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Edited by Rui Alexandre Castanho, Gualter Couto and Rossana Santos

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Chapter 2

The Most Meridional Border in Europe. Demographic and Environmental Changes

José Manuel Naranjo Gómez, Jacinto Garrido Velarde, José Martín Gallardo, José Manuel Jurado Almonte, Julian Mora Aliseda and José Cabezas Fernández

Abstract

Between 38°50′30"N/7° 04'35 W and 37°10′13"N/7°23′38"W has located the southernmost border of Europe, which stands apart from Portugal and Spain, which separates part of Portugal and Spain, making it one of the furthest from the central European area. A feature of this Spanish-Portuguese border stretch is that it is closely linked to the Guadiana River, one of the major waterways that cross the Iberian Peninsula from east to west. In 1998, the Albufeira Convention was signed, promoting Iberian cooperation at a scientific and technical level to strengthen the links of communication and collaboration at the technical level - the challenge of shared management of the waters and international basins that affect both countries. The Convention presented challenges and objectives on which the competent administrations have been working since then. Another peculiarity of this territory, except in a few situations, is its low population density. Therefore, knowing the demographic and environmental changes of the municipalities bordering the 'Raya' (common name as the border is known in these areas) constitutes valuable information that leads to the territorial management of these peripheral areas.

Keywords: cross-border, low population density, sustainability, landscape, development, tourism

1. Introduction

In a world that is increasingly global and dwarfed both in distance and socioeconomically, it is the cultural and economic interactions of the border territories that ensure the relations, continuity, and prosperity of its inhabitants [1]. The way of interpreting borders has evolved following the processes of geopolitical events that questioned them because alterations were caused in the context in which they were created and subsequently existed [2].

Research in various disciplines, from anthropology to geography, through economics, history, and even environmental matters, has revealed the constant flows that occur in border areas [3–5]. These movements are especially more palpable in third world countries, where the central power is less evident and it is the local powers that take the initiative and interact on both sides of the border [6]. In any

case, the generation of a border between two territories leads to a mismatch in many aspects such as political, cultural, linguistic, legal, economic, and ethnic, among others, as these territories remain under different orders [7].

This is the case of the line of separation between Spain and Portugal, the Spanish-Portuguese border, known as "La Raya or A Raia". It extends over 1214 km, being the longest of the European Union countries, and the oldest and most stable since it has undergone very few variations over the centuries of existence since the already distant treaties of Zamora (1143) and Alcañices (1297).

In its southernmost part, from the beginning of contact between the two countries with the Guadiana River (38° 50′30 "N / 7° 04′35), it begins to delimit a fluvial borderline, serving as such for the most of this lower section of the river, until it empties at 37° 10′13 "N / 7° 23′38" W. This portion of the border stands as the southernmost in Europe, which makes it one of the furthest from the central European area. A characteristic of this border section is that it is closely linked to the Guadiana River, one of the great watercourses that cross the Iberian Peninsula from east to west, serving as a physical separation between the populations on both sides, but also acting as a link between them for their peculiarities. In these territories, there are more pronounced linguistic contrasts than those detected further north, in the demarcation area between Portugal and the Spanish region of Galicia [8]. These differences have been losing strength as globalization, and especially European integration (1986), is leaving behind the old perception of the border as a wall, replacing it with a more current one in which they are seen as bridges that contribute to the cooperation, integration, and development [9–11].

The municipalities that border this border present eminently rural characteristics and a great demographic weakness that bears little relation to the current economic structure, which complicates their development [12]. The abandonment of the primary sector is a common process linked to industrialization, which is intensified in mountain areas, in areas settled on poor lands, and, in general, in border areas far from the decision-making and development centers of countries, currently constituting one of the main causes of landscape changes at the local scale [13]. These processes of abandonment of agricultural and livestock activities are spread worldwide [14, 15], appearing frequently in the Mediterranean basin during the last decades [16], linked to the decrease in population and, above all, in the labor force. Rural [17]. These series of circumstances often provoke complex phenomena that modify the regime in which disturbances in the landscape occur and are often overlooked in comparison with climate change and the fragmentation of the territory [18]. Among these disturbances we can consider the fires that, as has been observed in some abandoned territories, lead to increases in their frequency [16] and intensity, reaching in some areas up to more than twelve times the number registered before abandonment [19].

Even so, the alterations that abandonment is causing in ecosystems are not clear, in some cases it is causing a beneficial effect on diversity, but in other circumstances, this effect is the opposite, these changes being reflected in the heterogeneity of landscapes [20–24].

From both the continental and national or regional-local scales, the information obtained from land cover-uses and the evolution they suffer over the years is of primary interest to assess the impacts of anthropic pressures and incorporate them. in the organization and formulation of territorial policies. In this sense, and of great utility for this type of study, the CORINE Land Cover (CLC) is available, which is made up of a database of vector maps of the European territory, which it classifies into a series of homogeneous landscape units [25]. With a minimum mapping unit of 25 hectares and with a series of updates, four after the initial one, it stands

as a good study instrument for the evolution of landscapes at the different levels already indicated above from the supranational [26, 27] to the local [28, 29], passing through the national [30, 31] in very diverse aspects such as environmental, agricultural livestock, spatial planning or socioeconomic.

Border areas characterized by low population density, as is our field of study, face future challenges in which transformation and sustainability must be harmonized, allowing opportunities to be found by identifying changes and adaptations in the medium-long term together with balanced conservation [32, 33].

In 1998, the Albufeira Agreement was signed, promoting Iberian cooperation at the scientific and technical level to strengthen communication and collaboration ties in the challenge of shared management of waters and international basins that affect both countries. This agreement posed challenges and objectives on which the competent administrations have been working since then. Another peculiarity of this territory, except in a few situations, is its low population density, which has allowed many spaces to have high conservation values that allow their use as a resource to support other more traditional ones. Therefore, knowing the demographic and environmental changes of the municipalities bordering La Raya - A Raia and Bajo / Baixo Guadiana constitutes valuable information that leads to the territorial management of these peripheral areas.

2. Demographic evolution during the XXI century

The territorial scope established for this research includes a total of 38 municipalities, 15 of them in the Portuguese part (39.47%) and 23 (60.53%) in the Spanish (**Tables 1** and 2).

Portugal	Population 2019	Population 2011	Population 2001
Portalegre	22266	24789	25957
Elvas	20617	23000	23364
Vila Real de Sto. António	18819	19111	17981
Serpa	14339	15623	16705
Moura	13734	15091	16537
Reguengos de Monsaraz	10026	10815	11366
Vila Viçosa	7688	8306	8857
Mértola	6172	7226	8669
Campo Maior	7891	8449	8405
Castro Marim	6256	6695	6610
Alandroal	5028	5828	6554
Alcoutim	2202	2873	3743
Arronches	2840	3157	3381
Mourão	2453	2655	3204
Barrancos	1640	1822	1923
TOTAL inhabitants	141971	155440	163256

Source: National Institute of Statistics (Portugal).

Table 1.
Evolution of the number of inhabitants of the municipalities located in Portugal during the XXI century.

Spain	Population 2019	Population 2011	Population 2001
Badajoz	150702	151565	136319
Isla Cristina	21264	21903	18435
Ayamonte	20946	20763	17084
Olivenza	11963	12008	10739
Oliva de la Frontera	5137	5539	5933
Alburquerque	5343	5619	5605
Villanueva del Fresno	3397	3655	3487
Aroche	3073	3282	3446
Puebla de Guzmán	3073	3124	3220
Villanueva de los Castillejos	2820	2762	2672
La Codosera	2075	2320	2372
Alconchel	1680	1894	2069
Villablanca	2848	2916	2060
Rosal de la Frontera	1697	1913	1827
Encinasola	1305	1540	1772
Cheles	1176	1241	1323
Santa Bárbara de Casa	1035	1177	1312
Paymogo	1159	1308	1289
El Almendro	826	870	851
Valencia de Mombuey	744	809	811
San Silvestre de Guzmán	623	731	668
El Granado	516	567	653
Sanlúcar de Guadiana	409	440	381
TOTAL inhabitants	243811	247946	224328

Source: National Institute of Statistics (Spain).

Table 2.
Evolution of the number of inhabitants of border municipalities located in Spain during the XXI century.

If we carry out a detailed analysis of the municipalities located in the Portuguese territory, it stands out that from 2001 to 2019, 21,285 inhabitants have been lost (−13.03%). Especially striking are the cases of cities such as Portalegre, Elvas, or Moura with a population decline of between 2,000 and 3,000 inhabitants (**Table 1**). This shows a clear trend towards depopulation of these intermediate-scale municipalities.

However, if we analyze the 23 municipalities located in Spain, from 2001 to 2019 the population has grown by 19,483 inhabitants (+ 8.68%). However, if we analyze the data only from 2011, the last population census carried out in both countries concerning the 2019 data also shows a regressive trend (**Table 2**), which shows that as a whole the municipalities of The study area, especially as of 2011 on both sides of the borderline, shows a downward trend, although much more pronounced in the Portuguese part (**Tables 1** and **2**). These results coincide with the demographic predictions made by Mora, J. [34], where a trend towards the concentration of the population in large cities (Madrid and Lisbon, respectively) is confirmed, to the detriment of rural areas and even small cities and intermediate.

Population 2001
136319
18435
17084
10739
5933
5605
3487
3446
3220
2672
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2069
2060
1827
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3. Natural heritage

The study area is part of the Southwest of the Iberian Peninsula, a territory characterized by a series of environmental elements and processes that are described below.

The primeval Mediterranean forest, with large tree formations of holm oaks, cork oaks, gall oaks and oaks, is considered the starting stage from which the set of plant formations presently present in these border areas originated. It is not known exactly what the appearance of this immense quercine forest looked like, but it would have a different appearance than the current one, much more uniform and continuous, covering practically the entire surface considered and interrupting only in the few and temporary clearings caused by the natural fires [35].

Human pressure began to act on this pristine nature, intensifying with population growth, advances in the use of tools, as well as the use of fire to obtain pastures and farmland. These labors favored the development of the cork oak for its resistance to fire and the holm oak and wild olive for its fruits.

Subsequently, the anthropic pressure increased, appearing uses such as those aimed at obtaining fuels (charcoal and firewood), beekeeping, or livestock, which took advantage of the resources from the bushes generated with the thinning of the forests.

The areas of little slope and more fertile, although with still mediocre soils for cultivation, were transformed into pastures, mainly since the Middle Ages, completely eliminating the scrub and reducing the density of the trees. The pasture area was increased through logging and fire, maintaining it with the help of livestock pressure, resulting in a sabanoid-looking system in which the trees had much greater bearing and fruit production than those of the previous stage. The reduction practiced on the woody biomass with the elimination of the scrub and the thinning and pruning of the trees increases the livestock productivity of the system, channeling the photosynthetic activity towards the pastures and acorns, easy to collect and store, and with the added value of possess a high energy power. The holm oaks are pruned with a low cross, around two or three meters, and with two or three main branches tending horizontally, thus favoring the production of grasses and fruits. In the case of cork oaks, and especially those located in Portugal, the trend is towards verticality, guiding the trees with long shafts and branches, achieving higher production and quality of the cork.

The current olive groves are a typical case of the evolution of the wild olive meadows as their fruit acquires greater importance than the acorn. These pastures disappeared as such through an initial grafting process that preserved a random distribution, being later replaced by crops with a regular arrangement that facilitated the work. At present, only some wild olive meadows have been located in Portuguese territory. If the tree stratum was completely removed and the fertility of the soil was adequate, crops were made possible, the typical rainfed ones prevailing due to the climatic characteristics of the southwest of the peninsula. In these cultivated fields, the original woody vegetation is maintained on the borders in the form of hedges and in small areas that do not allow agricultural practices, forming the typical checkered landscape of the cultivated areas.

In other cases, the high requirement by certain industries (paper, wood, food industry) of vegetable raw material of a different nature to the native, led, especially in some periods, to an intense repopulation policy that promoted profound landscape and socio-economic changes. This is the case of the implantation of non-native species that gave rise to the eucaliptus and pine forests.

As a consequence, the following environmental units currently predominate:

- Holm oaks: The primitive structure of holm oak forest and very dense understory has survived to this day with a greater or lesser degree of transformation. It has the appearance of a set of tall, medium-density trees accompanied by a more or less dense shrub layer, made up of a great variety of scrub species.

- Cork oaks: This forest develops mainly on deep siliceous soils with precipitation higher than those registered in the holm oak areas, generally distributed in an altitudinal band higher than that occupied by the latter and / or in shady areas, with a lesser degree of insolation, replacing the holm oak forest.

- Forest repopulation: The forestry policies carried out in the area in past decades, of greater intensity in Portugal than in Spain, sometimes favored the replacement of natural vegetation by other.

- Riparian forest: The riparian vegetation constitutes one of the most interesting systems, both from the landscape and floristic point of view. As a whole, riparian forests can constitute edaphic climaxes, or serial stages in the course of the ecological succession, in which the degree of proximity to the water course and its characteristics influence in a special way, that is, if they are continuous or intermittent currents.

- Shrub formations: Within them, the jarales (areas dominated by *Cistus* spp.) stand out, which with their dense cover does not allow the development of herbaceous vegetation in lower strata. Heaths (*Erica arborea* formations) also appear, characteristically on acid substrates and which develop especially after the disappearance of the cork and oak forests. Retamares (*Retama sphaerocarpa* areas) are linked and favored by livestock farms, presenting a lower density than jarales and heaths. Finally, we have the so-called nanomatorral, located in soils with high degradation and stoniness.

- Herbaceous formations: All the vegetation formations described, both arboreal and shrub, are always accompanied by a more or less relevant herbaceous layer. The pastoral interest of this stratum has caused the disappearance of the forest and the elimination of the scrub in large areas that do not have a clear agricultural vocation.

Wild fauna, linked to the plant matrix, constitutes a very relevant element both in the European and global context. The great variety of plant systems, added to the geomorphological and climatic diversity of the studied area, contribute to the fauna a whole range of biotopes and habitats of great value, which constitute enclaves for the survival of numerous animal species. This explains the numerous protected areas existing in this field of study originating both from the Natura 2000 Network and from the environmental planning of each country and which become important environmental resources.

4. Land use changes

The European Environment Agency (EEA) offers the CORINE Land Cover project (Coordination of Information Environment-CLC). This geographical database supplies land-uses in the European Union through polygon graphic features at a

scale of 1:100,000 and with a minimum cartographic unit (MCU) of 25 hectares through polygonal graphic features. It also offers three hierarchical levels of information, consisting of the highest level of detail for 44 types of land-use classes in 1990, 2000, 2006, 2012 and 2018 [36]. The second layer of information used is also composed of polygonal graphic features containing the administrative delimitation of the 38 municipalities within the study area.

In this regard, the land-use information layer in 2000 and 2018, together with the administrative delimitation layer, were managed through a Geographic Information System (GIS) by using ArcGIS 10.5 software. Initially, the layer referring to the municipalities was used as a clipping mask on land-uses in 2000. Subsequently, the same procedure was repeated, but for the year 2018. In both cases, the resulting layer was a layer of polygons which contained for the year 2000 and 2018, the land-uses within each of the municipalities analyzed. In fact, within each polygon that delimited each municipality were the polygons related to land-uses according to CLC codification.

Then a field was then generated on each of the resulting layers. Then, in this field, the area of the polygons corresponding to the land-uses in hectares was geometrically calculated. Subsequently, through Structured Query Language (SQL), land-use records were selected for each municipality corresponding to 1) *Artificial surfaces*, 2) *Agricultural areas*, 3) *Forests and semi-natural areas*, 4) *Wetlands* and 5) *Water bodies* (CLC Level 1 nomenclature).

In the case of the layer corresponding to the year 2000, a total of 5,449 polygons were measured and by 2018 6,555 polygons were measured. Thus a greater diversification of land-uses was confirmed over the years.

In terms of land-uses in both 2000 and 2018, *Agricultural areas* predominated, increasing slightly from 64–68%. Therefore, more than half of the land is agricultural and this trend is maintained. The second main land-use corresponds to *Forests and semi-natural areas*, decreasing from 34% in 2000 to 28% in 2018. The remaining land-uses are quite a minority. Nonetheless, the increase of Water bodies is tripled, due to the creation of the Alqueva reservoir.

Regarding the land-uses analyzed by municipalities, the *Artificial surfaces* class only descends in 6 municipalities 4 in Portuguese territory and two Spaniards.

As for land-uses, taking into account the municipalities analyzed, the *Artificial surfaces* class only descends in 6 municipalities: 4 in Portuguese territory Alentejo, Alandroal, Campo Maior, Mértola, and Barrancos, and two of them are Spanish Cheles and Santa Bárbara de Casa. In all of them, there is a slight decrease. However, in Cheles this decrease is very pronounced going from 68.47 has to 44.49 has. There are also 4 municipalities, 2 of them Portuguese Portalegre and Alcoutim, and two Spaniards, Sanlúcar de Guadiana and Villanueva de los Castillejos, which do not vary. The rest of the 28 municipalities show an increase in the use of *Artificial surfaces*, highlighting those that experience an increase above 75% corresponding to the municipalities of Olivenza and Ayamonte.

As for *Agricultural areas*, the area goes down in 11 municipalities, highlighting the Spanish municipality of Isla Cristina whose decline is close to 25% and the Portuguese municipality of Reguengos de Monsaraz whose descent is close to 36%. The rest of the 27 municipalities increase in area for agricultural use, highlighting those that increase above 50% such as the Spaniards of La Codosera and Albuquerque, and the Portuguese municipality of Barrancos.

About *Forest and semi-natural* areas, there is a reduction in the area in 32 municipalities, 24 of which with a descent of more than 25%, highlighting Cheles that goes from 583.71 to 146.47 has and Alconchel that changes from 9,247.75 to 2,700.31 has. On the other hand, there are 6 municipalities with an increase in the area, which in Vila Real de Santo António reaches 25%, while in Campo Maior it reaches 66%.

Municipalities	1. Artif.	2. Agr	3. For.	4. Wet.	5. Wat.
Alandroal	337.3	35760.4	17887.0	0.0	703.8
Alburquerque	107.5	26093.0	44812.0	0.0	1283.5
Alconchel	40.2	20062.9	9247.8	0.0	206.3
Alcoutim	75.1	20043.3	38603.6	0.0	170.0
Almendro (El)	5.0	1700.7	12577.8	0.0	303.5
Aroche	26.0	12423.5	37443.8	0.0	0.0
Arronches	69.5	27003.5	3507.8	0.0	671.2
Ayamonte	246.1	2431.1	8604.2	2212.6	437.7
Badajoz	4375.1	128385.9	16657.5	0.0	790.6
Barrancos	49.7	8369.9	9566.0	0.0	0.0
Campo Maior	184.7	25197.7	196.3	0.0	60.9
Castro Marim	256.9	17221.8	9435.4	1272.0	953.6
Cheles	68.5	3969.1	583.7	0.0	182.3
Codosera (La)	63.8	1505.6	5372.7	0.0	0.0
Elvas	734.1	49075.4	5397.8	0.0	410.6
Encinasola	32.6	6915.5	10893.2	0.0	0.0
Granado (El)	0.0	1514.6	8022.1	0.0	157.7
Isla Cristina	295.2	2649.6	1050.1	690.0	108.0
Mértola	575.8	82931.6	43954.4	0.0	1028.3
Mourão	139.3	22621.9	5180.0	0.0	388.7
Moura	495.2	71961.7	23946.5	0.0	301.4
Oliva de la Frontera	75.9	9342.2	5538.8	0.0	0.0
Olivenza	126.7	33738.2	8737.2	0.0	493.3
Paymogo	26.7	10261.4	11082.7	0.0	0.0
Portalegre	0.0	8272.8	10083.8	0.0	0.0
Puebla de Guzmán	171.8	12247.3	19318.6	0.0	473.9
Reguengos de Monsar.	319.8	35648.4	9266.8	0.0	229.1
Rosal de la Frontera	46.3	6885.5	14090.7	0.0	0.0
San Silvestre de Guzm.	0.0	1100.2	3067.9	0.0	0.5
Sanlúcar de Guadiana	0.0	4001.8	4700.1	0.0	52.3
Santa Bárbara de Casa	37.6	5270.2	9422.1	0.0	0.0
Serpa	586.2	88163.4	19534.8	0.0	800.7
Valencia del Mombuey	0.0	3670.2	3834.4	0.0	0.0
Vila Real de Santo Ant.	248.7	1650.8	630.5	302.0	161.6
Vila Viçosa	987.8	14048.9	5131.2	0.0	0.0
Villablanca	36.6	2520.3	5278.1	0.0	30.2
Villanueva de los Cast.	0.0	605.4	371.1	0.0	0.0
Villanueva del Fresno	52.2	28746.4	7220.9	0.0	111.0
TOTAL	10893.5	834012.0	450249.2	4476.5	10510.7

Table 3.
Land-uses in 2000 measured in hectares according to the CLC level 1 nomenclature.

5. Wat.
703.8
1283.5
206.3
170.0
303.5
0.0
671.2
437.7
790.6
0.0
60.9
953.6
182.3
0.0
410.6
0.0
157.7
108.0
1028.3
388.7
301.4
0.0
493.3
0.0
0.0
473.9
229.1
0.0
0.5
52.3
0.0
800.7
0.0
161.6
0.0
30.2
0.0
111.0
10510.7

Municipalities	1. Artif.	2. Agr.	3. For.	4. Wet.	5. Wat.
Alandroal	292.8	41549.1	10734.6	0.0	2112.0
Alburquerque	216.5	43652.0	27106.6	0.0	1320.9
Alconchel	102.4	26112.1	2700.3	0.0	642.4
Alcoutim	75.1	17678.4	40940.8	0.0	197.8
Almendro (El)	11.8	3764.9	10082.3	0.0	728.0
Aroche	71.6	16654.9	33166.8	0.0	0.0
Arronches	86.0	27389.7	2856.8	0.0	919.5
Ayamonte	1025.3	3923.9	6071.4	2441.5	469.5
Badajoz	6297.7	135190.3	7949.4	103.1	668.8
Barrancos	44.5	10561.4	7379.7	0.0	0.0
Campo Maior	165.1	24633.0	590.5	0.0	251.1
Castro Marim	432.5	14464.9	12066.1	1221.2	955.1
Cheles	44.5	3919.5	146.5	0.0	693.2
Codosera (La)	80.8	2370.1	4491.2	0.0	0.0
Elvas	918.6	50545.9	3473.1	0.0	680.2
Encinasola	47.6	9144.4	8649.3	0.0	0.0
Granado (El)	38.6	3078.5	6406.9	0.0	170.4
Isla Cristina	400.5	3084.2	496.9	723.0	88.3
Mértola	569.5	77492.8	49404.3	0.0	1023.6
Mourão	146.0	20942.1	1989.4	0.0	5252.4
Moura	784.1	69087.3	22197.6	0.0	4635.7
Oliva de la Frontera	114.3	10561.3	4281.3	0.0	0.0
Olivenza	530.7	37336.3	4584.6	0.0	643.9
Paymogo	36.9	12493.0	8780.4	0.0	60.5
Portalegre	0.0	9052.3	9304.2	0.0	0.0
Puebla de Guzmán	247.5	17456.0	11248.7	0.0	3259.4
Reguengos de Monsar.	521.5	33717.4	6898.4	0.0	4326.7
Rosal de la Frontera	51.8	5545.5	15425.1	0.0	0.0
San Silvestre de Guzm.	25.1	2519.7	1623.0	0.0	0.8
Sanlúcar de Guadiana	0.0	5241.6	3468.0	0.0	44.7
Santa Bárbara de Casa	34.8	6377.1	8291.4	0.0	26.5
Serpa	703.7	87197.3	19351.7	0.0	1832.4
Valencia del Mombuey	28.4	5115.6	2360.5	0.0	0.0
Vila Real de Santo Ant.	435.8	1215.2	887.6	293.4	161.6
Vila Viçosa	1029.8	15636.6	3501.5	0.0	0.0
Villablanca	61.1	4328.3	3429.5	0.0	46.3
Villanueva de los Cast.	0.0	822.6	153.9	0.0	0.0
Villanueva del Fresno	105.2	32428.9	3039.1	0.0	557.3
TOTAL	15778.0	892283.9	365529.3	4782.0	31768.7

Table 4.
Land-uses in 2018 measured in hectares according to the CLC level 1 nomenclature.

Concerning *Wetlands*, it falls very slightly in two municipalities below 5% in Castro Marím and Vila Real de Santo António. In addition, there are also 33 municipalities where the *Wetlands* are not quantified. This type of coverage increases in 3 municipalities, and in two of them, Isla Cristina and Ayamonte, it is less than 10%. The most peculiar case is Badajoz with an increase of 100% from 0 to 103.03 has.

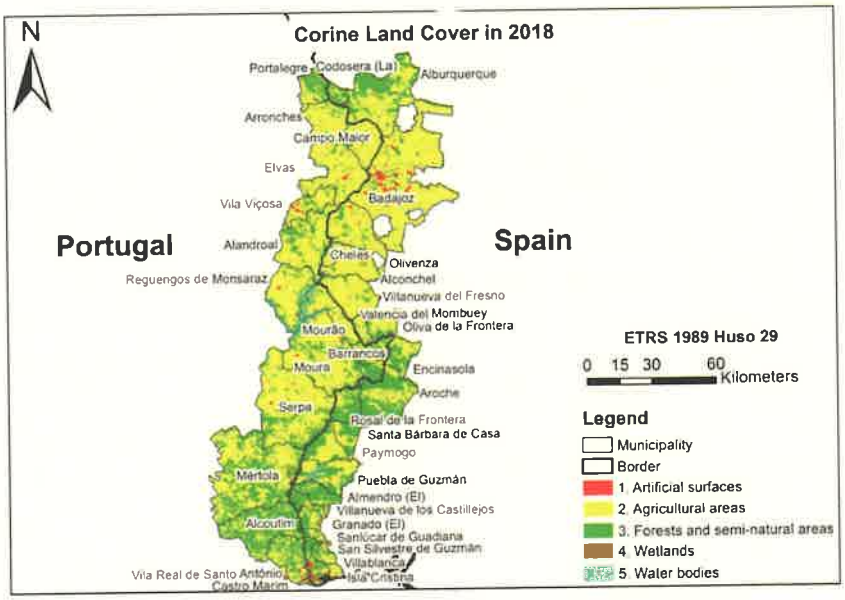

Figure 1.
CLC units in terms of land-use in 2018.

Municipalities	1. Artif.	2. Agr.	3. For.	4. Wet.	5. Wat.
Alandroal	−44.5	5788.7	−7152.4	0.0	1408.2
Alcoutim	0.0	−2365.0	2337.2	0.0	27.7
Arronches	16.5	386.2	−651.0	0.0	248.3
Barrancos	−5.2	2191.5	−2186.3	0.0	0.0
Campo Maior	−19.6	−564.7	394.2	0.0	190.2
Castro Marim	175.6	−2756.9	2630.7	−50.9	1.4
Elvas	184.6	1470.5	−1924.7	0.0	269.6
Mértola	−6.3	−5438.8	5449.9	0.0	−4.7
Mourão	6.7	−1679.8	−3190.6	0.0	4863.7
Moura	289.0	−2874.4	−1748.9	0.0	4334.3
Portalegre	0.0	779.5	−779.6	0.0	0.0
Reguengos de M.	201.7	−1931.0	−2368.4	0.0	4097.7
Serpa	117.5	−966.1	−183.1	0.0	1031.7
Vila Real de S. António	187.1	−435.6	257.1	−8.7	0.0
Vila Viçosa	42.0	1587.6	−1629.7	0.0	0.0
TOTAL	1145.2	−6808.2	−10745.5	−59.5	16468.1

Table 5.
Differences in Portugal in land-uses (hectares) between 2000 and 2018 according to the CLC level 1 nomenclature. Negative values indicate losses in 2018 compared to 2000.

Municipalities	1. Artif.	2. Agr.	3. For.	4. Wet.	5. Wat.
Alburquerque	109.0	17559.0	−17705.4	0.0	37.4
Alconchel	62.2	6049.2	−6547.4	0.0	436.1
Almendro (El)	6.8	2064.2	−2495.5	0.0	424.5
Aroche	45.6	4231.4	−4277.0	0.0	0.0
Ayamonte	779.2	1492.8	−2532.8	228.9	31.9
Badajoz	1922.6	6804.4	−8708.2	103.1	−121.9
Cheles	−24.0	−49.7	−437.2	0.0	510.9
Codosera (La)	17.0	864.5	−881.5	0.0	0.0
Encinasola	15.0	2228.9	−2243.9	0.0	0.0
Granado (El)	38.6	1563.9	−1615.2	0.0	12.7
Isla Cristina	105.3	434.6	−553.2	33.0	−19.7
Oliva de la Frontera	38.4	1219.1	−1257.5	0.0	0.0
Olivenza	404.0	3598.1	−4152.7	0.0	150.5
Paymogo	10.2	2231.6	−2302.3	0.0	60.5
Puebla de Guzmán	75.7	5208.7	−8069.9	0.0	2785.5
Rosal de la Frontera	5.5	−1340.0	1334.5	0.0	0.0
San Silvestre de G.	25.1	1419.5	−1444.9	0.0	0.3
Sanlúcar de Guadiana	0.0	1239.8	−1232.2	0.0	−7.6
Santa Bárbara de Casa	−2.8	1106.9	−1130.6	0.0	26.5
Valencia del Mombuey	28.4	1445.5	−1473.9	0.0	0.0
Villablanca	24.5	1808.0	−1848.6	0.0	16.1
Villanueva de los C.	0.0	217.2	−217.2	0.0	0.0
Villanueva del Fresno	53.0	3682.5	−4181.8	0.0	446.3
TOTAL	3739.3	65080.1	−73974.4	365.0	4789.9

Table 6.
Differences in Spain in land-uses (hectares) between 2000 and 2018 according to the CLC level 1 nomenclature. Negative values indicate losses in 2018 compared to 2000.

Finally, the land-use classified as *Water bodies* is registered by only 4 municipalities where its area is reduced: Mértola, Sanlúcar de Guadiana, Badajoz and Isla Cristina. The latter accumulates a drop above 22%. In another 11 there is no area difference; in 10 of them due to the fact that there is no hectare corresponding to this land-use neither in 2000 nor 2018. The increase in area is recorded in 23 municipalities, 8 of which above 75%, highlighting Paymogo and Santa Bárbara de Casa with an increase of 100% (**Tables 3** and **4**).

Subsequently, in order to identify the situation of land-uses and patterns in the territory, thematic maps were generated for each of the years analyzed and taking into account the classification of land-uses for CLC level 1.

Figure 1 shows that the predominant land-use in 2018 corresponds to *Agricultural areas*, although in the border area to the south and in the north the predominant coverage corresponds to *Forest and semi-natural areas*, with minor spots scattered throughout the rest of the territory. As for Artificial surfaces, there seems to be a greater concentration in Badajoz, due to the fact that it is the most populated

municipality within the area analyzed. As for the rest of the land-uses, due to being a minority in quantity, they are practically not observable.

Tables 5 and **6** shows the differences produced between 2000 and 2018. The loss of the total area of the *Forests and semi-natural areas* in both the territory of Spain and Portugal is the most prominent. The latter country also lost agricultural land, more than 6,800 ha. These losses are mainly compensated by the increase in the *Agricultural areas* and *Water bodies* classes on the Spanish side, while in the Portuguese side, what increases the most is the territory of *Water bodies* due to the appearance of the great reservoir of Alqueva, which closed its floodgates in 2002. When these variations are checked by municipalities in the Spanish territory, there are significant variations. In this way, there is a concentration of losses in forested areas and an increase in the other classes of the CLC. On the contrary in Portuguese municipalities, there is greater variability in losses and gains of areas in the five classes.

5. Heritage and border tourism

5.1 The Guadiana border as a tourist itinerary

Our territorial area of Bajo Guadiana is also a tourist space with a multitude of resources and various products. It contains a territory rich in historical-artistic and natural heritages and that could also benefit from border tourism. In this sense, our attention is going to focus on this "border tourism", a segment or tourism product that is recent in time, still poorly defined and that is very transversal to others (rural, ecotourism, agrotourism, gastronomic, etc.) that occur in border territories [37].

We are located in a border section with an interesting history that now allows a free movement of movements and travelers, apart from the recent problems caused by Covid 19. The border itself could become a destination and the main attraction for a very diverse tourist demand, eager to consume the history and heritage of the frontier territories.

Hernández [38] distinguishes between cross-border tourism and tourism on the border. In the first, the territory to be visited covers a more or less wide space, of transition and somewhat lax limits on both sides of the border and where the border fact has been felt. On the contrary, tourism on the border is characterized by the fact that the destination is the same border line and the tourist activity is focused on visiting neighboring populations that belong to different states. The most interesting examples are those that occur between neighboring towns, but from different countries, where the border is a river or a customs office. The most eloquent cases are those of Alcoutim and Sanlúcar de Guadiana or that of Badajoz and Elvas.

In the case of our field of study, the border has a linear sense. Somehow it is a route that runs parallel to the political dividing line between Spain and Portugal and that tourists can follow or cross looking for their border heritage and, at the same time, other resources: monuments, landscape, gastronomy, cultural events, sports practices, etc. The border, as a destination, thus not only becomes an attraction, but is also configured into a tourist itinerary. In a way, our border territory could act or convert in an analogous way to other well-known tourist-cultural itineraries or routes: historical roads, pilgrimage routes, routes of heritage cities, etc. This situation can develop in integrated borders, such as that of the Iberian line (La Raya), with the particularity of being an itinerary that for many centuries has been a political barrier (the oldest political border in Europe) and that only in the last decades it has been able to permeate to a greater degree for the transit of its inhabitants and travelers. At present it is an integrated border from the perspective of mobility with

numerous new bridges, with abolished customs and with territorial cooperation policies (Interreg) that try to revalue the cultural and natural heritage and activate leisure and tourism activities.

So far, a group of researchers (where the Turfront project stands out) have worked to make this product or typology of "border tourism" official, motivated by the desire that it be assumed by the different tourism policies and programs at regional and local scales. This new concept would encompass as such the movements of travelers and tourists and the tourist products that are supported as a destination mainly on the border, its history and heritage.

In our territory of Bajo Guadiana, which also extends to the whole of the Iberian Line, there is a rich history that has generated an outstanding historical and cultural legacy, to which the environment is added, and that could now be the main attractive or revulsive resources for a major and varied tourist activity. And with the particularity also of being a somewhat unexplored and little-known territory for mass tourism.

However, the task of inserting or consolidating these basically rural spaces, such as itineraries and international tourist destinations, is not easy. Campesino [39] refers that most of the time the natural and cultural heritages of the border are still "potential resources with attractions and expectant profitability" that have not yet been transformed into border tourism products. Undoubtedly, the great challenge of this type of incipient destinations is to make the leap from being spaces of complementary offer to being true destinations with an offer of sufficient and profitable accommodation for the hiker or accidental traveler to become a true tourist of the border.

5.2 Guadiana cultural heritage and tourism

We conceived the Guadiana River and the border of la Raya as a tourist itinerary from the South Atlantic Coast to a more unknown interior but rich in resources and historical-artistic and natural heritage. Therefore, we will then give a brief description of these potentials and resources by river areas from south to north.

At the southern apex, as a great linear and supporting element appears an unknown international section of the Guadiana River, between meanders and banks of unexpected and surprising attractiveness. We believe that this river has remarkable potential for tourist use (river walks and sports activities), at least in its approximately 60 kilometers of international and navigable stretch, from the mouth to its encounter with its tributary of Chanza. The river ports and fortifications of Alcoutim (Algarve), Mértola (Baixo Alentejo) and Sanlúcar de Guadiana (Huelva province) and the small jetties of Pomarão, Foz de Odeleite and Guerreiros, on the Portuguese shore, and Puerto La Laja in the municipality of El Granado stand out. They are joined by the larger ports of Ayamonte, Isla Cristina and Vila Real de Santo Antonio, almost at the same mouth.

With proper name, border towns such as Ayamonte, Sanlúcar de Guadiana and Aroche stand out, on the Spanish side, and Castro Marim, Alcoutim, Mértola and Serpa, in Portuguese lands stand out too. All of them are historical ensembles protected by their outstanding architectural cultural heritage. Likewise, an interesting network of trails, greenways and viewpoints has been built for the traveler who wants to discover nature and history. In addition, a set of mining testimonies, museums and interpretation centres mark this territory of Lower Guadiana. This cultural heritage is joined by spaces of marshes (zapales in Spanish) and Mediterranean forest that have been protected (Guadiana Valley Natural Park).

In this short descriptive route, we distinguish a second section and that refers to the Alqueva reservoir and its adjacent territory. In addition to the agricultural and energy objectives and uses, this territory has become due to its enormous

dimensions (almost an inland sea) a new and important tourist destination [40]. Various marinas and tourist villages have been built and several active leisure companies have appeared, with wide possibilities of river and land tours. Lake Alqueva has also been the world's first certified Starlight destination in 2011 under the name Dark Sky Alqueva Reserve.

These tourist uses around the water have brought the traveler and tourist closer to the cultural heritage, mainly of fortifications, of Portuguese towns such as Moura, Mourão, Reguengos de Monsaraz and Alandroal. Their castles and walls are impressive, they are witnesses of other times of wars and mistrust. On the Spanish side, the shores of the great lake reach Villanueva del Fresno, Cheles, Olivenza and Alconchel. Very outstanding is the historical-artistic complex in Olivenza. Further away from the shore of Alqueva there is a triangle formed by the towns of Barrancos, Encinasola, Valencia del Mombuey and Oliva de la Frontera, where its grasslands and other various defensive strongholds stand out.

A third zone, further north, would encompass the municipalities of Vila Visosa, Elvás, Campo Maior, Arronches and Portalegre; and for Spain, the municipalities of Badajoz, La Codosera and Alburquerque. Here are the most populated and urban centres (Badajoz and Portalegre). It also highlights its cultural heritage, where Elvás stands out, whose walled fortress has been declared a World Heritage Site since 2012. On the Portuguese side, the Sierra de San Mamede Natural Park highlights which reaches the border, facing lands in the province of Caceres. As for Spain, the historical and heritage legacy of Badajoz and Alburquerque, with walled enclosures, is equally outstanding.

The existence of the Eurocity Badajoz-Elvas-Campo Maior (Eurobec), with about 190,000 inhabitants, is noteworthy. Besides, since its formal creation in 2018, this Eurocity aims to strengthen border tourism and combine various services and facilities [41]. The Baluartes project has been launchedas part of the revaluation of the fortifications of the two cities. Likewise, work is also being done for the future integration of the municipality of Olivenza.

6. Conclusions: final reflections and proposals

The territory that hosts the border municipalities of the first line of the Guadiana basin is characterized by being deeply rural (not to be confused with agrarian), both due to the size of its localities, only one exceeds 150,000 inhabitants (Badajoz) and nine exceed 10,000 residents, which is the threshold that the INE considers "city": 6 in Portugal and 3 in Spain, although they host 78.97% of the total.

There is evidence of a gradual decline throughout the millennium of the Portuguese municipalities, except Vila Real de Santo António, due to its tourist beach function. In the Spanish part, growth is observed in most of the nuclei between 2001 and 2011, however, they all enter a regressive phase from 2011 to the present, except for Badajoz and Ayamonte.

We are witnessing a demographic decline in 94.4% of the municipalities and 92.7% of the border area, most of the localities being condemned to an irreversible scenario if the enormous natural and cultural potentials are not taken advantage of.

Regarding land uses, two uses are predominant. In the first place, the one corresponding to agricultural use, since it occupies more than half of the analyzed area. It even increased between 2000 and 2018, consolidating its hegemony. Second, the land use referred to Forests and semi-natural areas predominates, occupying approximately one third. However, the trend is contrary to the previous land use, since the area occupied by this type of land decreases slightly, thus progressively losing prominence over the years.

The rest of the land uses are a minority, although the notable increase in the Waterbodies class stands out. As a consequence of the creation of the Alqueva reservoir in 2002. This effect is more noticeable in the municipalities closest to the reservoir, Alandroal, Mourão, Moura, and Reguengos de Monsaraz in Portugal, and Alconchel, Cheles, Olivenza, and Villanueva del Fresno in Spain. Among all of them, Mourão stands out, since the use of the land water bodies now occupies 17% of the total area of the municipality and Cheles, where it now has 10%.

The evolution of the population of this territory is worrying, characterized by a general decline. Although in some municipalities there was a small rebound towards the middle of the period studied, almost a decade later they lose inhabitants again. Only the two coastal municipalities in Spain increase demographically, a situation that is not reflected in the Portuguese coastal municipalities. Consequently, the effect of the construction of the Alqueva reservoir has not been felt as a catalyst that contributes to the fixation of the population. Moreover, in the Portuguese area, the loss has been more pronounced. Precisely in the Baixo Alentejo the impact should have been greater since almost all of the newly irrigated areas have been built there. Undoubtedly, the demographic decline that was already dragging this territory outweighs the new economic exceptions of the aforementioned reservoir and where irrigated agriculture stands out.

We find a space with different geoenvironmental units whose common denominator is the Guadiana River and the border factor. We are facing a border culture and history linked to wars, the continuous construction, and deconstruction of the border, the unique relationships of attraction and repulsion with the neighbor, smuggling, mining, and a singular ethnography or immaterial culture. It is these endogenous resources (mining, river, forest, agricultural, hunting, landscape, historical, heritage ...) that should guide any policy or plan aimed at generating development processes. And ideally, these planning and intervention policies are comprehensive and cross-border.

A territory, that of Bajo Guadiana, with very high landscape and heritage values that show potentialities that are still very little exploited by tourism, far from being even a destination like other well-known cultural itineraries. However, the sum of the patrimonial factors, the better accessibility, and the cooperation policies have already allowed the emergence of some tourist offers and services in these border towns when, until recently, nothing existed.

The greater connection between the two countries and the permeabilization of the border, once an almost insurmountable barrier, has undoubtedly substantially changed the flows throughout the southwest of the peninsula. Therefore, at the level of communication infrastructures, now there are conditions to create or promote a linear tourist itinerary and, at the same time, cross border tourism that allows the traveler and tourist to travel and cross this part of the Iberian border enjoying its resources and attractive.

In a very concise way, we believe it is appropriate to point out some proposals for the promotion of border tourism and this border area:

- Creation of a brand for border tourism in this territory. It could contain the names of "Guadiana" and "Frontera".

- Enhancement of cross-border tourism products. In this sense, and as an example, products/routes such as routes of castles and fortifications or the offer of active leisure around the Guadiana river could be reinforced.

- Change of mentality towards a more touristy local culture in which quality is committed and, within the different tourist products, the border type.

We think that the Guadiana and the Border can become a necessary tourist itinerary, with offers geared towards tourist demands that seek new experiences in little-known destinations and around tourist typologies linked to rural areas, heritage, and history. A greater revaluation of the cultural and natural heritage and an increase in tourism could be a complementary solution to curb the phenomenon of rural depopulation that plagues this territory and most of the Portuguese-Spanish line. It would be a new product, border tourism, perfectly compatible and transversal to others in these border areas.

It will be necessary to see the behavior of the population in the next decade to draw more conclusions from the variations it suffers and from the activities and policies that are carried out, analyzing their value for both economic and environmental sustainability.

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