water and landscape
AGUA y TERRITORIO

Irrigation systems and regional socioeconomic development in Southwest Iberia: the cases of Extremadura, Spain, and Alentejo, Portugal, 1950-2020

Sistemas de regadío y desarrollo socioeconómico regional en el suroeste ibérico: los casos de Extremadura, España, y Alentejo, Portugal, 1950-2020

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ABSTRACT

Presently the construction of large public irrigation systems and the extension of existing ones in the dry regions of Southwest Iberia are being discussed. This article analyses the demographic and economic evolution of the irrigated territories of Alentejo and Extremadura, comparing them with those that have remained dry in the same regions. Based on statistical data, it was possible to identify that, unlike Alentejo, the region of Vegas Altas in Extremadura stands out as a success in a general context of depopulation and relative impoverishment. The development of an export-oriented industrial sector based on irrigated agricultural production, associated with auxiliary industries stimulated by this type of agriculture, appears to have been the distinguishing factor compared to Alentejo. In the future, further research is needed to understand the emergence of an industrial sector in a rural region in the early 21st century, facilitating replication in other territories.

KEYWORDS: Irrigation, Rural development, Dryland Iberia, Alentejo, Extremadura.

RESUMEN

Actualmente, se discute la construcción de sistemas de regadío y la ampliación de los existentes en las regiones secas del suroeste de la Península Ibérica. En este contexto, este artículo analiza la evolución demográfica y económica de los territorios de regadío del Alentejo y de Extremadura, comparándolos con aquellos que permanecieron en secano. Con base en datos estadísticos, se pudo identificar que, al contrario que el Alentejo, la región extremeña de Vegas Altas destaca como un raro caso de éxito en un contexto general de despoblación y empobrecimiento relativo. La creación de un sector industrial orientado a la exportación, basado en la producción de la agricultura de regadío, así como un conjunto de industrias auxiliares asociadas a este tipo de agricultura, parece haber sido el factor distintivo respecto al Alentejo. En el futuro, se profundizará esta línea de investigación como forma de identificar específicamente el surgimiento de un sector industrial en una región rural en el siglo XXI, promoviendo su eventual replicación en otros territorios.

PALABRAS CLAVE: Irrigación, Desarrollo rural, Iberia árida, Alentejo, Extremadura.

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Regadio e desenvolvimento socioeconómico regional no Sudoeste da Península Ibérica: os casos de Extremadura, Espanha, e Alentejo, Portugal, 1950-2020

RESUMO

Atualmente, discute-se a construção de sistemas de regadio e a ampliação dos existentes nas regiões secas do sudoeste da Península Ibérica. Neste contexto, este artigo analisa a evolução demográfica e económica dos territórios de regadio do Alentejo e da Extremadura, comparando-os com aqueles que permaneceram em sequeiro. Com base em dados estatísticos, foi possível identificar que, ao contrário do Alentejo, a região extremenha de Vegas Altas destaca-se como um raro sucesso num contexto geral de despovoamento e empobrecimento relativo. A criação de um setor industrial orientado para a exportação baseado na produção da agricultura de regadio, bem como um conjunto de indústrias auxiliares associadas a este tipo de agricultura, parece ter sido o fator distintivo relativamente ao Alentejo. No futuro, aprofundar-se-á esta linha de investigação como forma a identificar especificamente o surgimento de um setor industrial numa região rural no século XXI, promovendo a sua eventual replicação em outros territórios.

PALAVRAS-CHAVE: Regadio, Desenvolvimento rural, Península Ibérica seca, Alentejo, Extremadura.

Irrigation et développement socio-économique régional dans le sud-ouest de la péninsule ibérique: les cas de l'Estrémadure, en Espagne, et de l'Alentejo, au Portugal, 1950-2020

RÉSUMÉ

Actuellement, on discute de la construction de systèmes d'irrigation et de l'extension de ceux déjà existants dans les régions arides du sud-ouest de la péninsule Ibérique. Dans ce contexte, cet article analyse l'évolution démographique et économique des territoires irrigués de l'Alentejo et de l'Estrémadure, en les comparant à ceux qui sont restés en cultures pluviales. À partir de données statistiques, il a été possible d'identifier que, contrairement à l'Alentejo, la région estrémègne des Vegas Altas se distingue comme un rare succès dans un contexte général de dépeuplement et d'appauvrissement relatif. La création d'un secteur industriel orienté vers l'exportation, basé sur la production issue de l'agriculture irriguée, ainsi qu'un ensemble d'industries auxiliaires associées à ce type d'agriculture, semblent avoir été le facteur distinctif par rapport à l'Alentejo. À l'avenir, cette ligne de recherche sera approfondie afin d'identifier plus spécifiquement l'émergence d'un secteur industriel dans une région rurale au XXIe siècle, en favorisant sa possible reproduction dans d'autres territoires.

MOTS-CLÉS : Irrigation, Développement rural, Péninsule Ibérique sèche, Alentejo, Extremadura.

Irrigazione e sviluppo socio-economico regionale nel sud-ovest della penisola iberica: i casi dell'Estremadura, in Spagna, e dell'Alentejo, in Portogallo, 1950-2020

SOMMARIO

Attualmente si discute della costruzione di sistemi di irrigazione e dell'ampliamento di quelli esistenti nelle regioni aride del sud-ovest della Penisola Iberica. In questo contesto, questo articolo analizza l'evoluzione demografica ed economica dei territori irrigui dell'Alentejo e dell'Estremadura, confrontandoli con quelli rimasti a secco. Sulla base di dati statistici, è stato possibile identificare che, contrariamente all'Alentejo, la regione estremadura delle Vegas Altas si distingue come un raro caso di successo in un contesto generale di spopolamento e impoverimento relativo. La creazione di un settore industriale orientato all'esportazione, basato sulla produzione dell'agricoltura irrigua, nonché un insieme di industrie ausiliarie collegate a questo tipo di agricoltura, sembra essere stato il fattore distintivo rispetto all'Alentejo. In futuro, si approfondirà questa linea di ricerca al fine di identificare specificamente l'emergere di un settore industriale in una regione rurale nel XXI secolo, promuovendone l'eventuale replicazione in altri territori.

PAROLE CHIAVE: Irrigazione, Sviluppo rurale, Penisola Iberica arida, Alentejo, Extremadura.

Introduction

Water is a vital element in nearly all human activities, and agriculture is no exception. In agrarian economies, like the Iberian ones until the second half of the 20th century, the availability of water can play a significant role in economic performance, consequently affecting standards of living. Therefore, in the dry Iberian regions, such as Alentejo and Extremadura, for centuries enhancing water supply through the establishment of public irrigation systems has been considered a crucial factor for development. However, it was only from the end of the Second World War that the construction of extensive irrigation systems became financially possible, significantly changing landscapes and water utilization. After 70 years since the first large public irrigation systems started to be used, this article seeks to assess the impact of irrigation on the economic and social development of two comparable regions separated by a political border: Alentejo and Extremadura.

The initial hypothesis is that in Extremadura, Spain, in line with the conclusions of Pires de Almeida, Faísca & Freire[1], as well as Faísca[2] for southern Portugal, substantial public investment in irrigation, while increasing agricultural productivity, did not result in significant regional development compared to neighbouring dryland areas. This should be reflected in indicators such as demographic evolution and the average income of local populations. However, the findings paint a contrasting picture. The irrigated Vegas Altas[3] area has demonstrated an ability to retain population over the past decades, even amid a generalized rural exodus that led to the *España Vacíada* problem (empty Spain)[4]. Additionally, the mean income surpasses the regional average, and it is notably higher than the neighbouring La Serena[5] dryland region. It is crucial to underline that these positive trends emerged following the implementation of the *Plan Badajoz* irrigation systems, and not before. Although it is not always the case, there are other Modern irrigated regions in Spain with results similar to those found in Vegas Altas[6].

These findings hold particular significance for two distinct yet interconnected discussions within Portuguese and Spanish societies. Firstly, as public investment in irrigation systems continues in both countries — illustrated by the upcoming Pisão dam project in Alentejo, with an estimated cost of nearly 200 million euros[7], and the ongoing debate about extending irrigation to other areas of Extremadura— it is crucial to understand why previous irrigation initiatives, such as those in the Sorraia Valley and Alqueva, appear to have fallen short, while the *Plan Badajoz*[8] —a set of public policies developed since the 1950s, centred on the construction of dams and irrigation systems to populate and develop a significant area of Extremadura— achieved greater success. This will lead to further research of this issue in a near future. Secondly, from a broader perspective, by comparing two regions with similar socioeconomic backgrounds, this article contributes to the discussion on Portugal's economic backwardness, particularly in relation to neighbouring Spain. This topic has been recently explored by Nuno Palma[9], who attributes Portugal's last decades weaker economic performance to the mismanagement of European funds, stemming from a less efficient political system, which could be the case here.

In general, this research can be included in the studies on spatial economic inequality, a topic with strong contributions from Economics, Geography, and History. From this interdisciplinary intersection at least three theories that have left a lasting impact emerged – the neoclassical theory stemming from Alfred Weber's seminal work[10], the New Trade Theory[11], and the New Economic Geography, whose most famous author is probably Paul Krugman[12], who was also linked to the previous school of thought. In the Iberian Peninsula, this type of analysis gained prominence in the early 21st century, seeking to identify the regional evolution of economic development and the factors that explain it. Notably, Marc Badia-Miró, Pedro Lains, Jordi Guilera[13],

[1] Pires de Almeida; Faísca; Freire, 2023.
[2] Faísca, 2023.
[3] Vegas Altas is a comarca in Extremadura, with Don Benito as its capital. It consists of the following municipalities: Acedera, Cristina, Don Álvaro, Don Benito, Guareña, Madrigalejo, Manchita, Medellín, Mengabril, Rena, San Pedro de Mérida, Santa Amalia, Valdetorres, Valverde de Mérida, Villanueva de la Serena and Villar de Rena.
[4] For this concept see, for instance, Molino, 2016.
[5] La Serena is a comarca in Extremadura, with Castuera as its capital. It consists of the following municipalities: Benquerencia de La Serena, Cabeza del Buey, Campanario, Capilla, Castuera, Coronada, Esparragosa de La Serena, Higuera de La Serena, La Haba, Magacela, Malpartida de La Serena, Monterrubio de La Serena, Orellana de la Sierra, Orellana la Vieja, Peñalsordo, Quintana de La Serena, Valle de La Serena, Zalamea de La Serena, Zarza Capilla.
[6] Silvestre; Clair, 2010.
[7] Comunidade Intermunicipal do Alto Alentejo (CIMAA), 2024.
[8] Rodríguez Jiménez, 2022.
[9] Palma, 2023.
[10] Weber, 1929.
[11] Brülhart, 1998.
[12] Krügman, 1998.
[13] Badia-Miró; Guilera; Lains, 2012.

Daniel Tirado-Fabregat, Alfonso Herranz-Loncán, and Teresa Sanchis-Llopis[14], among others, have contributed to this field. Additionally, analysis on depopulation processes, especially in Spain – strongly correlated with spatial economic inequality – also presents a rich scientific literature[15].

However, specifically this research does not fall within a strongly established line of research in Iberian economic historiography. It is, therefore, a developing line of research that aims to assess the relationship between the expansion of irrigation through costly public policies and regional economic development, evaluating one of the main objectives of such policies and their outcomes. This article is expected to be followed by additional studies that will deepen and consolidate this line of research. Nevertheless, previous publications have approached the problem in the Spanish context both at a national[16] and regional level[17], and for Portugal the already mentioned publications[18].

To accomplish the proposed goals this article is divided as follows. After this introduction, the data and the chosen methodologic approaches are presented. The third section provides the historical context of the irrigation projects and implementation in the two regions. Subsequently, the fourth section presents the results, drawing from data on demographic trends in each region, agrarian output, and the current status of GDP per capita. To isolate the impact of irrigation on regional development as much as possible, not only the two aforementioned regions are compared but also neighbouring irrigated and non-irrigated areas within Alentejo and Extremadura are included. The fifth section discusses the results arguing what are the distinctive factors of the Vegas Altas area attributable to irrigation in comparison to the south of Portugal. Finally, the conclusions are presented.

The most obvious is the distinct impacts observed in the irrigated areas of Alentejo and Extremadura. The latter exhibits clear positive indicators of economic and social development compared to the former, and neighbouring dryland regions. On the contrary, in Alentejo, the distinction between irrigated and non-irrigated areas is nearly negligible. Extremadura, specifically the Vegas Altas region, succeeded in establishing a dynamic industrial sector based on the infrastructure developed for the irrigation-driven *Plan Badajoz*, a phenomenon not observed in southern Portugal, but with some other examples in Spain, although not always being the case[19]. The Portuguese inability to achieve this may be linked to the smaller size of the irrigated area, in the case of the Sorraia Valley, the short maturation time of the investment, in the case of Alqueva, or even to a broader explanation related to the use of European Union cohesion funds[20]. However, a detailed exploration of this aspect can only be done in a forthcoming study.

Data, sources and methodological approach

Regardless of the historical period, with the exception of demographic data, local data is usually difficult to gather. This problem comes from the organization of official statistics into larger regions such as provinces in Spain or districts in Portugal. More recently, in line with Eurostat's determinations, for many subjects the minimum territorial unit is NUTSIII or NUTSII regions. Furthermore, statistical territorial units undergo constant changes, making even more difficult the capture of historical evolution. For instance, in the 20th century alone, agricultural production was published by districts, agrarian regions, and presently by NUTSII[21]. In this context, it was possible to use data from each country official statistics on the evolution of population, between 1950 and 2021, for all the territories analysed; present agricultural output only for NUTSII regions – Extremadura, and Alentejo –, although historical production was published at smaller levels; and present GDP per capita on a municipal basis.

For the local economic structure and existing companies in Vegas Altas, information was obtained from the Moody's SABI database and the Directory of Companies from Extremadura[22]. For Coruche, data was sourced from the Informa D&B database. However, there is an important limitation to both databases: they do not capture other companies that, while headquartered in another municipality, have local branches, some of which are quite significant. One example is the cork

[14] Herranz-Loncán; Sanchis-Llopis; Tirado-Fabregat, 2024.
[15] Pinilla; Ayuda; Saéz, 2008.Collantes; Pinilla, 2011.
[16] Martín-Benito; Martinez Romero, 2017. Mélian Navarro; Melgarejo Moreno, 2020.
[17] Silvestre; Clair, 2010. Aznar-Sanchéz; Sanchez-Picón, 2010.
[18] Pires de Almeida; Faísca; Freire, 2023. Faísca, 2023.
[19] Silvestre; Clair, 2010.
[20] Palma, 2023, 251-289.
[21] Freire; Faísca, 2021.
[22] Junta de Extremadura, 2024.

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industry, which employs more than 400 workers in four factories in Ponte de Sor and a similar number in three factories in Coruche. However, since the headquarters are located in Santa Maria da Feira, 300 km away, these workers and all other company figures are attributed to this latter municipality in the SABI and Informa D&B databases. Nevertheless, both databases give a fairly picture of local economy.

Regional and local economic development is a multifaceted subject influenced by numerous factors, both internal and external. As a result, establishing a strict direct causality between irrigation and demographic and economic performance is very difficult. However, comparing bordering regions with similar socioeconomic structures before irrigation can provide a valuable proxy for measuring the impact of modern agricultural hydraulics. Alentejo and Extremadura are two neighbouring regions, as shown in Figure 1, with extensive areas far from the more dynamic coastal zones of the Iberian Peninsula. Nevertheless, despite both regions having hundreds of thousands of irrigated hectares, directly comparing the socioeconomic data of the two NUTSII regions would involve many factors beyond those that can be associated with the impact of irrigation.

Therefore, in this article, constant comparisons between dryland areas and recently irrigated ones are done. On Extremadura between Vegas Altas area as the irrigated example, and the La Serena area as the dry one. In Alentejo, the primary focus will be on the irrigated municipality of Coruche —roughly within the blue circle on Figure 2—, and the mostly dry municipality of Ponte de Sor —within the red circle— since, despite its size of 840 sq. km, only 500 hectares of Ponte de Sor are irrigated through the Sorraia Valley irrigation system. In both cases, the dams are constructed in neighbouring dry areas, supplying water downstream. The irrigated agricultural land in Coruche is supplied by water from the Montargil dam, located in the municipality of Ponte de Sor, and the Maranhão dam, in the municipality of Avis. These dams provide the water that sustains over 16,000 hectares of irrigated land within the Sorraia Valley irrigation system. The majority of this land is located in the municipality of Coruche, where over 8,000 hectares are irrigated. Additionally, other irrigated municipalities in Alentejo, including those within the Caia irrigation system, which covers 7,300 hectares, and Alqueva, with over 110,000 hectares[23], will be compared to neighbouring dry municipalities.

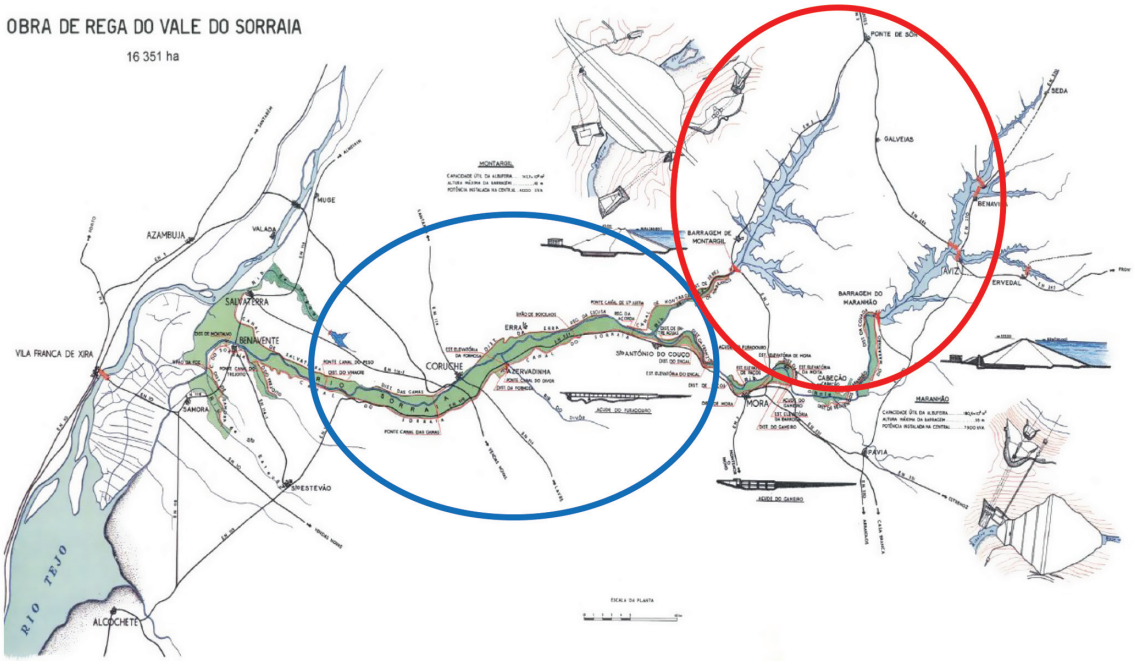
Figure 1. Alentejo and Extremadura in the Iberian Peninsula



Source: Own elaboration.

[23] Faísca, 2023, 217.

Figure 2. The Sorraia Valley irrigation system



Source: Associação de Regantes do Vale do Sorraia, 2024.

In La Serena, the Orellana and Zújar dams capture water from the Guadiana River used for the irrigation of the also neighbouring Vegas Altas area. These territories are of similar magnitude but with very different irrigated areas, as demonstrated by Table 1. As we will verify, the socio-economic differences from the moment the irrigation system began operating intensified in Extremadura, but not in Alentejo.

Table 1. Brief characterization of the analysed territories

Territory	Area (sq. Km)	Irrigated land (hectares)	Irrigated land (%)
La Serena, Spain	2,749	2,214	0.80
Vegas Altas, Spain	1,653	124,287	75.19
Ponte de Sor, Portugal	840	531	0.63
Coruche, Portugal	1,116	7,702	6.90

Source: For Spain, Rivero Nieto et al., 2022, 153-155; for Portugal, Direcção-Geral de Agricultura e de Desenvolvimento Rural (Portugal), 2024.

The historical context: southern dryland Iberia, the perceived potentialities of irrigation and its implementation (17th to 20th centuries)

The southern Iberian Peninsula, which includes the bordering regions of Alentejo and Extremadura, is characterized by a Mediterranean climate. This means irregular rainfall, concentrated primarily in a limited number of the coldest months of the year. During the warmest months, when temperatures can easily exceed 40°C, rainfall is usually scarce. As a result, except for the main rivers, most water courses face drought conditions, leading to a restricted water supply[24]. Under these circumstances, only dryland crops can thrive on a large scale, and the harsh climate conditions favour the development of large estates[25]. In an agrarian economy, which prevailed in southern rural Iberia until the 1980s, less productive dryland agriculture and extensive landholdings contributed to low population density. This occurred, in different historical periods, either due to the scarcity of income and well-being within a traditional Malthusian trap scenario, or through emigration when natural population growth exceeded the demand for wage labour.

In fact, Alentejo and Extremadura, the focus regions of this study, were – and still are – among the most depopulated of their respective countries. For instance, the population density of Alentejo was half of the Portugal average by 1700, decreased to almost one third by 1801, and approached one quarter by 1960, during the early phase of the new irrigated agriculture[26].

[24] Ribeiro; Lautensach; Daveau, 1991, 435-455. Nieto Masot, 2014, 53-58.
[25] Although there isn't the only factor behind latifundia. See, for instance, Santos, 2004 for the formation of latifundia in southern dryland Portugal.
[26] Faísca, 2023, 214.

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In Extremadura, while the disparity with the Spanish average is not as significant, it remained approximately half of the national average from the 1870s to the 1960s. Both regions are also characterized by low average incomes and pronounced inequalities[27]. The impoverished, landless rural populations across vast territories – almost 30 thousand sq. Km for Alentejo, and more of 40 thousand for Extremadura – have historically sparked conflicts during various periods of Modern History as they demanded for easier access to land, and consequently for improved living standards[28], leading in Alentejo to an Agrarian Reform in 1975, as a result of the 1974 Revolution[29].

In Extremadura, when agriculture began to mechanize in the 1950s, neither the relatively small industrial sector nor the services were able to retain the population, which emigrated significantly, without resulting in an extraordinary increase in the living standards of those who remained[30]. A similar situation occurred in Alentejo, and currently, both regions are even more depopulated than they were before the construction of the irrigation systems. Moreover, as recently noted, the poorest districts and provinces in the Iberian Peninsula have tended to cluster in a large region straddling the border between the two countries, precisely where Extremadura and Alentejo are located[31]. As it will be shown, within these two regions irrigated Vegas Altas area is an exception.

In this context, a current of opinion emerged at least as early as the 17th century, both in Portugal[32], and a little later in Spain[33], which perceived irrigation as the solution to the mentioned problems. The growth on water supply would increase agricultural productivity, making small landholdings economically viable. Consequently, these parcels could be divided and distributed among thousands of local or migrant farmers, effectively repopulating the arid southern regions. Moreover, irrigated agriculture would not only ensure an improved standard of living for local inhabitants but also served as a food supplier for urban centres such as Lisbon, mitigating the persistent food trade imbalances, particularly in grains, which have historically afflicted both Portugal and Spain[34].

However, it wasn't until the late 19th century that the first plans passed beyond the mere rhetoric. After, it took almost another century from the conception to the construction of large public irrigated systems. As an example, two cases discussed in this article are paradigmatic of this lengthy process. The Sorraia valley irrigation system was initially proposed in 1884, with a plan strikingly similar to the one finally implemented in the late 1950s[35]. Meanwhile, another attempt was made in the 1910s[36]. The situation in Extremadura mirrored a similar trajectory[37], ending finally with the construction of several dams inaugurated by early 1960s under the *Plan Badajoz*.

The disparity between the conception of building dams and their actual execution was so significant that, in both countries, the projects were redesigned to include hydroelectric power production. In the mid-20th century, the scarcity of electrical production was an obstacle to the industrialization of Spain and Portugal[38], including rural areas. By 1950, Spain used only 11% of its hydroelectric economic potential, whereas Portugal's utilisation was a mere 3%[39]. In Portugal, the 1945 Electrification Law led to the construction of numerous hydroelectric projects[40]. Within this context, the dams built in Extremadura and Alentejo included hydroelectric power plants. However, due to the topography of the territory and the variability of rainfall, the installed capacity led to rather modest energy production within the respective national contexts of both regions. By 1970, the electricity production from the dams in Extremadura accounted for only 1,7% of Spain's national hydroelectric power production[41]. In any case, the electricity supply in both regions grew significantly following the construction of the dams.

The *Plan Badajoz* was primarily aimed at transforming rainfed agriculture into irrigated agriculture and colonizing Extremadura[42]. To achieve this objective, by the end of the Spanish dictatorship, nearly 100 thousand hectares had been irrigated. However, contrary to initial planning, only about one-third of this land was allocated to nearly 5 thousand settlers[43]. Although implemented following the 1959 Spanish Public Plan – the

[27] Faísca, 2020.
[28] Riesco Roche, 2006.
[29] Pires de Almeida, 2006.
[30] Llopis Agelán; Zapata Blanco, 2001.
[31] Herranz-Loncán; Sanchis-Llopis; Tirado-Fabregat, 2024.
[32] Faísca, 2023, 213-216.
[33] Riesco Roche, 2022a, 24.
[34] Serrão, 2005, 168-171.
[35] Faísca, 2023, 216-218.
[36] Sá, 1911, 151-208.
[37] Riesco Roche, 2022a, 33-34.
[38] For Portugal see Pintado, 2002 [1964], 231-235.
[39] Henriques; Sharp, 2021, 98.
[40] Amaral, 2019, 189.
[41] Riesco Roche, 2022c, 331.
[42] Parejo Moruno; Lopéz, 2022, 231.
[43] Riesco Roche, 2022b, 157.

Plan de Estabilización y Liberalización de la Economía Española – recommended by the International Monetary Fund to end Franco's autarky, in return for the aid that Spain began to receive and that also promoted industrialization –, several authors have pointed out that industrialization was a secondary goal of the Badajoz Plan, as it was predominantly left to private initiative[44]. The result was an initial inability to stimulate industries, despite the construction of powerful transportation infrastructures, electricity production, and hundreds of kilometres of irrigation channels[45]. In fact, the authorities of the *Plan Badajoz* were very surprised by the limited response from the private initiative to what they considered to be stimulating measures. Consequently, it was decided to reinforce the public industrial presence in the Plan area, but this also was not successful[46].

In a recent analysis, it is argued that the problem was the lack of regional and local financial resources to invest in the relatively risky industrial endeavours required to generate economic growth[47]. Moreover, the Plan was not important enough to counteract nationwide economic trends occurring during the project's development, since, as happened in many other countries, Spanish manufacturing sector became increasingly concentrated over time, with a progressively increasing core-periphery pattern[48]. However, two aspects make this vision ran short regarding the study of the impact of irrigation in present day Extremadura. Firstly, and most important, is the limited chronology since the study ends by 1980, therefore leaving the last forty years, precisely when some authors point out that irrigation started to have a positive impact in local industry. Secondly, a good portion of the data used is at the regional level. Knowing that the irrigated area of Extremadura, even though significant, only covers a minority of the territory, the potential positive effects of agricultural hydraulic works could be diluted within a general negative trend similar to what happened with all rural regions in the hinterland of Spain. As I will argue, there is a strong probability of a positive trend of the irrigation system built in the Vegas Altas area.

In Alentejo, the construction of large dams began slightly earlier under Law No. 1914, published in 1935, with the first ones being completed by late 1940s. The goal was very similar to that on the Spanish side, involving both agrarian transformation and colonization processes. However, unlike Extremadura, only one settlement was implemented with roughly 2 thousand inhabitants – *Colónia Agrícola de Pegões*[49]. Similarly to Spain, industrialization was also somewhat secondary but still present. There isn't much historiographic production on the impact of modern irrigation in Portugal, but the existing literature highlights the relative failure to positively impact local and regional development in terms of both economic and demographic standards[50]. Since the initial construction of public irrigation systems, the irrigated areas in both Alentejo and Extremadura have continued to expand, reaching 180 thousand in the former[51], and 290 thousand in the latter[52].

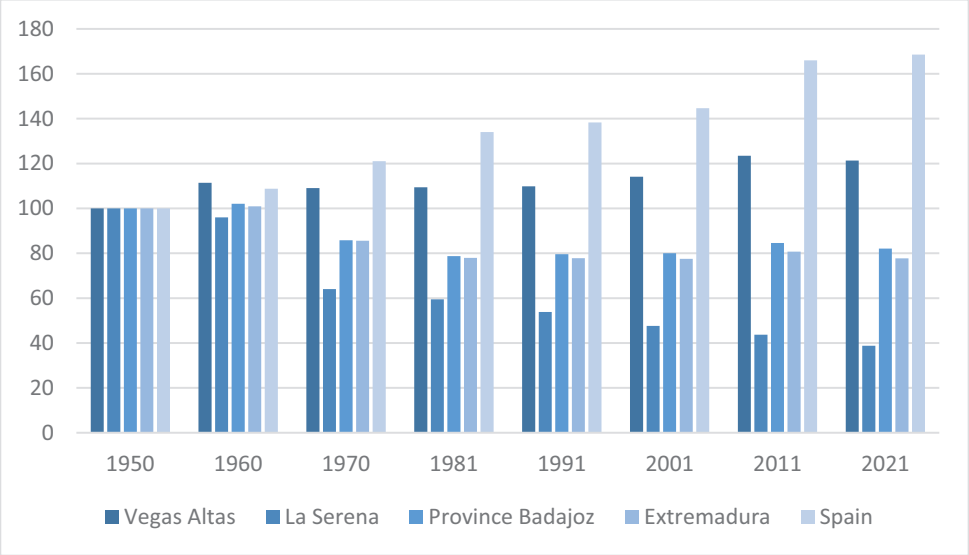
Results: from an inexistent impact in Alentejo to evidences of local development in Extremadura

In this section, the irrigated areas of Alentejo and Extremadura are compared with similar territories in the same regions that remained dependent of dryland agriculture, as well as among themselves. Wherever possible, the analysis covers the 1950s—the precise moment before irrigation began—and the present day. The initial objectives of irrigation— agrarian reform, population growth, agricultural product and productivity growth, and ultimately, economic growth—will all be analysed, with the exception of the first. This omission stems from a policy shift in the mid-1960s regarding the size of agrarian properties, where an increase in size was valorised rather than the opposite, following the indications of FAO[53]. The necessary data primarily comes from official statistical organizations such as the National Statistics Institute of Portugal, Spain's equivalent, and the regional statistical agency for Extremadura.

Starting with the population, there is a significant contrast between the irrigated area of Vegas Altas and the rest of Extremadura, as illustrated in Figure 3.

[44] Barciela López; López Ortiz, 1998. Cortés Sierra et al., 2014, 192.
[45] Barciela López; López Ortiz, 1998. Cortés Sierra et al., 2014, 192-193. Parejo Moruno; López, 2022, 229-233. Arminjon, 2023.
[46] Barciela López; López Ortiz, 1998.
[47] Arminjon, 2023, 27-29.
[48] Arminjon, 2023, 27-31.
[49] Silva, 2020, 309-322.
[50] Pires de Almeida; Faísca; Freire, 2023; Faísca, 2023.
[51] Faísca, 2023, 217.
[52] Rivero Nieto et al., 2022.
[53] Arminjon, 2023, 13.

Figure 3. Population evolution for selected territories in Extremadura, including irrigated and non-irrigated areas, 1950-2021 (1950=100)



Source: Own elaboration from the Spanish Census.

Unlike the trend observed in the vast majority of Spanish hinterlands, Vegas Altas currently has a higher population—albeit with a slight decline over the last decade—compared to its population in 1950. The different performance is particularly evident when compared with the population decline in both the Badajoz Province and the Extremadura region. However, the contrast becomes even more pronounced when compared with the neighbouring area of La Serena. The latter, like many other hinterland regions in Spain—and in Portugal for that matter—currently has slightly more than a third of its human population than in 1950. To be precise, in 1950, the municipalities of La Serena were home to 97,599 inhabitants, while in 2021 only 37,650 lived there. Differently, Vegas Altas had 70,379 inhabitants in 1950, and the 2021 census reported a population of 84,175.

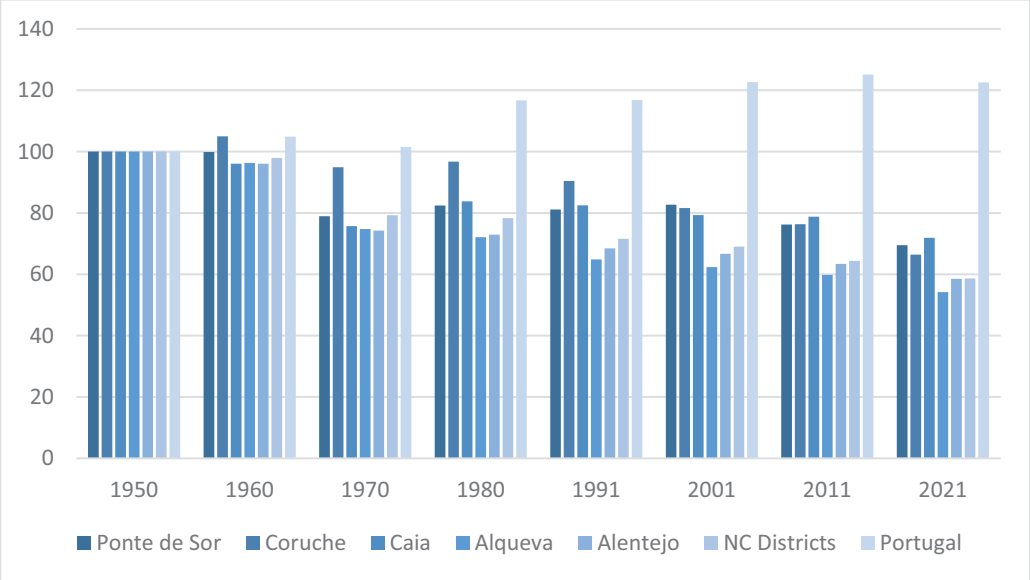
In Alentejo, regardless of irrigation, the depopulation process is constant, very similar and with a great magnitude. The Figure 4 shows it undoubtedly. The irrigated territories of Coruche – nearly 8 thousand hectares of irrigated land in 1,115 sq. km –, Caia – more than 7 thousand hectares in 878 sq. km –, and the vast Alqueva perimeter – over 110 thousand hectares of irrigated land in 4,135 sq. km – have lost population in the same proportion as the dryland areas of Ponte de Sor – only 500 hectares of irrigated land in nearly 850 sq. km – the northern and central districts of Portugal – with 40 thousand hectares of irrigated land in almost 29 thousand sq. km. When compared with all the Alentejo region, none of the irrigated areas show a significantly different path than the major region, and all the aforementioned diverge from the national average.

Regarding agriculture, irrigation brought significant changes in both regions, as anticipated. Traditional dryland crops, such as wheat or rye, were gradually replaced by more productive alternatives, including maize, rice, and tomatoes. Even some of the region's traditional dryland crops, such as olive or wine, began to be irrigated[54]. Regardless of the sustainability problems that, for instance, the scarcity of water can, and probably will, bring in a near future, this transition resulted in a notable increase in productivity and consequently, in production. However, the evolution of each region's share in the national agriculture sector differed considerably. Contrary to population trends, Alentejo increased its significance in the Portuguese agrarian sector, emerging as the primary region contributing the most to agriculture since 2013, as measured by Gross Added Value – GAV. Thus, while Alentejo's share of the GAV was around 23% in 1995, it reached 27% by 2000, and presently stands at nearly 30%. In Extremadura, the share of approximately 6% of the Spanish National Agrarian Income observed in the 1990s remains roughly the same.

In agrarian economies, or even in non-agrarian regions where agriculture, husbandry, and forestry maintain a relatively high share of production and

[54] Pulido García; Hernández Martínez; Pulido Moreno, 2014; Faísca, 2019.

Figure 4. Population evolution for selected territories in Alentejo, including irrigated and non-irrigated areas, 1950-2021 (1950=100)



Source: Own elaboration from the Portuguese Census.

employment, increases in agricultural productivity are expected to lead to economic growth. Although it is challenging to isolate the contribution of agriculture to regional economic growth due to numerous indirect inputs, such as the development of industrial and service sectors tied to an agrarian basis[55], GDP per capita serves as a reasonable indicator of the expected economic impact of irrigation in this context. The irrigated areas of Extremadura stand out, particularly in Vegas Altas. Despite falling below, the Spanish national average of €25,820, the GDP per capita reached approximately €21,607 in 2021, significantly exceeding the regional average of €19,072. This figure is notably higher than the neighbouring dry area of Serena-Castuera, which recorded only €17,354[56]. Undoubtedly, Vegas Altas demonstrates a different economic performance.

Once again, in Alentejo, things appear differently. As depicted in Table 2, the average income of individuals residing in both dry and irrigated territories have followed a similar trajectory, at least over the past 30 years. For this analysis, two sets of adjacent territories – one irrigated and the other non-irrigated – were examined. With the exception of non-irrigated Mértola, which initially experienced significantly greater growth than Serpa, the trends were nearly identical. Therefore, if we disregard the income growth of Mértola from 1993 to 2000, the overall growth becomes very similar between these two areas – Group 1 –, as well as between Ponte de Sor and Coruche – Group 2 –, the other pair chosen for comparison.

Table 2. Evolution of the mean income for a set of irrigated and non-irrigated municipalities, 1993-2021 (Portugal average = 100)

Municipality	1993	2000	2009	2019	2021	1993-2021
1. Mértola (d)	31.6	46.3	59.0	68.7	68.9	118.0 (48.8)
1. Serpa (i)	44.7	49.8	68.5	74.6	74.4	74.4 (49.4)
2. Ponte de Sor (d)	58.5	66.9	81.1	85.8	83.9	43.42
2. Coruche (i)	53.1	60.1	74.2	77.2	78.0	46.89

Source: Pordata, 2024.
Note: (d) stands for dry and indicates the municipalities that do not have significant irrigated areas, while (i) stands for irrigated and indicates the municipalities that do have significant irrigated areas.

In conclusion, the analysed data demonstrates the impact of irrigation on the local economic growth of Extremadura, as well as its effect on the population. Indeed, the latter is likely a consequence of the former. In Alentejo this is not the case, since there is no significant difference between the irrigated and dry areas. Regarding agrarian output, although both regions underwent structural changes, with a progressive increase in the share of irrigated crops, Alentejo stood out relatively more than Extremadura. In fact, Alentejo significantly increased its importance within

[55] For instance, the emergence of an industrial sector that produces agricultural machinery, seeds, fertilizers, or services based on agrarian tourism or agrarian research and development.
[56] Datosmacro, 2024.

the Portuguese agrarian sector, whereas Extremadura did not experience such phenomena. This may appear contradictory, but, in reality, it is not. As I will argue, the development of Vegas Altas is not exclusively reliant on agrarian activities. It is rooted in agro-industrial sectors and associated services that have emerged from irrigated agriculture.

Discussion: What makes Vegas Altas different?

As demonstrated in the preceding section, Vegas Altas area exhibits demographic and economic trends that are atypical for a rural hinterland region in Iberia. Indeed, since the latter half of the 20th century, 75% of the Portuguese territory and 54% of Spain have experienced significant population decline[57]. The rural exodus was hastened by the "deagrarisation" of the Iberian economies from the 1960s onward[58]. Since then, in rural areas and small towns of the hinterland regions, there was a notable absence of opportunities for creating a sufficient number of well-paying jobs. Consequently, there has been a persistent trend of high migration rates, either towards foreign countries or to the major metropolitan areas of Iberia such as Madrid, Barcelona, Lisbon, and Porto. Some regional main cities also absorbed a portion of this rural exodus, notably Badajoz in Extremadura, and to a lesser extent, Évora in Alentejo. However, Don Benito never functioned as a national or regional "capital" city. With only 22 thousand inhabitants by 1950, it is remarkable that Vegas Altas defied contemporary depopulation trends without the presence of a major urban centre. Deprived of any significant positive variance in birth rates or consistent colonization efforts, only a distinct economic performance can account for this phenomenon. This economic performance is probably directly and indirectly linked to the irrigation systems constructed by the Plan Badajoz.

As previously mentioned, the irrigation systems established under the *Plan Badajoz* were intended to facilitate the colonization of Extremadura. Thousands of colonisers, originating from various regions within Extremadura and across Spain, were expected to establish themselves in new settlements, utilizing the irrigated land provided by the Spanish State. One of the focal points of this effort was Vegas Altas, where new villages, such as Vivares, were constructed in the 1960s[59]. However, the scale of these villages alone cannot fully explain the recent demographic trends in Vegas Altas, as the colonization process fell short of initial projections, as only 30% of the irrigated land was allocated to just over 2 thousand settlers[60]. Moreover, these new villages would quickly be susceptible to rural exodus if situated in other areas than Vegas Altas. For instance, applying the population decline rate observed in the La Serena area for 1960-2021, the 2,170 new settlers established in Vegas Altas would diminish to less than 1,000 by 2021. Thus, the difference has to be on economic bases.

In fact, examining the economic structure of Vegas Altas reveals distinctive features not only in comparison to other regions in Extremadura, but also when contrasted with the irrigated areas of Alentejo. Vegas Altas has witnessed the emergence of a strong agro-industrial sector, at least since the early 1990s, primarily driven by irrigated crops such as tomatoes, rice, and various horticultural and fruit products. Characterized by a vertical integration model, the majority of companies work on agricultural production, industrial transformation, and extend their activities with the sale of the finished products to distributors or even directly to the final consumer, both locally, nationally, and internationally.

In the SABI database, as of 2015, this sector comprised 357 companies, providing employment to over 3,200 individuals, and generating an annual net income of 750 million euros[61]. The specialization coefficient of Vegas Altas for agro-industrial sector within Extremadura region was of 1.69[62]. This outcome could be somewhat anticipated, considering the availability of raw materials—namely agricultural products—that support the agro-industrial sector of Vegas Altas. Nevertheless, two aspects should be highlighted. Firstly, while the proximity of raw materials remains a significant factor in industrial location, its importance has considerably diminished since the mid-20th century[63]. Secondly, in Portuguese irrigated areas, such as Coruche, there are also some agro-industrial companies; however,

[57] Pinilla; Ayuda; Saéz, 2008.
[58] Amaral; Freire, 2017.
[59] Diputación de Badajoz; Ayuntamiento de Vivares, 2016.
[60] Riesco Roche, 2022b, 157.
[61] Rangel Preciado, 2018, 185-188.
[62] The coefficient of specialization exceeding 1 indicates a concentrated of a specific sector within a particular territory above the average of Extremadura. Rangel Preciado, 2018, 185-188.
[63] Faísca; Parejo Moruno, 2023.

they hold less significance, as the transformation of local agricultural production occurs on a larger scale in other regions of Portugal.

However, the most distinctive aspect of Vegas Altas lies in the development of two additional industrial sectors based on both on irrigated agricultural production and the subsequent agro-industrial sector. The first sector involves the production of agricultural machinery and of materials related to irrigation[64], which employed over 200 workers in 2015[65]. Driven by local demand, this sector has experienced significant growth, with major companies now deeply integrated into international markets, making it one of Extremadura's more significant sectors when considering exports. The second sector comprises the chemical industry, particularly focused on the production of fertilizers and pesticides. Employing around 250 workers in 2015, Vegas Altas' chemical industry concentrates one-third of Extremadura's overall income, with an annually net income surpassing 107 million euros[66]. Once again, the major companies exhibit strong capabilities for exportation. In fact, as Table 3 demonstrates, Vegas Altas is the area of Extremadura with more internationalized companies, with the exception of the sum of the capital cities of Badajoz, Cacéres and Mérida.

Table 3. Number of international companies in Extremadura by local action groups (2015)

Local Action Groups	Exporting companies	Total Income of all companies (€)
Vegas Altas	23	1,475,130,950
Sierra Grande	20	947,711,873
Zafra	11	730,765,556
Lácara	9	438,706,257
Sierra Suroeste	8	1,462,536,448
...		
La Serena	3	295,925,477

Source: Rangel Preciado, 2018.

The workforce of these two sectors may not be impressive, as they do not exceed five hundred workers. However, two aspects must be taken into consideration. First, as mentioned, the SABI database only registers companies headquartered in the Vegas Altas area and not those registered in other locations in Spain, but that operate and employ people locally. A good example of this is Fertiberia, with an important fertilizer production unit in Don Benito, but whose headquarters are located in Madrid. It is a multinational company producing agricultural machinery and fertilizers with 14 production units located in 3 countries – Spain, Portugal, and France – but whose contribution to the economy of Vegas Altas is not accounted for in either the SABI database or the Extremadura business directory. The estimate obtained from local residents is that this company may employ up to 100 workers, and it is not the only company in this situation. Secondly, it is important to underline the high sales volume of companies in these sectors, which, being capital-intensive, do not directly employ that many people, but whose revenues enable the creation of jobs indirectly through suppliers in the production chain, as well as through the income that remains in the local economy, creating a multiplier effect for other sectors, including services.

This has been increasingly noticed by scholars[67] identifying Vegas Altas as a growing multi-specialized rural district that relies on irrigation which supports an agro-industrial sector that, in turn, extends to other industrial sectors, namely machinery production and the chemical industry. Functioning as agglomeration economies, the resulting competitive advantages have allowed them to surpass mere local demand, with many of them becoming exporting companies[68]. In this regard, Vegas Altas resembles what has already been identified for Almeria, one of the regions whose economic development based on an irrigated agricultural sector is considered an example, despite the environmental problems meanwhile observed, as agglomeration economies also emerged from the concentration of a large number of small producers in the same sector that were able to export to foreign markets[69]. In fact, other authors have already noticed that for Vegas Altas empirical evidence shows that the agglomeration industry when organized in the form of agglomeration obtains better results in competitive terms than when it is achieved in a dispersed (non-agglomerated) way.[70]

The ability to create a spillover effect that extends beyond the transformation of locally produced agricultural products seems to be the major difference of Vegas Altas compared to the irrigated regions in

[64] For instance, consider the Agroriegos Montero Group, which reported a revenue of 9 million euros in 2022 with a workforce of 54 employees.
[65] Rangel Preciado, 2018, 189.
[66] Rangel Preciado, 2018, 193.
[67] Cortés Sierra, 2014, 192-193. Rangel Preciado, 2018. Rangel Preciado; Parejo Moruno; Cruz Hidalgo, 2019.
[68] Rangel Preciado; Parejo Moruno; Cruz Hidalgo, 2019.
[69] Aznar-Sanchéz; Sanchez-Picón, 2010.
[70] Rangel Preciado et al., 2021.

southern Portugal, at least considering the concrete example of Coruche, as shown in Table 4. In the later municipality, the local economic structure is based on solely in agro-industrial and agrarian companies, while the other major companies do not have any direct relation to irrigated agriculture – retail, cork and other services. The level of internationalization is also limited, with 6 of 10 companies having no exports. The same is true for Ponte de Sor, as expected since the respective area does not have a significant irrigated area. There, the main private employers are the cork industry, the aeronautical sector, and retail, with the sole exception of an agro-industrial company among the top 10 private local employers.

Table 4. Major companies headquartered in Coruche

Company	N. Workers	Sector	TOP 10 Turnover	% Exports in total Turnover
Dacsatlantic	88	Industrial Rice Husk	Yes	27%
Arrozeiras Mundiarroz	72	Industrial Rice Husk	Yes	19%
Bersil	58	Agriculture	No	0%
Supercoruche	55	Retail	Yes	0%
Jung Agricultura	55	Agriculture	No	0%
Convergência	52	Education	No	0%
Intercoruche	48	Retail	Yes	0%
Laverde	45	Cosmetic Industry	Yes	57%
ITS Indústria	43	Waste disposal	Yes	14%
Tomas & Ferreira	39	Industrial Meat Production	Yes	0%

Source: Informa database provided by the Municipality of Coruche, 2022.

It is possible to argue that the difference in scale between Vegas Altas and Coruche may have been decisive for this different outcome. In fact, all the irrigated area in the Sorraia Valley, with its bulk in the municipality of Coruche and extending across the municipalities of Benavente, Mora, Salvaterra de Magos, Avis, and Ponte de Sor, does not exceed 17 thousand hectares, which is markedly small when compared to the over 120 thousand hectares in the Vegas Altas area. However, the Alqueva perimeter, in southern Alentejo, comprising more than 110 thousand hectares of irrigation, shows a demographic and economic performance very similar to that of Coruche and other rainfed regions in the interior of Portugal, thus the opposite of the Vegas Altas area that has the same magnitude of irrigated area.

The comparison with the irrigation of Alqueva raises another question related to time. Between the construction of the *Plan Badajoz* irrigation system and the development of the mentioned industrial sectors – agro-industrial, production of irrigation machinery and equipment, and fertilizer production – several decades have passed, as noted by several authors[71]. Table 5 presents the Top 10 companies of Vegas Altas area, composed of the five largest employers registered in the region, as well as the 5 companies with the highest revenue in 2022. It also records each company foundation year, and the number of years that have elapsed between the inauguration of the Orellana dam and the founding of each of the companies. The situations vary widely, but except for two examples, at least two decades were required for these companies to emerge, with an average for all of 29 years. While this cannot be applied to the irrigation of the Sorraia Valley, whose main dams date back to the late 1950s, in the case of Alqueva, the coming years could be decisive, as the structure was inaugurated in 2002 and is close to completing a quarter of a century.

Table 5. Main present companies in Vegas Altas area and the time elapsed after the inauguration of Orellana Dam

Company	Workforce	Revenue 2022 (€)	Foundation Year	N years since Orrelana Dam inaugurated
Fruticola Castelnovo	408	15,543,000	1997	36
Sol de Badajoz	389	20,047,000	1997	36
Inquiba	186	204,206,000	1970	9
Transformaciones Agricolas	163	85,670,000	1965	4
MercoGuadiana	150	194,670,000	1991	30
Pronat	141	50,623,000	2003	42
Capilla	87	15,185,000	1992	31
Casat	80	79,409,000	1985	24
Agroriegos Montero	54	8,936,000	2001	40
Fertiex	22	31,382,000	1994	33

Source: Own elaboration from Junta de Extremadura, 2024.

[71] Cortés Sierra, 2014, 192-193. Parejo Moruno, 2022, 229-233. Arminjon, 2023.

It seems evident from the demonstrated demographic and economic performance, as well as the sectors that supported it, that irrigation had a positive long-term impact in Vegas Altas. However, examining the Portuguese case, irrigation does not appear to be a sole factor of development by itself. It is therefore imperative that, having identified this different outcome, research should be further explored in the near future. This entails detailed examination of the Vegas Altas area, as well as Extremadura and even Spain, cross-checking it with the main factors influencing economic activity. Fieldwork has to be conducted, including direct approaches to business and political leaders in the area, always from a comparative perspective with rainfed regions and the irrigated areas of southern Portugal and even others in Spain.

In fact, other Modern irrigated regions in Spain have shown both successful and unsuccessful results. In the more successful cases, Mélian Navarro and Melgarejo Moreno note that irrigation has stimulated agricultural production, the agri-food industry, and auxiliary industries, particularly in the supply of production inputs. These sectors began with a local focus but have expanded to international markets[72]. This appears to be the case in Vegas Altas. Similarly, in the Canal de Aragón y Cataluña irrigated land, the emphasis on labour-intensive irrigated agriculture, such as fruit and fodder, enabled the consolidation of an agro-industrial sector and helped to reduce rural exodus, which peaked between the 1960s and 1980s. By contrast, in the Riegos del Alto Aragón region, the impact of irrigation seems to have had the same limited or even negligible effect as observed thus far in Alentejo. The inability to convert cereal production to more productive and labour-intensive crops is cited as one of the mains reasons for the failure of this investment[73]. However, this is not applicable to Alentejo, since irrigation involved a change in agricultural crops[74], which, was observed in various locations regardless of the chronology in question[75].

There is also the well-known example of the Almeria "miracle", where, defying Kuznets' Modern Economic Growth model, a non-industrial sector showed the capacity to sustain economies of agglomeration and the dynamics typical of a cluster. Again, there was an initial focus on a labour-intensive agricultural sector that demonstrated the ability to generate immense positive externalities in other sectors of economic activity. However, the local socio-economic characteristics, with a high proportion of family farming and the proximity to the coast with significant tourism activity, in addition to the specific characteristics of the agriculture practiced – from water supply primarily through aquifers to the massive use of greenhouses – make this example less comparable to Extremadura and Alentejo[76].

Finally, looking into the literature at least another three aspects should be considered. Firstly, the historical context in which the infrastructures associated with dam and irrigation plans became operational, as better demographic and economic performance could be connected to a time and place where agriculture still held significant economic importance. Secondly, the type of agriculture practiced with the use of irrigation is fundamental, as the employability of crops, their ability to generate agro-industrial sectors, and, above all, their acceptance in international markets seem to be determining factors[77]. The application of European funds should also be analysed in detail, especially since a thesis has recently emerged claiming that one of the main reasons for the Portuguese recent poor performance is largely due to the bad utilization of European Union support, especially when compared, for example, with Spain[78].

Continuing this line of research, it is expected to contribute to the discussion of the construction of new dams and irrigation systems, as is the case in Alentejo, and the expansion of irrigated areas, as in Extremadura. In addition to the economic aspects addressed in this article, an environmental dimension will have to be considered. For example, the future possibilities of irrigated agriculture in the face of climate change and decreasing water availability, that had been recently discussed[79].

Conclusion

For centuries, irrigation has been viewed as a crucial factor for the development of the dry, depopulated hinterland regions of Southern Iberia. However, the

[72] Mélian Navarro; Melgarejo Moreno, 2020.
[73] Silvestre; Clair, 2010.
[74] Faísca, 2019.
[75] Parcerisas-Benedé, 2016.
[76] Aznar-Sanchéz; Sanchez-Picón, 2010.
[77] Silvestre; Clair, 2010.
[78] Palma, 2023, 251-288.
[79] Pires de Almeida; Faísca; Freire, 2023.

construction of dams and irrigation systems only began in the mid-20th century, precisely when the Portuguese and Spanish economies were undergoing modern economic growth, transitioning from agrarian activities to industry, and later, services. This led to an accelerated increase in depopulation and impoverishment processes in almost all rural areas of Iberia. Thus, according to the 2021 census, in Portugal the population density of urban areas is over 453 inhabitants/sq. km, while in rural areas is around 22 inhabitants/sq. km, the largest gap ever recorded. In this context, only 38% of the parish have a population density above the average, the large majority in coastal areas. The Alentejo stands as the paradigm of this massive depopulation: occupying 30% of Portuguese territory, in 2021, it had only 4.6% of the country's total population. In Spain, the scenario is very similar. Almost two-thirds of Spanish municipalities subsist with fewer than a thousand inhabitants; of the 8,125 that exist, half have fewer than five hundred people, and 1,286 have fewer than one hundred. Extremadura is also one of the most endangered regions.

In this context, on the contrary of expected in Southern Portugal, the transformation of thousands of hectares from rainfed to irrigated agriculture did not halt the continuous loss of population. There is no statistical difference between irrigated areas and rainfed areas within Alentejo, or when comparing them to other hinterland rainfed areas in the north of Portugal. This would also be the expected scenario for the irrigated area of Vegas Altas in Extremadura, Spain. Situated almost midway between two Iberian metropolitan areas – Lisbon and Madrid – approximately 300 km apart, it should be anticipated a significant depopulation and impoverishment process, similar to many other areas of the *España Vacíada*. However, the reality is quite different. Vegas Altas presents a case of population growth and economic development within a hinterland area, without relying on a regional capital city such as Badajoz. Prior to the construction of the Orellana irrigation systems in the 1960s, Vegas Altas had fewer 27 thousand inhabitants compared to the neighbouring La Serena area. Presently, it has more than 46 thousand inhabitants. This growth is attributed to the establishment of an industrial sector that capitalized on the changes brought by irrigation.

In fact, agro-industrial industries related to irrigated crops such as tomatoes, rice, maize, horticultural products, and fruits have been experiencing constant growth and are expected to continue expanding. Additionally, two other industrial sectors have developed due to the characteristics of modern irrigation agriculture, specifically, a sector for the production of agricultural machinery and support products for irrigation infrastructure, and a specialized chemical industry sector in the production of fertilizers. Initially created to meet local demand, companies in these sectors are currently among the most important exporters in the entire Extremadura region. Although the employment figures may not be that impressive, ranging between 4,000 to 5,000 workers, including those from companies headquartered outside the region whose count does not appear in local databases, the number of jobs created is significant for an essentially rural inland region. Moreover, the high volume of revenues, supported by a strong export component, generates a positive effect throughout the local economy upon which the service sector thrives.

This seems to be the difference when, for example, comparing it with the municipality of Coruche, in the centre of the Sorraia Valley irrigation area, where the agro-industrial sector also exists but, besides being smaller in scale, other subsidiary sectors have not developed. It can be argued that the scale of the irrigated area, much smaller than in Vegas Altas, is the cause of the lack of industrial impact of irrigated agriculture. However, in the perimeter of the Alqueva, in southern Alentejo, whose magnitude is similar to that of Vegas Altas, the demographic and economic performance shows no difference from other rainfed regions of Portugal or Spain. In the case of Alqueva, it may be a matter of time, as in Extremadura it took almost three decades for the first industrial effects associated with irrigation to become clear. Now, 22 years have passed since the inauguration of the Alqueva dam, and the next years could be decisive in understanding whether this project will finally have a local impact.

This article highlights the differences between the successful case of Vegas Altas and the failure of irrigation in southern Portugal concerning local development. However, it does not identify the causes, which is crucial, particularly as a new large dam is under construction in Alentejo, and discussions in Extremadura are ongoing about extending irrigated areas to other regions. To address this, it will be essential not only to deepen the understanding of the Vegas Altas region, including through fieldwork, but also to examine other seemingly successful cases in Spain, such as the Canal de Aragón y Cataluña, with which Extremadura appears to share certain characteristics, including similar crops, stimulation of other economic sectors, and integration

into international markets. The renowned Almería "miracle", although with some structural differences, must also be examined. Less successful cases, such as Riegos del Alto Aragón, will likewise be studied, along with factors like public incentive policies, including the use of European funds, which will be evaluated in the near future.

This approach will enable contributions to the ongoing discussion on whether Portugal's slower economic development in the 21st century is due to the mismanagement of funds allocated by the European Union to less developed regions. Finally, environmental issues must be considered, particularly the future of irrigated agriculture in the context of climate change and diminishing water availability.

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