (3+x), and a subject whose contents on global challenges have been incorporated into the geography curriculum (Duan *et al.*, 2018), and especially after the deployment of the great Chinese economic and geopolitical bet of the new Silk Road (One Belt, One Road).

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2 <https://blog.nationalgeographic.org/2010/11/18/gil-grosvenor-why-we-need-geography/>

Basically, it could be considered that only those elites who are deciding global change are showing real interest in geography and spatial knowledge and analysis, and not only the political elites, but also the large global corporations, which increasingly require more geopolitical analysis for their business decisions.<sup>3</sup>

In Europe, and especially in Spain, we are in an antagonistic position with respect to Geography and geographic education, with some exceptions such as France, which continues to maintain Geography at the same level as History at the baccalaureate level in a single compulsory subject. It is therefore necessary to clearly define the needs, the curriculum, and the role of Geography for an adequate acquisition of European citizenship in the context of global change, as well as to note that the evolution of the discipline of Geography runs as fast as the physical, human, and social changes of the territory in which it is located. Educational changes are usually slower, as curricular innovations take longer to settle in the culture and professional practice of teachers, and of course in the codification of national geography curricula.

This is contradictorily produced in Spain by the succession (and instability) of the curricular framework in primary and secondary education, with five educational laws and five geography curricula in the last three decades, especially in ESO and *Bachillerato*, which have not served to proceed to an updating of geographic contents adapted to the evolution of human civilization. In other words, teaching Geography well and teaching an updated Geography is more necessary than ever, as well as a new educational paradigm in Geography, according to the teaching of changes in a global world.

## 2. GEOGRAPHY, DEMOCRACY, AND EUROPEAN CITIZENSHIP IN THE DIGITAL AGE

The approaches of the previous introductory section have been part of the proposal that EUROGEO submitted to the European Commission in the framework of the call for Jean Monnet actions, and that has allowed to advance in the construction -if not of a European geography curriculum- of common curricular bases for the teaching of Europe from geographic assumptions. To this end, GeoDem encourages the improvement and updating of geography teaching from the approach of global change, understood in its double meaning of change in the physical environment and change in human organization in the territory, in the initial teacher training programs offered by European universities and in continuing education, as well as the interaction between the two, including climate, landscape and ecosystem change, as well as spatial changes in patterns, density, distribution, diffusion of spatial occupation, regional impacts, availability of water and energy, and regional and global population changes, etc. (Lidstone and Stoltman, 2008). A certain disbelief regarding global change is well known, despite the accompanying evidence from science. Geography has shown itself to be a field of knowledge in which it is possible to integrate these problems that are directly related to education for sustainability and can thus be integrated both in university curricula, in teacher training provided by the university, and in school curricula, which will also provide opportunities for access to new jobs (Martínez and Mínguez, 2023).

### 2.1. GEOGRAPHICAL COMPETENCIES

GeoDem constitutes a further step and gives continuity to two previous initiatives, the only thematic network of Geography in Higher Education approved by the European Commission, HERODOT, and one of its results, the Geo-Cube, which in turn strengthened and projected EUROGEO itself as an international geographical society, at the beginning of the century

<sup>3</sup> In this regard, read the Financial Times article <https://www.ft.com/content/608a43e2-710c-4918-84d6-e0d75511918e>

when the European Higher Education Area was implemented and the definition of a European framework of competences for the teaching of Geography in higher education was promoted, but also in the university training of Geography teachers for primary and secondary education (Donert, 2007; Donert, 2009; De Miguel, 2019; De Miguel and Donert, 2022). Subsequently, with the broad creation of the European Education Area, which also integrates school education, vocational education, adult education, and lifelong learning, GeoDem becomes more meaningful in non-university education. Following the establishment of the European framework of basic competencies for lifelong learning, among which geographic competencies are not included, EUROGEO has felt the need to define and disseminate them, encouraged by the geospatial revolution that has provided new tools, didactic resources, and geographic learning strategies.

In this way, three basic geographic competencies - spatial thinking, geographic thinking and spatial citizenship - have been specified and disaggregated into seven levels of competencies for the progressive acquisition of full geographic knowledge. This competency-based educational model is strongly influenced by the European Education Area and has an impact on the national Geography school curricula of various European Union countries, including in the United Kingdom after Brexit (Geographical Association, 2022). Furthermore, it has been conducted in international collaboration with other extra- European geographical education specialists such as Chang *et al.* (2019) and Solem *et al.* (2018) to put forward an integrated framework of geographical competencies for curriculum and assessment and contribute to promote a transformative geography.

1. SPATIAL THINKING I. LOCATE. Orientation, Location, Projections, Scales
2. SPATIAL THINKING II. PROCESS. Obtaining, processing of geographic information (quantitative/qualitative), fieldwork, geospatial technologies
3. SPATIAL THINKING III. REPRESENT. Spatial Visualization: Text, Figures, Statistics, Cartography
4. GEOGRAPHICAL THINKING AND UNDERSTANDING I. DESCRIBE. Spatial description, patterns, and geographical structures in the territory
5. GEOGRAPHICAL THINKING AND UNDERSTANDING II. EXPLAIN Physical and human systems. Human-environment interactions. Social and economic processes. Organization of space and settlements.
6. SPATIAL CITIZENSHIP I. INTERPRET. Critical thinking, global understanding, territorial imbalances, social justice.
7. SPACE CITIZENSHIP I. ACTING. Intervention, engagement, youth empowerment, social participation, SDGs

Table 1. Geographic competencies for lifelong learning.  
Source: De Miguel, 2021.

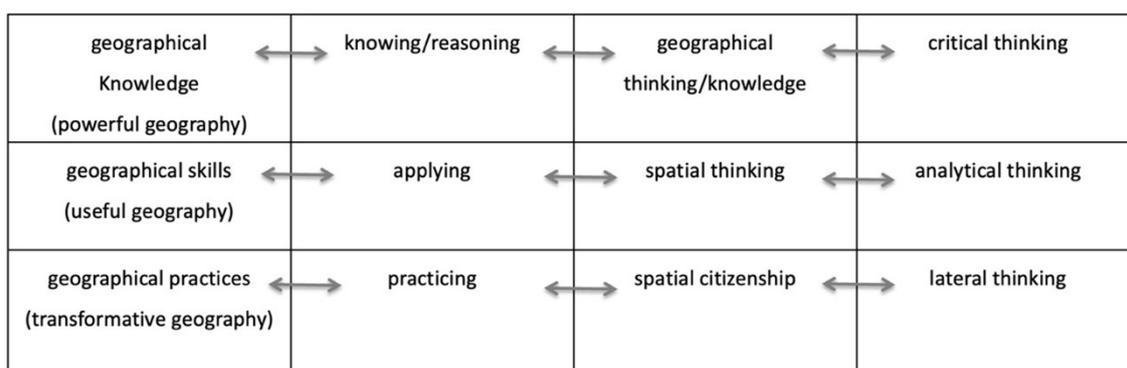


Figure 1. Integrated Geographic Competency Framework for Curriculum and Assessment.  
Source: De Miguel, 2021.

## 2.2. GEODEM, BENCHMARK STATEMENT

As part of the Jean Monet GeoDem action, EUROGEO has elaborated a benchmark statement and recommendation for teaching Europe from a geographical approach. The purpose is to establish an agreed position on the fundamental teaching and learning to be included in school and university studies, which has been submitted to the European Commission, as well as to various national and regional Ministries of Education.

The benchmark statement addresses the importance of geographic education for the teaching of Europe. It identifies key themes and topics, as well as teaching approaches and learning outcomes to be integrated into educational policy, and into the curriculum design of Geography in primary and secondary education. The elaboration of this reference statement has not been unilateral, but is the result of a series of workshops and meetings, held between 2022 and 2023, with university and school teachers, and experts in geographic education, who have discussed what are the key elements of teaching Europe in Geography classes, from this new paradigm approach to teaching Geography based on global change.

The ideas and themes generated from these meetings have been consolidated, reviewed, structured, and shared. Then, through a process of peer review and further consultation, the GeoDem reference statement, for teaching Europe in Geography, has been drafted and presented at the EUROGEO Krakow Annual Conference in May 2023. It is also planned to be presented in a monographic session at the 35th IGU International Geography Congress in Dublin, August 2024.

The Declaration begins by affirming that Geography is an integrative, diverse, and complex discipline that addresses current and future challenges of the real world, making it a scientific discipline and an essential school subject for knowing, understanding, and acting in a world of global change. The declaration sets out a series of essential themes and issues for teaching Europe based on this new paradigm:

- Presentation of Europe, its territorial problems, and challenges.
- Understanding of Europe, in its human and environmental processes and landscapes.
- Geopolitical dimension of Europe.
- Local case studies in Europe analyzing global challenges.
- Digital skills and geo-technologies for geographic literacy.

## 3. GEOGRAPHIC EDUCATION PROJECTS ON GLOBAL CHANGE

### 3.1. TEACHING THE FUTURE

#### 3.1.1. Objectives and challenges to which it responds

The *Teaching The Future* project has as its starting point the stipulations of the European Commission from the Education for Climate Coalition (2020) or the Digital Education Action Plan (2020), which proposes a development of high quality digital systems for the generation of educational tools and content. Taking these starting points, this project has four objectives:

- Assess the status and needs in geographic education that seeks to bring scientific rigor to the teaching of climate and climate change.
- Provide teachers with access to resources based on quality geographic climate information.

- Stimulate student and teacher participation in climate issues, using scientific data, truthful and effective sources of information.
- Promote interdisciplinary learning and digital skills among young people, awakening interest, motivation and stimulating their active citizenship at the local level.

### 3.1.2. Methodology.

In order to achieve these objectives, a work methodology consisting of the following actions has been proposed:

- Drafting of a state of the art and analysis of European curricula in climate education.
- Realization of a climate dashboard with open and accessible data, using ArcGIS Dashboard software (Kerski, 2021).
- Creation and delivery of a teacher training course to generate real practices in secondary schools with geospatial tools.
- Design of an educational research model based on experimentation with the use of geospatial climate resources, especially the climate dashboard.

### 3.1.3. Results and discussion

A dashboard, in ArcGIS Dashboard software, is a GIS tool with a particular view that is used for monitoring events, making decisions, reporting to others, and viewing trends. These dashboard applications are part of the ArcGIS Online universe and are powered by layers and web maps hosted on the servers. They are made up of different widgets such as graphs, indicators, tables, external elements, etc. and their most representative feature is that being programmed with spatial information, the map controls the rest of the information, changing according to the area displayed. Figures 2 and 3 show the two dashboards generated, one of observed climate and the other of modeled data according to the different IPCC scenarios, which serve as the main elements of the training course based on a discovery learning approach or didactic sequences from geo-inquiry, to be taken to the geography classroom in secondary and high school education, as real educational experiences of this new paradigm of geographic education for global change, based on competences and scientific contents of Geography.

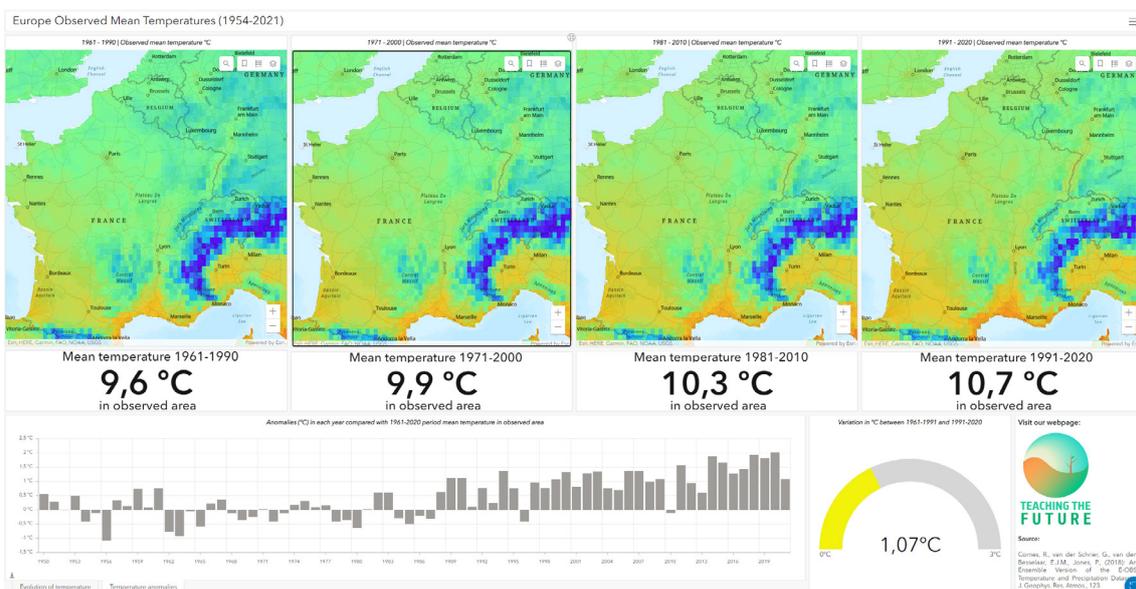


Figure 2. Dashboard of the observed climate by periods.  
Source: Own elaboration.

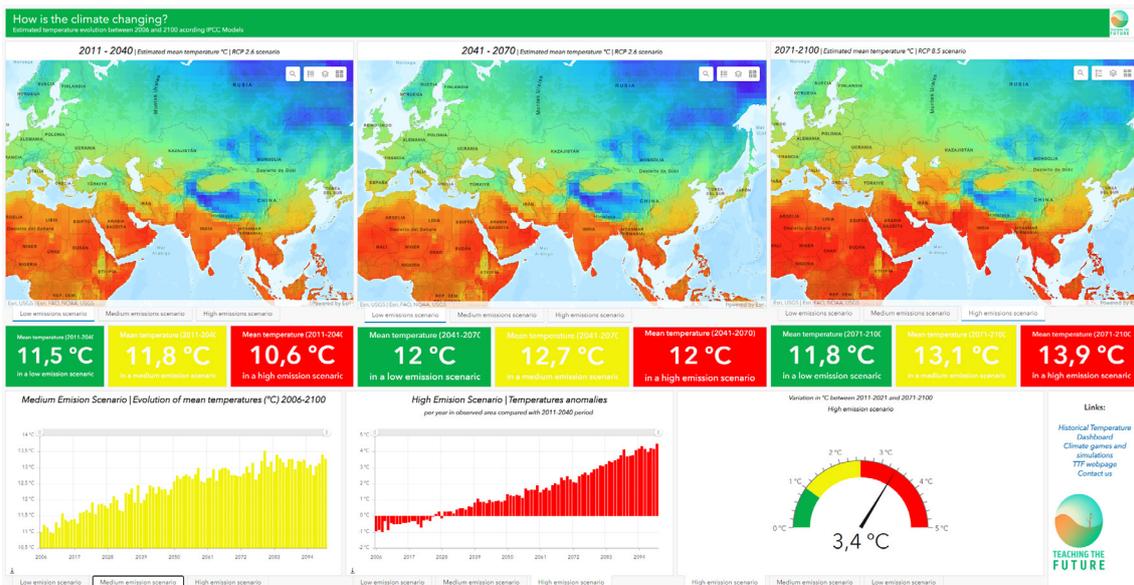


Figure 3. Climate dashboard modelled according to IPCC emission scenarios.  
Source: Own elaboration.

## 3.2. VIRTUAL FIELD WORK IN THE CONTEXT OF GLOBAL CHANGE - A BLENDED LEARNING APPROACH FOR HIGHER EDUCATION

### 3.2.1. Objectives and challenges to which it responds

The project responds to the scarcity of training offered to university faculty in relation to global change with a systemic and transdisciplinary approach, which encompasses sustainability issues affecting ecosystem processes in each place, something that does not occur in isolation, but as interactions of multiple changes that are not easily investigated (Zhou *et al.*, 2023). This emerging field of research completes experiential learning aimed at teacher trainees and culminates in the construction of a virtual journey. In doing so, it aims to equip university teachers with tools to teach by prioritizing the transmission of environmental concern to their own students, many of them future teachers, along the lines of what the European Commission marks in the GreenComp (Bianchi *et al.*, 2022). In addition to these spatial competencies, digital competencies are also promoted along the lines of DigComp (Vuorikari, 2022).

### 3.2.2. Methodology

For this purpose, we have sought to take advantage of the best practices in blended learning to which most of the teachers were devoted during the COVID-19 period, through more than 20 in-depth interviews carried out and analyzed (Leininger-Frézal *et al.*, 2023). In addition, a series of premises have been followed, such as (De Lázaro Torres and Gómez Ruiz, 2023, pp. 700):

- The use of nearby resources and their pedagogical design to improve geography learning.
- The use of mobile devices and the collection of geolocated data.
- Reflection on the elements and indicators of sustainability and global change detected in relation to environmental quality.

And with them, several virtual field trips have been developed, some of them through the technology provided by ArcGIS Survey 123, also from Esri.

### 3.3.3. Results and discussion

The results have focused on the construction of virtual trips, covering mainly the closest environment that becomes a living laboratory and appears as more sustainable, avoiding the environmental inconveniences that come with displacement. At the same time, spaces that have not always been studied, even though they have been lived in, are put in value. In this way, an experiential geographic knowledge derived from field work has been acquired, which has helped the perception, search and detection of evidence that drives global changes, thus initiating a process of interest in local sustainability problems and their global repercussions.

Although it is true that global change is often not perceived from direct observation through fieldwork or through virtual travel and subsequent analysis, until immersion in the evidence from the research is performed. All of this has been driven by COVID (Guillaume *et al.*, 2023; Leininger-Frézal *et al.*, 2023; Peace *et al.*, 2021; Pugsley *et al.*, 2022).

Another result has been the creation of a massive open online course (MOOC), available at UNED Abierta, which explains the main steps followed for the selection of tools and objectives necessary for the creation of a virtual field trip focused on effective and experiential learning.

With all this, the aim has been to reduce the scarcity in the use of the concept of global change in the classroom (Gallardo Beltrán *et al.*, 2023), since the cartography developed for the creation of virtual field trips incites its use, reflection, and application. In addition, the findings can be used by educational institutions to design high quality and effective virtual field trips that have the potential to enrich geographic education in digital learning environments.

## 4. CONCLUSIONS

These projects show an environmental, social, economic, but above all political and territorial concern: human actions on the geographical environment have impacts and consequences and contribute to global change. None of the systemic interactions that occur in space and places, whatever their scale, is innocuous, since they all induce geographic processes that contribute to modify spatial structures, to reinforce or diminish geographic diversity in the world. At the same time, these projects, in addition to providing accurate and reliable scientific content, promote the acquisition of geo-spatial skills and competencies, seek to encourage critical thinking in geography students about who has the power over the territory, who is able to influence global change, how to act to contribute to the sustainability of the planet, or what can be the response as European citizens to the spatial challenges that lie ahead, even beyond 2030. In short, these projects seek a new geographic-educational paradigm, focused on global change.

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# Application of Spatial Big Data for understanding mobility flows

IN URBAN AGGLOMERATIONS OF MÁLAGA AND SEVILLE (ANDALUSIA, SPAIN).

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## ABSTRACT

Gaining insights into urban and metropolitan mobility is of paramount importance for territorial planning aimed at optimizing transportation systems and elevating the quality of life of residents. This study embarks on an exhaustive examination of the mobility flows that manifest in the Andalusian urban agglomerations of Málaga and Seville, based on data from the *Estudio de la movilidad con Big Data* provided in an open format by MITMS (Ministry of Transport and Sustainable Mobility) of the Spanish Government. The findings unearth intricate patterns of mobility within each examined area. The discourse pivots on the potential benefits that the strategic utilization of large-scale spatial data can contribute to the enhancement of decision-making processes. The study culminates by illustrating the significant capacity of these methodological approaches to reveal sophisticated and nuanced patterns of mobility in areas characterized by their dynamic nature.

## KEYWORDS

Spatial Big Data, population flows, urban and metropolitan mobility, intermetropolitan displacements, urban agglomerations of Málaga and Seville.

## 1. INTRODUCTION

Geography has long since evolved from being the science of places to a discipline focused on movements within terrestrial space (Ramírez & López, 2015). From the work of F. Ratzel (1844-1904), human flows began to gain significant prominence in his *Anthropogeography* (1882) (Luis, 1983). However, it was during the 20<sup>th</sup> century that their importance grew, and the Geography of Transport, encompassing both people and goods, emerged as a significant thematic area. This is evidenced by its inclusion among the working commissions of the International Geographical Union (IGU).

Over time, obtaining reliable sources for information on these topics has become crucial for validating the accuracy of results. In Spain, the national censuses provide microdata from the Instituto Nacional de Estadística (INE), detailing commuter movements for work purposes. This data helps define the so-called local employment areas (LEAs) (Feria-Toribio *et al.*, 2005). Surveys have also been frequently utilized to unravel the complex flows in urban and metropolitan areas, as demonstrated in the *Plan de Movilidad Urbana Sostenible del municipio de Sevilla* (Ayuntamiento de Sevilla, 2021).

All these sources, both direct and indirect, had shortcomings that are largely being addressed by the integration of new technologies into geographic data management. In particular, the widespread use of mobile telephony, also known as cellular telephony in some Spanish-speaking areas, and especially the adoption of smartphones by increasingly larger segments of the population, is generating a vast amount of information (Big Data). If utilized effectively, this data can provide highly plausible insights, even in tumultuous socio-economic contexts (Gómez-Campos *et al.*, 2023).

In Spain, specifically, the Ministry of Transport and Sustainable Mobility (MITMS) has been leveraging this type of data since 2017, making it available in open access to enhance the monitoring, evaluation, and planning of the national transport system. This contributes to increasingly sustainable mobility (Fernández, 2021). The COVID-19 pandemic marked a crucial turning point due to the need to understand the impacts of various measures to ease mobility restrictions across Spanish territory (Osorio *et al.*, 2023).

This study examines the mobility flows within two metropolitan areas that are geographically proximate yet distinctly different—Malaga and Seville in the Region of Andalusia, the southernmost and most populous of Spain's 17 administrative regions. Malaga serves as the central hub of the Costa del Sol, traditionally associated with sun and beach tourism and characterized by its coastal conurbation features. In contrast, Seville, the capital of the Region of Andalusia, is encircled by various metropolitan areas.

While neither city has distinct administrative recognition, they both exhibit metropolitan functional characteristics. This is evidenced by their independent transport consortiums and specific sub-regional land-use plans. Utilizing Spatial Big Data sourced from mobile telephony, this study not only explores the flows between these two areas but also investigates internal movements based on established subdivisions for this purpose, as well as movements to and from higher territorial levels: the other provinces in which they are located, the other NUTS1 III regions of the Andalusian community, and the rest of Spain (Sierra, 2020).

## 2. THEORICAL FRAMEWORK

Human movements across various spaces –land, sea, and air– serve the fundamental purpose of transporting people from one settlement to another. Therefore, understanding population dynamics is crucial for a thorough analysis of mobility phenomena. Specifically, the region of Andalusia has maintained well-defined boundaries since ancient times. In his 1st-century AD work 'Geography,' Strabo described Turdetania (the precursor to the later Roman province of *Baetica*, named after the river, which flowed through it) as a 'country of cities' (Marchena, 1987). During the Islamic period, specifically within the Cordoba Caliphate of the 10th and 11th centuries, a series of koras were established, outlining boundaries that closely mirror those of modern-day Andalusia (Cano & Ventura, 2012).

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1 The NUTS system (Nomenclature des Unités Territoriales Statistiques), a hierarchical schema for subdividing the economic territories of the European Union and the United Kingdom, serves statistical purposes and aids in the allocation of European cohesion funds. In Spain, the NUTS Level III designation corresponds to the country's 50 provinces, facilitating detailed regional analysis and fund distribution based on statistical data.

The Region of Andalusia currently has 8,538,376 inhabitants, representing 18.08% of Spain's total population, while its land area constitutes only 17.31% of the national total. The distribution of these inhabitants is highly uneven across the region, having seen a demographic reconcentration along both the Atlantic –excluding the vicinity of the Doñana Natural Area– and especially along the Mediterranean coasts. These areas not only focus on intensive agriculture (such as red fruits) but also on massive summer tourism centered on sun and beach activities. This demographic pattern also extends to the urban agglomerations identified in official documents like the *Plan de Ordenación del Territorio de Andalucía* (POTA, 2006), which influence areas surrounding the eight provincial capitals, including Jerez de la Frontera in Cádiz, and the Campo de Gibraltar region, led by Algeciras.

Historically, the primary source of population data in Spain has been the *Nomenclátor*, linked to the decennial national censuses and, since the early 21st century, to the continuous registry of inhabitants managed by town councils, the foundational units of Spanish territorial organization. According to this registry, Andalusia comprises 2,769 population centers, of which only 146 exceed 10,000 inhabitants, the threshold set by the INE for considering a population statistically urban. However, there is significant centralization around the provincial capitals and other similar centers, a process known as metropolitanization, which has been extensively studied (e.g., Gutiérrez Puebla in Méndez and Molinero, 1993). This functional reality often lacks administrative recognition in Spain, although it is frequently used in official studies, such as the Metropolitan Mobility Observatory (2020).

In Andalusia, the importance and degree of metropolitanization vary, but nearly all areas have a consortium managing internal mobility and often a specific sub-regional planning document. Here, administrative structures typically overlap significantly with actual population distributions, more so than in many other contexts. Given its size –87,599 km<sup>2</sup>, larger than 15 of the 27 European Union member states and nearly as large as Portugal– Andalusia is suited for regional-scale studies. Such studies have been conducted elsewhere, like in Estonia (Novak *et al.*, 2013), focusing on functional regionalization, and in the Czech Republic (Halás *et al.*, 2021), aiming to identify flows to major cities. Similar studies have been done in densely populated sub-state areas like the Yangtze River Delta in China (Cui *et al.*, 2020).

This paper highlights the dominant roles of Andalusia's two main metropolitan areas –Malaga and Seville– which, despite their differences, exhibit synergies that contribute to the socio-economic development of the region. As we proceed to characterize these areas, it is pertinent to mention the Andalusian Government's ongoing efforts in infrastructure and transportation planning, up to the current PITMA 2030. This plan emphasizes sustainable mobility, not just theoretically but through committed implementation of less polluting transport options (rail, bicycles, and walking) and various intermodality strategies (Ventura & Gavira, 2022).

### 3. SPATIAL SCOPE AND APPLIED METHODOLOGY

After selecting the two spatial areas for this study on Spatial Big Data, we proceeded to define their precise boundaries. As previously noted, there is no official demarcation for either area. Ultimately, we decided to use the boundaries outlined in the land-use plans currently in force: the Malaga Urban Agglomeration and the Seville Urban Agglomeration.

The primary units for both areas are the municipalities – 16 in Malaga and 46 in Seville. However, due to concerns about statistical secrecy, MITMS does not always provide data at this level of administrative detail. Instead, it sometimes groups two or more contiguous municipalities into what are referred to as Municipal Groupings (MAs).

In the case of Seville, there was no need to extend the already large spatial framework of the study (almost 4,500 km<sup>2</sup>). For Malaga, however, the initially planned 13 municipalities were increased by three to address the aforementioned issues, as indicated by diagonal lines on the corresponding orthophoto.

A further step involved subdividing both areas to facilitate a deeper analysis of the internal flows occurring within them. For Seville, we adopted the existing geographical subdivision used by Sierra (2020). In contrast, for Malaga, we applied the same criteria but developed our own subdivision.

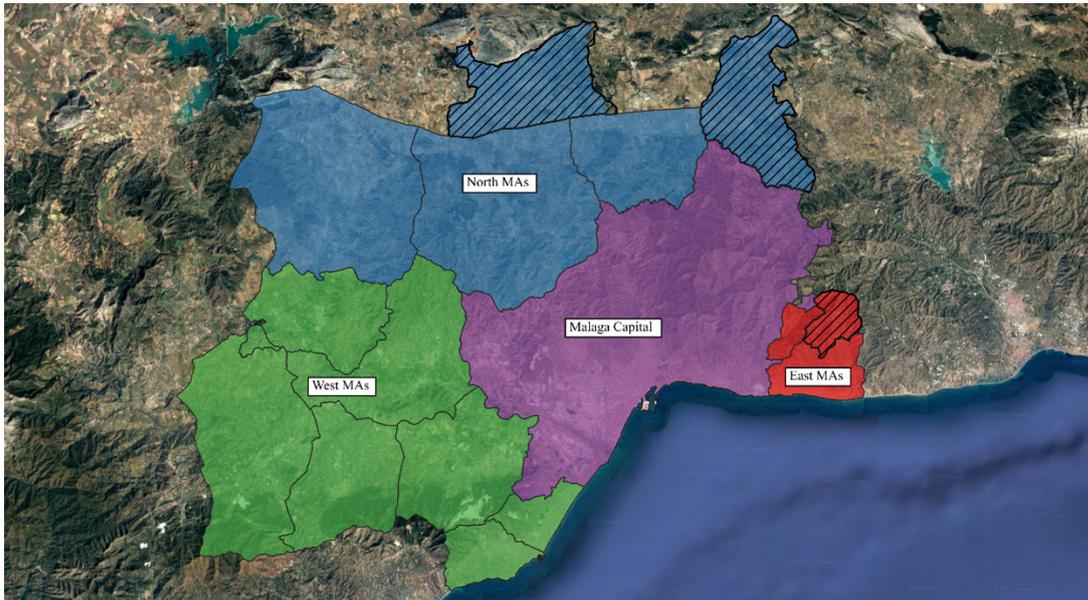


Figure 1. Study area of the Urban Agglomeration of Malaga with delimitation of its municipalities and subdivisions applied. Source: own elaboration based on the *Plan de Ordenación del Territorio de la Aglomeración Urbana de Málaga* and the demarcations used in MITMS's *Estudio de la movilidad con Big Data*.

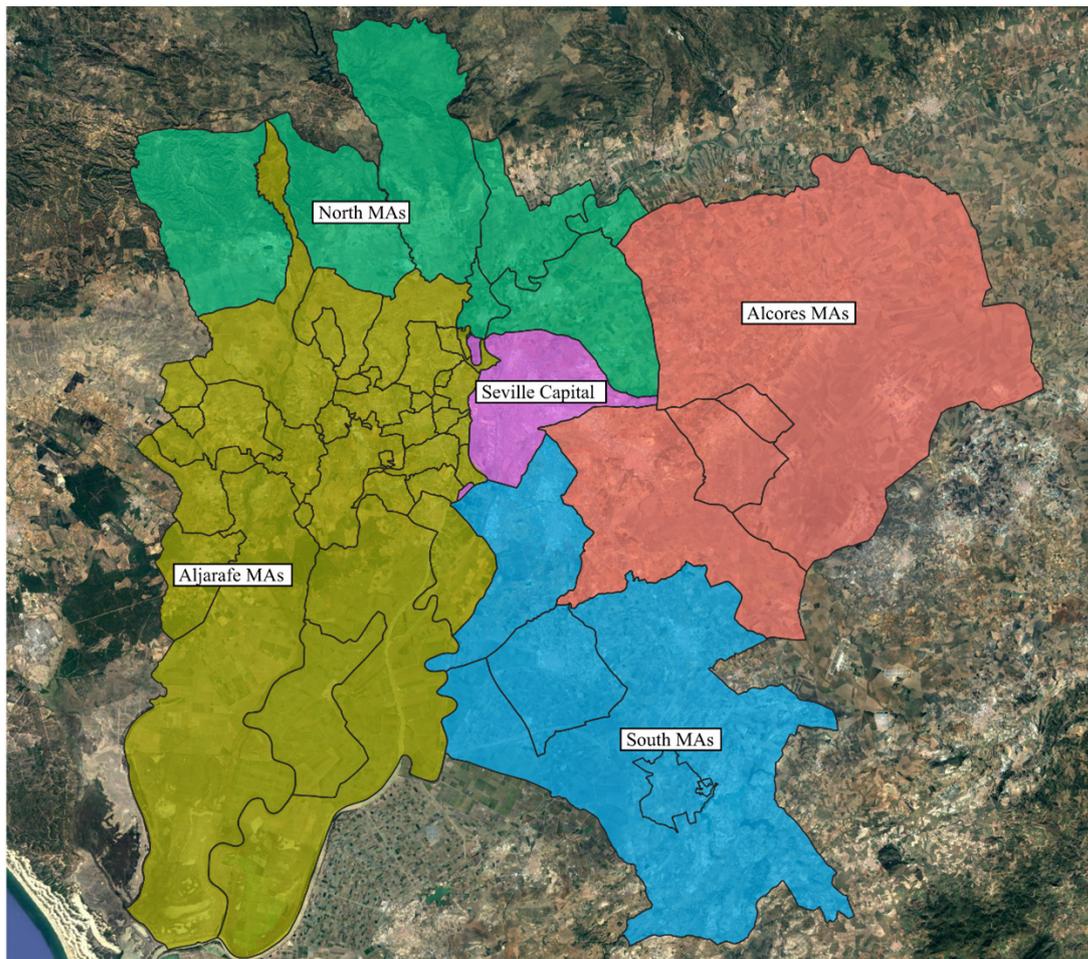


Figure 2. Study area of the Urban Agglomeration of Seville with delimitation of its municipalities and subdivisions applied. Source: own elaboration based on the *Plan de Ordenación del Territorio de la Aglomeración Urbana de Sevilla* and the demarcations used in MITMS's *Estudio de la movilidad con Big Data*.

After identifying the municipalities comprising the urban agglomerations of Malaga and Seville, we accessed relevant mobility datasets from the Ministry of Transport and Sustainable Mobility (MITMS), available in <https://www.mitma.es/ministerio/proyectos-singulares/estudio-de-movilidad-con-big-data>. These datasets, provided daily in CSV format, cover a full calendar year from January 1, 2022, to December 31, 2022. To handle the data more efficiently, we automated the process using an RStudio script, converting file encoding to UTF-8 and changing file extensions to .TXT. This modification facilitated the processing of approximately 420 million records.

We then used the R programming environment to consolidate these files into a database, leveraging R's capabilities for robust data handling and advanced statistical analysis. Data manipulation and visualization were performed to analyze mobility patterns, focusing on municipalities within the defined urban agglomerations.

To prepare the data for cartographic representation, we first mapped each record to its respective municipal code, assigning a corresponding polygon for spatial representation. We also implemented an automatic function to calculate the geographic centroids for each movement, enhancing the data with precise latitude and longitude coordinates.

As the study progressed, we developed additional scripts to track wider mobility flows between the urban agglomerations and other Spanish peninsular municipalities. This included implementing a one-way hash function to ensure uniform data inclusion and correct anomalies caused by encoding discrepancies during data integration.

For the spatial analysis, we utilized Geographic Information Systems (GIS). Initially, QGIS was employed to create layers depicting flows between origins and destinations, directly linked to the database via pgAdmin4. For more sophisticated processing, ArcGIS was utilized due to its extensive analytical tools. Alongside GIS, RStats was used for creating advanced graphical visualizations, handling the large datasets effectively.

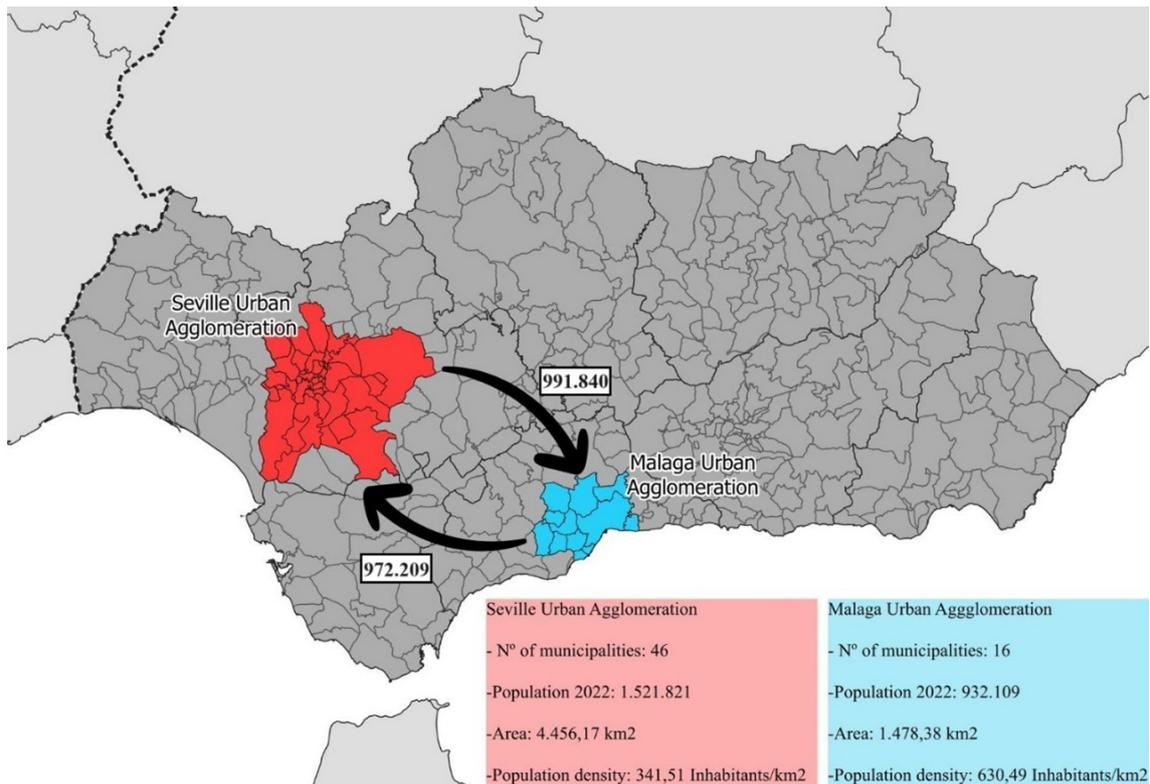
In conclusion, integrating GIS with spatial databases has significantly enhanced our analysis, allowing for efficient management and high-accuracy storage of extensive data. This methodological approach has been crucial for thoroughly examining mobility within and beyond the urban agglomerations of Malaga and Seville, providing insights at provincial, regional, and national levels.

## 4. ANALYSIS OF THE RESULTS

Mobility serves as the vital pulse of metropolitan entities, capturing the intricate interconnections among their various areas and the dynamics of population movements. This section delves into the travel patterns within the urban agglomerations of Malaga and Seville, utilizing data from MITMS's *Estudio de la movilidad con Big Data* and additional information from the Instituto de Estadística y Cartografía de Andalucía (IECA). Specifically, we leverage resources from its *Sistema de Información Multiterritorial de Andalucía* (SIMA) and *Datos Espaciales de Referencia de Andalucía* (DERA). Our detailed analysis will explore how mobility flows influence daily life in these regions and assess their implications for territorial development planning and broader regional strategies.

### 4.1. INTER-URBAN MOBILITY

Analyzing the data presented in Figure 3, we observe that the metropolitan area of Seville has a population of 1,521,821 and spans an area of 4,456.17 km<sup>2</sup>, resulting in a population density of 341.51 inhabitants per km<sup>2</sup>. In contrast, the metropolitan area of Malaga, with a population



**Figure 3. Inter-agglomeration urban flows.**

Source: own elaboration based on MITMS's *Estudio de la movilidad con Big Data* with its corresponding demarcations and information from the IECA.

of 932,109 over an area of 1,478.38 km<sup>2</sup>, exhibits a significantly higher density of 630.49 inhabitants per km<sup>2</sup>. This marked difference in density indicates that Malaga is more urbanized or at least has a higher concentration of population, nearly double that of Seville.

Regarding commuting flows, the map reveals substantial movement between the two metropolitan areas. In 2022, there were 991,840 trips from Seville to Malaga and 972,209 in the opposite direction. The similar magnitude of these figures suggests a balanced interaction between the two areas, indicating that the number of people traveling from Seville to Malaga closely matches those traveling from Malaga to Seville.

This equilibrium in commuting flows may suggest comparable job opportunities, educational facilities, general services, and cultural and leisure attractions in both metropolitan areas, fostering an equitable population exchange. It might also reflect the presence of networks (primarily economic) that link the two areas and promote mobility between these two functional spaces.

From a planning and development perspective, the travel data between Seville and Malaga highlight the necessity for efficient transport infrastructure that moves beyond costly and unsuccessful projects, such as the high-speed rail link between Malaga and Seville (Romero *et al.*, 2018). Such infrastructure should support the high volumes of human mobility observed. The significant travel volume in both directions suggests that any investment in enhancing connectivity would benefit not only the residents of the main cities but also positively impact the wider metropolitan populations.

Lastly, the higher population density in Malaga, combined with the nearly balanced commuting flows between the areas, poses challenges related to urban congestion and strain on public services. These issues should be addressed in medium to long-term planning to ensure sustainable growth and development of both areas, while maintaining a high quality of life for their residents.

## 4.2. INTRA-URBAN MOBILITY

The data presented in Figure 4 illustrate the annual commuting patterns within the Seville Urban Agglomeration, depicted through a histogram that captures the frequency of commuting between different subareas of the agglomeration. This histogram reveals a dominant trend of internal movements within Seville city itself, totaling over 500 million trips per year. This significant number highlights Seville as the primary hub of activity within the agglomeration. In contrast, the number of trips from the capital to surrounding metropolitan areas such as Aljarafe, Alcores, North, and South is markedly lower, yet still substantial, with figures ranging from approximately 14 to 45 million trips annually.

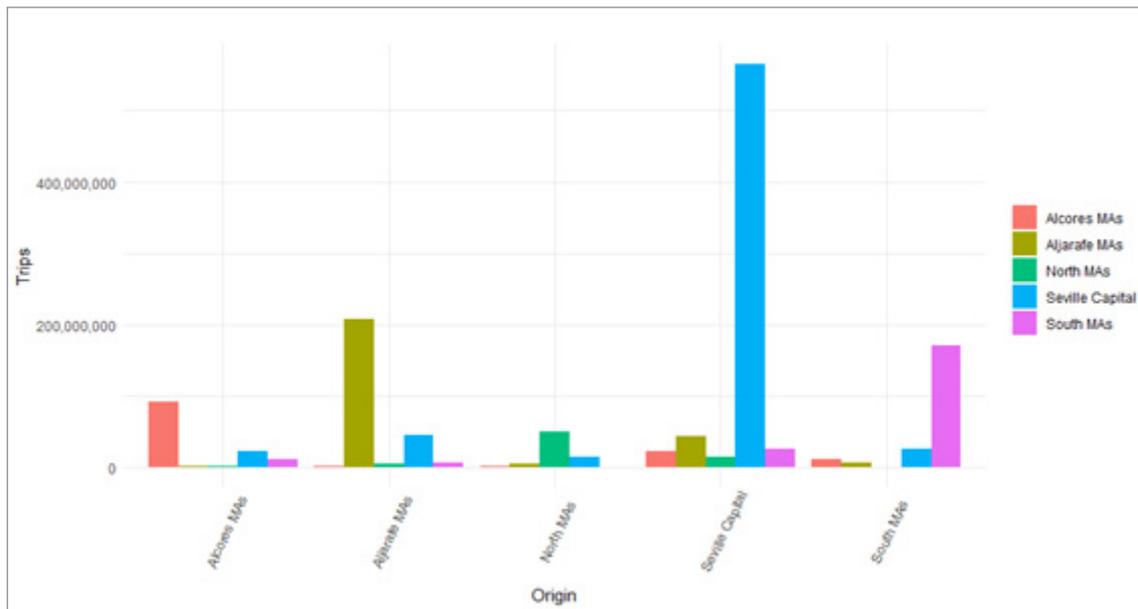


Figure 4. Annual trips (2022) within the Seville Urban Agglomeration.

Source: own elaboration based on data from MITMS's *Estudio de la movilidad con Big Data*.

Significantly, the Aljarafe area not only exhibits a high number of internal movements, with 208,532,525 trips, but also maintains considerable commuting flows with Seville city (44,250,271 trips to Seville and 45,250,532 trips in the opposite direction). These figures highlight Aljarafe's role as a key residential and commercial suburb, historically part of Seville and now a major contributor to the agglomeration's dynamics, with strong pendular connectivity underscoring the mutual dependency between these areas (Braçe, 2018).

Similarly, the North and South metropolitan sectors also demonstrate significant mobility, recording 49,773,599 and 170,861,421 annual trips, respectively. This suggests robust service and employment infrastructures within these areas that drive high internal mobility.

The commuting patterns in Los Alcores mirror those of Aljarafe, with a substantial volume of internal movements totaling 91,792,291 trips, and considerable flows towards Seville city amounting to 22,331,617 trips. This reinforces the concept of interconnectedness and dependency of the surrounding metropolitan areas on Seville for services and employment.

Overall, this analysis reveals that Seville city stands as the central hub of its urban agglomeration, commanding significant commuting flows to and from its surrounding areas. These patterns support a centralized urban model, where the capital functions as the principal economic, cultural, and administrative center, shaping mobility across the agglomeration. For urban planners and policymakers, further dissecting these data at the level of municipal districts and groupings within metropolitan areas, similar to the approach by Gutiérrez and García-Palomares (2007), would be crucial. It would provide a detailed understanding of mobility patterns, essential for informed decision-making in transport, urban planning, and public service provision.

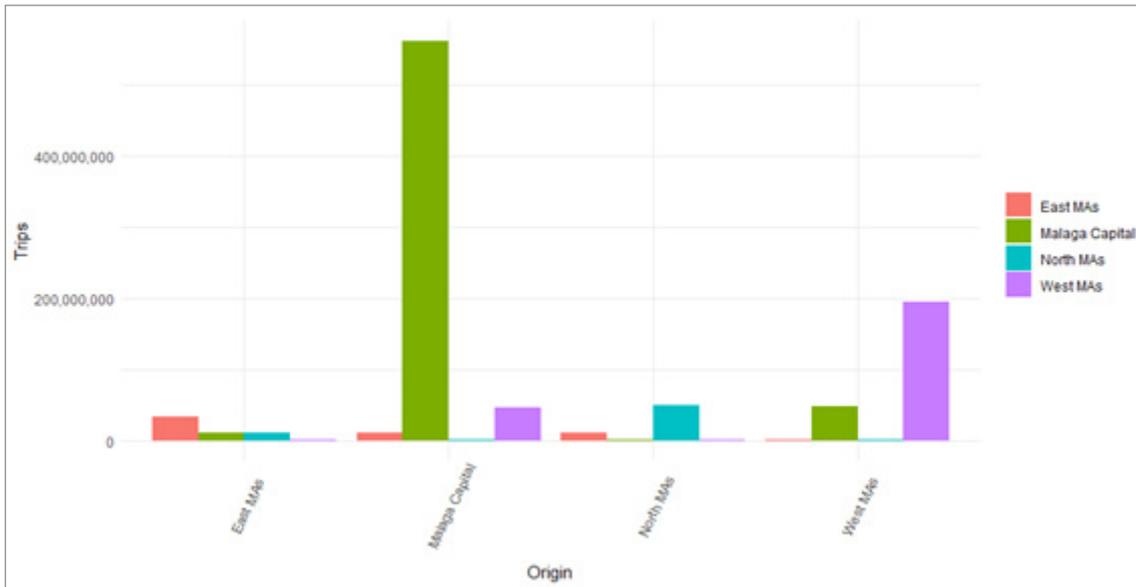


Figure 5. Annual trips (2022) within the Malaga Urban Agglomeration.

Source: own elaboration based on data from MITMS's *Estudio de la movilidad con Big Data*.

The data depicted in Figure 5 illustrates the annual travel patterns within the urban agglomeration of Malaga. A histogram analysis reveals a trend similar to that observed in Seville, with a significant predominance of trips within the city of Malaga itself, exceeding 561 million trips annually. This underscores the centrality of the capital in mobility terms and indicates a high density of activities and services that stimulate these internal movements.

Examining the distribution of trips emanating from Malaga city to surrounding areas, the majority are directed towards the West, with over 47 million trips. In contrast, journeys to the East and North are considerably less frequent, with approximately 10.8 million and 790,000 annual trips, respectively. This trend suggests that the Western area, extending towards central Costa del Sol (Marbella), hosts significant attractions, including employment, educational, and recreational centers, necessitating substantial mobility from the capital.

Moreover, substantial internal commuting is evident in other sub-districts such as the North and West, with 49.7 million and 195 million trips respectively. This suggests a more dispersed urbanization structure compared to Seville, with a mobility network that supports extensive internal commuting.

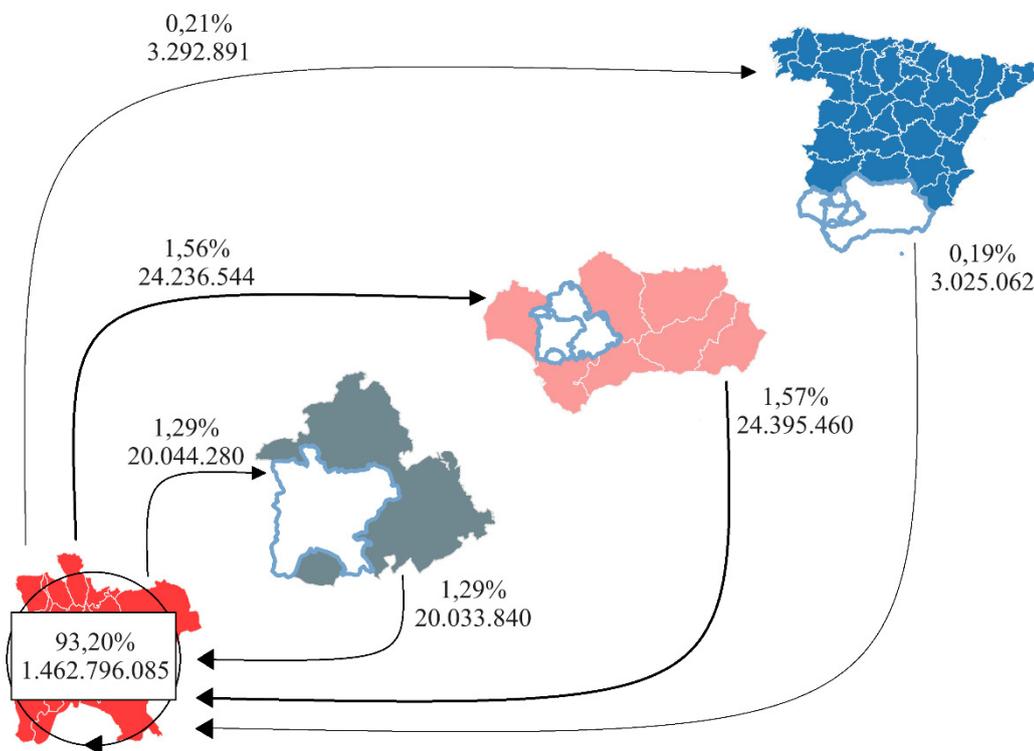
While connectivity between subareas is notable, it is less pronounced than the internal trips. For example, the North interacts with the West and East, though these numbers are relatively modest compared to internal flows. The East displays a similar pattern, with a significant volume of intra-East travel and lesser movements to other sub-areas.

This data is crucial for understanding Malaga's mobility dynamics and plays a vital role in transport planning and urban development. The centrality of Malaga city, along with significant mobility within and between neighboring subareas, should be carefully considered in developing transport policies and planning future infrastructure. Additionally, these mobility patterns are integral to urban sustainability planning. Efforts to reduce congestion and greenhouse gas emissions, as well as to improve residents' quality of life by ensuring access to essential services and better employment opportunities, must align with these observed trends.

### 4.3. SCALAR MOBILITY OF URBAN AGGLOMERATIONS

The first diagram (Figure 6) illustrates the hierarchy and dynamics of mobility within the Seville Urban Agglomeration. The travel flows depicted reveal a strong predominance of movements within the metropolitan area, indicating a high level of intra-urban activity.

Specifically, more than 1,462 million trips, representing 93.20% of all travel originating in or destined for one of the municipalities within the agglomeration, underscore the vibrant daily life of its residents. These journeys predominantly involve commuting to work, educational and health facilities, shopping centers, and other services.



**Figure 6. Scalar mobility diagram of the Seville Urban Agglomeration.**  
Source: own elaboration based on MITMS's *Estudio de la movilidad con Big Data*.

In terms of journeys from the Seville Urban Agglomeration to the rest of the province, around 20.04 million trips were made, highlighting substantial interactions between the metropolitan and provincial areas. These trips typically involve work, leisure, and accessing services not available within the metropolitan confines.

The flow of trips to the other seven provinces of the Region of Andalusia is slightly higher, totaling more than 24.23 million trips. This underscores the regional connectivity and the importance of the Seville metropolitan area as a key economic and social hub for much of Andalusia.

Conversely, trips to the rest of mainland Spain are considerably fewer, with only 3.29 million trips recorded. This indicates that the interconnection between the Seville metropolis and other Spanish regions is markedly less intense compared to its links within its own province and region.

Looking from the opposite direction, the Seville area receives significant inbound trips. It attracts more than 3 million trips from the rest of mainland Spain—slightly less than the number of outbound trips. From the Region of Andalusia, it receives over 24.39 million trips, a figure that closely mirrors the outbound trips. Similarly, the inflow from the province of Seville is nearly equal to the outflow, with approximately 20.03 million trips.

Overall, these mobility patterns emphasize the role of the Seville Urban Agglomeration as a central gravitational force within its province and, to a lesser extent, across the Region of Andalusia, acting as a primary hub for attracting and distributing trips.

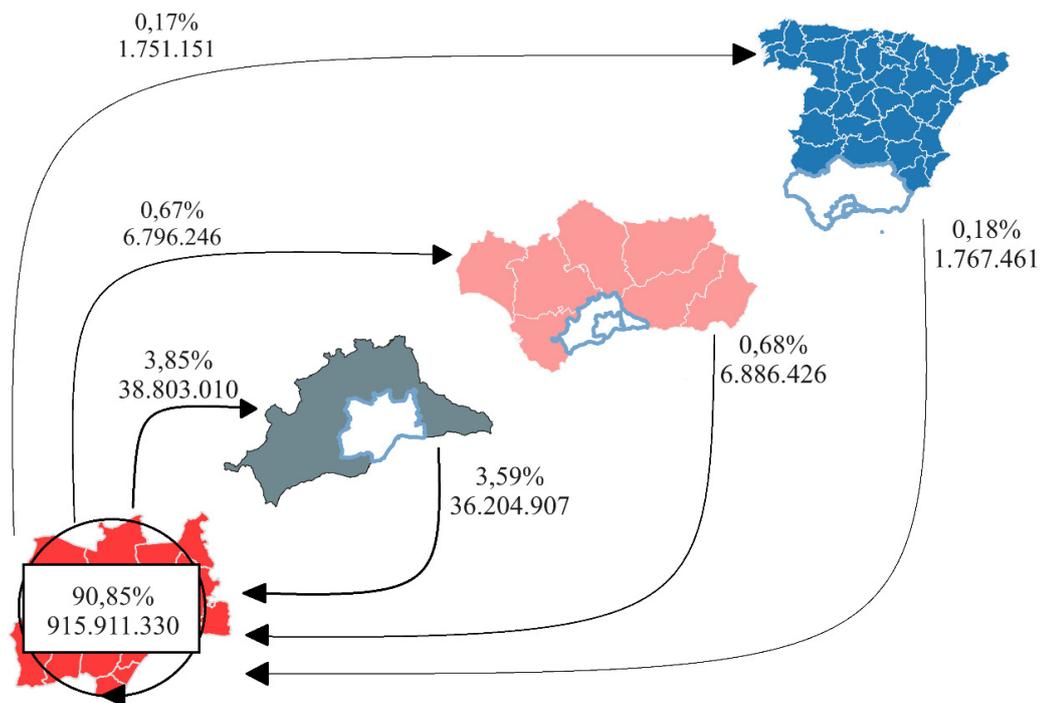


Figure 7. Scalar mobility diagram of the Malaga Urban Agglomeration.  
Source: own elaboration based on MITMS's *Estudio de la movilidad con Big Data*.

The graph (Figure 7) presents a flow diagram that highlights travel patterns at various scales around the Malaga Urban Agglomeration. The central node, highlighted in red, captures 90.85% of all trips, totaling 915.9 million. This intense activity within the metropolitan area reflects a robust urban fabric where high mobility demands are driven by daily activities such as work, education, health, and leisure.

The transfer of trips from the Urban Agglomeration of Malaga to the rest of the province is noteworthy, accounting for approximately 38.8 million trips. This flow indicates a symbiotic relationship between the metropolis and its broader province, likely spurred by employment, specialized services, and cultural events accessible from the metropolitan center.

Conversely, trips to the other seven provinces of the Region of Andalusia are significantly lower, with about 6.8 million trips, demonstrating a reduced regional influence of this metropolitan area, particularly in comparison to its provincial impact.

The flow toward the rest of mainland Spain is smaller still, at around 1.75 million trips, highlighting the Urban Agglomeration of Malaga's more limited interaction with other Spanish regions due to its geographical position and the presence of more consolidated urban centers elsewhere that serve as major connection or destination nodes.

In the opposite direction, the Urban Agglomeration of Malaga receives 1.76 million trips from the rest of Spain and 6.89 million from other provinces within Andalusia. These figures reflect Malaga's attractiveness beyond its immediate surroundings, influenced by its economic, touristic, and cultural significance as a gateway in the Andalusian region, albeit to a lesser extent compared to the regional capital, Seville.

Finally, the influx of approximately 36.2 million trips from the rest of Malaga province to its metropolitan area underscores a strong mutual dependency, likely driven by employment opportunities, higher education<sup>2</sup>, and centralized services within the metropolis. This pattern affirms the centrality of Malaga within its provincial context, with more modest interactions at the regional and national levels.

<sup>2</sup> This assertion is supported by the anticipated increase in the number of private universities within the Malaga urban agglomeration, rising to three, in contrast to Seville, where two such institutions are expected to be established in the medium term.

## 5. DISCUSSION OF THE RESULTS

The recent integration of massive data from diverse sources has dramatically enhanced our understanding of population movements across territories. This paradigm shift has revolutionized urban and rural dynamics analysis, significantly influencing transport planning, public policy design, and the examination of socio-economic patterns. The approach is now pervasive across various sectors, including urban planning, spatial planning, marketing, and public health, enabling more informed decision-making.

Since 2017, MITMS has utilized mobile phone data, a practice that became particularly critical during the COVID-19 pandemic. The real-time tracking and analysis of population movements proved invaluable for managing health emergencies, containing virus outbreaks, and planning resource allocation. This crisis underscored the importance of understanding and predicting human movements to enforce quarantines effectively and strategize the phased reopening of activities.

The study in question stems from a ministerial agreement with the telecom operator Orange, which holds a significant but not exhaustive market share of 27.3% in Spain (Ministerio de Fomento, 2019). This public-private partnership exemplifies how telecommunications data, while respecting privacy and data protection laws, can serve the public good.

The data's daily frequency and detailed origin-destination matrix offer considerable potential despite the complexity of its processing. Advanced tools like Machine Learning and Geographic Information Systems (GIS) enhance the precision of insights into human behavioral patterns. In Spain, the focus is not just on population settlements but more granular administrative units like municipalities.

For statistical secrecy, it's often necessary to group these units into Municipal Groupings (MAs), reducing the granularity. For example, while INE recognizes 8,129 municipalities, MITMS works with 2,735 municipal groupings, a reduction of 66.35%. This trend is less pronounced in Andalusia due to the larger population size of its municipal units –out of 786 municipalities, only 463 are identified by MITMS, a reduction of 41.09%. Additionally, Spatial Big Data can integrate data from other sources, such as social media platforms like Twitter (now X), enriching the analytical landscape. This integration allows for the exploration of correlations between different behaviors and phenomena, providing a deeper layer of insight into how people communicate and move.

The ongoing advancements in data acquisition and analysis technologies herald even greater potential for future studies of spatial phenomena. Big data analytics opens up new possibilities for understanding the complex interplay between spaces and societies, paving the way for novel research avenues, technological advancements, and strategic decision-making across a broad spectrum of disciplines.

## 6. CONCLUSIONS

This research utilizes Spatial Big Data to analyze mobility within the main Andalusian urban agglomerations, Malaga and Seville, which display metropolitan characteristics despite lacking formal administrative recognition. The application of geospatial data dissects the complex dynamics of urban and metropolitan regions, offering insights for more effective management of these territories and their resources, critical in an era of increasing urbanization and climate change challenges.

Both agglomerations are interrelated, aiming to enhance regional synergies, yet they exhibit distinct characteristics. Malaga is more of a conurbation extending towards the coast, whereas Seville, the capital of Andalusia, demonstrates a different influence on the surrounding provinces, with significant seasonal movements affecting the coastal regions of Cadiz and Huelva. These movements are not limited to demographic shifts but also involve cultural, commercial, and service exchanges, impacting the infrastructural and economic landscape of the affected areas.

Seville, situated in the Guadalquivir Valley, acts as a cultural and economic nexus for the region, attracting resources and individuals, particularly from its western sector. Malaga, with its mild climate and coastal location, serves as a pivotal tourism and leisure destination, contributing to its economic vitality but also presenting sustainability challenges. Collectively, these dynamics enhance the cultural and economic diversity of Andalusia, presenting a complex array of challenges and opportunities.

The study further explores the movement patterns within these metropolitanized spaces, emphasizing the centrality of the capital cities. By leveraging Spatial Big Data, this research identifies these urban centers as pivotal economic and cultural engines, facilitating the understanding of their roles and projecting future needs and trends.

Due to data limitations, the analysis is confined to municipalities and municipal groupings, with a need for traditional data sources for more detailed insights at smaller geographic scales. However, ongoing technological advancements are likely to yield more granular data, enhancing the precision of future analyses for stakeholders in urban and regional research. This field is poised for a transformative integration of varied data sources and analytical methods, from IoT to AI, aiming for a dynamic and holistic understanding of urban territories.

Overall, the information gleaned from this study is invaluable for urban and regional planners, impacting the development of transportation infrastructures, urban mobility policies, and the planning of services and resources, ultimately improving the quality of life for residents and mitigating environmental impacts related to mobility.

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