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Impact of the COVID-19 Pandemic on Tourism: A Clustering Approach for the Spanish Tourism Analysis

Nerea Ríos Rodríguez, Ana Nieto Masot * and Gema Cárdenas Alonso

Department of Art and Territorial Sciences, University of Extremadura, 10003 Cáceres, Spain; nerearios@unex.es (N.R.R.); gemacardenas@unex.es (G.C.A.)
* Correspondence: ananieto@unex.es

Abstract: Since the middle of the last century, the Spanish tourism sector has experienced significant growth, which was interrupted by the effects of the COVID-19 pandemic. This situation had a considerable impact on Spain, as the country is a leading world tourism destination and relies heavily on this sector in its economy, making it vulnerable when demand for tourism services declines. The tourism model in Spain is not homogeneous, and the Mediterranean coastal regions and island areas are highly dependent on tourism as a main source of economic income and were particularly affected by the consequences of the pandemic. This study analyzes the impact of the pandemic on the tourism sector in each Spanish autonomous community, focusing on tourism demand through the use of Geographic Information Systems (GIS). The results reveal the disparity and vulnerability of Spanish regions to the tourism crisis. The most tourist-dependent areas dependent on international tourism have experienced a decline due to restrictions and a fall in demand. On the other hand, rural regions that depend mainly on national tourism have suffered fewer effects.

Keywords: travelers; tourist accommodation; geographic information systems; Spain

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1. Introduction

The COVID-19 pandemic has had a significant impact on all countries in the world, and Spain has been no exception. As a result, the Spanish economy has been particularly affected by its high dependence on the tourism sector. Spain is one of the most popular tourist destinations in the world and receives millions of visitors each year, which contributes greatly to its economy [1,2]. In 2019, Spain received more than 83 million travelers, making it one of the most important tourist destinations in the world. It occupied the second position in the ranking of international tourist arrivals, followed by France with 89 million travelers, according to the World Tourism Organization (UNWTO). This activity has established itself as one of the main economic resources due to its weight in both GDP and employment. In 2019, the weight of the tourism sector in the Gross Domestic Product (GDP) increased to 12.4% (154,487 million euros), and it accounted for almost 13% (2.72 million jobs) of employment throughout the country, according to data from the Tourism Satellite Account of the National Institute of Statistics (NIS) [3].

In order to study the current situation, it is necessary to know that tourism is an economic sector of great importance that has undergone significant development throughout history. In the mid-20th century, tourism established itself as a mass phenomenon. Several factors contributed to the growth and development of tourism at that time. Firstly, there were developments in transport, such as the expansion of road networks and the improvement of air and sea transport systems. Secondly, political and economic stability after the Second World War allowed more people to have the opportunity to travel. The growth of the middle class and the increase in disposable income but played an important role in the development of mass tourism [4,5].

Taking into account these events, Spain took advantage of the opportunity and made significant changes in order to adapt and develop its tourism sector. Over the last few

years, the tourism sector in Spain has undergone significant transformations to adapt to the changing needs and demands of travelers. During the 1960s, Spain began to be recognized as a popular tourist destination, attracting a large number of international visitors, especially with the tourism model known as "sun and beach," which took advantage of Spain's favorable geographical conditions. However, in the late 1980s and early 1990s, the uncontrolled increase in the number of tourists in specific tourist destinations caused problems of overcrowding and deterioration in the quality of services, and this model began to deteriorate [6]. Coastal areas suffered a crisis due to saturation and a lack of diversification in the tourist offer. This situation led to a re-evaluation of the Spanish tourism model and the search for new strategies to attract travelers. New preferences emerged among tourists, who began to look for short-stay trips in destinations close to cities and in less transformed spaces, such as rural and natural areas [7–9]. In response to these changes, the Spanish tourism sector has sought to diversify its offer, promoting cultural tourism, rural tourism, gastronomic tourism, and other forms of thematic tourism [10–12]. Furthermore, policies and strategies have been implemented to preserve and promote cultural heritage, encourage more sustainable and environmentally responsible tourism [7,11,13], and generate new tourist activities.

These changes in the tourism sector led to an increase in tourism in the interior of the country, where a tourist experience away from the coastal areas is promoted and where cultural and natural heritage and resources are valued [14,15]. This led to the development of new tourist destinations characterized by a low degree of transformation of the territory and a wide variety of natural and cultural sites. This strategy has made it possible to diversify the tourist offer, break with seasonality, and extend it to the interior of the country [16–18].

The problem of mass tourism has led to the search for a more sustainable approach, both in environmental and social terms. Today's tourists are looking for more meaningful travel experiences, that allow them to connect emotionally with the destination, its history, its people, and its culture. It is therefore increasingly important for tourism providers to understand how travel can offer a new and authentic perspective on the world around us, as this is what is in demand today. This is why new forms of tourism, such as experiential tourism [19], have emerged to complement traditional tourism offerings, offering unique experiences where tourists can actively participate, immerse themselves in the local culture, and connect more deeply with the destination.

Among the destinations that experienced benefits due to changes in tourist habits are rural areas. These regions have seen tourism as a strategic opportunity to boost their economic development and generate wealth. In particular, rural tourism emerged as a complementary activity to agricultural activities, especially in areas affected by depopulation and the crisis in their productive model. Rural tourism enabled the economic growth and revitalization of disadvantaged or isolated areas, as well as the maintenance or even growth of the local population. These areas, facing difficulties due to a lack of employment and the decline of traditional economic activity, have found in rural tourism a way to generate complementary income and take advantage of the attractions of these areas, such as natural landscapes, cultural traditions, and the tranquility of the rural environment [20]. This has attracted visitors seeking to escape urban agglomerations and enjoy authentic experiences in contact with nature and rural life.

However, despite the increase in tourism in rural and inland areas, the "sun and beach" tourism model is still predominant in Spain. Although tourism has increased in rural and inland areas, the sun and beach tourism model is still predominant in Spain, where it is overexploited and overcrowded in some destinations (Balearic Islands, several cities on the Mediterranean coast, such as Barcelona) [21]. For this reason, recent years have seen a strategic approach by rural and inland areas of the country to promote their tourist destinations based on their natural, heritage, and cultural resources. Although the sun and beach tourism model is still predominant, in recent years there has been a rediscovery of historic and heritage cities, attracting tourists interested in cultural tourism [22]. These

cities, which for a long time were in the shadow of sun and beach destinations, have gained prominence and have concentrated an important part of cultural tourism flows. This phenomenon has given rise to the emergence and growth of other tourism segments, such as nature tourism, water tourism, cultural tourism, business tourism, health tourism, gastronomic tourism, and astronomic tourism, among others. These segments complement sun and beach tourism and, in some cases, take advantage of the seasonal nature of the latter [7].

In accordance with what has been established and taking into account their different typologies, the tourism sector in Spain has a fundamental role in the country's economy, being one of the main economic drivers in terms of contribution to Gross Domestic Product (GDP) and employment generation [23,24]. In the year before the COVID-19 pandemic, tourism accounted for approximately 12.4% of GDP and employed around 13% of the total workforce in the country, according to data from the Tourism Satellite Account of the National Institute of Statistics (NIS). Considering the pandemic, Spanish tourism GDP fell by 59% in 2020 and increased by almost 51% in 2021. A clear example can be found in the Easter period (March and April) of 2019, which brought 12.8 million tourists to the country with an income of 13.1 billion euros, 6.4% more than in 2018 [25]. However, it should be noted that this activity was destabilized by the pandemic crisis (Figure 1). During the first half of 2020, Spain experienced a 72.4% decrease in the number of tourists compared to the same period of the previous year (Figure 1), according to data from the National Institute of Statistics. This drop was even more pronounced in the month of July, with a 75% decrease in tourist arrivals to our country [25].

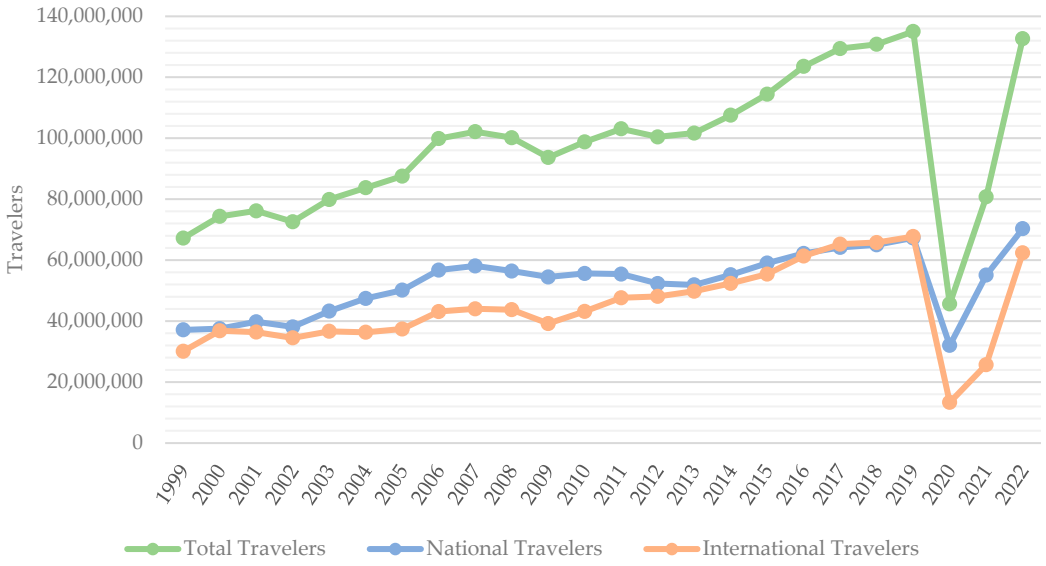


Figure 1. Evolution of total, national, and international travelers in Spain (1999–2022).

At this point, it is important to highlight that Spain has become one of the most important tourist destinations in the world, attracting millions of visitors every year. Its appeal is based on its favorable climatic conditions, its natural and cultural wealth, and its delicious gastronomy.

Impact of the Pandemic on the Tourism Sector: Initial Data and Research

The first studies carried out by the UNWTO on the impact of COVID-19 on the tourism sector showed that this health crisis is the one that has had the greatest impact on tourism in the last century. Both the public health consequences and the containment measures adopted by countries have led to significant travel disruptions and restrictions worldwide [2,26]. Thus, in the first months of the pandemic, from March to May 2020, all countries implemented some form of travel restriction. According to UNWTO data, 83% of destinations in Europe completely closed their borders to international tourism, while

in the Americas it was 80%, in Asia and the Pacific 70%, in the Middle East 62%, and in Africa 57% [27]. These restrictions had a drastic impact on global tourism, ranking 2020 as the worst year for the sector with a 74% drop in international arrivals, according to the UNWTO in its 2022 report [28]. This unprecedented decline in international travel had devastating consequences for tourism activity, including job losses and the bankruptcy of many tourism businesses.

The UNWTO stated that "the cooperation of the tourism sector will be vital to stop the spread of the virus and limit its impact on individuals and communities" [29]. Thus, the main consequence is the restriction of non-essential mobility, in addition to home confinement, to establish social distancing between people and thus prevent interaction. These measures led to the total paralysis of tourism activity, restricting the demand for tourism-related goods and services and making this productive sector one of the hardest hit by the impact of COVID-19, as stated by UNWTO Secretary-General Zurab Pololikashvili: "Tourism has been the sector hardest hit by this crisis because countries close borders and people stay at home" [27]. It is important to note that the impact of the health, economic, and social crises caused by COVID-19 has not been the same in all countries. Some countries, such as China, the United States, and Italy, which rely heavily on tourism as part of their economic model, have been particularly hard hit [30].

In the case of Spain, the COVID-19 pandemic brought all sectors and activities to a standstill, with the exception of essential basic services. In addition, borders between countries were closed, and the population had to comply with home confinement measures to control the spread of the virus, which implied limitations on the free movement of people.

For this reason, after the pandemic, over the last few years, it has become clear that, as Pitarch-Garrido [31] has shown, there are major differences in the tourism model according to the type of destination, which has conditioned the reception of travelers according to the type of accommodation offered and its characteristics. Thus, coastal destinations, which traditionally receive a high number of travelers, especially international travelers, have suffered a reduction in demand [32]. This is also the case in urban destinations, which have needed to improve their offer and adopt the necessary measures to guarantee optimum hygiene and safety conditions in order to attract travelers. In contrast, authors such as Agudo et al. [33] state that more than 30% of travelers surveyed in the Region of Murcia (Spain) undertook rural and nature tourism after the removal of mobility restrictions due to the pandemic. The same happened in the north of Extremadura, where, due to its rich natural heritage and the use made of it, during the summer period, the number of travelers increased compared to 2019 [34]. Benítez-Aurioles [35] establishes that there is a greater dynamism in rural tourism compared to urban tourism, at least in the high-season months (July, August, and September) during the years of the pandemic. This reflects how the less crowded destinations [36] have been able to adapt better to the existing demand in recent years [37–39].

In short, all tourist destinations have had to face a change in order to resist the effects of the pandemic, creating a more diversified and attractive offer so that travelers do not perceive health risks when making leisure trips.

Thus, in view of the above and following the lines of previous research [34,40], this study's main objective is to analyze the effect of the pandemic caused by COVID-19 on Spanish tourism activity, specifically by observing which types of accommodation in the Autonomous Community have been most affected by the health crisis in relation, moreover, to tourist demand. In addition, it seeks to identify the regions that have been most resilient to the closure of establishments due to the pandemic and those that are recovering most rapidly in the process of gradually returning to normality. The COVID-19 pandemic has had a significant impact on Spanish tourism, as travel restrictions, border closures [41], and social distancing measures have led to a drastic decrease in the number of tourists and the paralysis of a large part of tourism activity [42,43]. This has particularly affected certain tourist typologies and areas, such as mass tourism in sun and beach destinations, which have been severely affected due to cancelled bookings and a lack of demand. However, it

is important to note that some regions have been better able to withstand the effects of the pandemic and have experienced a more rapid recovery as progress has been made towards reopening [44]. In addition, these regions were less affected due to their lower independence from international tourism, in contrast to others where international travelers declined by up to 90% [40]. This may be due to a combination of factors, such as the diversification of their tourism offer, the promotion of alternative destinations, and the focus on more resilient tourism segments, such as rural tourism, nature tourism, or cultural tourism [33,39,45,46].

In order to achieve this objective, a methodology based on the assignment of spatial clusters has been developed, such as the Grouping Analysis, to form a model whose result serves to determine which Autonomous Communities have suffered the greatest impact of the pandemic and, consequently, which types of accommodation have been most affected. For this reason, Geographic Information Systems (GIS) have been used as a tool to obtain the appropriate cartographic outputs and carry out the necessary analysis to determine this impact.

Next, taking into account the above considerations, the materials and methods of this work are described, followed by Section 3, in which the results obtained are shown. These are discussed in Section 4, along with the conclusions extracted.

2. Materials and Methods

The methodology is one of the most important points for carrying out the research. The following figure (Figure 2) shows the steps followed to develop the study.

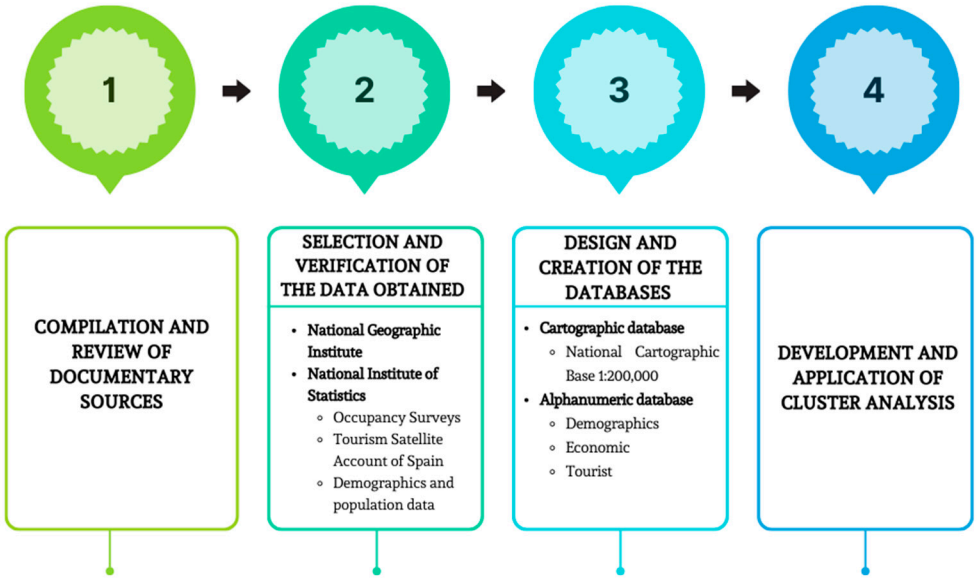


Figure 2. Methodological scheme.

2.1. Study Area

This research analyzes the 17 Autonomous Communities of Spain (Figure 3), whose territory extends over almost 506,000 km^2 with a population of 48,059,777 inhabitants in 2023. The population density is 94 inhabitants/km^2, which is lower than the European Union average of around 117 inhabitants/km^2.

Spain is characterized by a coastline with more than 9000 km of coastline and an average altitude of 660 m above sea level. It is a country with notable orographic contrasts due to the marked differences between the interior and the coast and the mountains and the valleys. Its geographical configuration revolves around a vast central plateau, surrounded by a mountain range known as the Sistema Central. The rest of the peninsular interior features coastal strips, the depressions of the Ebro and Guadalquivir rivers, the outer mountain systems of the Pyrenees, and the mountain systems of southern Andalucía.

Besides, there are two archipelagos, Islas Baleares and Islas Canarias, with very different characteristics due to their different geological origins.

Figure 3. Location of the study area.

The geographical characteristics described above have had a significant impact on the lifestyle, attractiveness, and development of tourism in the different regions of Spain. The coast has experienced greater economic growth, demographic dynamism, and tourism development due to its strategic location, as well as the historical development of commercial and industrial activities related to the sea. This growth was further boosted by the boom in sun and beach tourism, which has developed since the mid-20th century.

On the other hand, inland and mountain areas have traditionally suffered greater isolation due to their more adverse geographical conditions, less developed transportation, and, perhaps for this reason, less attractiveness to tourists. Nonetheless, tourism activity in the interior of Spain can be considered to be in the process of growth since the rural regions of the interior still depend to a large extent on the primary (agriculture and livestock) and secondary sectors. In summary, tourism in Spain has historically been focused on coastal areas due to their economic development and strategic location. However, efforts are being made to promote tourism in the peninsular hinterland and to improve transport infrastructure, recognizing the potential of these regions.

2.2. Database

Firstly, alphanumeric and cartographic information was collected on tourism supply and demand in the different Autonomous Communities of Spain, as well as their demographic and socio-economic characteristics. Subsequently, detailed information was compiled on tourism indicators, both on a quantitative and qualitative level, including data such as number of visitors, overnight stays, tourist expenditure, types of accommodation, and tourist activities, among others. In addition, relevant demographic and socio-economic data were used, such as population, employment, per capita income, and other factors that may influence the tourism sector. These variables were then analyzed in a general and descriptive way in order to understand the current situation of the Spanish tourism sector and its evolution over time. Trends, seasonal fluctuations, and possible correlations between variables were examined.

In the methodological process of this research, one of the fundamental points is the creation of cartographic and alphanumeric databases. This step involves reviewing and collecting information from relevant documentary sources and then selecting the data needed for the analysis. First, a thorough review of documentary sources that provide relevant information for the study was carried out [40,47]. This was followed by the selection of the data needed to construct the databases. It was therefore necessary to identify the key indicators and variables to be used in the analysis, as well as the criteria for the inclusion or exclusion of certain data. Once the data had been collected, the cartographic and alphanumeric databases were constructed. The cartographic databases contain geographic information such as coordinates, territorial boundaries, and thematic maps. On the other hand, alphanumeric databases would contain numerical and descriptive information related to the selected variables.

A cartographic database was created using the polygonal mapping layer of the Autonomous Communities obtained from the National Cartographic Base 1:200,000 (BCN200) provided by the National Geographic Institute of Spain. The tabular information corresponding to the 17 Autonomous Communities of the study area was extracted from this layer. The cartographic database was constructed using the geographical information of the Autonomous Communities derived from the cartographic layer. Using the polygonal cartography layer, a specific selection was made to include the 17 Autonomous Communities that make up the study area. Then, alphanumeric databases were designed and created according to demographic, economic, and tourism variables. These alphanumeric databases were designed to store and organize textual and numerical information related to various aspects relevant to the study.

With regard to the variables of the tourism sector, we have examined, firstly, tourism supply (places offered and staff employed) and, secondly, tourism demand (travelers and overnight stays), information provided by the NSI for the years 2019, 2020, 2021, and 2022. Tourism supply means the set of goods, services, products, resources, and infrastructure found in a given place and structured in a way that is available for consumption or use by tourists [48]. The NSI establishes as variables or indicators of tourism supply: the number of establishments, the degree of occupancy, the estimated bed places, and the staff employed.

Following the NSI methodology, the data referring to the Occupancy Surveys by type of accommodation have been used, establishing the following five typologies: hotel establishments, which include those classified as hotels, hotel flats or aparthotels, motels, hostels, pensions, inns, or guest houses; rural tourism accommodation: those establishments that are located in rural areas and which include rural flats, rural hotels, and rural houses; campsites: as those areas of land duly delimited, equipped and fitted out, intended to provide people with a place to live outdoors for a limited period of time for holiday or tourist purposes and using caravans, tents or other similar easily transportable elements as a residence; hostels: those establishments that offer the public the service of accommodation mainly in multiple rooms, with or without complementary services, and usually with the possibility of practicing some activity related to the environment; and, finally, tourist flats: considered to be any production unit whose exclusive or main activity is the accommodation of tourists, distributed in furnished units such as flats, chalets, villas, bungalows, etc. Finally, these five groups were grouped into three typologies: hotel, rural, and non-hotel.

On the other hand, tourism demand is the set of users or tourists who, individually or collectively, are motivated by a series of tourism products or services with the aim of covering their needs. Thus, a tourism user or tourist is considered to be the person who uses tourism establishments and goods or receives services offered by companies and who demands and enjoys them [48]. Moreover, according to the National Statistics Institute (NSI), a traveler is a person who travels to another place and stays at least one night. In this way, it differentiates between travelers and excursionists, whom it defines as those who travel but do not stay in the place of travel, also known as transient travelers.

As mentioned above, the tourism data were obtained from the NSI, specifically from the Occupancy Surveys of each of the accommodation typologies for the years 2019, 2020, 2021, and 2022, from which the different variables were elaborated (Table 1).

Table 1. Variables used in the research.

Typologies	Variables	
Demographics	Increase in the population of the study year (2019–2021) (2019–2022) Population in the year of study by Autonomous Community with respect to the total population	
Economic	Gross Domestic Product Tourism 2019	
Tourist	Variation of hotel travelers in the study year compared to 2019 (%) Variation of non-hotel travelers in the year of study with respect to 2019 (%) Variation of rural travelers in the study year compared to 2019 (%) Variation of national travelers in the year of study with respect to 2019 (%) Variation of international travelers in the study year compared to 2019 (%) Total travelers in the study year (%) Total overnights in the study year (%) Total places in the year of study (%) Total staff employed in the study year (%)	
	Travelers Overnight stays Places offered Staff employed	Per 1000 inhabitants in each year analyzed

In this way, the difference in national and international travelers in 2021 and 2022 with respect to 2019 was calculated in order to obtain the percentage loss of these travelers. In addition, the variation was calculated for each type of accommodation (hotel, non-hotel, and rural). It should be noted that they have been grouped into three typologies due to the fact that hostels and campsites are typologies with low numbers during this period, which is why they were included in non-hotel accommodation together with tourist flats. Then, joining all the typologies together, the percentage variation of the total number of travelers, overnight stays, estimated bed places, and staff employed was calculated for each category of tourist accommodation (hotel, non-hotel, and rural) and in terms of 1000 inhabitants, taking into account the total population of each Autonomous Community. Furthermore, as mentioned above, the variables were established in percentages and per inhabitant in order to standardize their importance; otherwise, it would not be possible to relate the influence of each of these variables in the different Spanish Autonomous Communities.

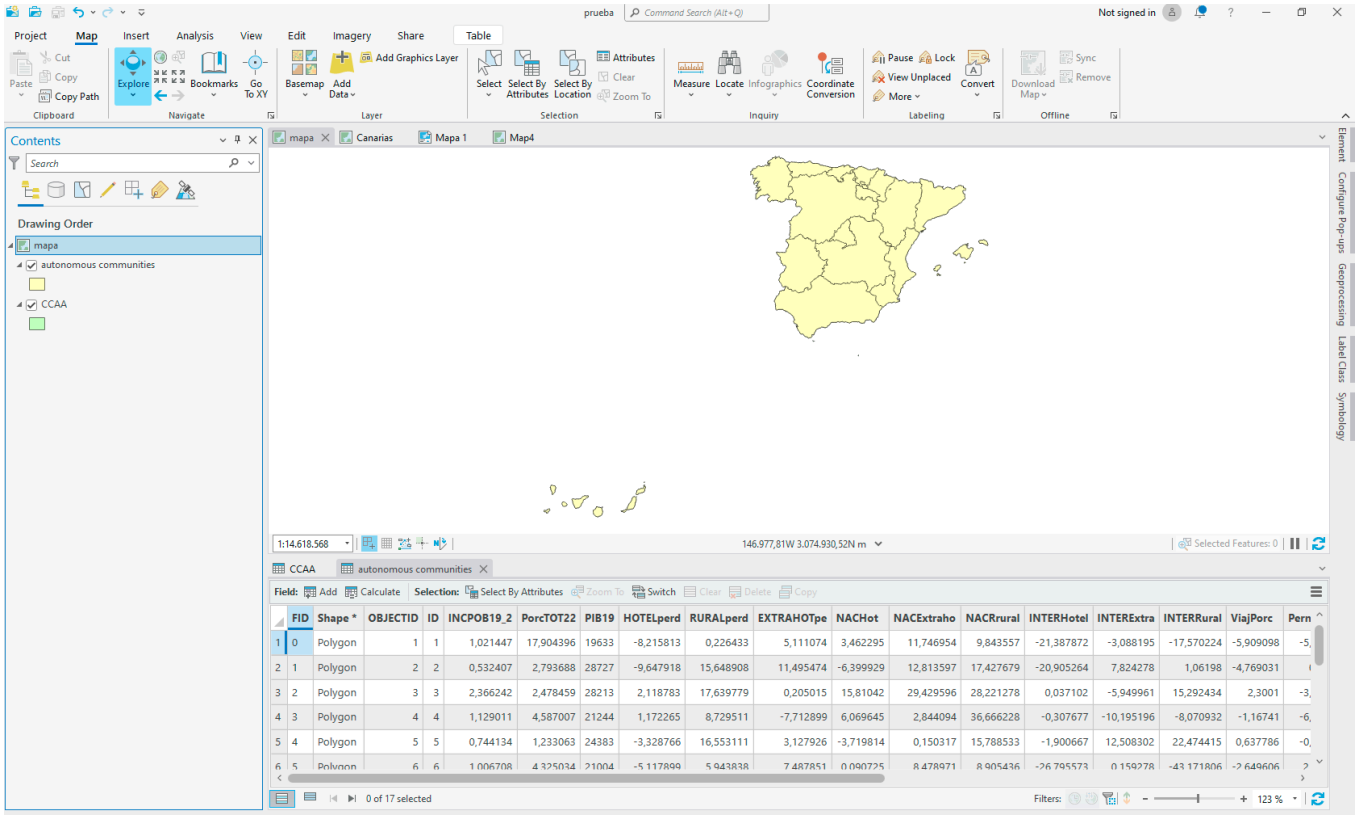
In order to obtain information on the socio-demographic characteristics of the Spanish population, population data and demographic censuses provided by the NSI were used. Two calculations were performed: first, the population of each Autonomous Community in the year corresponding to the study was determined in relation to the national total; and second, the population increase in each region was analyzed considering the existing population on 1 January 2021, and 2022, respectively, compared to the year prior to the start of the pandemic (2019).

Furthermore, the contribution of tourism to the Spanish economy was included in this study using the Gross Domestic Product (GDP) data corresponding to the year 2019 for each Autonomous Community. These data were obtained from the Tourism Satellite Account of Spain, published by the NSI [25].

This alphanumeric information was joined to the cartographic information for further analysis (Figure 4).

Next, a geostatistical analysis was carried out to identify spatial and regional patterns in tourism supply and demand. This involves the use of statistical techniques and cartographic tools to analyze the spatial distribution of the data and detect clustering or geographical dispersion. Taking into account that the focus of the study is on the impact of the COVID-19 pandemic on the Spanish tourism sector and to understand how the health

crisis has affected tourism supply and demand in different regions of the country, as well as to identify possible explanatory factors for these variations, a spatial analysis was carried out. It made it possible to examine geographical patterns and look for relationships between variables in order to obtain conclusions relevant to the tourism sector and contribute to the design of post-pandemic recovery and development strategies.



FID	Shape *	OBJECTID	ID	INCPOB19_2	PorcTOT22	PIB19	HOTELperd	RURALperd	EXTRAHOTpe	NACHot	NACExtraho	NACRrural	INTERHotel	INTERExtra	INTERRural	ViajPorc	Pern
0	Polygon	1	1	1,021447	17,904396	19633	-8,215813	0,226433	5,111074	3,462295	11,746954	9,843557	-21,387872	-3,088195	-17,570224	-5,909098	-5,
1	Polygon	2	2	0,532407	2,793688	28727	-9,647918	15,648908	11,495474	-6,399929	12,813597	17,427679	-20,905264	7,824278	1,06198	-4,769031	
2	Polygon	3	3	2,366242	2,478459	28213	2,118783	17,639779	0,205015	15,81042	29,429596	28,221278	0,037102	-5,949961	15,292434	2,3001	-3,
3	Polygon	4	4	1,129011	4,587007	21244	1,172265	8,729511	-7,712899	6,069645	2,844094	36,666228	-0,307677	-10,195196	-8,070932	-1,16741	-6,
4	Polygon	5	5	0,744134	1,233063	24383	-3,328766	16,553111	3,127926	-3,719814	0,150317	15,788533	-1,900667	12,508302	22,474415	0,637786	-0,
5	Polygon	6	6	1,006708	4,325034	21004	-5,117899	5,943838	7,487851	0,090725	8,478971	8,905436	-26,795573	0,159278	-43,171806	-2,649606	2

Figure 4. Polygonal layer of the Autonomous Communities with alphanumeric information.

2.3. Clustering Analysis

In order to achieve the proposed objective and to be able to understand the effects of the COVID-19 pandemic on the Spanish tourism sector, Grouping Analysis was used. This is a technique widely used in numerous scientific disciplines to address economic [49], social [50], spatial distribution of diseases [51,52], and even applied in tourism research [53–55], as in the case of this research.

This tool analyzes spatial entities and their characteristics by establishing groupings or clusters in the data in order to subsequently map the assignment of each entity to one of the established groups. This analysis aims to create groups with homogeneous patterns and, therefore, looks for similar characteristics between the variables used for each group that makes up the model.

All of this takes into account 100% of the variance, so that the groups are as homogeneous as possible. Homogeneity is based on the set of attributes selected for analysis and can also optionally incorporate spatial properties or spatio-temporal properties [56].

The clustering efficiency of each group was measured by the Caliński-Harabasz pseudo-F-statistic [57], which is a ratio reflecting within-group similarity and is expressed as:

$$\frac{\left(R^2/n_c - 1\right)}{\left(1 - R^2\right)/\left(n - n_c\right)}$$

where:

$$R^2 = \frac{SST - SSE}{SST}$$

SST is the total sum of squares obtained for the variable under consideration, reflecting the differences between the groups, while *SSE* is the explained sum of squares and shows the level of similarity within each group. These two parameters are calculated using the following formula:

$$SST = \sum_{i=1}^{n_c} \sum_{j=1}^{n_i} \sum_{v=1}^{n_v} \left(V_{ij}^k - \overline{V^k} \right)^2$$

$$SSE = \sum_{i=1}^{n_c} \sum_{j=1}^{n_i} \sum_{v=1}^{n_v} \left(V_{ij}^k - \overline{V_t^k} \right)^2$$

where n is the number of characteristics; n_i the number of characteristics in group i; n_c the number of groups; n_v the number of variables used; V_{ij}^k the value that the k-th variable acquires in the j-th characteristic within the i-th group; V^k, the average of the k-th variable; and V_t^k the average value of the k-th variable in group i.

Considering this and using ArcGIS 10.6 software, the cluster analysis has been performed following the established parameters of the K-means algorithm. In K-means clustering, a spatially unassigned method was used, i.e., without spatial restrictions, to ensure that data are clustered according to variables and without the influence of neighboring data, as would be the case if clustering methods with space-time restrictions were selected. The objective of the K-means algorithm is to divide the entities into smaller groups, identifying for them entities called "seeds." The selection of the first seed is random; however, for the selection of the remaining seeds, a weighting is applied that favors the selection of subsequent seeds (average values K++). After establishing these seeds, those closest in value to the data are identified to determine to which group each entity belongs. In this analysis, each group considers all the variance in the data set, which is an advantage compared to other correlational analyses. However, it should be noted that the main problem with clustering methods is that they are sensitive to slight changes in the sample [58].

In this research, different cluster values were selected until it was determined that obtaining four groups was the most optimal, taking into account their characteristics. The results were obtained for the Autonomous Community characterized by its central value; this value was established as a reference (ss_seed) for each of the four groups. Besides, it is necessary to know that for the development of this analysis, different time ranges were taken into account; finally, the periods from 2019 to 2021 and from 2019 to 2022 were used to compare and determine the current situation of tourism.

The previous standardization of the variables and the elaboration of the averages facilitated the study, as it made it possible to determine which variables best describe each group by identifying whether they are above or below the mean and the magnitude of their deviation.

3. Results

Firstly, the number of national and international travelers by autonomous community for the period 2019–2022 was analyzed in order to determine their evolution and the impact of the health crisis on tourism.

With regard to the impact of COVID-19, it is important to keep in mind that the pandemic has significantly affected the entire tourism and travel sectors in general. However, some autonomous communities may have experienced a greater impact due to various factors, such as dependence on international tourism, population density, or the implementation of stricter health restrictions and measures. Autonomous communities that depend heavily on international tourism, such as Islas Canarias, Islas Baleares, Cataluña, and Andalucía, are likely to have experienced a significant decrease in traveler arrivals during 2020 and 2021 due to travel restrictions and health-related concerns. In addition, Madrid, being the country's capital and one of Spain's main economic, business, and tourism hubs, may also have experienced a decrease in travelers due to mobility restrictions and limitations implemented to contain the transmission of the virus.

As for the last year of study (2022), the autonomous communities of La Rioja, Murcia, Navarre, and Extremadura continue to be the ones with the lowest number of travelers. The same happens with Cataluña, Andalucía, both islands, Madrid, and Valencia, which continue to top the ranking of regions that receive the highest number of travelers.

It should be noted that several autonomous communities in Spain have experienced an increase in the number of total travelers in 2022 compared to 2019 (Figure 5), based on inland rural tourism, including Murcia, Cantabria, and Asturias, with an increase of between 10,000 and 60,000 travelers. More notable figures, around 290,000 travelers, are shown in the increases in Islas Baleares, Navarra, and País Vasco; these last two regions, together with Galicia, have notably increased the number of travelers, which is largely due to the modification of the framework of the shelter occupancy survey of the National Institute of Statistics, going from only including hostels of the Spanish Youth Hostel Network to also including tourist hostels and pilgrim hostels on the Pilgrims' Route to Santiago de Compostela. Moreover, there are several Autonomous Communities that traditionally receive a higher number of international travelers than national travelers, such as Islas Canarias, Cataluña, and Islas Baleares. In the latter case, the Balearic Islands have managed to overcome the crisis (the high drop in international travelers caused by COVID).

After establishing an overview of the situation in terms of tourism demand at Autonomous Community level in Spain and the impact of the pandemic on them, the results obtained by assigning spatial groupings or clusters based on the analysis of groups are set out below. In view of this, previous analyses were carried out by selecting different cluster values until it was determined that obtaining four groups was the most optimal due to the number of variables used and the number of regions analyzed. These four groups bring together the 17 Autonomous Communities, and each one has homogeneous characteristics in terms of tourism, demographics, and socio-economic variables. The prior standardization of the variables and the elaboration of the averages facilitated the study, as it made it possible to determine which variables best describe each group by identifying whether they are above or below the mean and the magnitude of their deviation. For the development of this analysis, different time ranges were taken into account (2019–2020, 2020–2021, and 2019–2021), finally using the periods 2019–2021 and 2019–2022 to compare the tourism situation.

Firstly, the period 2019−2021 will be analyzed to find out which autonomous communities are most affected by COVID-19, and then, in a second study taking into account the period 2019–2022, to find out which of these regions have fully recovered with the new normality or have even surpassed the figures achieved in the record year for tourism data in Spain.

The following table (Table 2) shows the average values obtained for the different variables of each group for the period 2019–2021, as this information allows us to know the characteristics of each one.

Table 2. Cluster analysis groups and mean variables (2019–2021).

Variables	Group 1	Group 2	Group 3	Group 4
Population Growth (2019–2021)	1.5	1.1	−0.3	0.8
Population 2021 in relation to the total (%)	3.5	16.2	2.7	4.4
Gross Domestic Product Tourism 2019	24,728	28,888	24,149	26,315
Variation of hotel travelers (%)	−50.4	−48.4	−33.8	−34.0
Variation of non-hotel travelers (%)	−18.1	−22.2	−19.5	−30.5
Variation of rural travelers (%)	−50.8	−25.2	−8.6	8.5
Variation of national travelers (%)	−11.03	−20.49	−22.38	−18.29
Variation of international travelers (%)	−58.61	−67.39	−56.47	−52.70
Variation of total travelers (%)	−50.1	−44.8	−29.2	−28.2
Variation of total overnight stays (%)	−55.7	−45.1	−24.8	−26.4
Total places (%)	−37.3	−20.3	−16.0	−9.8
Total staff employed (%)	−45.1	−39.4	−21.4	−23.5
Travelers per-1000 inhabitants (2021)	4173	1531	1872	1367

Table 2. *Cont.*

Variables	Group 1	Group 2	Group 3	Group 4
Overnight stays per-1000 inhabitants (2021)	22,750	4330	4487	3486
Places offered per-1000 inhabitants (2021)	1497	436	556	432
Staff employed per-1000 inhabitants (2021)	199	32	46	30

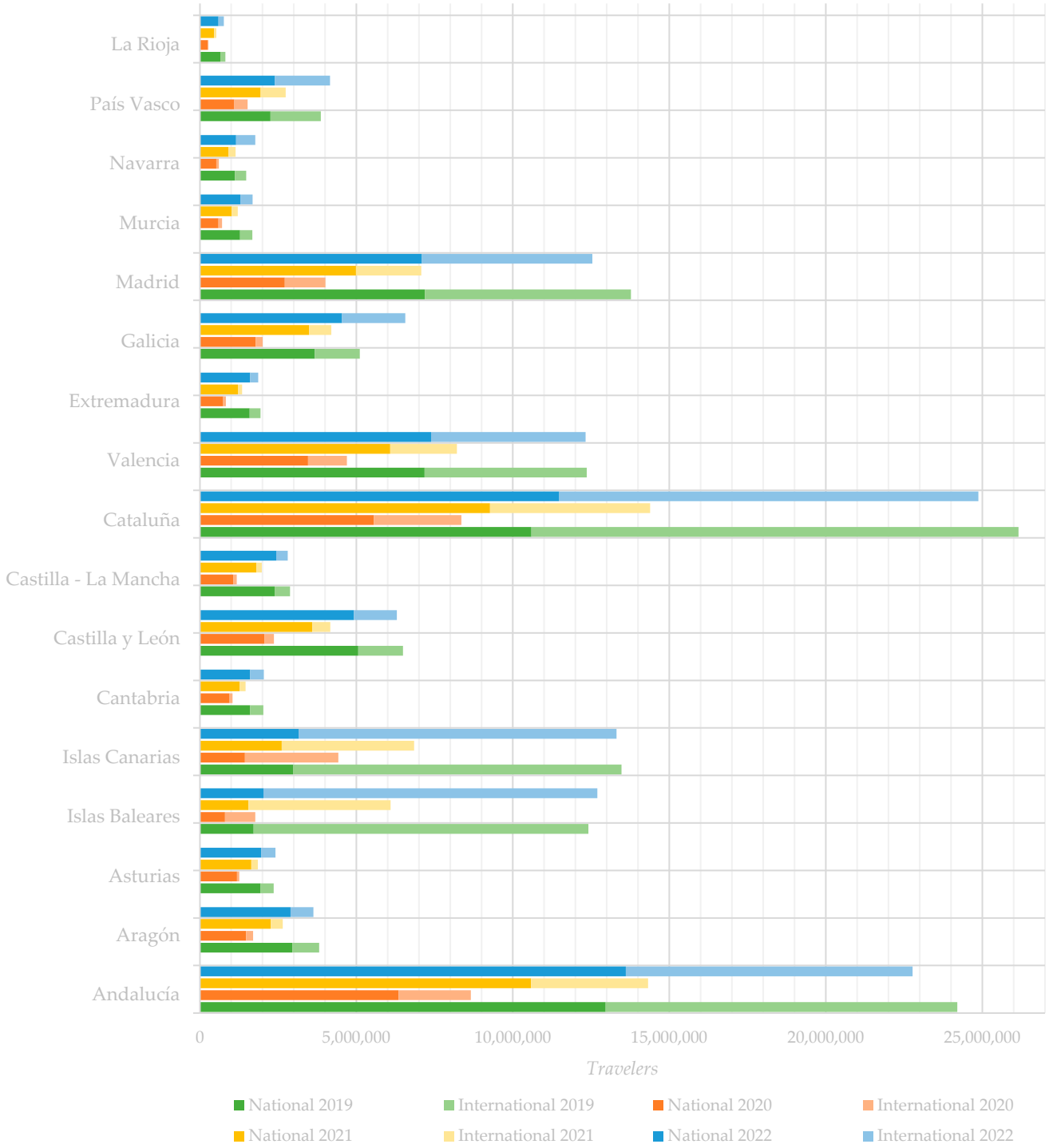


Figure 5. Number of national and international travelers by Autonomous Community (2019–2022).

The spatial distribution (Figure 6) of the groups is presented below:

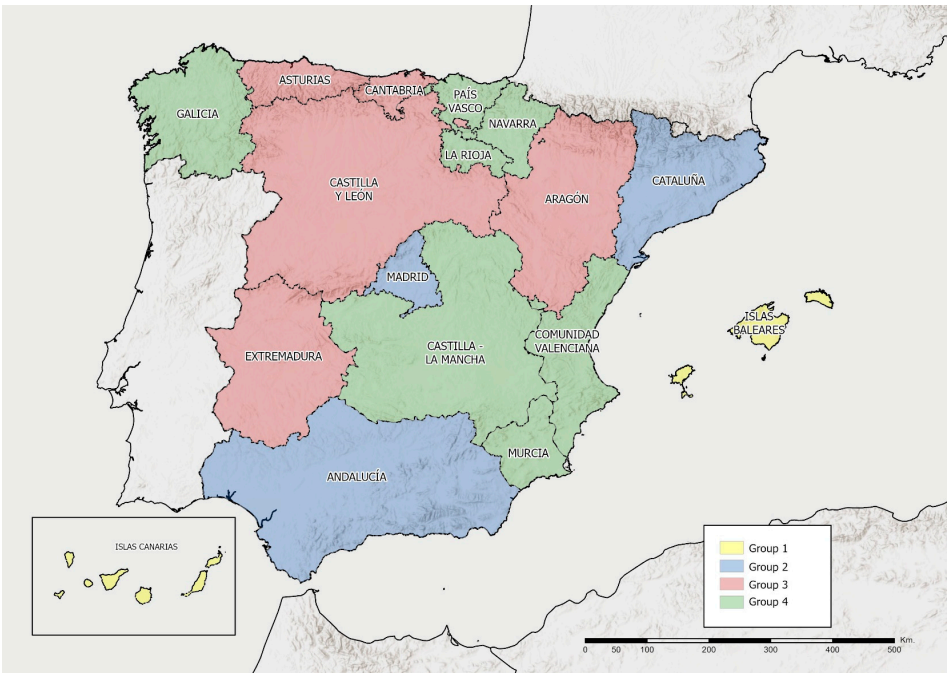


Figure 6. Map resulting from the clustering analysis (2019–2021).

As the previous map shows, Group 1 is formed by the archipelagos of Islas Canarias and Islas Baleares. Both share characteristics such as a strong dependence on the tourist sector, and as a result, the loss of travelers is over 50%. This reduction is accentuated in hotel accommodation (−50.4%) and non-hotel accommodation (−50.8%), mainly as a consequence of the decrease in the number of international travelers (from the main sending countries such as Germany and the United Kingdom, which together represent almost 50% of tourist arrivals to these islands). In the case of national travelers, they have increased their trips to non-hotel and rural accommodations, rising by almost 17% and 7%, respectively, compared to pre-pandemic levels. This reduction in total travelers is closely linked to the high loss of overnight stays, which exceeded 55%. Once the period of confinement was over and after the de-escalation process, these archipelagos received both national travelers from Autonomous Communities that began to allow their populations to travel and international travelers. Thus, in mid-October 2020, the governments of countries such as Germany and the United Kingdom once again allowed unrestricted travel to Islas Canarias, which led to an increase in the number of travelers after that date. In Islas Canarias and Islas Baleares, there is a great tourist attraction given their climatic conditions throughout the year, which is why almost 200 out of every thousand inhabitants are dedicated to the activity of tourist accommodation. Related to this is the high number of places offered in the total tourist accommodation, which is almost 1500 places per 1000 inhabitants. It is worth mentioning that, in these regions, there has been an increase in their population during the year 2021 based on the values of the year 2019, with an increase of up to 2% in Islas Baleares (the loss of tourism did not lead to a demographic decline). These two regions are the ones that have suffered the greatest losses in terms of travelers and overnight stays with respect to the original situation in 2019, as they are also the regions that are most dependent on the sector in their economies and are highly dependent on foreign tourism.

On the other hand, in Group 2, there are three Autonomous Communities, which are Andalucía, Cataluña, and Madrid. These regions will account for almost 48.4% of the total national population in 2021, an increase of 1.1% with respect to 2019; they also have a tourism GDP of over 29,000€ per capita (2019). In terms of tourism variables, these show a high loss in the number of travelers and overnight stays, with average values close to −45%. It is the group with the second highest loss of travelers (−44.8%) and overnight stays (−45.1%) since 2019. These losses are accentuated for travelers in hotel-type

accommodations, with a reduction of more than 48%, especially for international travelers, reaching values of around −68%. This decrease is due to the tourism pattern, mainly in Andalucía and Cataluña, as these coastal areas attract international tourism in hotel accommodation. In relation to this, many Spanish hotel companies were gradually forced to close their establishments as a result of the pandemic, which led to a reduction in the number of staff employed, falling by more than 60% by 2020. These regions present a model of sun and beach tourism similar to that developed in the island areas, although to a lesser extent (these are larger areas that offer a range of tourism models related to rural tourism, nature tourism, etc.). Furthermore, there is an excessive dependence on international tourism, as is the case in the islands. Therefore, although they have recovered with respect to the values reached in 2020 (which lost more than 67% of travelers and 69% of total overnight stays), their levels are still far from reaching pre-COVID-19 values. These are territories in which their economies have suffered severely, particularly in the tourism sector, from the consequences of the health crisis.

Next, Group 3 is made up of five regions: Aragón, Asturias, Castilla y León, Extremadura, and Cantabria. This group has recorded a slight loss of population (−0.3%), a trend that has been going on for decades, giving rise in some of its territories to the so-called "empty" or "depopulated" Spain. Regarding economic indicators, these regions have on average a lower GDP than the rest of the groups analyzed and are still highly dependent on a primary sector that does not generate sufficient economic income to sustain the population. With regard to the study of tourism variables, this group has suffered less from the effects of the health crisis on tourism, although they have reduced the number of travelers and overnight stays in all types of accommodations, also because their volume of travelers prior to the pandemic was not so significant. In this decrease, the most affected typology has been hotel accommodation, as it has been the worst adapted to the health crisis in all Spanish regions due to the confinement measures. The greatest loss is established in national travelers due to the fact that their tourism is based on the reception of this typology of travelers (these regions do not present either before or after the COVID high figures in international tourists; for example, in 2019, in Extremadura, these travelers only accounted for 0.5%, in Castilla y León, 2.1%, and in Aragón, 1.3%).

The regions in Group 3 are the third in terms of loss of travelers because, although they have lost national travelers, the drop in Spanish tourism has not been as drastic in comparison with international travelers. The pandemic restrictions have blocked the arrival of international travelers, and these measures have also meant that national travelers have not traveled to foreign countries. Moreover, these regions and this type of tourism have a type of accommodation that has allowed them to adapt better to the health, safety, and disease containment measures (rural houses where only one family stays, small tourist flats, etc.) compared to the large hotels near the coast, which have reduced their occupancy rate and, in many cases, have closed their establishments. In most of the inland regions, tourism has become one of the economic sectors that may prove to be key to their socio-economic development and slow down the demographic loss suffered by many areas. It should be pointed out that, although the number of travelers, overnight stays, and bed places is small in relation to the national total, when standardized in relation to the population, the figures are very high and increase the ratio, since we are in the so-called depopulated Spain; but on an overall level, they do not have enough appeal because there are still a small number of bed places and, consequently, a small number of travelers and overnight stays.

Lastly, Group 4 is formed by the largest number of Autonomous Communities, a total of seven: Castilla-La Mancha, Galicia, La Rioja, Murcia, Navarra, País Vasco, and Valencia. On the whole, this group is the one that has lost the least percentage of travelers, around −28%, but with almost identical values to the previous group (29% loss). La Rioja stands out, with the largest decrease of travelers in each type of tourist accommodation (hotel, non-hotel, and rural); in contrast, the smallest losses of travelers occurred in Galicia. This is mostly due to the modification of the survey carried out by the NSI, since in non-hotel accommodation, specifically hostels, previously only the hostels of the Spanish Youth

Hostel Network were included, and now it also includes tourist hostels and the pilgrims' hostels of the Camino de Santiago. Due to the fact that there is a greater offer in this typology, all of them linked to the accommodation of pilgrims who follow numerous routes, positive values have been obtained in terms of the variation in the number of travelers in non-hotel accommodation. Furthermore, analyzing the types of travelers separately, there is a marked decrease in international travelers in tourist accommodation; however, as in the previous group, the dependence on international travelers was not as high as in the sun and beach areas. Unlike the previous group, the reduction in international travelers and travelers staying in non-hotel establishments is more accentuated in the Mediterranean and Cantabrian regions, or regions with a strong influence of international travelers visiting the country's capital, as is the case in Castilla-La Mancha. Taking into account other types of accommodations, there is a greater reduction in the number of travelers received by hotel and non-hotel accommodations, which have suffered a reduction of around −30% since all the Autonomous Communities have suffered losses in this type of accommodation, reaching values of more than −42% in the case of La Rioja. As in the previous groups, most of the rural accommodation in the regions in this group has been able to adapt better to the health restrictions.

Thus, after the analysis carried out, it can be established that the regions most affected in the period 2019–2021 are those whose economies are highly dependent on tourism, such as the two archipelagos, the coastal communities such as Cataluña and Andalucía, and the capital of Spain, Madrid.

Following this analysis, a comparison was made between the data obtained in the period 2019–2021 and the pre-pandemic variation up to the current data (2019–2022) (Table 3). As a result of this comparison, a table was generated presenting the average values obtained.

Table 3. Cluster analysis groups and mean variables (2019–2022).

Variables	Group 1	Group 2	Group 3	Group 4
Population Growth (2019–2022)	1.7	1.7	−0.1	0.4
Population 2022 in relation to the total (%)	3.5	12.5	2.6	3.9
Gross Domestic Product Tourism 2019	24,729	26,303	24,279	30,052
Variation of hotel travelers (%)	1.6	−7.8	−6.1	−0.3
Variation of non-hotel travelers (%)	13.2	−16.4	−0.1	1.2
Variation of rural travelers (%)	−3.8	23.0	18.1	156.1
Variation of national travelers (%)	12.0	3.2	−1.5	11.2
Variation of international travelers (%)	−1.7	−11.0	−7.2	39.6
Variation of total travelers (%)	0.6	−3.9	−2.5	18.5
Variation of total overnight stays (%)	−5.3	−5.1	1.0	11.9
Total places (%)	−2.0	−1.8	0.3	7.2
Total staff employed (%)	−0.6	−7.3	1.3	0.8
Travelers per-1000 inhabitants (2022)	8454	2250	2402	2330
Overnight stays per-1000 inhabitants (2022)	48,519	7028	5421	4737
Places offered per-1000 inhabitants (2022)	2338	548	623	435
Staff employed per-1000 inhabitants (2022)	369	47	53	40

The table above shows the values of the variables for each of the groups. Comparing these values with the previous values (2019–2022), it can be seen that:

In Group 1 (Islas Baleares and Islas Canarias), most of the variables have experienced a slight increase. Population growth has increased to 1.7% (0.2% more than in the previous period), while the population in relation to the total has remained stable. In terms of tourism variables, a significant increase in the number of hotel travelers was noted, reaching 52%. Likewise, considerable increases were observed in the variation of non-hotel travelers (31.3%) and rural travelers (47%). This is why the total number of travelers has increased both from 2019 to the present (0.6%) and in comparison with the period previously analyzed (50.7%). In the rest of the variables (overnight stays, total bed places, and staff employed), although they have decreased with respect to 2019, the variation with respect to the previous

period is positive and growing, exceeding 35% in all cases. These data suggest a growth in the tourism industry and a higher growth of tourism in this group.

On the other hand, Group 2 (Andalucía, Cataluña, Madrid, Valencia, and Murcia) recorded a population growth of 0.6% over the period 2019−2021. However, in 2021, the population in relation to the total experienced a decrease of 3.7%. Although there was a 40.6% increase in hotel travelers, increases in other types of travelers were smaller, such as non-hotel travelers (5.8%) and rural travelers (48.2%). It is necessary to mention that the autonomous communities belonging to this group did not reach the international travelers obtained in 2019, and the same happens in hotel accommodations. Similarly, the rest of the variables experienced growth, although less significantly than in Group 1. However, in the case of autonomous communities such as Cataluña and Andalucía, they have once again been the regions with the highest number of travelers and overnight stays after the pandemic.

Next, Group 3 (Aragón, Asturias, Castilla y León, Castilla-La Mancha, La Rioja, Extremadura, and Cantabria) showed a population growth of 0.2% during the period 2019−2022. Increases were observed in the variation of all types of travelers, although to a lesser extent compared to the previous groups, without reaching 50% in any variable. The change in international travelers was 49.3%, while the change in total travelers was 26.7%. In this group, the figures for rural accommodation have increased, but in the rest of the typologies, they have not managed to reach the data for the year 2019.

Finally, Group 4 (Galicia, Navarra, and País Vasco) experienced a decrease in population of −0.4% over the period 2019−2022. In 2022, the population relative to the total also decreased by −0.5%. However, this group showed a significantly higher Tourism Gross Domestic Product than in the previous period. There were considerable increases in the variation of hotel travelers (33.7%), but more remarkable increases in other types of accommodation, such as rural accommodation, which increased by 147%. Mention should be made of the high growth in international travelers, which suggests that, despite the decline in population, tourism in Group 4 has been a strong economic sector and has attracted many international tourists. In the rest of the variables, taking into account the total value, these follow a very similar pattern to Group 2, except for the number of places offered, which has not increased as much.

The following map (Figure 7) shows each of the groups described above.

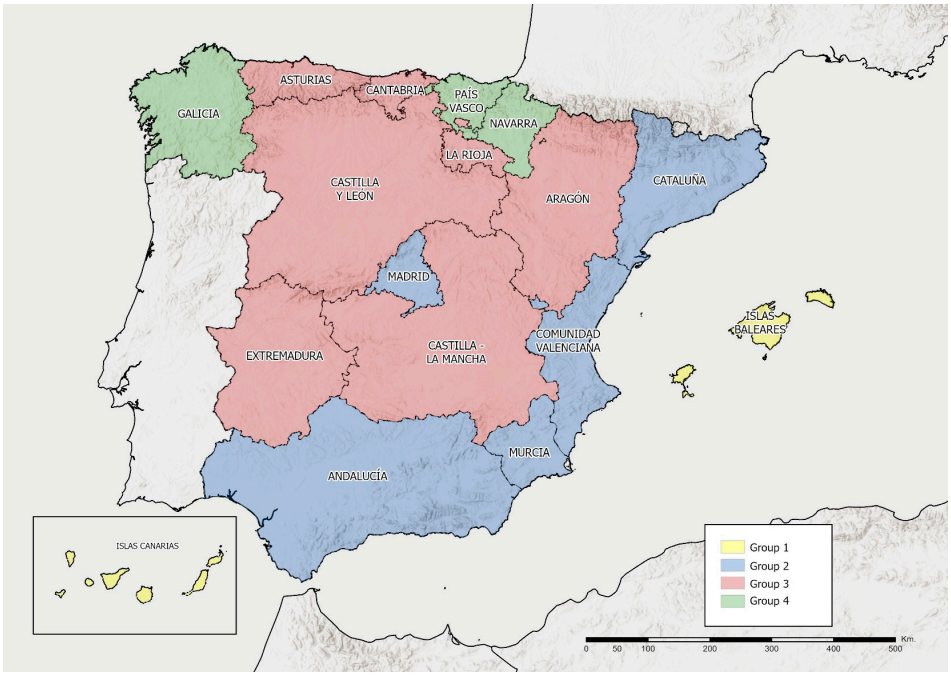


Figure 7. Map resulting from the clustering analysis (2019–2022).

4. Discussion and Conclusions

In Spain, tourism is a crucial economic sector; however, its development is not the same in all Spanish Autonomous Communities; this is due to the demographic, social, and economic structures and characteristics of each one. For this reason, there are several studies that analyze the impact of the pandemic from different perspectives [1,2], since the limitations and restrictions on population movement have drastically affected incomes, employment, and, as a consequence, the reduction in tourist flows, causing a large drop in the transit of travelers. In Spain, this high reduction in the number of travelers during the year 2020, specifically during the month of April (where the number of travelers fell to zero), led to the total or partial closure of numerous tourist accommodations, which generated a negative impact on the economy of the tourism sector, increasing the unemployment rate due to the temporary and, in many cases, even permanent loss of employment.

Therefore, this research has fulfilled the objectives set out through the methodology used, namely, the assignment of spatial clusters. This analysis is widely used in disciplines such as economics, sociology, health geography, and tourism, in other words, disciplines in which multivariate problems are covered, investigated, and evaluated on the basis of multi-criteria methods such as Grouping Analysis. It is remarkable the fact of its combination with Geographic Information Systems (GIS) tools, which are booming in recent years due to the territorial and spatial nature of the problems affecting the population today [59], as is clearly the impact of COVID-19.

The results obtained show that the regions have behaved differently with regard to the effects of the COVID-19 pandemic on their tourism sectors. These results reflect the disparity and vulnerability of the Spanish regions in the face of the tourism crisis, with more specialized areas linked to tourism suffering a decline caused by the limitations and the fall in demand from international travelers. This is the case of the Autonomous Communities in Groups 1 and 2, characterized on the one hand by sun and beach tourism and, on the other hand, Madrid, with the effect of being the capital of Spain, which has generated a dependence on international tourism, especially in hotel accommodation, which has led to a decrease in the number of vacancies and staff. The difference between the two groups is noteworthy since, in the case of the islands, the reduction in both national and international travelers was greater due to their dependence on air transport. Considering all this, it is worth mentioning that the impact in Group 1 was higher, as the tourism sector is their main source of income, while in the regions that make up Group 2, such as Cataluña and Madrid, they also have other sectors (industry or administrative services) that are fundamental to their economy. Taking into account this dependence and fall in international travelers, Arbulú [37] argues that simulations of tourism flow suggest that domestic tourism and the reorientation of outbound tourism can be a fruitful strategy to help the tourism sector survive a crisis when inbound tourism falls to zero.

The results of this study are similar to those reported by authors such as Benítez-Aurioles [38], who conclude that during the pandemic, the importance of domestic tourism has been reinforced, suggesting that international travel has been replaced by domestic travel and, especially, by travel within the autonomous community of residence. Zaar [39] establishes that a more sustainable model of tourism has been promoted, in which the main attractions are natural landscapes, the activities carried out in their surroundings, culture, art, local gastronomy, and the environment. Interrelated with these destinations, Moreno [45] states that in recent years tourism plans have been created, as well as marketing campaigns to diversify the tourist offer in Spain, which contribute to highlighting and increasing tourism in destinations that are emerging, which can lead to positive aspects such as an increase in the employability of these areas due to the economic growth that this can bring, as well as avoiding the depopulation that many of these rural areas are suffering. In addition, Méndez [43] argues that it is necessary to consider renewing the tourism sector in order to rejuvenate some destinations by means of an appropriate territorial reordering, to support innovative initiatives and the construction of local networks, as well as to make a more decisive commitment to forms of tourism that favor true territorial development.

On the other hand, according to our study, there are regions with more rural areas that receive mostly national tourism and have therefore suffered, to a lesser extent, from the effects of the crisis. This is the case for Groups 3 and 4, as they are not so dependent on tourism in their economies or on international tourism. They have suffered minor losses in the volume of travelers and overnight stays compared to Groups 1 and 2, and, moreover, to a much lesser extent in the variation of extra-hotel accommodation and rural tourism (it should be noted that in Group 4 there was an increase in travelers in rural tourism). It should be mentioned that, during the summer months of 2020, tourism activity was slightly reactivated, although due to new health concerns, travelers began to demand other types of destinations more related to nature, such as outdoor spaces, rural areas, inland tourism, and less crowded accommodation such as rural houses or flats, and the regions of Groups 3 and 4 benefited from this.

In the last variables analyzed, travelers, overnight stays, and supply in the last two years of the study, it can be determined that the regions that suffered the greatest negative consequences (Group 1 and Group 2) are recovering and are once again receiving large numbers of travelers at present, although some have not yet reached pre-pandemic levels. In the case of Groups 3 and 4, they lost fewer travelers but have not yet recovered their pre-pandemic (2019) levels, both in terms of the number of travelers and the importance of travelers in the economies of these regions.

Finally, it is necessary to reconsider: what if we suffer another crisis like the one we have gone through in recent years? According to the results, COVID-19 has not led to a change or rethink in the Spanish tourism development model. Today, it seems that a sustainable model is not being developed, as we are still developing, to a greater extent, an overcrowded sun and beach tourism industry with great saturation in many destinations. Therefore, in order to avoid suffering such a negative impact in the future, it is necessary to continue promoting and contributing to the activation and implementation of other destinations that favor sustainability and are more integrated with the environment, such as rural tourism, nature tourism, etc., which in most cases prefer to visit nearby areas, as well as the interest in getting to know the nearby cultural and natural heritage, in such a way as to promote the revitalization of areas that are traditionally not so touristy. By promoting and strengthening this type of tourism, it contributes to the resilience of the sector, reducing its dependence on international tourism flows and providing a solid base at the national level. Furthermore, by focusing on sustainability and integration with the natural and cultural environment, a more balanced and sustainable tourism development is ensured in the long term. To this end, the development of rural accommodation and extra-hotel accommodation options, such as campsites, should be promoted. These alternatives make it possible to diversify the tourist offer, attract different types of travelers, and generate a positive impact on the local economy.

As future lines of study, we intend to continue this study by analyzing recently updated data to determine whether the trends studied are maintained in future research. In addition to knowing if the evolution of tourism and its distribution will be similar in the next few years or if an increase in domestic tourism has developed in inland areas of our country.

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