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The Common Agricultural Policy (CAP) in Extremadura (SW Spain) during the Period 2014–2020:New Opportunities for Economic Diversification in Rural Areas?

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Abstract: The Common Agricultural Policy (CAP) is a European policy created in the early 1960s to address the food and economic problems affecting European society and the agricultural sector in particular. Throughout its history, the various reforms carried out in this policy have oriented it towards a reduction of direct aid to farmers' production (due to its excessive cost, among other reasons), in favor of income-related aid. In recent years, the agricultural sector in Extremadura has received CAP aid in a very unequal manner, with a more significant concentration in the agricultural areas where intensive production has been established as a base and where there is a larger population. Thus, the main objective of this research is to analyze the spatial relationships between CAP subsidies and other demographic, economic and social context variables. To achieve the proposed objective, a spatial regression model, namely Geographically Weighted Regression (GWR), has been calculated to determine the relationship between the amounts received from the CAP and the socioeconomic situation of each of the municipalities in the region. The results show a concentration of this aid in the most dynamic areas, with municipalities with a larger population and a more productive agriculture, mainly related to irrigated farms.

Keywords: common agricultural policy (CAP); extremadura; agricultural sector; 2014–2020; geographically weighted regression (GWR)

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1. Introduction

The Common Agricultural Policy (CAP) is a strategic tool created in the early 1960s to address the food and economic problems affecting European society [1,2]. With the incorporation of Spain into the European Economic Community (EEC) in 1986, a process of transformation began for the Spanish agricultural sector and, more specifically, for that of the Autonomous Community of Extremadura (the area of study), causing this region to begin to benefit from aid from the different funds (European Regional Development Fund (ERDF), European Social Fund (ESF) and European Agricultural Guidance and Guarantee Fund (EAGGF-Guidance Section) with the aim of improving its productive structure [3,4]. Since Extremadura was considered an Objective 1 region within the European framework, due to its weak socio-economic structure, the financial application of these funds was established in order to improve its productive structures [5,6]. Thus, the CAP has meant a great support to farmers and stockbreeders in the country, especially in Extremadura, where, due to its rural characteristics, the agricultural sector has an important weight in the whole economy [7], with a representation of 7.4% of Gross Domestic Product (GDP) in 2019, 5 points higher than the Spanish average (2.5%) and 6 points higher than the European average (1.3%) in the same year. In terms of agricultural assets, according to the National Statistical Institute (NSI), Extremadura in 2022 had a percentage value of 9.8% compared to 3.95% of the national total. The application of this aid has led to a process

of transformation that over the years has enabled Extremadura's agricultural sector to increase its competitiveness on the international market [8], with a commitment to greater mechanization and modernization of agricultural structures.

Therefore, during its successive reforms, the operation of the CAP has been reoriented towards the search for a more competitive agriculture in the market, trying to improve producers' incomes and environmental improvements [9,10] and towards greater support for the development of the EU's rural areas. In November 2010, the European Commission presented its communication "The CAP towards 2020: Meeting the food, natural resources and territorial challenges" [11], this led to the initiation of a reform proposal which, after meetings, discussions and negotiations, resulted in the 2013 reform. This reform arose from the need to achieve greater efficiency in the EU's rural areas due to the fact that the CAP was not achieving the European results in many of Europe's rural areas: they are areas in decline, with an unattractive labor supply and demographic losses that mainly affect their young population, with the danger of depopulation of these areas. For this reason, the 2013 reform aimed to make more optimal use of the financial resources granted to rural areas in order to achieve sustainable, inclusive and smart agricultural growth [12,13]. Thus, it covers the budgetary framework from 2014 to 2020, although it came into force in 2014 and many of its new rules were applicable from 2015 (legislatively supported by regulations 1305/2013, 1306/2013, 1307/2013 and 1308/2013) so that member states had sufficient time to implement the new policy and inform potential beneficiaries of this aid. Nowadays, the new European agricultural structure is fully in line with the fundamental principles of the CAP, which focus on guaranteeing food security, stabilizing markets and ensuring reasonable prices and a fair standard of living for the farming community [14–16].

1.1. The CAP for the Period 2014–2020

The 2013 reform was the latest stage in the process of adapting the CAP to changing agricultural markets and continued concern for the environment [17–19]. This reform aimed to achieve a better focus of support on active farmers (farm owners who have a real activity), coupled with an increased importance of environmental aspects, with specific support linked to these aspects in order to achieve a more sustainable CAP [20,21].

In the period 2014–2020, the focus is on environmentally and climate friendly farming [17,22,23], thus, the general lines pursued are the conversion of decoupled aid into a multifunctional aid system [20,24], the consolidation of the two fundamental pillars of the CAP, the strengthening of the tools of the single Common Organization of Agricultural Markets (CMO), and the establishment of a more integrated, specific and territorial approach to rural development [25,26]. Through its environmental and multifunctional guidelines, the CAP seeks to bring the community's rural environment and its agriculture into line with the requirements of the World Trade Organization (WTO), in terms of limiting or eliminating all aid that could distort international agri-food trade [27–29]. The aim of this reform is to promote the conservation and efficiency of natural spaces in rural areas in order to achieve sustainable and inclusive growth in the agricultural sector [20,30]. This reform also sought to promote the diversification of economic activities in rural areas with new sectors to complement agriculture and livestock farming.

During this budgetary framework, the two-pillar structure established in previous reforms is maintained, although greater flexibility and linkages are now established between the two pillars for the transfer of funds [10,31,32]. With this reform, Regulation (EU) 1306/2013 of the European Parliament and of the Council of 17 December 2013 on the financing, management and monitoring of the CAP for the period 2014–2020 was adopted. Thus, as set out in Article 3, the funds for financing agricultural expenditure will be provided by the EAGF (European Agricultural Guarantee Fund) and the EAFRD (European Agricultural Fund for Rural Development). In the state regulatory framework, in Spain, these funds are controlled by Royal Decree 92/2018, of 2 March, which regulates the system of paying agencies and coordination with European agricultural funds, EAGF and EAFRD. One of the main objectives of the CAP is the consolidation of both pillars, with

the first pillar financing direct aids and market measures under the EAGF and the second pillar financing rural development aids under co-financing through the EAFRD.

The first pillar is therefore made up of direct payments to farms and the CMO for agricultural products. Thus, direct payments are composed of a multifunctional payment system, regulated by Regulation (EU) No. 1307/2013 of the European Parliament and of the Council of 17 December 2013 on Direct Payments, establishing a basic payment system which is defined as a support system that has been decoupled from production and has been based on the provision of payment entitlements linked to the admissible agricultural area [33]. The second pillar of the support system is the rural development policy, which complements the first pillar, with the aim of increasing competitiveness and sustainable management of rural communities [34,35]. Thus, rural development measures are governed by Regulation (EU) 1305/2013 of 17 December on support for rural development by the EAFRD and repealing Regulation (EC) 1698/2005.

In recent years, on 23 November 2021, the European Parliament approved the 2023–2027 reform after several years of discussions with the various representatives of the agricultural sector. Through this reform, an agricultural policy is adopted that is theoretically fairer, greener and more focused on achieving concrete results. This policy is linked to objectives based on the three pillars of sustainability, focusing on economic, environmental and social aspects that are complemented by a cross-cutting objective, the modernization of the agricultural sector through knowledge, innovation and digitalization in rural areas [36]. Thus, it is divided into three blocks: the economic block that aims to promote a smart, resilient and diversified agricultural sector that guarantees food security, the environmental block that aims to intensify care for the environment and climate action, and the rural and social block that aims to strengthen the socio-economic fabric of rural areas.

1.2. Justification of the Study

In view of the above statements, the interest and usefulness of analyzing CAP aid in the Spanish region of Extremadura and using Geographic Information Technologies (GIT) is considered, as they are tools that help in the study of the spatial location of the distribution of the amounts associated with this aid. This can help to optimize the functioning of a policy aimed at strengthening the European agricultural sector, particularly in Extremadura, and contribute to the reduction of depopulation in rural areas.

Thus, the main objective of this research is to analyze CAP aid in Extremadura and its spatial distribution, to determine its influence on the economy and the development of the regional agricultural sector. Moreover, this study aims to show whether the changes introduced in the CAP, with a greater orientation towards organic production, led to improvements in disadvantaged areas and the promotion of the incorporation of young farmers in areas with a decline in agricultural exploitation. To achieve the proposed objective, the calculation of a spatial regression model has been carried out, with which different agricultural, economic, and demographic variables are interrelated.

The Autonomous Community of Extremadura was chosen as the study area, as it is a region where the agricultural sector is of particular importance for the regional economy and represents the fourth highest amount of CAP aid in the study period at national level, behind the Autonomous Communities of Andalucía, Castilla y León and Castilla-La Mancha.

Authors such as Rumanovska and Pottori et al. [9,37] have carried out studies on the impact of the CAP on different territories but from a theoretical point of view, analyzing the different changes established in the reforms and how these can affect countries with different agricultural characteristics. Cárdenas and Nieto [6] have sought to use GIS tools and the interrelation of variables to observe how European policies impact on the development of rural areas, carrying out an exhaustive analysis of EAFRD aid in the 2007–2013 programming period and its impact on economic growth in areas of low demographic density. It is necessary to highlight several studies that explain, through a descriptive analysis, how agricultural and rural development measures, beneficiaries and amounts received are distributed over the territory at the municipal level and how they have affected agricultural

structures [38], as well as research on the implementation of Rural Development measures through the EAFRD as the second pillar of the CAP and its impact on the territory [39]. Other noteworthy research includes that carried out by Ribas et al. [40] on the behavior and territorial distribution of CAP direct aid in Spain, and that developed by Leco and Pérez [24] on the role of the Basic Payment in Spain, analyzing its distribution and the possible territorial imbalances of this aid system. Leco et al. [41] have studied the deagrarianization of Spain and how this process has directly contributed to the depopulation of rural areas. Undoubtedly, all these works have helped in the construction of a theoretical, but also methodological basis for the subject of study of this research, because they take as a study area territory with demographic and socio-economic characteristics similar to those of the Extremadura region.

From a methodological point of view, the Geographically Weighted Regression (GWR) model as a GIS-based spatial regression method has been used in tourism-related research aimed at assessing the tourism potential of rural areas [42,43] and urban areas [44]. At the same time, Molinero-Parejo et al. and Zheng et al. [45,46] have applied it to research on landscape and land use changes in suburban and rural areas due to urban sprawl and on the mechanisms and changes in agricultural areas [47]. Evans et al. [48] have used GWR to analyze farms, seeking to determine, through this tool, how the use of digital technologies can improve farm profitability and sustainability. This tool has also been used to study the different spatio-temporal changes in a territory, on the one hand, Deng et al. [49] have analyzed the spatial correlation between population distribution and the economy in the Chinese region of the Hu Line and, on the other hand, Zhang et al. [50] have studied these spatial dynamics in an urban environment.

The application of this tool with a social character can be seen in the work carried out by He et al. [51], who analyze how physical geographical factors affect poverty and local conditions in a territory. These studies therefore demonstrate the versatility of the method and its applicability in various fields with appropriate results.

2. Materials and Methods

2.1. Study Area

Extremadura (Figure 1) is situated in the south-western part of the Iberian Peninsula, bordering with Castilla y León to the north, Castilla la Mancha to the east, Andalusia to the south and Portugal to the west. This region has a total population of 1,054,776 inhabitants, according to the NSI as of 1 January 2022. It is also made up of the two largest provinces in Spain (Cáceres and Badajoz), covering an area of 41,635 km^2. Its vast extension gives rise to its population being distributed in a very dispersed manner throughout the territory, resulting in a low population density of 25.33 inhabitants/km^2.

As a territorial reference framework within the Autonomous Community itself, we have opted to use the agricultural districts, since they allow us to situate the municipalities within a delimitation from an agrarian point of view, as they represent areas that have a certain homogeneity both in their productive potential and in their crop systems and agricultural use, as well as a similar economic development [52,53]. Thus, Extremadura is divided into 22 agricultural districts, 12 of which are in the province of Badajoz (in the south) and 10 in the province of Cáceres (in the north).

The relief of Extremadura is very varied, which has conditioned the different types of agricultural production found in the region. The existence of elevated formations, plains and peneplains, broad plains and valleys has led to the establishment of large-scale, mainly dry farming systems in the peneplains, and small-scale, self-sufficient or single-crop monopoly farming systems in the elevated areas and valleys. The existence of fertile plains around its main rivers: Guadiana and the tributaries of the Tajo: Tiétar, Alagón and Árrago have given rise to the consolidation of intensive irrigated agriculture based on products such as rice, tomatoes, fruit trees and tobacco. These characteristics have conditioned the agricultural system in Extremadura, with systems of higher agricultural yields coinciding with the most densely populated areas dedicated to irrigated farms, vineyards and olive

groves, especially around the agricultural region of Almendralejo (known as Tierra de Barros). On the opposite side, there are the large-scale dry land farms with low yields, in the peneplain and in the countryside, and the mountain areas, with small farms, also with low yields, in which, consequently, low population density and the risk of disappearance are the main demographic characteristics.

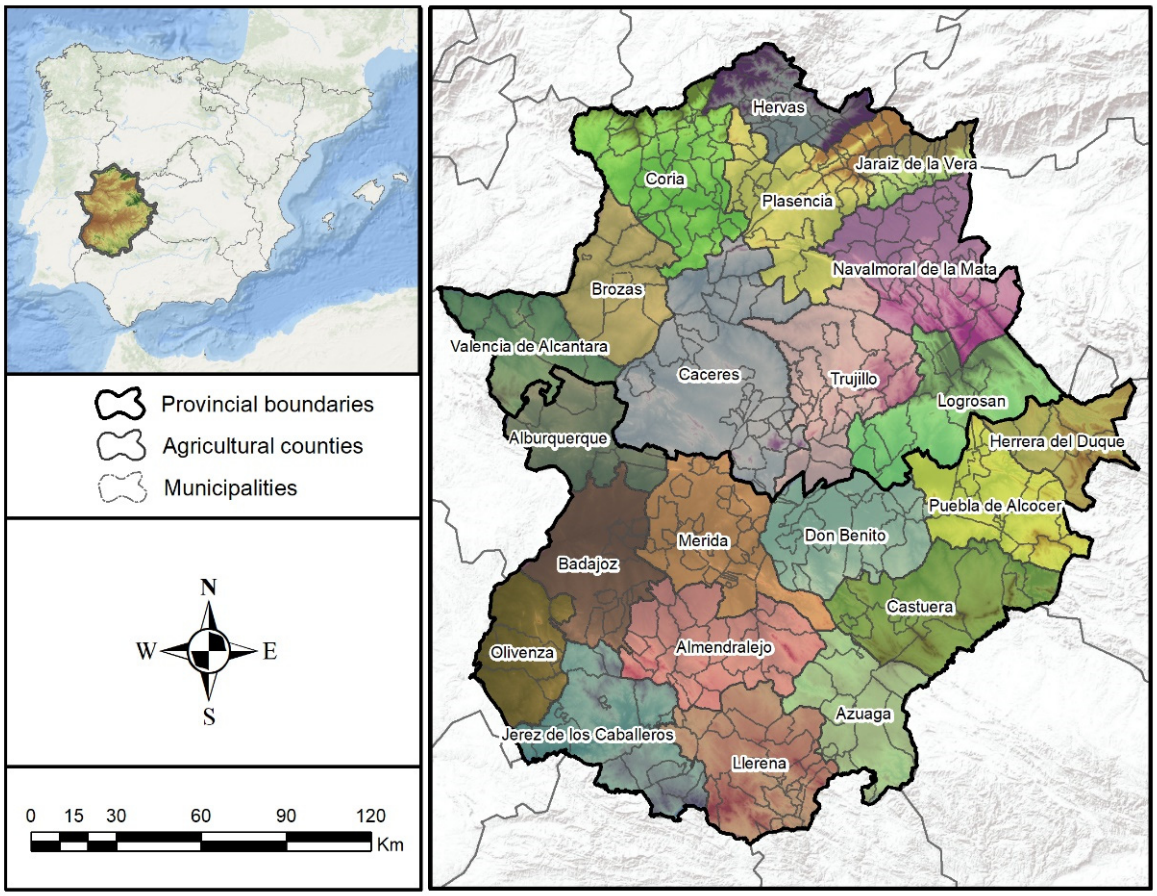


Figure 1. Location of study area. Municipal distribution in the agricultural counties of the Autonomous Community of Extremadura.

2.2. Methodological Process

The following figure (Figure 2) shows the process carried out for the development of this research. Firstly, the necessary data were obtained from different sources of information in order to subsequently calculate the agricultural, economic and demographic variables. Thus, it was considered that the selection and use of the following variables (Table 1) was the most optimal for the development of this research, since, as has been observed in previous studies [6,54,55], they reflect the influence of this type of aid on the socio-economic reality of Extremadura's municipalities. These variables have been used to create the regression model and its validation by means of Moran's I.

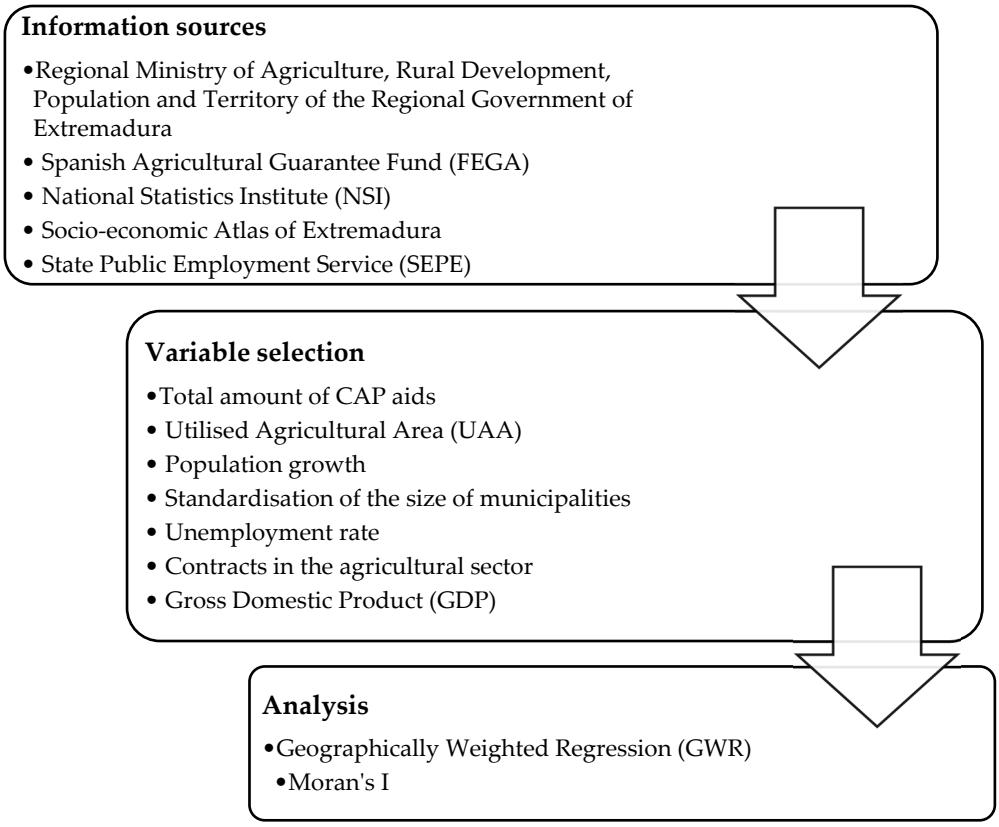


Figure 2. Methodological process diagram.

2.2.1. Variables and Information Sources

Using the agricultural, economic and demographic variables mentioned above (Figure 2), an alphanumeric database was constructed to quantitatively analyze CAP support in relation to them. These were obtained from two data sources. On the one hand, data relating to CAP aid at the municipal level between 2014 and 2016 were provided by the Ministry of Agriculture, Rural Development, Population and Territory of the Regional Government of Extremadura. On the other hand, data for the years 2017, 2018, 2019 and 2020 were obtained from the open data information portal of the Spanish Agricultural Guarantee Fund (FEGA). These data are available due to the regulation on transparency of information on beneficiaries of EAGF and EAFRD funds, contained in articles 111 to 114 of Regulation (EU) No. 1306/2013 of the European Parliament and of the Council of 17 December 2013 on the financing, management and monitoring of the Common Agricultural Policy; and articles 57 to 62 of Commission Implementing Regulation (EU) No. 908/2014 of 6 August 2014 outlining detailed rules for the implementation of Regulation (EU) No. 1306/2013.

For the development of this research, the INE [56,57] has been used as a source of data for the calculation of demographic variables (population growth and standardization of the size of municipalities) and agricultural variables (UAA). The socio-economic variables have been calculated from data published by the SEPE [58] (unemployment rate and contracts in the agricultural sector) and from the socio-economic atlas of Extremadura (GDP) [59].

The following table (Table 1) presents a summary of the variables used, their source and the calculation necessary to obtain them.

Table 1. Selected agricultural, demographic and socio-economic variables.

Variables	Calculation	Source
Total amount of CAP aid	Total amount of aid for the period per municipality	[60,61]
Percentage of UAA	(UAA/municipal area) × 100	[57]
Population growth	(Population 2020-population 2014)/population 2014	[56]
Standardization of the size of municipalities	Three population groups according to NSI: • <2000 inhabitants • 2000–10,000 inhabitants • >10,000 inhabitants	[56]
Unemployment rate	(Unemployed/total active population) × 100	[56,58]
Contracts in the agricultural sector	(Agricultural contracts/total contracts) × 100	[58]
GDP	GDP per capita	[59]

2.2.2. Geographically Weighted Regression (GWR)

The variables selected were used to apply Geographically Weighted Regression (GWR), by means of which the relationship between the amounts received from the CAP and the socio-economic situation of each of the Extremadura municipalities can be determined. GWR is a spatial regression technique that provides a local model of the variable and process that makes a forecast by fitting a regression equation to each entity in the dataset, [43,62], in this case, the municipalities of Extremadura. In this way, the individual equations are formed through the incorporation of a dependent variable and several explanatory variables of the entities that are located in each destination entity, in order to obtain the geographical variations [63–65]. Thus, the dependent variable is the total amount of CAP aid and the explanatory variables are the percentage of UAA with respect to the total surface area of the municipality, population growth in the period 2014–2020, the standardization of the size of the municipalities into three groups according to the criteria established by the NSI (less than 2000 inhabitants, between 2000 and 10,000 inhabitants and more than 10,000 inhabitants), the unemployment rate, the contracts in the agricultural sector in this period and the Gross Domestic Product (GDP).

The use of this type of regression allows greater weight to be given to the analysis of the neighborhood of the entities, which is why, in addition, the adaptive *Kernel* function was used, thus allowing higher measures of density variations to be assigned to those areas where the values of the percentage of UAA with respect to the total surface area of the municipality, population growth, standardization of the size of municipalities, contracts in the agricultural sector and GDP are more concentrated, and lower values where there is greater dispersion, adapting better to an irregular distribution of observations [44,45,66].

To carry out the model it is necessary to determine the overall regression coefficients (β) for the independent variables [67]:

$$yi = \beta 0 + \beta 1x1i + \beta 2x2i + \ldots + \beta nxni + \varepsilon i \quad (1)$$

with the estimator:

$$\beta' = (XT\ X) - 1\ XT\ Y \quad (2)$$

Once the independent variables to be retained in the model are identified, and there is a theoretical basis for thinking that relationships may differ spatially, GWR may be an appropriate next step. The regression models underlying GWR:

$$yi = \beta 0 + \beta 1x1i + \beta 2x2i + \ldots + \beta nxni + \varepsilon i \quad (3)$$

with the estimator:

$$\beta'(i) = (XTW(i)\ X) - 1XTW(i)Y \quad (4)$$

where $W(i)$ is a matrix of location-specific weights for location i, so that observations closer to i are weighted more heavily than observations further away.

Finally, the geostatistical analysis of the Global Moran Index [68], was carried out in order to find the relationship between the variables used and the residuals resulting from the regression model. Thus, when the values for neighboring entities are higher than the average or lower, the cross-product will be positive; while when the former are lower than the average and the value of the analyzed entity is higher, the cross-product will be negative, thus detecting whether the analyzed variable is clustered, dispersed or random. Therefore, in order to know the presence of correlations between groups of territorial units, it is first necessary to estimate whether the established pattern is dispersed, clustered or random by calculating Moran's I Global. It is established according to the following equation [68]:

$$I = \frac{n}{S_0} \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} w_{i,j} z_i z_j}{\sum_{i=1}^{n} z_i^2} \tag{5}$$

where Z_I is the mean deviation of an attribute for feature i, $w_{i,j}$ is the spatial weighting between i and j, n is equal to the total number of features and S_0 is the aggregate of all spatial weights:

$$S_0 = \sum_{i=1}^{n} \sum_{j=1}^{n} w_{i,j} \tag{6}$$

Z_I score is calculated as:

$$z_I = \frac{I - E[I]}{\sqrt{V[I]}} \tag{7}$$

where:

$$E[I] = -1/(n-1) \tag{8}$$

$$V[I] = E\left[I^2\right] - E[I]^2 \tag{9}$$

Moran's Global I indicates the degree of correlation between the values represented, with a value ranging from −1 to +1. Positive (clustered) values indicate the existence of similar analysis values, either high or low, while negative (dispersed) values indicate values that are different from each other. Random values are those close to 0, which show little spatial relationship between the values [69]. The Moran Global I presents a z-score and a p-value, which are measures of statistical significance that establish whether or not the null hypothesis should be rejected. The z-scores are standard deviations that can be very high or low and are regularly associated with very small p-values that are set in the tails of the normal distribution. This p-value is a probability and when it is very low, it means that it is very unlikely that the spatial pattern presents random results, thus rejecting the null hypothesis [70].

3. Results

Firstly, the distribution of the total amount of CAP aid (dependent variable) over space has been analyzed, as it is considered necessary in order to indicate how it is located and distributed in the territory. Thus, the distribution of CAP budgets in the 2014–2020 period at the municipal level in Extremadura establishes a very unequal distribution. On the one hand, as can be seen in Figure 3, the amounts are higher in the province of Badajoz, as a significant number of its municipalities have received more than 5 million euros over the period and, among them, 54 municipalities receive more than 20 million euros. The municipalities in the agricultural districts of Don Benito, Mérida and Badajoz, in the center and west of the region, where irrigated farming is predominant, are the most populated and economically dynamic areas of the region. On the other hand, in the province of Cáceres there is a greater dispersion in the allocation of aid, although there are municipalities that receive larger amounts than the rest, such as the city of Cáceres and nearby towns, the

municipalities belonging to the agricultural district of Navalmoral de la Mata and the county seats of the districts of Plasencia, Jaraíz de la Vera and Coria.

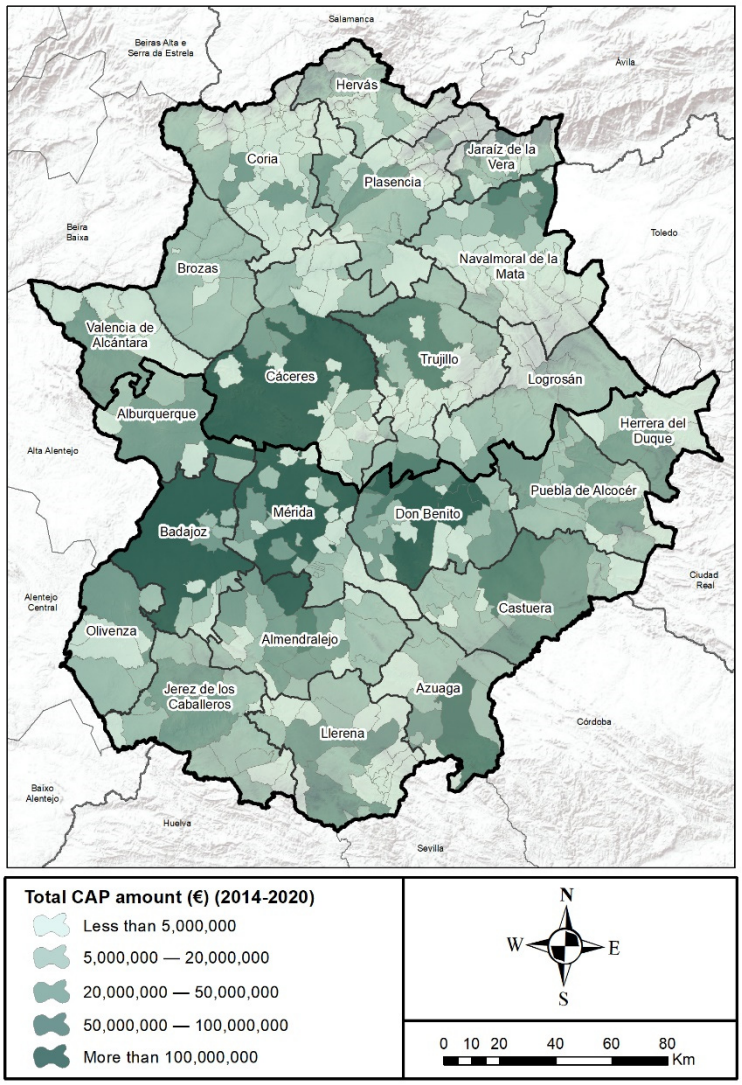
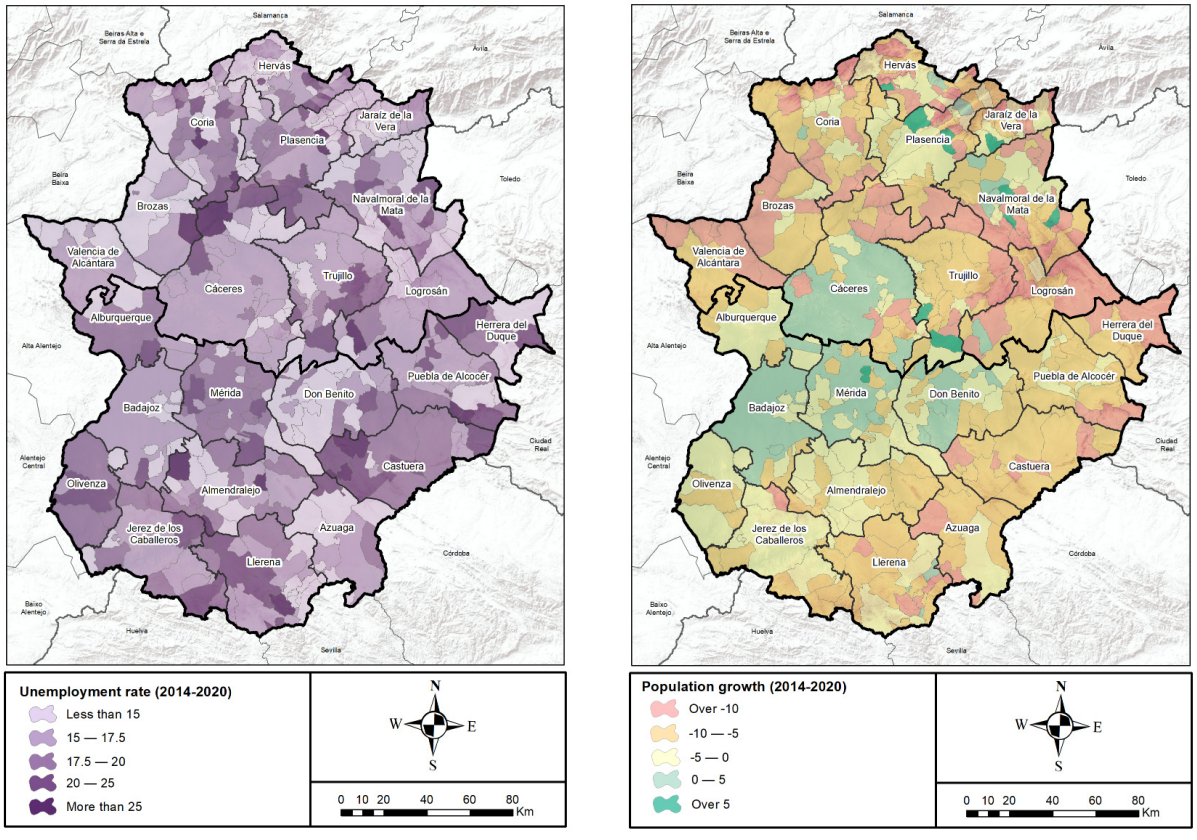


Figure 3. Total CAP support by municipality (2014–2020).

Among the 388 municipalities in Extremadura, there are 10 that concentrate more than 30% of the aid, which are located in areas where there is a greater demographic concentration and a consolidated agricultural system, the main municipalities being the agricultural districts of Vegas del Guadiana (Badajoz, Mérida, Don Benito, Villanueva de la Serena) and Almendralejo (Almendralejo and Villafranca de los Barros), as well as the towns of Cáceres, Trujillo and Talayuela. The municipalities of Badajoz, Mérida and Don Benito stand out, receiving more than 150 million euros and where there is a greater concentration of farms and where irrigation predominates as a type of crop. Likewise, Villanueva de la Serena, Cáceres and Almendralejo receive between 100 and 120 million euros, highlighting the role of irrigation in the case of Villanueva de la Serena, as well as the livestock production distributed throughout the extensive municipal district of Cáceres and the strong productivity of the wine sector in the agricultural district of Almendralejo. In addition, the municipalities of Miajadas-Trujillo, Talayuela, Villafranca de los Barros (located in irrigated areas and Tierra de Barros) receive aid of between 50 and 100 million euros, which is well above the regional average (around 11 million euros). This is due to their intensive agricultural structure and the large population volume compared to the rest of the region, as they are municipalities with between 10,000 and 15,000 inhabitants, which

is higher than the average population of Extremadura during the study period, which was around 3000 inhabitants.

Subsequently, the main explanatory variables used for the GWR model have been spatially represented to observe the socio-demographic situation of Extremadura's municipalities. Thus, first of all, the unemployment and population growth rates (Figure 4) during the study period have been plotted at the municipal level. In this way, the distribution of these variables over the territory is shown and they are associated to the demographic and economic characteristics of the municipalities, seeking to associate their values to the size of the population, territorial situation and source of development of these municipalities. As for the unemployment rate, during the study period, the regional average was slightly above 17%, reflecting the economic and employment recovery that the region underwent after the crisis that began in 2008. At the municipal level, Figure 4a shows that many municipalities have a rate of less than 15%, with groups of municipalities with the lowest rates in the agricultural districts of Don Benito, Almendralejo and Azuaga, in the province of Badajoz, and in the districts of Plasencia, Jaraíz de la Vera and Navalmoral, in Cáceres. These rates demonstrate a greater socio-economic dynamism in districts where the agricultural sector is of great importance for the economy of their municipalities, since they have developed an outstanding productivity in intensive agriculture, as is the case of Navalmoral de la Mata and Don Benito with the irrigation systems established around the fertile plains of these areas, the high productivity of the valleys in the districts of Plasencia and Jaraíz de la Vera and the dry farming in Almendralejo. Among the municipalities with a lower unemployment rate, it should be noted that most of them have a population of less than 10,000 inhabitants, except for Don Benito, which is the only municipality in rank 3 (>10,000 inhabitants) with a rate of less than 15%, although all of them have a population of more than 5000 inhabitants.

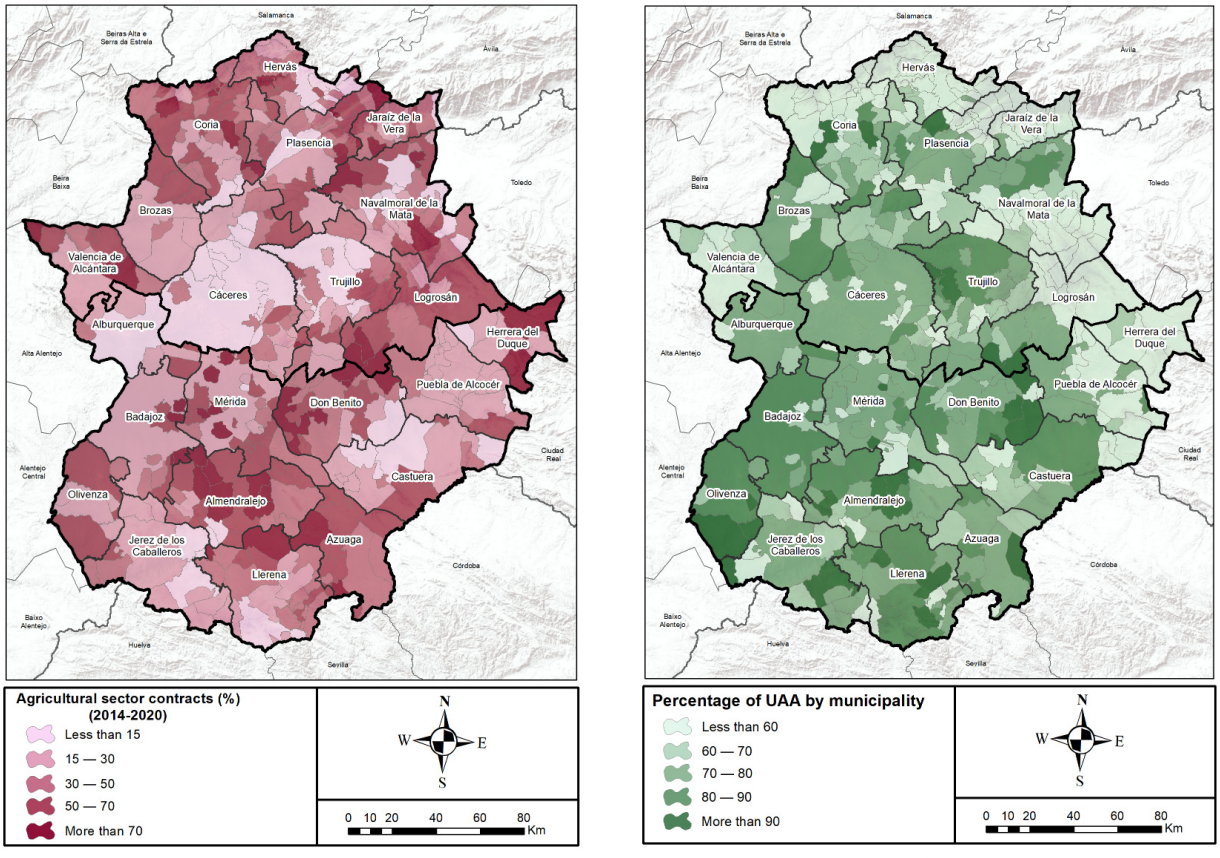


(**a**) (**b**)

Figure 4. Territorial distribution of socio-demographic variables by municipality. (**a**) Unemployment rate (2014–2020); (**b**) population growth (2014–2020).

Regarding population growth, during the study period, Extremadura has suffered a gradual loss of population, with a negative growth of −6.5, with this effect extending to more than 90% of the municipalities that make up the region. Thus, Figure 4b illustrates how many Extremadura municipalities have a negative growth rate of more than −10, mostly distributed in the province of Cáceres. Most of the municipalities in this range have a population of less than 2000 inhabitants, except for Talayuela, with a population of more than 7000 inhabitants and an economy affected by the loss of importance of tobacco production due, above all, to the changes made to the CAP in recent years. The municipalities with positive growth represent less than 10% of the total, and among them are some of the most populated in the region, such as Badajoz, Cáceres, Mérida and Don Benito. The largest increases have been experienced by municipalities with less than 2000 inhabitants (Group 1) in the agricultural districts of Plasencia, Jaraíz de la Vera and Navalmoral de la Mata, mainly in municipalities around the county seats. However, in the case of these municipalities, these statistics must be observed in a relative way as they have a small population, since the variations, even if they are not very significant in absolute data, will be very significant in relative data. Therefore, municipalities with populations of less than 300 inhabitants, such as Gargüera (54), Campillo de Deleitosa (38), Collado de la Vera (25) and Oliva de Plasencia (12) have a very high growth rate due to their small number of inhabitants.

Focusing on the agricultural variables used, Figure 5 shows the percentage of agricultural contracts made during the period 2014–2020 and the percentage of UAA in 2020, on the one hand, which municipalities have a greater impact of the agricultural sector on their economy and, on the other hand, where there is a greater agricultural use of the total surface area of the municipalities.



(**a**) (**b**)

Figure 5. Territorial distribution of agricultural variables by municipality: (**a**) agricultural sector contracts (2014–2020); (**b**) percentage of UAA.

In Figure 5a it can be seen how the municipalities with the lowest percentage of agricultural contracts are located in areas where the tourism sector is of great importance for their economies, and not so much the agricultural sector, as in the cases of Cáceres, Hervás, Trujillo and Plasencia. It is also worth mentioning that most of the municipalities where the percentage of agricultural contracts is lower are in agricultural districts where extensive livestock farming and rainfed crops are grown due to the larger size of the farms, such as Alburquerque, Cáceres, Trujillo, Castuera and Jerez de los Caballeros, located in the Cáceres and Badajoz peneplains. Regarding the municipalities with the highest percentage of agricultural contracts, those located in the regions of Almendralejo, Herrera del Duque and Don Benito (mainly located in the fertile plain areas) stand out, as a high number of these municipalities have more than 70%. This is associated with the importance of the agricultural sector on their economies, mainly associated with the important dry farming of Tierra de Barros, in the case of Almendralejo, extensive livestock farming in Herrera del Duque and intensive farming through irrigation systems in the area of Don Benito.

The Figure 5b establishes that the municipalities with the lowest percentage of UAA are in the north of Extremadura, in the regions of Coria, Hervás, Plasencia and Jaraíz de la Vera, in the east of the region in Navalmoral de la Mata, Logrosán, Herrera del Duque and Puebla de Alcocer, and in the west in the agricultural county of Valencia de Alcántara. These municipalities are in mountainous areas where the orography makes it more difficult to develop agricultural activities, or on a peneplain dedicated to extensive livestock farming with low economic yields. About the municipalities with a higher percentage of UAA, these represent around 6% of the total number of municipalities in Extremadura and are located in irrigated areas, as is the case of Moraleja around the Alagón Valley, and municipalities in the agricultural districts of Don Benito, Olivenza (fertile lowland areas) or Trujillo and Llerena where dry cereal crops predominate.

The CAP as a Development Model for Extremadura's Municipalities?

The GWR was carried out to determine the relationships between the dependent variable (amount of CAP aid for the period 2014–2020) and the explanatory variables analyzed (percentage of UAA in relation to the total surface area of the municipality, population growth, standardization of the size of the municipalities, unemployment rate, contracts in the agricultural sector and GDP).

To assess the results obtained after performing the GWR, Moran's I analysis was performed (Figure 6), which allows us to know the spatial autocorrelation based on the locations and values of the entities simultaneously, assessing whether they exist in a clustered, dispersed or random pattern. This analysis was performed with the residual values obtained from the GWR, as a result that the variables established have a random character which shows that there is no direct interrelation between them.

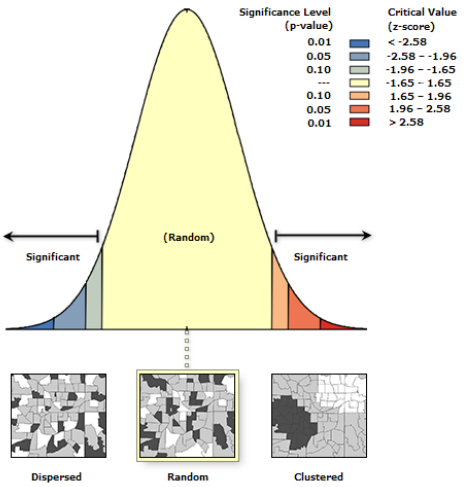


Figure 6. Moran's index result.

After performing the GWR, the values obtained for the multiple R^2 and for the R^2 are 0.82 and 0.77, respectively, which means that the variability of the selected variables is explained with an accuracy of more than 75%. The closeness of the values to 1 reflects the suitability of the variables for the study and the high proportion of the variance of the dependent variable (total amounts of CAP support) explained by the regression model. The spatial distribution of the local adjustments produced with the GWR (local R^2) allows us to know the spatial variation of the explanatory power of the model. For that reason, the distribution of the local R^2 at the municipal level (Figure 7) varies between 0.43 and 0.84, reaching the highest values in the municipalities located around the Vegas del Guadiana, in the central area of the region, and in the Valle del Alagón in the northwest, where they increase to over 0.77.

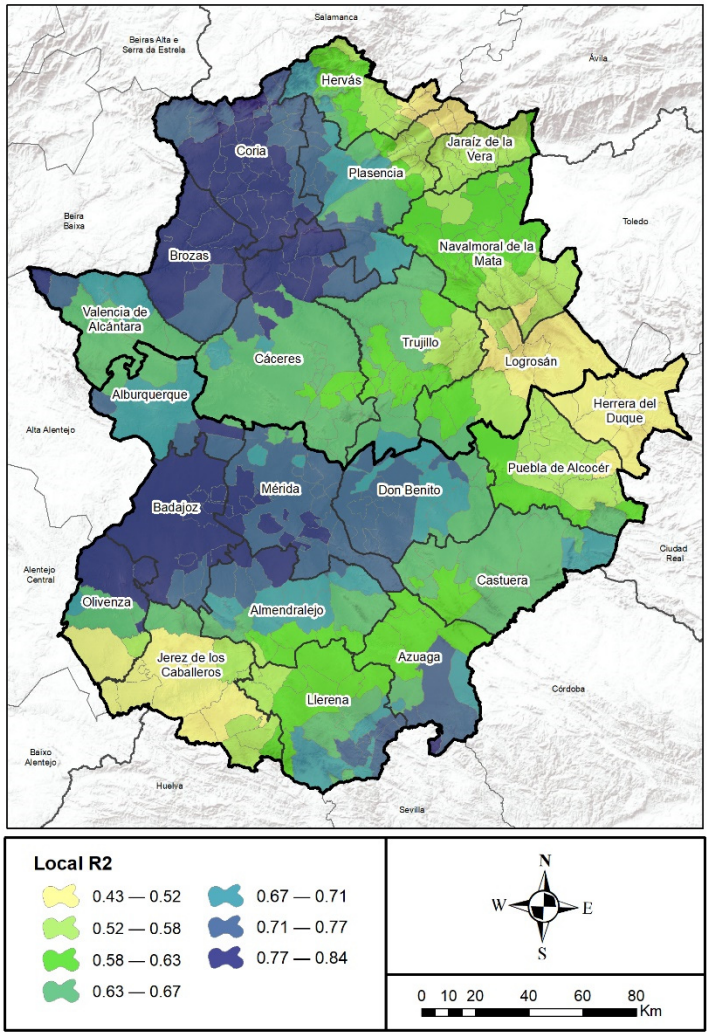


Figure 7. Local R^2 results in the GWR model.

The municipalities with a higher interrelation of the dependent variable with the explanatory variables and which have values closer to 1 (range 0.77 to 0.84) are, to a large extent, the municipalities located in the areas of the Vegas Bajas del Guadiana, including a large number of municipalities in the agricultural districts of Olivenza, Badajoz, Mérida and Almendralejo, as well as the municipalities located in the Alagón Valley in the northwest of the region, specifically those located in the districts of Coria, Don Benito and Brozas. Consequently, a concentration of aid is detected (municipalities with values below 0.77) in territories with similar characteristics in the agricultural variables, with an unemployment rate above 14%, with more than 50% of contracts in the agricultural sector and more than 60% of UAA with respect to the total municipalities. This means that the concentration

of these values is located in agricultural districts in which intensive irrigated crops stand out, as is the case of the lower plains of the Guadiana and the Valle del Alagón. There are also municipalities in Tierra de Barros, where the agricultural sector has an important role to play in socio-economic development due to the high productivity of olive groves and unirrigated vineyards. Likewise, there are also socio-demographic similarities, since the main urban centers of the region and the highest incomes are located in the same agricultural districts (Badajoz, Mérida, Don Benito-Villanueva de la Serena, Almendralejo).

The municipalities with the lowest R^2 values (between 0.43 and 0.52) are located in the north-eastern districts of the province of Cáceres (Hervás, Jaraíz de la Vera and Navalmoral de la Mata) and in the east and south-west of the province of Badajoz (a large part of the municipalities of the districts of Logrosán and Herrera del Duque, Jerez de los Caballeros and the southern municipalities of the agricultural district of Olivenza). The municipalities in this range include, on the one hand, those characterized by small farms (due to the complexities of the orography), in agricultural districts in the north of Extremadura (Plasencia, Jaraíz de la Vera and Hervás), and, on the other hand, those located in districts where the farms are larger and are used for extensive livestock farming and dry crops (Herrera del Duque, Jerez de los Caballeros and Olivenza). At the demographic level, these municipalities have suffered a significant drop in population and, for the most part, have a population size of less than 2000 inhabitants (this is the case in 20 of the 29 municipalities in this range).

4. Discussion

The use of a spatial regression model to study the impact of CAP aid on the territory of the Extremadura region has made it possible to identify the areas where this aid makes the greatest contribution in terms of socio-economic and demographic development.

In this case, the use of the GWR facilitates the determination of the spatial distribution of the impact of CAP aid on specific delimitations, and, as established by different authors [43,44,64,71], the use of this regression model has made it possible to analyze damage with different and non-uniform spatial distributions, helping to observe the municipalities with the greatest interrelation between the dependent variable and the independent variables.

The analyses carried out help to identify in greater depth the relationships between CAP aid and Extremadura society (characterized, in this case, through demographic, socio-economic and agricultural variables), expanding on the studies carried out by authors such as Rumanosvka [9] on the impact of the CAP in Slovakia or the work carried out by González-Moralejo and Estruch Sanchís [33] on how the CAP has improved competitiveness in Spanish rural regions. Similarly, Lillemets et al. [14] highlights how CAP support has a positive effect on employment in rural areas, but that it remains unproven whether there is a significant impact on economic production and generational change in rural areas, interpreting this from a descriptive approach to support. Mikus et al. [72] show a theoretical approach to the effect of the CAP on the most vulnerable territories and on the territorial cohesion of European regions, interpreting the different objectives set out in this policy, giving an important role to local actors in European rural territories to make efficient use of the different tools provided by European administrations. These studies show a theoretical vision of how the CAP has an impact on the European territorial economy, but the aim of this study is to extend the results of these studies through the use of GIS tools that interrelate variables, to show how this aid can have a clear development effect on the economy of a territory as ruralized as Extremadura. In this way, it has been possible to see how the municipalities located around intensive agricultural systems have a more dynamic socio-economic development, also due to their location around the principal communication routes in Extremadura, which has favored the growth and development of a strong agri-food industry.

The typology of farms has shown a high importance on the relationships between variables and CAP aid, with higher values being observed in territories where intensive

agriculture through irrigation systems predominates. At the same time, the areas with the greatest agricultural and socio-economic development are located around the large municipalities of Extremadura, as highlighted by authors such as Leco and Pérez [24], the large municipalities are the ones that absorb the largest amounts of CAP aid even though they do not have significant agricultural and livestock farming activity. However, in the larger municipalities of Extremadura there is an economic diversification in which the agricultural sector is of some importance, although it is far removed from the other sectors. The above could have similar characteristics to that presented by Molinero et al. [38], whose research shows the characteristics of CAP payments in Castilla y León, showing here how the main municipalities of this community and the surrounding areas are the ones that receive the greatest amounts.

On the other hand, Cárdenas and Nieto [6] have investigated the impact of EAFRD rural development measures to determine whether they help the development of municipalities with lower socio-economic dynamism during the 2007–2013 period. In this way, they have been able to draw similar conclusions in several aspects, as the Vegas del Guadiana and Alagón areas show a greater impact of the aid on their development. In this research, all CAP aid has been collected, including both EAFRD and EAGF financed aid, resulting in a direct relationship, to a certain extent, with the results obtained in the previously mentioned research. The impact on employment of CAP support, mainly first pillar support, has demonstrated positive results in various studies, such as that carried out by Bojnec and Fertő [73], which confirms a positive effect of CAP support on employment in agricultural holdings in Hungary and Slovenia. Alonso and Otero [74] have analyzed the effect of the CAP on the population dynamization of rural areas in Asturias, considering that CAP aid has a positive influence on the population of this region. Rudnicki et al. [34] show how the spatial distribution of European funds in Poland, such as the CAP, shows important territorial differences, as they are negatively correlated with the level of socio-economic development, having an important impact on the quality of the main centers of Polish regions.

5. Conclusions

Using GIS tools, demographic, agricultural and socio-economic variables have been analyzed spatially and the possible interrelationships between these variables and CAP support have been observed. The importance of this aid in Extremadura is very notable, as it was the fourth Spanish region that received the most money through this European policy during the period under study. A concentration of aid has been observed in the most dynamic areas of the region, with municipalities with a larger population and a significantly productive agriculture, mainly related to irrigated farms. Thus, there is a significant disparity in the distribution of CAP amounts in Extremadura, as there is a high concentration in the municipalities with the highest population. In this way, it is established that the distribution of aid is mainly established in areas where there is a high population density, where the most productive crop systems exist and in those territories where the natural limitations of the terrain are scarce. The great majority of these municipalities are located in areas with the most developed agricultural production systems, such as irrigation, and around the main communication routes, which has led to the development of a consolidated agri-food industry. In contrast, mountainous areas receive smaller amounts, due to their regressive territorial and population characteristics. This means that there is a clear disparity in the funds received by the municipalities, with funds being diverted to those which are also located in the vicinity of the main communication routes and whose areas have optimal physical characteristics that have allowed them to exploit the territory competitively, both in the agricultural and livestock sectors. Moreover, they are suffering a progressive loss of population and an ageing population, with the generation that has traditionally been dedicated to the agricultural sector disappearing.

Although the CAP provides tools to the different EU member states to strengthen their agricultural systems, in order to achieve the objectives set out in the 2013 reform to improve

environmental aspects, increase incomes, employment, living standards, economic and social cohesion of European rural territories, in Extremadura the results in the most disadvantaged areas are still not as expected despite decades of work. There is no doubt that this aid has a positive impact on the regional agricultural economy, boosting competitiveness and innovation in agriculture in the municipalities that make up the region, facilitating the development of quality products and agricultural technology to improve productive efficiency, but not in a balanced way.

As future lines of research, it is considered necessary to compare CAP aid data between different programming periods in order to determine the disparities that exist between the reforms that have affected this agricultural policy. Therefore, given that the new CAP 2023–2027 aims to increase the contribution of agriculture to the EU's environmental and climate objectives, to offer more targeted support to smaller farms and to increase the flexibility of Member States to adapt measures to local conditions, future research needs to analyze this new support model to determine how it differs from the previous reform and whether the changes introduced contribute to the development of the agricultural sector and European rural areas, taking into account the territorial characteristics of the beneficiary areas. This can be complemented with detailed studies of the different measures to determine whether the contributions to other economic incomes of the CAP are increasing, such as aid to young people, the incorporation of women into the agricultural sector, repopulation and reforestation of areas in environmental danger, ecological, higher quality and environmentally sustainable agriculture, etc. In addition, the use of different methods and spatial analyses is considered appropriate in order to observe the results obtained from various perspectives, thus helping to better interpret them and, consequently, to better optimize the distribution of funds and the impact of public policies such as the CAP.

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