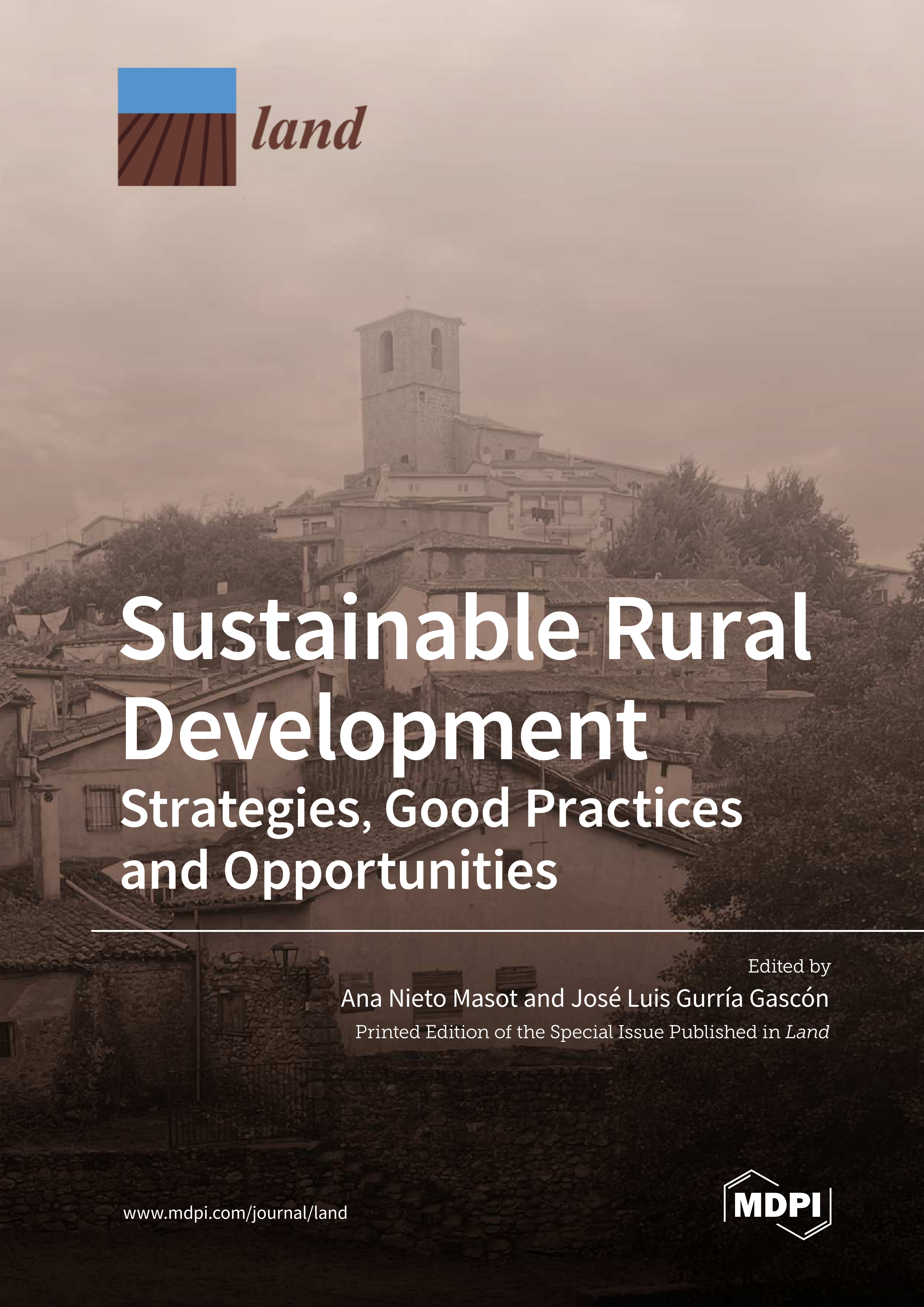

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Sustainable Rural Development

Strategies, Good Practices and Opportunities

Edited by
Ana Nieto Masot and José Luis Gurría Gascón

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Editors

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About the Editors

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Ph.D. in Geography and Associate Professor in Human Geography at the University of Extremadura. Her main areas of research are rural development, demography, and geographic information systems. She has directed six Research and Development (R&D) projects and participated as a collaborator in more than 30 (OECD, EU, various Spanish Ministries, regional government and various companies). She has more than 80 publications in articles, books, and contributions to congresses and conferences related to Sustainable Rural Development, most of them indexed in JCR, SJR, or SPI.

At present, she is the Coordinator of the Research Group Development and Territorial Planningof the University of Extremadura and President of the Geographic Information Technologies (Spanish Geographical Association) and the Ibero-American Society of Geographic Information Systems (SIBSIG).

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Professor of Human Geography at the University of Extremadura, where he has been a professor since 1979. His lines of research, basically, are Population and Demographic Challenge, Rural Development and Sustainable Development. He has participated as PI or researcher in several projects, and he has written or collaborated in twenty books and about forty journal articles, about eighty congresses and fifty research projects (OECD, EU, various Spanish Ministries, regional government and various companies).

He has been Director of the Department of Geography and Land Management, University of Extremadura, President of the Quantitative Methods Group (Association of Spanish Geographers), and the Ibero-American Society of Geographic Information Systems (SIBSIG), UNESCO Chair of Ibero-American Community and Integration, and, later, Director of the Extremadura Center for Studies and Cooperation with Ibero-America and Vice-Rector of Academic Planning.

Preface to "Sustainable Rural Development: Strategies, Good Practices and Opportunities"

The urban concentration has intensified worldwide in recent decades, causing a progressive and widespread exodus of the rural environment and the abandonment of these areas with consequent agriculture, environment, heritage, and leisure resource deterioration. The environmental and socio-economic transformations have been very intense in these "fields"that are gradually left deserted, and cities have become increasingly unsustainable due to their populations growing in an accelerated and disorderly way.

There is no doubt that urban intensification is a problem of integral, multiscale, and sustainable planning, in which the city and its rural surroundings are inseparable parts of the same territory. The city offers equipment and services, but above all activities, it provides employment and houses to its inhabitants and also to those in its rural environment through mobility. This is a complex and multidisciplinary problem in which numerous researchers are involved and that can be approached from multiple perspectives as: approaches and models of rural development and their evolution in the world (European policies and rural development programs or strategies); integrated forms of urban–rural planning and multilevel governance (urban partnerships and the role of the city in the development and stability of the rural population); the diversification of activities, employment, and income: agribusiness, heritage, and tourism as the basis of rural competitiveness and its impact on new models of land organization, the insertion of SDGs 2030 in rural development or the green circular economy.

In 2020, a Special Issue entitled Rural Development: Strategies, Good Practices and Opportunitieswas launched, in which 16 papers were published. The aim of this monograph was to study this problem with contributions in which different initiatives or projects are presented to reduce the demographic, economic and social imbalances between rural and urban areas. On the other hand, some studies highlighted the weaknesses that certain projects and programmes are having in achieving the same objectives. The papers presented were very diverse and provided cases in a wide variety of territories including European, American, and Asian. The different strategies presented focused on achieving rural development through the promotion of activities complementary to agriculture, such as rural tourism, the revaluation of natural heritage, the promotion of agroecological products, the industrial promotion of rural areas, the introduction of Information and Communication Technologies (ICTs) and Internet to improve their communications and teleworking, the design of sustainable housing for youngers and new settlers, etc.

This book serves as a reference to showcase current papers that address more or less successfully sustainable rural development strategies. It is aimed at researchers from multiple and different fields such as geography, earth sciences, political science, economics, econometrics, econometrics, and other fields of study.

Ana Nieto Masot, José Luis Gurría Gascón
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Editorial

Sustainable Rural Development: Strategies, Good Practices and Opportunities

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In 2020, a special issue titled "Sustainable Rural Development: Strategies, Good Practices and Opportunities" was launched, in which 16 papers were published. The aim of this monograph is to study a problem that is occurring on a global scale and, above all, in the most developed countries, which is the population emigrate from rural areas to urban areas due to the labour and service opportunities offered by the latter [1,2]. This is causing a demographic deterioration of rural areas due to the abandonment in large areas of numerous villages, and those that remain show high rates of ageing, masculinisation or low demographic growth [3–5]. In addition, and interrelated with this demographic deterioration, there was economic [6] and environmental degradation [7–9]. Rural areas are territories with increasingly lower purchasing power, job opportunities and services for the population [10] which are classified as "spaces in crisis" [11–13]. In addition, and due to the abandonment of agricultural holdings [14,15], it is causing problems such as the increase in desertification, deforestation and even risk phenomena such as forest fires [16–19].

The aim of this special issue was to present, on the one hand, contributions in which different initiatives or projects are managed to reduce the demographic, economic and social imbalances between rural and urban areas. On the other hand, it aimed to present some studies that highlight the weaknesses that certain projects are having in achieving the same objectives. The papers presented are very varied and provide cases in a wide variety of territories, in European, American or Asian regions where there are rural areas in crisis and, a review [20] on the opportunities that may arise for rural areas to introduce integration of technology such as Internet networks, telecommuting, distance-learning education, the use of electric cars, etc. to achieve development.

There are strategies focused on achieving rural development through the promotion of activities complementary to agriculture. Agriculture was the predominant activity in rural areas until decades ago [21] and has become a minority activity due to the transformations of the global economy and its greater mechanisation [22] and it does not generate enough income to sustain the population in rural areas. For this reason, the agricultural sector should be complemented with other economic activities in rural areas, as recommended by organisations such as the EU [21–23] and the OECD [2,24–26]. Thus, there are papers in which different types of complementary activities, such as rural tourism, the revaluation of natural heritage, the promotion of agroecological products, the transformation of agricultural areas into industrial land, the introduction of ICTs and internet access in rural areas, improve their communications and teleworking or the design of sustainable housing that can fundamentally attract new settlers. In addition, some papers that have focused on initiatives with new models of development, such as Leader at European level or the design of smart villages, have been put forward. As a complement, other papers have focused on the design of indicator models to measure the sustainable rural development strategies.

In the following paragraphs, the main results of the papers presented are detailed.

In Spain, there are cases presented such as the strategies carried out in the rural and coastal communities of Galicia [27], where the aim has been to achieve complementary incomes for fishermen by means of the diversification of the Common Fisheries Policy aid

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(CFP). It focused on creating synergies between the fishing sector and tourism and trying to implement a fishing tourism. However, its results are not yet as expected in terms of employment despite the financial support, not only from EU aid, but also from the regional government. This is due to the fishermen's lack of experience and previous training in tourism activities, their advanced age, the irregular distribution of these activities and the regulatory restrictions of the Spanish legal system that made it very difficult for people other than the crew to embark on boats dedicated to fishing as their main activity.

There is a study about Murcia [28], which analyses the transformation of large areas in this region into irrigated land over the last 30 years (the majority of which are former rainfed areas). The conclusions presented in this work show that although at an economic level they are obtaining high profitability and favouring the stabilisation of the population in this region, at an environmental level and due to the water deficit in this region, the consequences are not as beneficial. They present an excessive dependence on water transfers from hydrographic basins in other regions such as those of the Tagus river, an over-exploitation of aquifers and the reduction of natural flows and, lastly, the possibility of the disappearance of these areas in future decades if these external transfers diminish.

LEADER programme aid and their entrepreneurs are analysed in Andalusia [29]. The authors focus on two aspects: social and spatial disparities in the distribution of funds and the success or failure of the projects granted in the period 2007–2015. In the results on failed projects, those that were granted but not executed, it is determined that this was due to different causes: the degree of rurality, women and young people and the distance to cities had higher failure rates, and therefore those placed with a higher success rate were the projects located in peri-urban areas.

Being Extremadura the study area, four papers are presented. The first one focuses on the analysis of the LEADER programme [30] in a mountain territory, based on the intangible aspect of the design and success of these development programmes (less studied because most approaches have focused on economic aspects). Using a qualitative methodology with surveys of relevant actors who have participated in the process (public and government sectors, businessmen, associations), it has been determined that aspects such as the contribution of LEADER to the county identity are well valued, but others, such as the participation of the local population in decision-making, are still considered to be scarce.

The second one [31] shows the success that a polycentric system of small towns well distributed throughout the territory can help to maintain the rural population in certain areas located in Extremadura through rural–urban partnerships and integrated territorial investments. A polycentric system can help in the design of new political strategies in the fight against the demographic challenge and in the recovery of the so-called "empty Spain".

The third paper [32] focuses on how hunting tourism in rural areas with a deep-rooted hunting tradition is favouring the introduction of new incomes by creating an accommodation infrastructure. The results of this paper (carried out with questionnaires and statistical techniques) show that hunting tourists also take advantage of their stay to carry out other activities in the area, which can produce synergies with other sectors such as restaurants and leisure activities complementary to hunting.

Finally, the fourth analyses [33] the business agglomerations in rural districts (LAG) of LEADER. A typology of three classes according to their number of companies, employment, specialization, income generated, weight within the region and their degree of innovation is created. The results show those areas where there are booming industrial sectors related to a specialisation sector, mostly agri-food or meat, and which can be exploited by the rural development strategies of the rural districts in their investments.

A new composite indicator of sustainable rural development was established for Aragón [34]. It is based on the vulnerability of the ecosystem services being designed. This indicator is tested in 10 study areas and results in a ranking that produces a greater disparity in levels of development when vulnerability is added to the process, suggesting that the environmental dimension and the perspective from which it is conceived and applied are important in approaching sustainable rural development.

The activities that have enhanced the value of territorial heritage in declining areas are analysed in Castilla la Mancha [35]. It highlighted through the creation of a co-operation strategy between two counties that have a mining park and a Geopark, both recognised by UNESCO as World Heritage Sites. This strategy of harnessing the potential synergy between the two resources and offering a shared quality tourism resource has also been developed in collaboration between the institutions (top-down approach) and supported by the local population (bottom-up) as co-operative strategies that aim to minimise depopulation processes in areas in crisis.

Outside Spain but within in Europe, a paper about Poland [36] is presented. It is one of the initiatives being promoted by the EU, the design of smart villages, where establishing new technologies and an efficient internet network could favour the maintenance of the population in rural areas. In this work and using detailed socio-economic data, an association has been established between poor internet access and rural decline. The pre-liminary findings of implementing smart villages in Poland present theoretical and methodological dilemmas, but these are expected to be overcome as the implementation of these initiatives helps to encourage other areas to participate because of improvements in their economic incomes and maintenance of the population.

About America, there are two papers. The first is about Mexico [37], and more specifically in rural areas of the Yucatan Peninsula, where the aim has been to achieve sustainable rural development by supporting agroecological products. In this study, interviews were carried out to analyse the role of entrepreneurs and their vision of public policies in the promotion of this activity in order to achieve development. The visions obtained were pessimistic because there is still a policy of little support for these activities, inadequate management and trust in the public management and in the structure of the sector itself. In addition, the entrepreneurs say they encounter other problems as the still low profitability due to an insufficient commercial distribution network, the lack of ecological awareness among consumers and the lack of training of the farmers themselves when it comes to carrying out their projects.

The second in the USA [38] is a case study on new sustainable residential construction in rural areas with a pilot project in Texas. They analysed the most efficient materials and energy systems with the lowest economic cost. It is to show a model that in the medium term recovers the additional investment in the construction of this sustainable housing and that positively affects the environment by reducing pollution and the use of non-renewable energies. As a proposal, the authors argue that administrations should promote regulations and codes that advocate the implementation of this type of construction in rural areas that can encourage new settlers to move in.

Finally, three papers are in Asia, two of them in China and another in Kazakhstan.

The first one in China has focused [39] on the leasing of forestland by farmers for sustainable harvesting and income extension and the factors that contribute to its success. The results show that the age and educational level of the farmers, the proportion of income from other non-agricultural sources, the benefits they obtain from these leases and whether institutional and market factors facilitate the procedures (simpler in some areas than in others) have encouraged them to expand their income with other activities carried out on the leased forest land.

The second one in China [40] has focused on designing a weighted geographical regression model to analyse a pilot land reform system in 25 cities in the Dingzhou area, consisting of the transfer of industrial land to agricultural land. Positive correlations will be obtained with the price of industrial transfer land in those areas with demographic and economic growth, greater population density, health resources and proximity to cities because they are the most demanded and most profitable. It can be a reference model for the sustainable use of industrial land.

The paper of Kazakhstan [41] is about the agricultural intensification of peri-urban areas in the Shortandy district based on an integrated study of land use dynamics and sustainable development indicators (SDI). The results show that the increase of agricultural land in peri-urban areas is achieving economic, social and environmental development. Therefore, the methodological approach can be a starting point for similar studies in other areas and also these new uses can produce economic and social development in declining rural areas which, due to their proximity to the city, can take advantage of this proximity to produce flows between them.

The papers in this special issue evidence the many public and private strategies that are being pursued to achieve sustainable rural development in declining areas. The diversity of approaches and challenges offer a vision of the practical application of these strategies and the obstacles or difficulties that many of them are having to achieve their objectives. All of these strategies intended to achieve economic dynamism that is respectful of the environment and from there to be able to reduce the regressive demographic processes in rural areas. These are different approaches that allow us to contribute, from scientific, holistic and multidisciplinary knowledge, new strategies that can help decision making in public policy managers and in equitable planning and management strategies. It is a current issue that can still be further developed in new special monographs due to the numerous initiatives and projects that are being carried out.

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References

1. MacDonald, D.; Crabtree, J.R.; Wiesinger, G.; Dax, T.; Stamou, N.; Fleury, P.; Gutierrez Lazpita, J.; Gibon, A. Agricultural abandonment in mountain areas of Europe: Environmental consequences and policy response. *J. Environ. Manag.* **2000**, *59*, 47–69. [CrossRef]
2. OECD. *Competitive Cities in a Global Economy*; OECD: Paris, France, 2006.
3. Lutz, W.; Sanderson, W.; Scherbov, S. The coming acceleration of global population ageing. *Nature* **2008**, *451*, 716–719. [CrossRef] [PubMed]
4. Schoeni, R.F.; Ofstedal, M.B. Key themes in research on the demography of aging. *Demography* **2010**, *47*, S5–S15. [CrossRef]
5. Johnson, K.M.; Lichter, D.T. Rural Depopulation: Growth and Decline Processes over the Past Century. *Rural Sociol.* **2019**, *84*, 3–27. [CrossRef]
6. De Cos Guerra, O.; Reques Velasco, P. Vulnerabilidad territorial y demográfica en España. Posibilidades del análisis multicriterio y la lógica difusa para la definición de patrones espaciale. *J. Reg. Res.* **2019**, *45*, 201–255.
7. Molinero Hernando, F. El espacio rural de España: Evolución, delimitación y clasificación. *Cuad. Geográficos* **2019**, *58*. [CrossRef]
8. Coleman, D.; Rowthorn, R. Who's Afraid of Population Decline? A Critical Examination of Its Consequences. *Popul. Dev. Rev.* **2011**, *37*, 217–248. [CrossRef]
9. Smailes, P.J.; Argent, N.; Griffin, T.L.C. Rural Population Density: Its Impact on Social and Demographic Aspects of Rural Communities. *J. Rural Stud.* **2002**, *18*, 385–404. [CrossRef]
10. Delgado Viñas, C. Depopulation Processes in European Rural Areas: A Case Study of Cantabria (Spain). *Eur. Ctry.* **2019**, *11*, 341–369. [CrossRef]
11. Carpio Martín, J. Desarrollo local en los espacios rurales. *Polis* **2000**, *2*. Available online: https://journals.openedition.org/polis/7803 (accessed on 9 October 2020).
12. Ocaña, M.C. El espacio rural andaluz, permanencias y cambios de la crisis abierta a mediados de siglo. *Cuad. Geográficos* **2000**, *30*, 77–95.
13. Nieto Masot, A.; Cárdenas Alonso, G.; Engelmo Moriche, Á. Design of a Development Index for Spanish Municipalities. *Sustainability* **2020**, *12*, 8910. [CrossRef]
14. Mantero, G.; Morresi, D.; Marzano, R.; Motta, R.; Mladenoff, D.J.; Garbarino, M. The influence of land abandonment on forest disturbance regimes: A global review. *Landsc. Ecol.* **2020**, *35*, 2723–2744. [CrossRef]
15. Varga, D.; Vila Subirós, J.; Barriocanal, C.; Pujantell, J. Landscape Transformation under Global Environmental Change in Mediterranean Mountains: Agrarian Lands as a Guarantee for Maintaining Their Multifunctionality. *Forests* **2018**, *9*, 27. [CrossRef]
16. Rey Benayas, J.M.; Martins, A.; Nicolau, J.M.; Schulz, J.J. Abandonment of agricultural land: An overview of drivers and consequences. *Cab Rev.* **2007**, *2*, 14. [CrossRef]

17. Lasanta, T.; Arnáez, J.; Pascual, N.; Ruiz-Flaño, P.; Errea, M.P.; Lana-Renault, N. Space-time process and drivers of land abandonment in Europe. *Catena* **2017**, *149*, 810–823. [CrossRef]
18. Pausas, J.G.; Fernández-Muñoz, S. Fire regime changes in the Western Mediterranean Basin: From fuel-limited to drought-driven fire regime. *Clim. Chang.* **2012**, *110*, 215–226. [CrossRef]
19. Viedma, O.; Moity, N.; Moreno, J. Changes in landscape fire-hazard during the second half of the 20th century: Agriculture abandonment and the changing role of driving factors. *Agric. Ecosyst. Environ.* **2015**, *207*, 126–140. [CrossRef]
20. Gomes, E. Sustainable Population Growth in Low-Density Areas in a New Technological Era: Prospective Thinking on How to Support Planning Policies Using Complex Spatial Models. *Land* **2020**, *9*, 221. [CrossRef]
21. Conferencia de Cork "Un Medio Rural Vivo". Available online: http://www.redr.es/es/portal.do?TR=A&IDR=1&identificador=770 (accessed on 20 October 2020).
22. Comisión Europea. *Estrategia Territorial Europea: Hacia un Desarrollo Equilibrado y Sostenible del Territorio de la Unión Europea*; Oficina de Publicaciones Oficiales de las Comunidades Europeas: Luxemburgo, 2009.
23. Comisión Europea. *Dictamen del Comité Económico y Social Europeo sobre la «Propuesta de Reglamento del Consejo por el que Se Establecen Disposiciones Generales Sobre el Fondo Europeo de Desarrollo Regional, el Fondo Social Europeo y el Fondo de Cohesión*; (COM(2004) 492 Final—2004/0163 (AVC); Diario Oficial de la Unión Europea: Bruselas, Belgium, 2005.
24. OECD. *Iniciatives Locales de Création D'emplois: Entreprises et Emplois dans le Monde Rural*; OECD: Paris, France, 1992.
25. OECD. *Multifunctionality. Towards an Analytical Framework*; OECD: Paris, France, 2001.
26. OECD. Strategies to Improve Rural Service Delivery. In *OECD Rural Policy Reviews*; OECD: Paris, France, 2010.
27. González, R.C.L.; Piñeiro Antelo, M.d.l.Á. Fishing Tourism as an Opportunity for Sustainable Rural Development—The Case of Galicia, Spain. *Land* **2020**, *9*, 437. [CrossRef]
28. García-Marín, R.; Espejo-Marín, C.; Giménez-García, R.; Ruiz-Álvarez, V. Transformations in the Agricultural and Scenic Landscapes in the Northwest of the Region of Murcia (Spain): Moving towards Long Awaited (Un)Sustainability. *Land* **2020**, *9*, 314. [CrossRef]
29. Cejudo García, E.; Cañete Pérez, J.A.; Navarro Valverde, F.; Ruiz Moya, N. Entrepreneurs and Territorial Diversity: Success and Failure in Andalusia 2007–2015. *Land* **2020**, *9*, 262. [CrossRef]
30. Castellano-Álvarez, F.J.; Nieto Masot, A.; Castro-Serrano, J. Intangibles of Rural Development. The Case Study of La Vera (Extremadura, Spain). *Land* **2020**, *9*, 203. [CrossRef]
31. Gurría Gascón, J.L.; Nieto Masot, A. Rururban Partnerships: Urban Accessibility and Its Influence on the Stabilization of the Population in Rural Territories (Extremadura, Spain). *Land* **2020**, *9*, 254. [CrossRef]
32. Martín-Delgado, L.-M.; Rengifo-Gallego, J.-I.; Sánchez-Martín, J.-M. Hunting Tourism as a Possible Development Tool in Protected Areas of Extremadura, Spain. *Land* **2020**, *9*, 86. [CrossRef]
33. Rangel-Preciado, J.F.; Parejo-Moruno, F.M.; Cruz-Hidalgo, E.; Castellano-Álvarez, F.J. Rural Districts and Business Agglomerations in Low-Density Business Environments. The Case of Extremadura (Spain). *Land* **2021**, *10*, 280. [CrossRef]
34. Fernández Martínez, P.; de Castro-Pardo, M.; Barroso, V.M.; Azevedo, J.C. Assessing Sustainable Rural Development Based on Ecosystem Services Vulnerability. *Land* **2020**, *9*, 222. [CrossRef]
35. Ruiz Pulpón, Á.R.; Cañizares Ruiz, M.D.C. Enhancing the Territorial Heritage of Declining Rural Areas in Spain: Towards Integrating Top-Down and Bottom-Up Approaches. *Land* **2020**, *9*, 216. [CrossRef]
36. Komorowski, Ł.; Stanny, M. Smart Villages: Where Can They Happen? *Land* **2020**, *9*, 151. [CrossRef]
37. Blanco-Gregory, R.; López-Canto, L.E.; Sanagustín-Fons, M.V.; Martínez-Quintana, V. Agroecological Entrepreneurship, Public Support, and Sustainable Development: The Case of Rural Yucatan (Mexico). *Land* **2020**, *9*, 401. [CrossRef]
38. Fulton, L.; Beauvais, B.; Brooks, M.; Kruse, S.; Lee, K. Sustainable Residential Building Considerations for Rural Areas: A Case Study. *Land* **2020**, *9*, 152. [CrossRef]
39. Li, X.; Cirella, G.T.; Wen, Y.; Xie, Y. Farmers' Intentions to Lease Forestland: Evidence from Rural China. *Land* **2020**, *9*, 78. [CrossRef]
40. Yang, Z.; Li, C.; Fang, Y. Driving Factors of the Industrial Land Transfer Price Based on a Geographically Weighted Regression Model: Evidence from a Rural Land System Reform Pilot in China. *Land* **2020**, *9*, 7. [CrossRef]
41. Alipbeki, O.; Alipbekova, C.; Sterenharz, A.; Toleubekova, Z.; Makenova, S.; Aliyev, M.; Mineyev, N. Analysis of Land-Use Change in Shortandy District in Terms of Sustainable Development. *Land* **2020**, *9*, 147. [CrossRef]

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Article

Analysis of Land-Use Change in Shortandy District in Terms of Sustainable Development

Onggarbek Alipbeki [1,*], Chaimgul Alipbekova [2], Arnold Sterenharz [3], Zhanat Toleubekova [1], Saule Makenova [1], Meirzhan Aliyev [1] and Nursultan Mineyev [1]

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Abstract: The suburban territories of large cities are transitional zones where intensive transformations in land use are constantly taking place. Therefore, the presented work is devoted to an integrated assessment of land use changes in the Shortandy district (Kazakhstan) based on an integrated study of the dynamics of land use and sustainable development indicators (SDIs). It was found that the main tendency in the land use of this Peri-urban area (PUA) during 1992–2018 is their intensification, through an increase in arable lands. Kazakhstan only recently started the systematic collection of SDIs according to international standards. Therefore, to assess the sustainable development of the study area, limited amounts of information were available. Nevertheless, the use of SDIs from 2007 to 2017 showed that the growth of economic development inthe study area is almost adequately accompanied by an increase in the level of social and environmental development. The methodological approach used can be widely used to assess the sustainable development of specific territories in general and the development of the capital of Kazakhstan and their PUA, in particular.

Keywords: land use change; analyze; sustainable development; Shortandy district

1. Introduction

According to the Food and Agriculture Organization (FAO) statement on food security "by 2050, the world's population will grow to almost 10 billion," which will increase food demand by about 50% compared to 2013 [1]. At the same time, the share of the rural population will decrease, and the urban population of the world will reach 68% [2]. Increased food production is recommended to be accompanied by sustainable agricultural land management [3], including PUA.

The purpose of increasing the effectiveness of land use management is to stop or at least slow down the negative impact of land use on natural resources. Moreover, adverse processes are often understood as degradation of the soil cover under the influence of various types of erosion [4], desertification and salinization [5,6], depletion of soil fertility [7], pollution [8], reduced water quality [9], land grabs by rapidly growing cities and their consequences [10], etc. These local changes in land use together have a global impact on climate, hydrology, biogeochemistry, biodiversity and the ability of biological systems to meet human needs [11,12]. Besides, changes in land use significantly affect the energy balance of the entire Earth and the biogeochemical cycles in it, of which 60% are associated with direct human activities (for example, urban sprawl and intensification of agriculture) and only 40% with indirect environmental factors (for example, climate change) [13–17].Ultimately, these undesirable processes occurring in the environment, if detected and not prevented in time, lead to undesirable economic, social and environmental consequences, the indicators of which should also be measured and evaluated. It is emphasized that the process of sustainable development is multidimensional and interdisciplinary, and the indicators proposed for its assessment are an attempt to combine them into a measurable set [18–21], which usually focus on a certain aspect of sustainable development.

In the light of the above context, there is an urgent need for a comprehensive and systematic assessment of changes in land use, environmental factors, economic and social conditions by instrumental and statistical methods based on indicators of sustainable development (SDI) [22].

On the one hand, the transformation of land use is the main driver of environmental change at all levels. Instrumental methods using Remote Sensing (RS) and Geographic Information Systems (GIS) are widely used to evaluate Land Use and Land Cover (LULC) changes. The accuracy of the LULC assessment using RS and GIS depends on the potential of the devices used and their sensors, the frequency of measurement repeatability and the qualifications of an expert [23–25]. For example, the assessment of long-term LULC changes based on RS and GIS is implemented at the global, regional, national and local levels [26–31]. It is obvious that over time, the level of reliability of the assessment of changes in LULC will increase with the development of geoinformatics, in general, and geoinformation technologies, in particular. Apparently, instrumental research methods supplemented by data on the state of social, economic and environmental factors may be more useful in assessing the sustainable development of a particular territory.

On the other hand, the concept of sustainable development is one of the doctrines of the economy and assumes that “it meets the needs of the present, without compromising the ability of future generations to satisfy their own needs” [32]. The Sustainable Development Goals (SDGs) are the foundation for a better and sustainable future for all. They address the global challenges that we face, including those related to poverty, inequality, climate change, environmental degradation, peace and justice. All 17 SDGs are interlinked [33] and provide for the balance between economic growth (economic aspect), care for nature (environmental aspect) and quality of life (social aspect), and are closely related to space and land use. To assess the transformation of sustainable development, different approaches are used [34]. In our opinion, studies on sustainable development using LULC digital maps in integration with economic social and environmental indicators are of the greatest interest. This is because land use always represents a correlation between different economic, social and environmental needs [35]. For example, LULC digital maps were used in conjunction with environmental statistics [35,36], land use intensity [37], socio-economic consequences of land use [38], and a combination of environmental, economic and social factors based on land processing [22]. In order to conduct such comprehensive studies, in addition to reliable digital cards, reliable SDI [39,40] and adequate methodological approaches are additionally needed.

In Kazakhstan, to date, research in the field of sustainable development has been carried out either using LULC digital maps [41], or using reliable scientific and official source statistical data [42]. Initial statistical indicators of sustainable development to date in the republic have not been fully systematized according to the requirements of the SDGs, the use of which still requires their transformation into three or more stages. Nevertheless, the republic fully supports the principles of sustainable development [43] and the country has joined the United Nations (UN) special program “Sustainable Development Goals for the Period until 2030” [44]. Therefore, to monitor the sustainable development of land use, the RS group was created from KazEOSAT 1 and KazEOSAT 2 (Kazakhstan) [45]. In addition, in recent years, studies have been launched in the field of long-term observation of changes in LULC using RS [41,46–51]. However, the problem of a comprehensive assessment of the sustainable development of PUA using instrumental methods for studying changes in land use in combination with the use of SDI remains open.

Based on the foregoing, the goal of our research is a comprehensive assessment of the sustainable development of the Shortandy region, which is the PUA of the metropolis Nur-Sultan, using instrumental and statistical indicators of sustainable development. The research objectives are the development of spatial and temporal LULC maps for determining changes in land use trends, as well as assessing the level of sustainable development of the Shortandy district based on a multi-step transformation of the currently available initial statistical indicators of sustainable development in the fields of ecology, economics and social conditions.

2. Materials and Methods

2.1. Study Area

The research area is the Shortandy district, Akmola oblast, which is located on the northern border of the city Nur-Sultan which isthe capital of Kazakhstan (Figure 1), where lack of free space is a problem, as in many other metropolises.

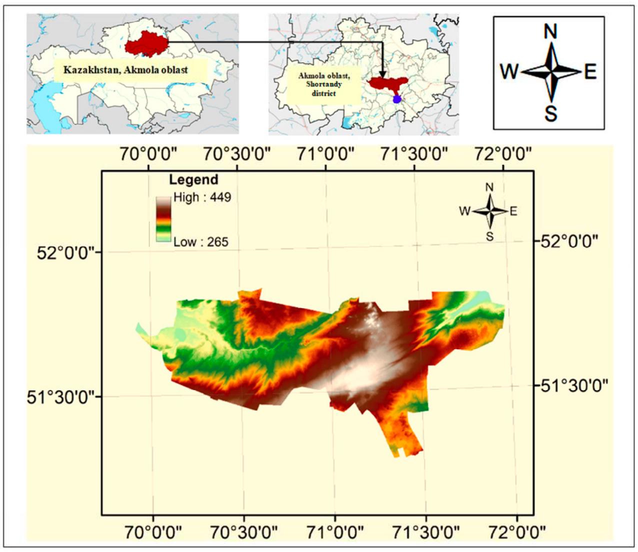

Figure 1. Digital elevation map [52] of the Shortandy district.

The area of interest (AOI) covers an area of 4675.6 km^2. There are 11 villages in the district. The population of the district as of January 1, 2018, was 29,421 people. The region specializes in gold mining, grain production, livestock farming and processing of agricultural products. The industry focus is agrarian-industrial. A railway passes through the territory of the Shortandy region in several directions: Almaty-Petropavlovsk, Kokshetau-Kyzylorda, etc., roads of international, republican and regional significance, which makes it attractive both for the development of industry and agriculture. The hydrographic network is represented by 11 lakes and several small drains, the flow of which is insignificant. The main water artery flowing through the territory of the district is the Damsa River [53–55].

2.2. Data

Landsat data 5 and 8 [56] for 1992, 1998, 2008, 2018 were used to study land use changes in the AOI. The Metadata of images are: LT51550241992155ISP00; LT51560241992162ISP00; LT51550241998267BIK00; LT51560241998258BIK00; LT51550242008103BJC01; LT51560242008126KHC01; LC81550242018146LGN00; LC81560242018185LGN00.

To assess the sustainability of the development of the district, we used statistical data obtained from the relevant internet resources of Kazakhstan [57,58], as well as from the official data provided by the “Republican Scientific and Methodological Centre of the Agrochemical Service” of the Ministry of Agriculture of the Republic of Kazakhstan” (RSMCAS).

2.3. Methods

Methodology for classifying land use, it's accuracy assessment and land use map generation is described in our previous work [41], which used the methodological approaches and solutions given in [52,56,59–62]. Methods of assessing sustainable development include four steps (Figure 2) [63].

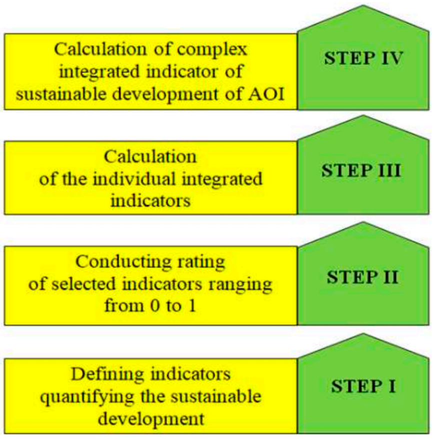

Figure 2. Methods of assessing sustainable development [63] of Shortandy district.

Table 1 shows the three groups of SDIs we used: economic, social, and environmental.

Table 1. Indicators for the assessment of sustainable development of Shortandy district.

Indicators	Indicator's Title	Unit of Measurement
Economic	The volume of industrial output	million tenge
	The volume of output of plant products	million tenge
	The volume of output of animal products	million tenge
	Investment in fixed capital	million tenge
Social	Population;	thousand people
	Ratio of the average monthly salary to the average wage in the economy as a hole	%
	Unemployment rate;	%
	Natural population migration coefficient	%
	Provision of rural population with drinking water	%
	The share of paved roads in the total length of roads	Per mille
Environmental	The weighted average content of humus;	%
	The weighted average content of easily mobile nitrogen	%
	The weighted average content of phosphorus;	%
	The weighted average content of exchangeable potassium	%

3. Results

3.1. Land Use Changes in Shortandy District

The land use classification of the Shortandy district for the period 1992–2018 indicates the presence of noticeable changes in land use (Tables 2 and 3). Agricultural land occupies the bulk of the AOI (~96%, with arable land ~66% and pasture ~30%), which is clearly seen in Figure 3. In 1992, arable lands and pastures amounted to 95.83%; in 1998, 95.84%; in 2008, 95.71%; and in 2018, 95.61% (Table 2). From the above data, it can be seen that there was a gradual increase in the area of arable land mainly due to pasture ploughing (Table 3). From 1992 to 1998, there was only a slight tendency to reduce pastures and increase arable lands. Noticeable increases in the share of arable land began in 1998. The territories occupied by arable land from 1992 to 2008 increased by 1.4 km^2, and from 1992 to 2018 by 16.5 km^2.

Table 2. Characteristics of land use changes in Shortandy district.

Land Use Classes	**Area**							
	1992		**1998**		**2008**		**2018**	
	km^2	**%**	**km^2**	**%**	**km^2**	**%**	**km^2**	**%**
Arable land	3057.5	66.05	3057.70	66.06	3058.90	66.08	3074.00	66.41
Pasture	1378.50	29.78	1378.30	29.78	1374.40	29.69	1358.00	29.34
Water	125.00	2.70	125.00	2.70	125.00	2.70	125.00	2.70
Forest	36.70	0.79	36.70	0.79	37.40	0.81	37.60	0.81
Built-up area	31.10	0.67	31.10	0.67	33.10	0.72	34.20	0.74
Total	4628.80	100	4628.80	100	4628.80	100	4628.80	100
Overall accuracy (%)	93.1		92.2		94.7		94.0	
Kappa	0.85		0.83		0.89		0.89	

Table 3. Land use area difference of Shortandy district between 1992–2018.

Land Use Classes	**Area of Difference (km^2)**		
	1992–1998	**1992–2008**	**1992–2018**
Arable land	0.20	1.40	16.50
Pasture	−0.20	−4.10	−20.50
Water	0.00	0.00	0.00
Forest	0.00	0.70	0.90
Built-up area	0.00	2.00	3.10

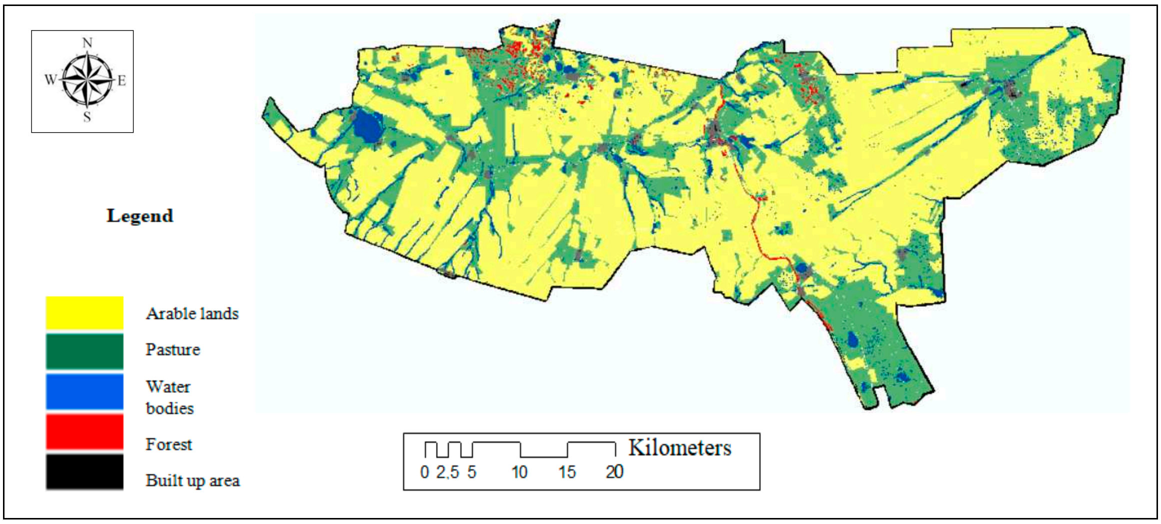

Figure 3. Land use map of Shortandy district.

Over the same period (1992–2018), the rangelands AOI decreased by 20.5 km^2, of which 16.5 km^2 became arable land. A typical example of the expansion of the sown area due to the ploughing of pastures is shown in Figure 4.

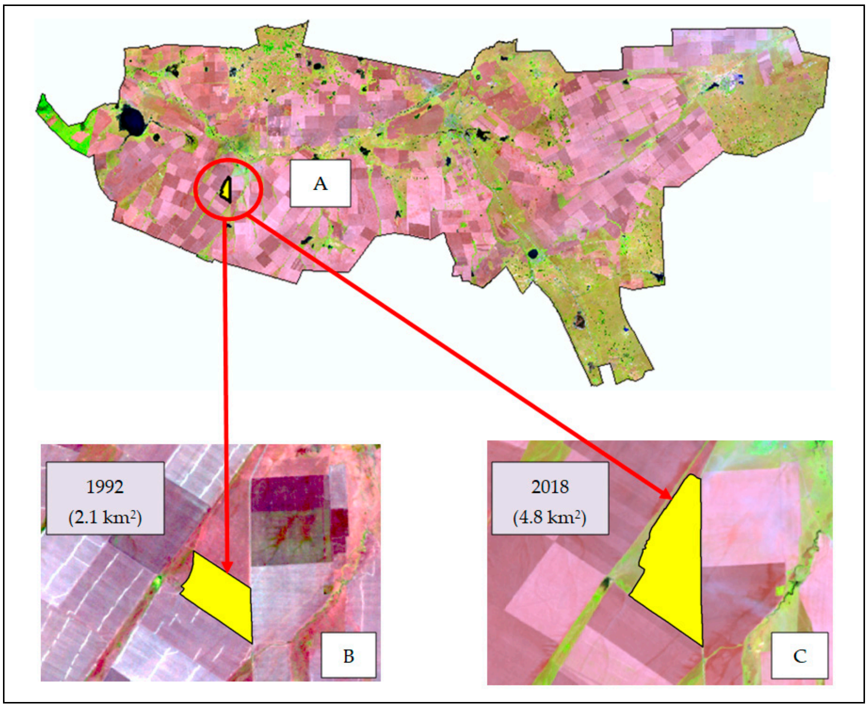

Figure 4. An example of change the area of arable land in Shortandy district (**A**) from1992 (**B**) to 2018 (**C**).

The area of water bodies over the years of research remained virtually unchanged and remained at the level of 2.7%.

Forests in the study area occupy less than one percent (0.79%–0.81%). It was noted that the area used for growing trees markedly increased, mainly due to the planting of new forest stands [64].

Urban areas occupy only 0.67%–0.72% of the entire territory of the district. From 1992 to 1998, until the city of Akmola was declared the capital of the republic, the area of the urbanized territories of the district remained unchanged. From 1998 to 2008, the built-up area of the district increased by 2.0 km^2. From 1992 to 2018, the total built-up area increased by 3.1 km^2 compared to the beginning of our observations.

The overall classification accuracy of land use varied between 92.2%–95.0%. The Kappa coefficient for classified images in 1992 was 0.85; in 1998, 0.83; in 2008, 0.89; and in 2018, 0.89, which indicates the reliability of our land use classification (Table 2).

3.2. Analyze of Sustainable Development of Shortandy District

The results of the calculation of SDI are shown in Table 4. In general, there are positive changes intheeconomicandsocialSDI, whichis possible due to strong growth offixed assets in agriculture and industrial production of Shortandy district.

Table 4. The individual integrated sustainable development indicators (SDI)of Shortandy district in 2007–2017.

Year	Economic	Social	Environmental
2007	0.56	0.64	0.66
2008	0.58	0.74	0.69
2010	0.69	0.78	0.71
2014	0.83	0.77	0.85
2017	0.91	0.77	0.85

The limitation of the period of assessment of sustainable development from 2007 to 2017 is due to the lack of SDIs that have been conducted hitherto unsystematically on the scale of not only the Shortandy district but the whole republic [65].

In the social sphere, individual indicators are also improving. However, their pace of development is slightly lower than the economic sector. The best SDI in the social sphere was achieved in 2014, after which stagnation was observed.

It should be noted that, according to RSMCAS, an increase in the amountof arable lands is observed, where there is no restoration of soil humus. For example, the weighted average humus content in AOI soils decreased by about 30% compared with 1989, and this process has not completely stopped. At the same time, in recent years, there has been a tendency to increase in the study area soils the mobile form of nitrogen, phosphorus and potassium, which is apparently due to the intensive use of arable land, where it is difficult to obtain high yields without fertilizing.

Evaluation of individual SDI study area allows building hypothetical sustainability testing grounds based on local criteria over some of the years (Figure 5).

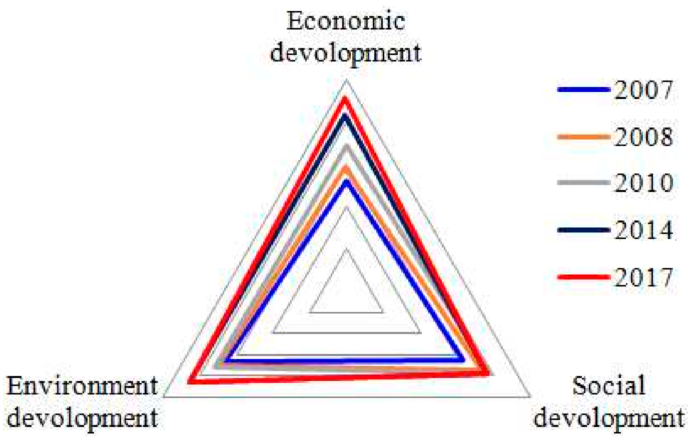

Figure 5. Polygons of sustainable development of Shortandy district in 2007–2017.

In general, the nature of the change in the size and shape of landfills convincingly indicates a steady increase in integrated economic, social and environmental indicators. Forms of test polygons are quite smooth, but not always an ideal triangle. This indicates an uneven change in one or another integral indicator over years or measured periods of time, which is quite logical. In this regard, a relatively small deviation of the triangle of 2007 and 2017 towards environmental indicators can be noted, which indicates a noticeable criticality of this indicator in comparison with the economic and social characteristics of the sustainable development of the Shortandy district.

A comprehensive integral indicator of sustainable development of AOI is shown in Figure 6.

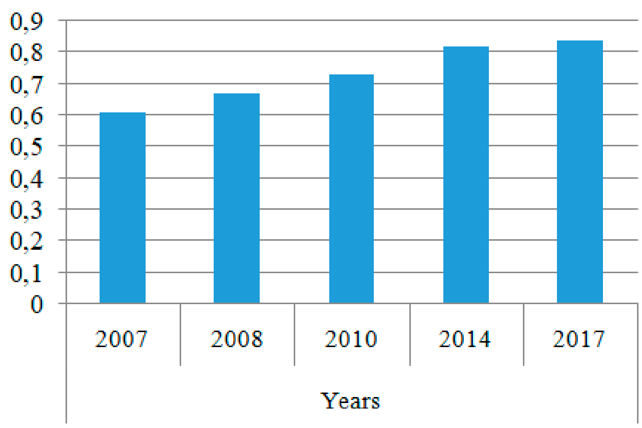

Figure 6. The dynamics of the complex SDI of Shortandy district in 2007–2017.

Changes in the comprehensive indicator of sustainable development, which combines all three integrated indicators of economic, environmental and social development, indicate a positive trend. During the estimated period, the process of improving all three sides of development was generally going on, although these dynamics slowed down in the period from 2014 to 2017.

The analysis allows us to conclude about the positive dynamics of the integral index of stability of the Shortandy district. Such changes are primarily associated with a relatively high level of investment in the economy of the study area.

4. Discussion

Comprehensive studies aimed at assessing the sustainable development of PUA, which can be divided into two large groups. The first group is land use research using the advantages of instrumental methods (RS and GIS), the second is the widespread use of knowledge-based on transformed statistics in the field of economic and social sciences, as well as environmental protection.

To evaluate changes in land use, RS is presented as a tool to obtain information about an object or a phenomenon at a distance and in a non-destructive way to conduct a spatiotemporal analysis of long-term trends in land use development [22,66]. However, not one of the land use features is measured directly using RS instruments. The relationship between what is measured (radiation) and the characteristics of the land use must be modelled to deduce the last from the first. Therefore, the use of RS to study land usechanges is always accompanied by an assessment of classification accuracy [67].

Interest in the instrumental assessment of land use is very high, since it has moved to a new level [29] and, due to its unique characteristics, can be extremely useful for assessing the sustainable development of territories: local, national, regional and global.

One example in this regard is the Polish Coordination of Information of Environment (CORINE) Land Cover, which assessesthe period from 1990 to 2018 [68]. Interpreting changes in the time horizon, one can obtain information on change trends, which is a valuable guide for the further development of sustainable development policies [22]. This is evidenced by the increase in the depth of land use analysis, associated with sustainable development goals [31,69]. Of considerable interest is the study of processes and determination of sustainable development paths in PUAs, which are caused by modern trends in the growth of urban population in the world [2]. Researches by instrumental methods of specific PUAs are carried out from the following positions: assessing the risk of competition for land-based on spatial indicators [70] the impact of urban expansion on the intensity of agricultural land use [71] and their losses [72,73]; urban planning and management policies [74]; valuation of ecosystem services [75]; assessment of degradation and loss of productive agricultural land [76]; search for driving forces affecting land use [77], etc. Those instrumental approaches to land use assessment can identify the main trends in spatial changes in PUAs for making objective decisions on sustainable development of PUAs.

At the same time, without the use of sustainable development indicators (SDI), based on the transformation of the initial statistical data in the field of economic and social sciences, as well as environmental protection, it is impossible to objectively assess the sustainability of rural development [63], including PUAs.

To this end, a single SDI metadata catalogue and international guidelines have been developed [78]. SDIs have many functions and can lead to more effective decisions by simplifying, refining and making summary information available to politicians. SDIs can help measure and calibrate progress toward sustainable development goals, and can also provide early warning to prevent economic, social and environmental failures [79].

The concept of sustainable development is an attempt to combine growing concern about a number of environmental problems with socio-economic problems [80], which are difficult to accomplish using only instrumental methods. The science of sustainability is based on the study of interdisciplinary connections and combines natural, social, humanitarian, engineering and other sciences to assess the long-term integrity of the environment [81]. For example, in order to identify mechanisms for sustainable development of PUAs, the processes driving the current global land grabbing are analyzed [82]. The expansion of cities to arable land may be accompanied by a decrease in the sustainability of the development of PUAs [83]; therefore, this problem becomes one of the key research areas, as it is associated with food security [84]. It is argued that a general agricultural and/or socio-economic profile may not be sufficient to understand sustainable development between urban and rural areas and suggest stricter definitions [85], as well as a new approach [86] aimed at identifying the socio-economic consequences of this process. Diversification in suburban agriculture [87], as well as an approach based on smart specialization [88], etc., can play a positive role in increasing the sustainability of the development of PUAs.

Researchers studying the problems of sustainable development of rural areas of Kazakhstan so far consider solutions to this problem at the level of the whole country. For sustainable development, countries propose diversification of the economy [42]; the development of "clean" production, the rational use of natural resources with the maximum possible preservation of the environment through improved technologies [37]; the development of industrial and social infrastructure [89]; solving the problem of accessibility and data quality [90]; studying the positive foreign practice of regulating land relations [91]; and taking into account economic, social, environmental and institutional factors of each region of the republic and choose adequate indicators [92].

For the quantitative assessment of sustainable rural development using indicators of sustainable development, two main approaches are distinguished [93–95]: the creation of separate indicators combined into a system [93,94] and a single integrated indicator [92].

In this regard, international guidelines will serve for national SDI kits, which should be developed taking into account the availability of relevant statistics and reflect the specific situation in countries and specific administrative-territorial units of the country. Therefore, Kazakhstan joined the development of initiatives and measures for sustainable development goals (SDGs) within the framework of the 2030 Agenda [43] and began to collect information according to sustainable development goals indicators [95].

At the same time, the historical imbalance, when a country consumes resources disproportionately compared to their production, is the basis for future problems of sustainable development of Kazakhstan. Calculations showed that reaching the trajectory of "sustainable development" can be ensured if the coefficient of resource utilization is 53%, but not lower than 43% [96]. When forecasting sustainable socio-economic growth, Kazakhstan adheres to three scenarios: optimistic, basic and pessimistic [97]. The forecasted values of Kazakhstan's sustainable growth for 2020–2024, when estimated according to the basic scenario, assumed an oil price of $55 [98]. Real Gross Domestic Product (GDP) growth was projected at 4.1% in 2020. In 2024, it was supposed to reach 4.7%. For five years, the average annual GDP growth rate would be 4.4%. The pessimistic forecast [93] is associated with a decrease in oil prices, which are formed on world markets [99], and the COVID-19 virus epidemic has also added to it [100]. During this period, the government of Kazakhstan is considering the worst option for socio-economic development [101]; the results of such a forecast are not yet available to us. It should be emphasized that in the case of a pessimistic scenario, the adoption of anti-crisis measures is envisaged [97]. They cover measures to ensure macroeconomic stability, including monetary policy instruments, targeted measures to support the real economy, small and medium-sized businesses, and social security. At the same time, depending on the specifics of the crisis, the measures will be revised and adapted to current realities and sustainable development will continue, but its pace will decrease.

The forecast for sustainable development in Russia and Central Asian countries for the future is being formed as in Kazakhstan [102,103]. That is, the sustainable development of Kazakhstan's closest neighbours also depends on the prices of world markets.

It is quite interesting to consider the comparative aspects of the official sustainable development index between Kazakhstan and the Russian Federation [104]. During 1990 and 2015, the sustainable development index in Russia was constantly higher than in Kazakhstan. This indicates the need for close attention of the government of Kazakhstan to the problem of sustainable development in its republic since the country has already joined the goals of sustainable development 2030.

Thus, the presented material shows that for the most objective assessment of the sustainability of the development of PUAs, it is necessary to use an integrated assessment using instrumental studies of multi-temporal LULC changes and SDI statistical indicators. An example of such an approach already exists [22,35,36,38,105]. However, most of these studies are related to the study of urbanization of cities, and the ways of integrating the results of the LULC study with all three SDI groups (economic, environmental andsocial) for rural areas remain insufficiently studied.In this paper, we also tried to supplement the dynamics of spatiotemporal changes in LULC with SDI analysis using the example of the Shortandy district. In general, the results show the usefulness of the chosen approach, where the development trend of land use and the degree of PUA stability are comprehensively determined. At the same time, due to the limited information on SDI that Kazakhstan has just begun collecting, our work should be considered as an initial step in the chosen areas of research. Nevertheless, the results obtained are of significant value for local and republican bodies interested in developing sustainable development plans.

5. Conclusions

As a result of the studies, a comprehensive assessment of the development of the Shortandy region, which is the PUA of a fast-growing metropolis, was carried out. As a result, information was received:

- on the spatiotemporal change in the structure of the LULC using the instrumental analysis method (RS and GIS);
- on the development of the economic, environmental and social potential of the AOI with the use of statistical indicators transformed and combined into three target groups of sustainable development indicators; specifically, economic, ecological and social characteristics.

The study of changes in the land use structure in the AOI from 1992 to 2018 using digital maps revealed an intensification of land use in the study area due to the constant increase in the share of arable land in the LULC structure.

Using the methodology of multi-step conversion of source statistical data into individual, integrated and aggregated of sustainable development indicators revealed that in the last 10years (from 2007 to 2017) there has been a steady development of AOI.

Thus, we have shown that the integrated use of instrumental data and systematic statistical indicators allows us to assess the tendency of land use and the sustainability of the development of a particular agricultural region as a whole. At the same time, due to a lack of initial statistical indicators for AOI, we were not able to evaluate the entire study period covered by the land use study (1992–2018). As a result, we should have limited ourselves to SDI analysis only from 2007 to 2017 with a relatively small number of indicators. Nevertheless, the information obtained in our work is valuable material for interested authorities to plan their activities in the field of sustainable development of a specific PUA. In addition, our approach gives other researchers the opportunity to expand their research in the field of assessing the sustainable development of specific territories, such as the Shortandy district.

The future problems of sustainable development of Kazakhstan are based on the historical imbalance when a country consumes resources disproportionately compared to their production. When forecasting sustainable socio-economic growth, Kazakhstan adheres to three scenarios: optimistic, basic and pessimistic. In all scenarios, sustainable development will continue, but its pace will vary depending on the specifics of the crisis.

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References

1. FAO. *The Future of Food and Agriculture—Trends and Challenges*; Food and Agriculture Organization of the United Nations: Rome, Italy, 2017; 180p, Available online: http://www.fao.org/3/a-i6583e.pdf (accessed on 3 May 2020).
2. *World Urbanization Prospects: The 2018 Revision*; United Nations, Department of Economic and SocialAffairs, Population Division: New York, NY, USA, 2019; 126p. Available online: http://www.fao.org/3/I8429EN/i8429en.pdf (accessed on 3 May 2020).
3. FAO. *The Future of Food and Agriculture—Alternative Pathways to 2050*; FAO: Rome, Italy, 2018; 224p.
4. Alam, A. Soil Degradation: A Challenge to Sustainable Agriculture. *Int. J. Sci. Res. Agric. Sci.* **2014**, *1*, 50–55, ISSN 2345-6795. [CrossRef]
5. Mirzabaev, A. Land Degradation and Sustainable Land Management Innovations in Central Asia. In *Technological and Institutional Innovations for Marginalized Smallholders in Agricultural Development*; Gatzweiler, F., von Braun, J., Eds.; Springer: Cham, Switzerland, 2016. [CrossRef]
6. Keesstra, S.; Mol, G.; de Leeuw, J.; Okx, J.; Molenaar, C.; de Cleen, M.; Visser, S. Soil-Related Sustainable Development Goals: Four Concepts to Make Land Degradation Neutrality and Restoration Work. *Land* **2018**, *7*, 133. [CrossRef]
7. Panpatte, D.G.; Jhala, Y.K. *Soil Fertility Management for Sustainable Development*; Springer: Singapore, January 2019; 303p. [CrossRef]
8. UN 2030 Agenda for Sustainable Development and SDGs. Available online: https://chemicalleasing.org/concept/policy-background/un-2030-agenda-sustainable-development-and-sdgs (accessed on 3 May 2020).
9. International Initiative on Water Quality (IIWQ). Available online: https://en.unesco.org/waterquality-iiwq/wq-challenge (accessed on 3 May 2020).
10. Devisscher, T.; Konijnendijk, C.; Nesbitt, L.; Lenhart, J.; Salbitano, F.; Cheng, Z.C.; Lwasa, S.; van den Bosch, M. *SDG 11: Sustainable Cities and Communities—Impacts on Forests and Forest-Based Livelihoods*; Cambridge University Press: Cambridge, UK, 2019; pp. 349–385. Available online: https://www.cambridge.org/core/services/aop-cambridge-core/content/view/82DBFCBBB457D4D1DD460FB5F075B5AD/9781108486996c11_349-385.pdf/sdg_11_sustainable_cities_and_communities_impacts_on_forests_and_forestbased_livelihoods.pdf (accessed on 3 May 2020).
11. Foley, J.A.; De Fries, R.; Asner, G.P.; Barford, C.; Bonan, G.; Carpenter, S.R.; Chapin, F.S.; Coe, M.T.; Daily, G.C.; Gibbs, H.K.; et al. Global consequences of land use. *Science* **2005**, *309*, 570–574. [CrossRef] [PubMed]
12. Sala, O.E.; Chapin, F.S., III; Armesto, J.J.; Berlow, E.; Bloomfield, J.; Dirzo, R.; Huber-Sanwald, E.; Huenneke, L.F.; Jackson, R.B.; Kinzig, A.; et al. Global biodiversity scenarios for the year 2100. *Science* **2000**, *287*, 1770–1774. [CrossRef] [PubMed]
13. Song, X.P.; Hansen, M.C.; Stehman, S.V.; Potapov, P.V.; Tyukavina, A.; Vermote, E.F.; Townshend, J.R. Global land change from 1982 to 2016. *Nature* **2018**, *560*, 639–643. [CrossRef] [PubMed]
14. Turner, B.; Meyer, W.B.; Skole, D.L. Global land use/land cover change: Towards an integrated study. *AMBIO* **1994**, *23*, 91–95.
15. Feranec, J.; Soukup, T.; Hazeu, G.; Jaffrain, G. (Eds.) *European Landscape Dynamics: CORINE Land Cover Data*, 1st ed.; CRC Press: Boca Raton, FL, USA, 2016; ISBN 9781315372860.
16. Szumacher, I.; Pabjanek, P. Temporal Changes in Ecosystem Services in European Cities in the Continental Biogeographical Region in the Period from 1990–2012. *Sustainability* **2017**, *9*, 665. [CrossRef]
17. Seto, K.C.; Fragkias, M.; Güneralp, B.; Reilly, M.K. A meta-analysis of global urban land expansion. *PLoS ONE* **2011**, *6*, e23777. [CrossRef]

18. Rennings, K.; Wiggering, H. Steps towards indicators of sustainable development: Linking economic and ecological concepts. *Ecol. Econ.* **1997**, *20*, 25–36. [CrossRef]
19. Kuik, O.; Verbruggen, H. *In Search of Indicators of Sustainable Development*; Media, B.V., Ed.; Sprigner—Science + Business: Dordrecht, The Netherlands, 2012.
20. Hák, T.; Moldan, B.; Dahl, A.L. *Sustainability Indicators: A Scientific Assessment*; Scientific Committee on Problems of the Environment (SCOPE): Washington, DC, USA, 2007.
21. Steurer, R.; Hametner, M. Objectives and Indicators in Sustainable Development Strategies: Similarities and Variances across Europe. *Sustain. Dev.* **2013**, *21*, 224–241. [CrossRef]
22. Gibas, P.; Majorek, A. Analysis of Land-Use Change between 2012–2018 in Europe in Terms of Sustainable Development. *Land* **2020**, *9*, 46. [CrossRef]
23. Blaschke, T.; Hay, G.J.; Kelly, M.; Lang, S.; Hofmann, P.; Addink, E.; Feitosa, Q.R.; van der Meer, F.; van der Werff, H.; van Coillie, F.; et al. Geographic Object-Based Image Analysis -Towardsanewparadigm. *ISPRS J. Photogramm. Remote Sens.* **2014**, *87*, 180–191. [CrossRef] [PubMed]
24. Ma, L.; Li, M.; Ma, X.; Cheng, L.; Du, P.; Liu, Y. Areviewofsupervisedobject-basedland-coverimageclassification. *ISPRS J. Photogramm. Remote Sens.* **2017**, *130*, 277–293. [CrossRef]
25. Atzberger, C. Advancesin Remote Sensing of Agriculture: Context Description, Existin Operational Monitoring Systems and Major Information Needs. *Remote Sens.* **2013**, *5*, 949–981. [CrossRef]
26. Land Use and Land Cover Change. Available online: https://nca2014.globalchange.gov/report/sectors/land-use-and-land-cover-change (accessed on 3 May 2020).
27. Calicioglu, O.; Flammini, A.; Bracco, S.; Bellu, L.; Sims, R. The Future Challenges of Food and Agriculture: AnIntegrated Analysis of Trends and Solutions. *Sustainability* **2019**, *11*, 222. [CrossRef]
28. Global Land Cover Characterization (GLCC). Available online: http://www.fao.org/land-water/land/land-governance/land-resources-planning-toolbox/category/details/en/c/1036354/ (accessed on 3 May 2020).
29. Wulder, M.A.; Coops, N.C.; Roy, D.P.; White, J.C.; Hermosilla, T. Land cover 2.0. *Int. J.Remote Sens.* **2018**, *39*, 4254–4284. [CrossRef]
30. CORINE Land Cover. Available online: https://land.copernicus.eu/pan-european/corine-land-cover (accessed on 8 May 2020).
31. Bielecka, E.; Jenerowicz, A. Intellectual Structure of CORINE Land Cover Research Applications in Web of Science: A Europe-Wide Review. *Remote Sens.* **2019**, *11*, 2017. [CrossRef]
32. The World Commission on Environment and Development. *Report of the World Commission on Environment and Development: Our Common Future*; Oxford University Press: Oxford, UK, 1987; p. 16.
33. About the Sustainable Development Goals. Available online: https://www.un.org/sustainabledevelopment/sustainable-development-goals/ (accessed on 3 May 2020).
34. Braimoh, A.K.; Osaki, M. Land-use change and environmental sustainability. *Sustain. Sci.* **2010**, *5*, 5–7. [CrossRef]
35. Sandru, M.I.V.; Iatu, C.; Sandru, D.C.; Cimbru, D.G. Approaching Land Cover-Land Use Changes Using Statistical Data Validation for Urban Policies Improvement. *J. Settl. Spat. Plan.* **2017**, *8*, 119–129.
36. Salata, S. Land use change analysis in the urban region of Milan. Manag. *Environ. Qual. Int. J.* **2017**, *28*, 879–901. [CrossRef]
37. Karbetova, Z.; Karbetova, S.; Otyzbayeva, K.; Daribayeva, A.; Dulatbekova, Z.; Tastanbekova, K. Strategic Priorities and Challenges of Environmental Management in Kazakhstan. *J. Adv. Res. Law Econ.* **2016**, *7*, 1058–1065.
38. Mezősi, G.; Meyer, B.C.; Bata, T.; Kovács, F.; Czúcz, B.; Ladányi, Z.; Blanka, V. Integrated Approach to Estimate Land Use Intensity for Hungary. *J. Environ. Geogr.* **2019**, *12*, 45–52. [CrossRef]
39. *Indicators of Sustainable Development: Guidelines and Methodologies*, 3rd ed.; United Nations: New York, NY, USA, 2007; 99p. Available online: https://www.un.org/esa/sustdev/natlinfo/indicators/guidelines.pdf (accessed on 3 May 2020).
40. Workshop on Environment Statistics in Support of the Implementation of the Framework for the Development of Environment Statistics. United Nations Statistics Division (UNSD). Land Cover and Land use in Environment Statistics. Arusha, Tanzania, 6–10 July 2015. 37p. Available online: https://unstats.un.org/unsd/ENVIRONMENT/envpdf/unsd_EAC_Workshop/Session%206b_Anand%20Land%20cover%20and%20land%20use%20in%20environment%20statistics.pdf (accessed on 3 May 2020).

41. Alipbeki, O.; Alipbekova, C.; Sterenharz, A.; Toleubekova, Z.; Aliyev, M.; Mineyev, N.; Amangaliyev, K. A Spatiotemporal Assessment of Land Use and Land Cover Changes in Peri-Urban Areas: A Case Study of Arshaly District, Kazakhstan. *Sustainability* **2020**, *12*, 1556. [CrossRef]
42. Thomas, M. Social, environmental and economic sustainability of Kazakhstan: A long-term perspective. *Cent. Asian Surv.* **2015**, *34*, 456–483. Available online: https://www.tandfonline.com/doi/full/10.1080/02634937.2015.1119552?scroll=top&needAccess=true (accessed on 3 May 2020). [CrossRef]
43. Kazakhstan. Voluntary National Review 2019 on the Implementation of the 2030 Agenda for Sustainable Development. 2019. 159p. Available online: https://sustainabledevelopment.un.org/content/documents/23946KAZAKHSTAN_DNO__eng_4.Juli19.pdf (accessed on 3 May 2020).
44. Sustainable Development Goal Indicators Website. Available online: https://unstats.un.org/sdgs/indicators/database/ (accessed on 3 May 2020).
45. KGS. Available online: https://www.gharysh.kz/AboutKA_DZZ/ (accessed on 26 February 2020).
46. Eisfelder, C.; Markus Niklaus, M.; Kuenzer, C. Net primary productivity in Kazakhstan, its spatio-temporal patterns and relation to meteorological variables. *J. Arid Environ.* **2014**, *103*, 17–30. [CrossRef]
47. Kraemer, R.; Prishchepov, A.V.; Müller, D.; Kuemmerle, T.; Radelof, V.C.; Dara, A.; Terekhov, A.; Frühauf, M. Long-term agricultural land-cover change and potential for cropland expansion in the former Virgin Lands area of Kazakhstan. *Environ. Res. Lett.* **2015**, *10*, 054012. [CrossRef]
48. Samarkhanov, K.; Abuduwaili, J.; Samat, A.; Issanova, G. The Spatial and Temporal Land Cover Patterns of the Qazaly Irrigation Zone in 2003–2018: The Case of Syrdarya River's Lower Reaches, Kazakhstan. *Sustainability* **2019**, *11*, 4035. [CrossRef]
49. Taibassarova, Z. *Nazarbayev Detection of the Vegetation Change Cover Using Landsat TM5 in the Burabay State National Natural Park, Kazakhstan*; Nazarbayev University: Astana, Kazakhstan. Available online: https://nur.nu.edu.kz/bitstream/handle/123456789/3190/Taibassarova.PDF?sequence=1&isAllowed=y (accessed on 18 February 2020).
50. Ilyassova, A.; Kantakumar, N.L.; Boyd, D. Urban growth analysis and simulations using cellular automataand geo-informatics: Comparison between Almaty and Astana in Kazakhstan. *Geocarto Int.* **2019**. Corpus ID: 181852613. [CrossRef]
51. Qi, J.; Tao, S.; Pueppke, S.G.; Espolov, T.E.; Beksultanov, M.; Chen, X.; Xiumin Cai, X. Changes in land use/land cover and net primary productivity in the transboundary Ili-Balkhash basin of Central Asia, 1995–2015. *Environ. Res. Commun.* **2020**, *2*, 011006. [CrossRef]
52. SRTM Data. Available online: http://srtm.csi.cgiar.org/ (accessed on 15 October 2019).
53. Agroclimatic Resources of the Akmola Oblast: A Scientific Applied Reference. Available online: https://ingeo.kz/wp-content/uploads/2017/11/%D0%90%D0%B3%D1%80%D0%BE%D0%BA%D0%BB%D0%B8%D0%BC%D0%B0%D1%82%D0%B8%D1%87%D0%B5%D1%81%D0%BA%D0%B8%D0%B5-%D1%80%D0%B5%D1%81%D1%83%D1%80%D1%81%D1%8B-%D0%90%D0%BA%D0%BC%D0%BE%D0%BB%D0%B8%D0%BD%D1%81%D0%BA%D0%BE%D0%B9-%D0%BE%D0%B1%D0%BB%D0%B0%D1%81%D1%82%D0%B82.pdf (accessed on 3 May 2020). (In Russia)
54. The Official Internet Resource of the Shortandy District. Available online: http://shortandy.akmo.gov.kz/page/read/Obcshie_svedeniya.html (accessed on 3 May 2020).
55. Shortandy (Shortandy District). Available online: http://ru.encyclopedia.kz/index.php/%D0%A8%D0%BE%D1%80%D1%82%D0%B0%D0%BD%D0%B4%D1%8B_(%D0%A8%D0%BE%D1%80%D1%82%D0%B0%D0%BD%D0%B4%D0%B8%D0%BD%D1%81%D0%BA%D0%B8%D0%B9_%D1%80%D0%B0%D0%B9%D0%BE%D0%BD) (accessed on 3 May 2020).
56. United States Geological Survey. Available online: https://earthexplorer.usgs.gov/ (accessed on 18 February 2020).
57. The Dynamics of the Main Socio-Economic Indicators. Available online: https://old.stat.gov.kz/faces/akmola/reg_main/regDinamo?_afrLoop=14341087210159499#%40%3F_afrLoop%3D14341087210159499%26_adf.ctrl-state%3Dg39cu191d_204 (accessed on 3 May 2020).
58. National Report on the State of the Environment and the Use of Natural Resources: 2011–2014. Available online: http://ecogosfond.kz/wp-content/uploads/2018/03/NDSOS_2011-2014.pdf (accessed on 3 May 2020).
59. Bossard, M.; Feranec, J.; Otahel, J. CORINE Land Cover Technical Guide-Addendum. 2000. Technical Report No. 40/2000. Copenhagen. Available online: https://www.eea.europa.eu/publications/tech40add (accessed on 9 January 2020).

60. Kaul, H.A.; Sopan, I.T. Land Use Land Cover Classification and Change Detection Using High-ResolutionTemporal Satellite Data. *J. Environ.* **2012**, *1*, 146–152.
61. Nguyen, T.B.P.; Zhang, X.; Wu, W.; Liu, H. Land Use/Land Cover Changes from 1995 to 2017 in Trang Bang, Southern Vietnam. *Agric. Sci.* **2019**, *10*, 413–422. [CrossRef]
62. Lurie, I.K.; Kosikov, A.G. *Theory and Practice of Digital Image Processing*; Berlyant, A.M., Ed.; Scientific World: Moscow, Russia, 2003; 168p. (In Russia)
63. Semenova, N.N.; Busalova, S.G.; Eremina, O.I.; Makeikina, S.M.; Ivanova, I.A. Assessment of Sustainable Development of Rural Areas of Russia. *Indian J. Sci. Technol.* **2016**, *9*. [CrossRef]
64. Green Belt of Astana. Available online: http://astana.gov.kz/en/page/zelenyy_poyas_astany (accessed on 3 December 2019).
65. Ministry of National Economy Republic of Kazakhstan. Statistics Committee. Available online: https://old.stat.gov.kz/faces/akmola/regPublications?_afrLoop=14325556427266828#%40%3F_afrLoop%3D14325556427266828%26_adf.ctrl-state%3Dtqmb1bxpa_43 (accessed on 3 May 2020).
66. Weiss, M.; Jacob, F.; Duveiller, G. Remote sensing for agricultural applications: A meta-review. *Remote Sens. Environ.* **2019**, 1–39. [CrossRef]
67. Gomez, C.; White, J.C.; Wulder, M.A. Optical remotely sensed time series data for land cover classification: Areview. *ISPRS J. Photogramm. Remote Sens.* **2016**, *116*, 55–72.
68. CORINE Land Cover—CLC. Available online: http://clc.gios.gov.pl/index.php/o-clc/program-clc (accessed on 3 May 2020).
69. Nakamura, M.; Pendlebury, D.; Schnell, J.; Szomszor, M. *Navigating the Structure of Research on Sustainable Development Goals*; Clarivate Analytics: Philadelphia, PA, USA, 2019.
70. Debolini, M.; Valette, E.; François, M.; Jean-Pierre, C. Mapping land use competition in the rural–urban fringe and future perspectives on land policies: A case study of Meknès (Morocco). *Land Use Policy* **2015**, *47*, 373–381. [CrossRef]
71. Jiang, L.; Deng, X.; Setoc, K.C. The impact of urban expansion on agricultural land use intensity in China. *Land Use Policy* **2013**, *35*, 33–39. [CrossRef]
72. Rimal, B. Urbanization and the Decline of Agricultural Land in Pokhara Sub-metropolitan City, Nepal. *J. Agric. Sci.* **2013**, *5*, 12p. [CrossRef]
73. Pandey, B.; Zhang, Q.; Seto, K.C. Time series analysis of satellite data to characterize multiple land use transitions: A case study of urban growth and agricultural land loss in India. *J. Land Use Sci.* **2018**, *13*, 221–237. [CrossRef]
74. Fenta, A.A.; Hiroshi, Y.; Haregeweyn, N.; Belay, A.S.; Hadush, Z.; Gebremedhin, M.A.; Mekonnen, G. The dynamics of urban expansion and land use/land cover changes using remote sensing and spatial metrics: The case of Mekelle City of northern Ethiopia. *Int. J. Remote Sens.* **2017**, *38*, 4107–4129. [CrossRef]
75. Akber, A.K.; Wahidur, R.I.; Atikul, R.; Munsur, R.M. Impact of land use change on ecosystem services of southwest coastal Bangladesh. *J. Land Use Sci.* **2018**, *13*, 238–250. [CrossRef]
76. Wadduwage, S.; Millington, A.; Crossman, N.D.; Sandhu, H. Agricultural Land Fragmentation at Urban Fringes: An Application of Urban-To-Rural Gradient Analysis in Adelaide. *Land* **2017**, *6*, 28. [CrossRef]
77. Essien, E.; Cyrus, S. Detection of Urban Development in Uyo (Nigeria) Using Remote Sensing. *Land* **2019**, *8*, 102. [CrossRef]
78. Indicators of Sustainable Development: Guidelines and Methodologies. 2007. 315p. Available online: https://sustainabledevelopment.un.org/content/documents/indisd-mg2001.pdf (accessed on 3 May 2020).
79. Zharova, L.; Khlobystov, I.; Eremeeva, N. Indicators of sustainable development in framework of environmental policy: Experience of eastern neighbors. *Mind J.* **2016**. Available online: https://www.researchgate.net/publication/308379579_INDICATORS_OF_SUSTAINABLE_DEVELOPMENT_IN_FRAMEWORK_OF_ENVIRONMENTAL_POLICY_EXPERIENCE_OF_EASTERN_NEIGHBORS (accessed on 23 February 2020).
80. Hopwood, B.; Mellor, M.; O'Brien, G. Sustainable development: Mapping different approaches sustainabledevelopment. *Sustain.Dev.* **2005**, *13*, 38–52. [CrossRef]
81. Wu, J. Linking landscape, land system and design approaches to achieve sustainability. *J. Land Use Sci.* **2019**, *14*, 173–179. [CrossRef]
82. Zoomers, A. Globalisation and the foreignisation of space: Seven processes driving the current global land grab. *J. Peasant Stud.* **2010**, *37*, 429–447. [CrossRef]

83. Bren d'Amour, C.; Reitsma, F.; Baiocchi, G.; Barthel, S.; Güneralp, B.; Erb, K.H.; Haberl, H.; Creutzig, F.; Seto, K.C. Future urban land expansion and implications for global croplands. *Proc. Natl. Acad. Sci. USA* **2017**, *114*, 8939–8944. Available online: https://www.pnas.org/content/pnas/114/34/8939.full.pdf (accessed on 3 May 2020). [CrossRef]
84. The Future of Food and Farming: Challenges and choices for global sustainability. Foresight. Final Project. Report. The Government Office for Science, London. 2011. Available online: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/288329/11-546-future-of-food-and-farming-report.pdf (accessed on 3 May 2020).
85. Guastella, G.; Pareglio, S. Sustainable Development of Rural Areas: Using Urban Patterns to Map the Agricultural Systems. *Agric. Agric. Sci. Procedia* **2016**, *8*, 88–98. Available online: https://reader.elsevier.com/reader/sd/pii/S2210784316300122?token= (accessed on 3 May 2020). [CrossRef]
86. Wadduwage, S. Peri-urban agricultural land vulnerability due to urban sprawl—A multi-criteria spatially-explicit scenario analysis. *J. Land Use Sci.* **2018**, *13*, 358–374. [CrossRef]
87. Neimark, B.; Toulmin, C.; Batterbury, S. Peri-urban land grabbing? dilemmas of formalising tenure and land acquisitions around the cities of Bamako and Ségou, Mali. *J. Land Use Sci.* **2018**, *13*, 319–324. [CrossRef]
88. Sipilova, V.; Ostrovska, I.; Jermolajeva, E.; Aleksejeva, L.; OLehnovics, D. Evaluation of Sustainable Development in Rural Territories in Latgale Region (Latvia) by Using the Conception of Smart Specialization. *J. Teach. Educ. Sustain.* **2017**, *19*, 82–105. [CrossRef]
89. Stukach, V.F.; Saparova, G.K.; Sultanova, G.T. Infrastructure of Agriculture of Kazakhstan: Dynamics of Agricultural Production, Interaction of Industrial and Social Spheres. MPRA Paper 96291. 20p. Available online: https://mpra.ub.uni-muenchen.de/96291/1/MPRA_paper_96291.pdf (accessed on 3 May 2020).
90. Russell, A.; Ghalaieny, M.; Gazdiyeva, B.; Zhumabayeva, S.; Kurmanbayeva, A.; Akhmetov, K.K.; Mukanov, Y.; McCann, M.; Ali, M.; Tucker, A.; et al. A Spatial Survey of Environmental Indicators for Kazakhstan: An Examination of Current Conditions and Future Needs. Review. *Int. J. Environ. Res.* **2018**, 14p. [CrossRef]
91. Tokbergenova, A.; Kiyassova, L.; Kairova, S. Sustainable Development Agriculture in the Republic of Kazakhstan. Review. *Pol. J. Environ. Stud.* **2018**, *27*, 1923–1933. [CrossRef]
92. Tasmaganbetov, A.B.; Abayev, A.A.; Rahmanova, A.S.; Tleukabylova, K.B. Theoretical and methodlogical bases of assessment of sustainable development of rural areas. *Ser. Econ.* **2019**, *4*, 8p. Available online: http://rep.ksu.kz/bitstream/handle/data/9323/%d0%ad%d0%ba-2019-4-67-74.pdf?sequence=1&isAllowed=y (accessed on 3 May 2020).
93. Lescheva, M.G.; Ivolga, A.G.; Labenko, O.M. Special methodological aspects of economic analysis for rural territories development. *Actual Probl. Econ.* **2014**, *159*, 432–439.
94. Kusakina, O.N.; Dykan, Y.A. Methodology for assessing the sustainable development of rural areas. *Fundam. Res.* **2015**, 748–752. Available online: https://www.fundamental-research.ru/ru/article/view?id=38335 (accessed on 3 May 2020). (In Russia)
95. Merenkova, I.N.; Medkov, A.N. Formation of the mechanism of sustainable development of rural areas on the basis of their overall assessment. *FES Financ. Econ. Strategy* **2011**, *5*, 53–57.
96. Analysis and Forecast of Parameters of Transition to Sustainable Development. Available online: http://bibliotekar.kz/istorija-kazahstana-za-11-klass-hrestoma/1-2-analiz-i-prognoz-parametrov-perehoda.html (accessed on 3 May 2020). (In Russia)
97. Maksimov, M. Kazakhstan in 2020–2024: Three Scenarios. Available online: https://www.zakon.kz/4989348-kazahstan-v-2020-2024-gody-tri.html (accessed on 3 May 2020). (In Russia)
98. Forecast of Socio-Economic Development for 2020–2024. 27 August 2019. Official Information Resource of the Prime Minister of the Republic of Kazakhstan. Available online: https://primeminister.kz/ru/news/prognoz-socialno-ekonomicheskogo-razvitiya-na-2020-2024-gody-vvp-na-dushu-naseleniya-uvelichitsya-do-14-3-tyshttps://primeminister.kz/ru/news/prognoz-socialno-ekonomicheskogo-razvitiya-na-2020-2024-gody-vvp-na-dushu-naseleniya-uvelichitsya-do-14-3-tys (accessed on 3 May 2020). (In Russia)
99. Analysts Forecast a Drop in Oil Prices to $ 5–10 per Barrel. 20 March 2020. Available online: https://zonakz.net/2020/03/20/analitiki-prognoziruyut-padenie-ceny-na-neft-do-5-10-za-barr/ (accessed on 3 May 2020). (In Russia)
100. An Epidemic of the COVID-19 Virus Can Lead to a Recession. Available online: https://news.un.org/ru/story/2020/03/1374011 (accessed on 3 May 2020). (In Russia)

101. The Forecast of Socio-Economic Development of Kazakhstan Will be Reviewed. 13 March 2020. Available online: https://kapital.kz/economic/85397/prognoz-sotsial-no-ekonomicheskogo-razvitiya-kazakhstana-peresmotryat.html (accessed on 3 May 2020). (In Russia)
102. Forecast of the Long-Term Socio-Economic Development of the Russian Federation for the Period Until 2030. Available online: http://www.consultant.ru/document/cons_doc_LAW_144190/ (accessed on 3 May 2020). (In Russia)
103. Prospects for Economic Development in Central Asia. ADB Forecast. Available online: http://cc-sauran.kz/rubriki/economika/233-perspektivy-ekonomicheskogo-razvitiya-v-centralnoy-azii-prognoz-abr.html (accessed on 3 May 2020). (In Russia)
104. Sustainable Development Index. Available online: https://www.sustainabledevelopmentindex.org/time-series (accessed on 3 May 2020).
105. Castanho, R.A.; Naranjo Gómez, J.M.; Kurowska-Pysz, J. Assessing Land Use Changes in Polish Territories: Patterns, Directions and Socioeconomic Impacts on Territorial Management. *Sustainability* **2019**, *11*, 1354. [CrossRef]

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Article

Agroecological Entrepreneurship, Public Support, and Sustainable Development: The Case of Rural Yucatan (Mexico)

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Abstract: This paper offers an approach to Yucatecan social reality in terms of entrepreneurship and the process of creating companies dedicated to the production and/or commercialization of agroecological products, considering its contribution to sustainable rural development. The key actors' perspective towards the existence of policies that favor land sustainability, assist in the development of rural areas and their population, and support these business initiatives is also presented. Likewise, it illustrates the small entrepreneurs' standpoint on the role of public institutions in promoting wealth generation and sustainable development in lower growth areas, such as the state of Yucatan, in Mexico. A qualitative methodology was used for this research, based on in-depth interviews with a group of businessmen and -women from the region. The main results give a pessimistic view of institutional concern regarding both production and consumption of agroecological products and, therefore, the promotion of these enterprises for the socioeconomic development of Yucatan. From these findings, we detect: (a) A policy of scarce support for this type of production, due to political priorities; (b) inadequate management that prevents the consolidation of certain structures needed to support agroecological enterprises; (c) a lack of confidence in the Yucatecan government, which does not promote or support a social network of collaboration between agroecological producers and marketers; (d) a difficulty in undertaking agroecological enterprises because of social and cultural norms and poor environmental awareness among the population; (e) significant training deficiencies among entrepreneurs in agroecological agriculture; (f) absence of adequate distribution channels for agroecological products; and (g) excessive bureaucratic obstacles through laws that hinder entrepreneurial processes.

Keywords: entrepreneurship; agroecological production; sustainable development; public institutions; rurality

1. Introduction

In order to combat the decreasing population of rural areas, it is of considerable importance that public institutions encourage entrepreneurial initiatives that generate wealth and employment in a sustainable manner. Such measures would prevent the depletion and degradation of these areas and contribute to the development of the territories in accordance with their natural resources and biodiversity [1,2].

The neoliberal economical model has caused enormous damage to the planet. Governments in rural areas are faced with the dilemma of either maintaining the current paradigm or transitioning to a new one based on a notion known by multiple names: Organic, biological, ecological, or biodynamic agriculture [3].

Since its emergence in the early 1980s, the concept of agroecology has evolved both in approach and analysis. In its beginnings, this term referred to "the application of ecological concepts and principles to the design and management of sustainable agroecosystems, or the science of sustainable agriculture" [4] (p. 599), encouraging farmers to substitute the inputs and practices of conventional industrial farming and move towards certifiable organic production systems. By the end of the 1990s agroecology was conceived as a way of building relationship-based market systems that are equitable, fair, and accessible for all, focusing on political economy: "The approach is grounded in ecological thinking where a holistic, systems-level understanding of food system sustainability is required" [4] (p. 599). Today, agroecology is both a new discipline and a practice "seeking to develop food and fiber production in a sustainable manner. At the same time, it is a broader social movement integrating politically the social actors who promote institutional and social changes towards sustainable agriculture" [5] (p. 485). The aforementioned paradigm shift implies, for national governments and public institutions, a transformation in perception of the countryside and its inhabitants. This transformation must be manifested in the promotion of agroecological entrepreneurial initiatives that contribute to sustainable territorial development.

This document presents the results of a study on entrepreneurial initiatives in the agroecological sector of the Mexican state of Yucatan. These initiatives function as a sustainable development option for entrepreneurs by contributing to the preservation of their lands, the improvement of their quality of life, and the adoption of a natural and healthy food culture.

In Yucatan, agroecological products are those derived from chemical-free agriculture and farming, that is, natural products subjected to a natural production process that respects the cycles and elements provided by nature [6]. This type of merchandise could include both those with and without organic qualifications. It is pertinent to mention this since only a portion of the agroecological produce is certified as organic by the Mexican government's Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA). The "Organico SAGARPA México" seal is the accreditation granted to products that meet quality, health, and food safety guidelines; it also guarantees consumers that the Mexican standards established in the Organic Products Law have been complied with [7].

The role of institutions is fundamental, not only in the economic aspect by implementing policies to promote this type of entrepreneurial projects, but also in the educational and social aspect by generating awareness among the population that sustainable development implies the moderate and rational exploitation of natural resources, taking care to preserve them for future generations.

Mexico's agroecology sector has experienced dynamic growth since 1996 (the organic surface area, the number of producers, and the foreign exchange generated have grown at an annual rate of over 25% concentrated in the Mexican states of Oaxaca and Chiapas, the poorest in the country). However, organic agriculture in the country has only developed due to the efforts of the producers themselves [3]. The meagre support of official institutions, a condition known as "institutional inertia" or inability to assimilate change, which also occurs in the state of Yucatan, is particularly noteworthy [8]. Despite the existence of a robust legal framework in Mexico on this matter, laws have not translated into sufficient institutional support [9]. The small-farming systems deal with "technical problems such as pests and disease as well as the lack of markets and opportunities for commercialization ... there is also evidence of failures by the government in terms of the lack of public policy and programs geared toward promoting and incentivizing the use of these agroecological systems" [10] (p. 342).

The objectives of this study focus on ascertaining the existence of effective support for agroecological production by public institutions at a national level in Mexico, but, mainly, in the state of Yucatan. In this sense, we were keen to learn our witnesses' opinion regarding: (a) The existence of government policies that favor this sort of production, or, on the contrary, if there are many bureaucratic or legal obstacles for the regulation of these activities; (b) social and cultural norms embedded in the population to benefit such initiatives; (c) whether the entrepreneurs' training is sufficient for the development of this type of business, and the main training deficiencies of the producers; (d) the presence of production, distribution, and sale channels; (e) their promotion through public institutions; and (f) the population's income and environmental awareness as elements that facilitate and enable these activities.

Based on this introduction, this article is structured in five further sections: Section 2, a theoretical framework on agroecological entrepreneurship and production that refers to: The entrepreneurial process, the role of public institutions in this process, the consideration of elements which favor agroecological entrepreneurship (the training of entrepreneurs, the population's income, and environmental awareness) and, finally, agroecological production and the Slow Food market in Yucatan. Next, Section 3 presents the materials and methods used in the study, explaining the geographical context in which the research has been developed and the methodology that has been applied. Section 4 presents the results obtained from the subjects who have been studied. Section 5 provides a discussion of the results obtained; and, finally, Section 6 describes the conclusions reached and sets out the limitations of the study, as well as future lines of research that could be established.

2. Entrepreneurship and Agroecological Production

2.1. Entrepreneurship and the Business Creation Process

In view of the consequences of globalization, in Yucatan, as in many regions of the world, there is an increasingly important movement that strives for the preservation of the environment from a perspective of sustainable local development. Consumers now respond to different visions of politics and consumption, culture and economy [11]. Thus, nowadays the revival of varieties of plants and foods threatened by agricultural standardization resulting from the extensive use of conventional practices [12] has gained popularity amongst consumers who reject the assimilation of intensive agriculture due to its negative impact on society and the environment [13]. From the perspective of New Institutionalism (NI) based on social actors [14–17], the aforesaid situation has led to the creation of a new institutional field [18], a concept based on Dimaggio and Powell, who described a set of "organizations that, in the aggregate, constitute a recognized area of institutional life: key suppliers, resource and product consumers, regulatory agencies and other organizations that produce similar services and products" [19] (p. 148). The Slow Food movement is positioned in such an institutional field as a result of the incorporation of new actors and the creation of an extended collective identity. Now, it includes not only gastronomes, but also social justice activists and environmentalists [18]. Within this context, there is a movement among local entrepreneurs who have incorporated this vision of sustainability, i.e., agroecological products, into their productive processes.

Entrepreneurship implies the entrepreneur's vision, the creation of new economic opportunities and the introduction of their ideas into the market, facing uncertainty and taking decisions related to the location, form, and use of resources and institutions [20] (p. 18).

Although entrepreneurs are usually studied in a business context, several of their theoretical principles such as networks, resource mobilization, business representation are also valid for other kinds of organizations [21], for example, in the areas of education, culture, and agroecology. Specialized literature distinguishes between traditional business-related entrepreneurship and social entrepreneurship [22]. The latter is characterized by a concern for aspects that go beyond private profit, mobilizing resources in areas with low productivity to strengthen the economy through job creation for local residents [22,23], and also to preserve the environment.

Regardless of the entrepreneur's orientation (traditional or social), the result of their initiatives tends to crystalize into the creation of a company. This process is a complex phenomenon, contextualized around specific moments and environments in which social, cultural, and economic factors interact [21,24–27].

Following the above, Kantis et al. [27] defined three stages in the company creation process: The *project gestation*, the *set-up*, and the *initial development of the firm*. In each of these phases, certain main factors that affect the critical events of the said phases can be identified, all of which are shown in Figure 1.

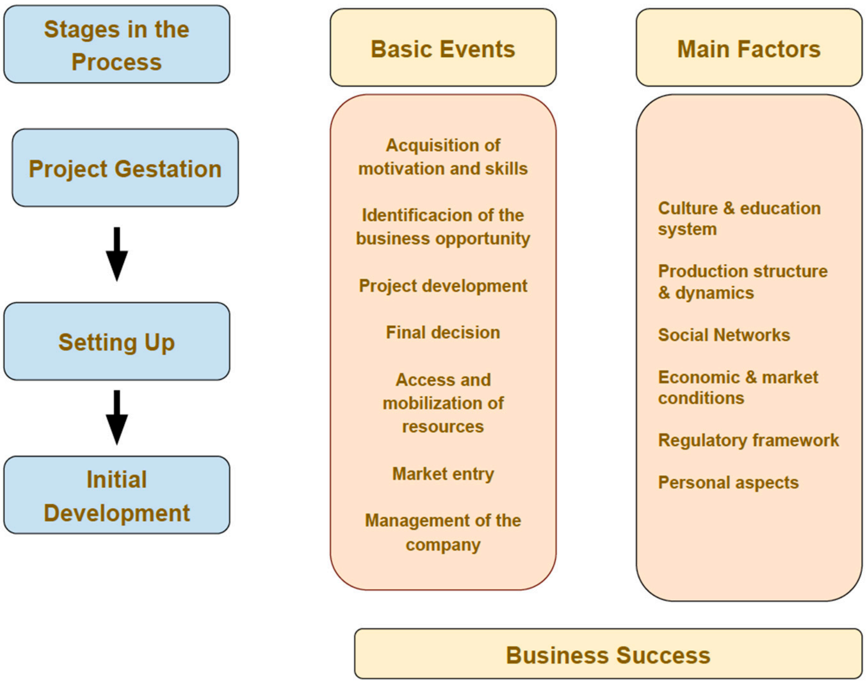

Figure 1. Entrepreneurial process. Source: Partially adapted from [27].

The growth of small successful businesses into large-sized organizations implies several administrative and organizational adjustments for their creators [28]. Their ability to face these adjustments is crucial to the survival and success of their companies.

2.2. The Role of Public Institutions in Entrepreneurship

For agroecological enterprises to become a clear and solid reality, they require a series of conditions and factors that enable them to do so. Knowing that the public administrations' relationships with, and support for entrepreneurial projects can be identified as one of the said major factors, it is vital to address the following question: Which significant aspects should prevail in their promotion of entrepreneurship? (i) transparency, trust, and institutional responsibility; (ii) support for entrepreneurial leadership, especially female leadership; and (iii) technological commitment.

First and foremost, relations with public administrations should be based on transparency and trust [29]; they should be directed towards providing essential support to micro-enterprises so that they get to be implemented. A study conducted by Ramírez et al. [30] in Mexico showed that when the government generates support structures by investing, funding, and training in this type of business, the results, even in cases of extreme vulnerability, are overwhelmingly positive. In addition, these highly profitable social projects contribute to alleviating poverty even if maximum levels of competitiveness are not achieved. Nevertheless, in reality this support does not occur exactly as described above. There are diverse political priorities and management gaps that prevent the consolidation of precise entrepreneurship support structures (co-working spaces, soft micro-credits, tax facilities, and exemptions, etc.).

Furthermore, public institutions should potentialize female entrepreneurial leadership, given that it effectively responds to the demands of competitive and rigorous environments that require perseverance, effort, a certain degree of pragmatism, and ultimately unity [31]. Although this leadership ideal should be contingent on socioeconomic situations and contexts, the fact is that women respond more and better, as has been demonstrated in recent studies oriented towards the institutionalization of female entrepreneurship [32].

Finally, technological incorporation allows the local/rural entrepreneurial processes not only to have access to structural economic support, but also to become the center of a global perspective, thanks to the existence of social media. For this purpose, the role of public administrations is still crucial to supplying the indispensable infrastructures that facilitate online interconnections. New unexplored paths are opening up in the rural sphere. It might even be possible to overcome the rural-urban dichotomy that constantly emerges in connection with certain weaknesses and deficiencies made explicit by the inhabitants. Taking advantage of technology requires institutional support, education, and training of the population, as well as essential attitudinal changes so that individual action is oriented towards collectivity and its benefits are evident. Considering new consumption habits, new forms of leisure, and methods of selling and buying, there are experiences in this area which demonstrate that agricultural and livestock producers can be geolocated through mobile telephony (see Figure 2). Thus, producers who can promote their products, their retail outlets, and surroundings are identified and localized [33].

Figure 2. Luraki APP. Source: [33].

2.3. *Entrepreneur Training, the Population's Income, and Environmental Awareness as Elements that Favor Agroecological Entrepreneurship*

Entrepreneur *training* is directly associated with the factors and conditions enabled by public administrations in agroecological entrepreneurship projects. Moreover, the modernization of globalized economies and their labor markets allows the acquisition of wealth, which determines the different *incomes of the population*. It is this population which finds in the transformation processes of the agri-food system the option to choose natural products from organic farming over products derived from modern industrial agriculture. The public institutions that promote the industrial or ecological agriculture sector [34] and those consumers who decide to buy agroecological products play a very important role in this alternative.

The disjunctive between industrial agriculture and ecological agriculture opens two pathways for entrepreneurial training. A first training, related to traditional agriculture, incorporates processes that need large areas, sophisticated machinery, and the utilization of chemical products (synthetic fertilizers and chemicals). It implies some environmental impact (especially pollution of soil, aquifers, and water resources) besides the devastating effects on living beings such as the decline of bee populations [35]. However, a second training scheme, linked to ecological agriculture, must incorporate traditional techniques that, by definition, do not include chemical products. This training is complemented and enriched by a variety of studies in Good Agricultural Practices, Masters degrees in the Organization and Control of Cultivation Operations and in Cultivation Techniques, Masters in Agri-food Biotechnology, Agricultural Engineering and Agri-food, and the use of ICTs and modern marketing techniques.

Certainly, *environmental awareness*, among both entrepreneurs and the general population, has a favorable influence on agroecological entrepreneurship. It encourages the adoption of conscious food consumption habits (related to questions of how much, how, when, and where). It also influences concerns regarding distancing from traditional diets and good health, problems related to food abundance and globalization—studied by the Sociology of Food—[36] and rural gastronomic tourism, which promotes local culture and proposes the experiential component of food as a tourist product, and indeed the main attraction of a destination [37] (p. 175).

Definitely, this environmental awareness was progressively established as the liberal economic model changed to a new cyclical model of nature. In this new model, a green and circular economy with eco-intelligent mobility, an endogenous development, a sustainable management, a sustainable touristic product, and the fight against climate change took center stage [38–42].

In its report "The new Rural Paradigm: Politics and Governance" [43], the OECD seeks to explain the paradigm shift in implemented rural development policies. It takes into account the diversity of rural regions, their problems (migration, ageing, deterioration of skills, decline in labor productivity), as well as the exploitation of available opportunities and assets. In the context of this paradigmatic change, agroecological entrepreneurs tirelessly promote and develop their projects.

2.4. Agroecological Production and the Slow Food Market in Yucatan

In Yucatan, traditional agricultural activities such as the *milpa* and beekeeping are sustainable development strategies that have allowed the preservation of a portion of the region's forests. For this reason, it is still possible to find Mayan biocultural heritage, where production practices reflect traditional knowledge and belief systems that revolve around agroecology [44]. This is not the case in other areas of Mexico, where extensive cattle farming, and commercial crops have replaced them, eroding this patrimony and generating social conflicts as a result of globalization and neoliberal markets.

Specifically, the agricultural system of the milpa is based on polyculture: Combining corn, sweet potato, pumpkin, and various types of legumes. In Yucatan one third of the land is still dedicated to the milpa [45].

However, the sustainability of the milpa system is threatened by the shortening of fallow periods and the ever-decreasing diversity of crops integrated into the system.

The lack of interest and support from public institutions means that most of the public policies applied to the rural sector have contributed to aggravating the environmental and socioeconomic problem of the Mayan milpa. The solutions that have been implemented to modernize the milpa system have been exogenous and poorly adapted to local conditions in the area, such as the use of chemical fertilizers and hybrid corn seeds [45].

In this context of socio-environmental conflict in Yucatan, movements and support networks have emerged to vindicate agroecological models and traditional sustainable production practices.

At the same time, following the international *Slow Food* movement that emerged in Italy in 1986, the Mexican state of Yucatan saw the birth of *Slow Food Yucatan*, which promotes local food production, the preservation of rich regional culinary traditions, and healthy eating. This, in turn, provides economic benefits for local producers and health benefits for consumers of these types of products.

The *Slow Food* organization is located in 130 countries across five continents and is recognized by the Food and Agriculture Organization (FAO) as a non-profit organization [46].

Slow Food's "Earth Markets" project consists of bringing together markets around the globe that offer healthy, quality food at a fair price, through direct contact with consumers, and guaranteeing environmentally sustainable methods [47]. Today there are 57 markets in 17 countries.

Established in 2010 by the *Slow Food Yucatan Convivium* in Mexico, the Earth Market "Mercado Fresco" is held every Wednesday and Saturday in the Plaza Colón, a small square in Merida, the state capital.

The Market has been included in "*Slow* Yucatán: Development of a good, clean and fair food system, based on the sustainability model of the international project *Slow Food Movement*", funded by the W.K. Kellogg Foundation (WKKF). One of the objectives will be to use *Slow Food* Earth Markets to consolidate networks of local producers through the marketing of their products.

In this sense, the *Slow Food* movement could play an important part in Yucatan by acting as a nexus for the exchange of experiences among agroecological producers. The "Mercado Fresco" is not a conventional market. It is linked to the slow and healthy food movement and its participants must abide by increasingly strict guidelines not only for their own benefit and that of their consumers, but also for the sake of achieving greater visibility for these microenterprises, since for some of them this market is their only distribution channel.

Just over fifty food producers participate in this market. Most of them are Mexican, but there are also Italian, French, American, German, Chilean, and Brazilian entrepreneurs who have chosen to settle in Merida because of its quality of life. Fifty percent of the entrepreneurs are dedicated to primary activities: They produce eggs, milk, vegetables, etc., and the other half are processors because they cook their products. The market offers fruits and vegetables (spinach, lettuce, bananas, tropical fruits, pumpkins, carrots), pork, and sausage from a hairless pig (a local breed of pigs), dried meat, quail, eggs, butter, goat cheese, confectionery and baked goods, fruit juices, preserves, coconut milk, etc. Traditional local dishes are also for sale, as well as Korean, German, Italian, and Arabic specialties prepared by members of immigrant communities.

Thanks to the great variety of food products on offer, the market attracts many visitors, including chefs and students of gastronomy. The *Slow Food Yucatan Convivium* organizes various workshops for members of the public interested in subjects such as cheese production with raw milk, making bread with natural yeast, the principles of organic agriculture, etc.

The subjects interviewed in this research are entrepreneurs who participate in Yucatan's "Mercado Fresco" Earth Market.

3. Materials and Methods

3.1. The Study's Geographical Context

The study was carried out in the state of Yucatan. Yucatan is one of the 32 federal entities that constitute the Mexican Republic. The specific case study area is Merida, the state's most populated city, and its capital. While the commercial center is located in Merida, where entrepreneurs market and distribute much of their produce, in large part, most of the agroecological enterprises (farms, especially agricultural and livestock) are located in small municipalities located around the capital (see Figure 3).

The state is located in the southwest of the country, on the peninsula of the same name, which also includes the states of Campeche and Quintana Roo. Yucatan consists of seven regions: West, Northwest (where Merida is located), Center, Central littoral, Northeast, East and South, with a total of 106 municipalities altogether.

Figure 3. Geographical location of the State of Yucatan (Mexico) and main municipalities. Source: https://www.mapade.org/yucatan.html.

3.2. *Applied Methodology*

The methodology applied in the design of this research consisted of conducting semi-structured interviews with Yucatecan entrepreneurs in the agroecological production sector. The results have been processed through a content analysis of the transcripts of these interviews (coding, categorization, thematization). The study of these texts was hermeneutical in character as well as interpretative-comprehensive [48]. This places us in a different situation compared to the observed social reality, considering latent meanings and freely expressed subjectivities. In parallel, a quantification of the responses was carried out to observe certain social trends within the group of entrepreneurs interviewed. This qualitative research has great importance due to the peculiarity and value of the informants' contributions, as well as the free and spontaneous manifestation of their opinions, which leads to a methodological induction that enriches the research topic.

The sample was selected based on convenience, targeting those agroecological entrepreneurs who attended the *Slow Food* Market in the capital of Yucatan on a weekly basis to exhibit and sell their products—some of which were organic—and expressed their willingness to collaborate in this research. The sample consisted of twenty people and was distributed as follows: Nine male and eleven female entrepreneurs, with the majority of the enterprises being led by women. The geographical area where the fieldwork was done was the state of Yucatan, specifically, in Merida and other nearby municipalities. The interviews were conducted between March and April of 2017 in a personalized manner, through audio recording, and annotating of the relevant aspects for the research.

The interview script addressed thematic issues regarding entrepreneurship initiatives in local agroecological production in the main municipalities of Yucatan. Questions were asked about such aspects as:

- Entrepreneurs' opinion on the existence of a government policy of effective support for ecological production and consumption, as well as on governmental promotion and support for collaboration amongst ecological companies in the agro-livestock sector.
- Their opinion about Yucatecan society concerning whether the social and cultural norms that guide their habits and traditions favor this type of business initiative, both in terms of agroecological consumption and production.

- Entrepreneurs' perception concerning whether their own training is sufficient for this type of agroecological enterprise and the subjects in which the main training deficiencies can be noticed.
- Entrepreneurs' knowledge of the existence of adequate distribution channels for agroecological products.
- Entrepreneurs' perception regarding the population's income as a key factor in favoring the consumption of agroecological and/or organic products.
- Their viewpoint on the population's environmental awareness as a promoter of agroecological and/or organic product consumption.
- Their opinion on the detection of bureaucratic obstacles to the creation of this type of business.
- Their opinion on whether legislation favors the entrepreneurship of agroecological companies and the initiation of young people into this type of enterprise.
- Their knowledge of the frequency with which events are organized (fairs, exhibitions, etc.) by public institutions, considering them as support mechanisms for agroecological entrepreneurs to advertise their products and boost their selling possibilities and market penetration.

The set of variables considered relevant for the investigation (Figure 4), based on which the microentrepreneur sample was obtained, are the following:

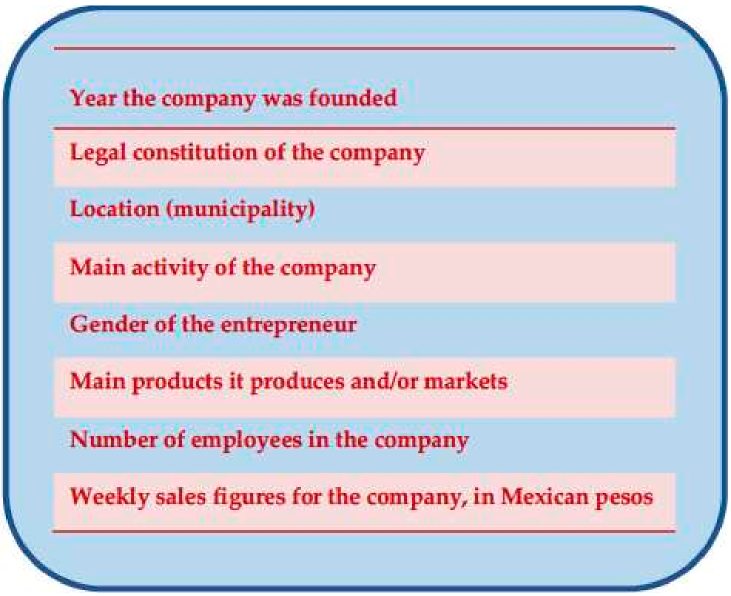

Figure 4. Selection of variables used in the study. Source: Own elaboration.

The main characteristics of the entrepreneurs interviewed are summarized in Appendix A.

4. Results

4.1. Factors Which Generate Obstacles and/or Support for the Production and Consumption of Agroecological Products

The research question is: What have been the effects of public policies on the development of agroecological production in the Yucatecan market? Specifically, it is about trying to determine if the public administration and the national and state governments in Mexico, but fundamentally in the state of Yucatan, really and effectively support the production and consumption of agroecological products.

4.1.1. Existence of an Effective Government Policy to Support Agroecological Production and Consumption

About 60% of informants state that there is a policy of little or some support for this type of production [I20: *"Some, and that's it. There isn't an office, as such, that is organized like in Chiapas"*; I7: *"There's some support ... it just doesn't reach the real people"*; I11: *"Some support, but I don't think it's in the* *government's interest"*]. In this sense it can be deduced, as Ramírez et al. [30] pointed out, that there are other political priorities as well as inadequate administration that impede the consolidation of certain structures that are needed to support the ventures, and that the informants notice their lack.

On the other hand, 40% strongly deny that there is any effective governmental support [I2: *"No, write 'double No'"*; I5: *"It doesn't exist...these plans stay on paper, nothing else"*].

If we look at the theory of New Institutionalism (NI) based on social actors [14–17], discussed above, and at the creation of a new institutional field, mentioned by authors such as Van Bommel and Spicer [18] and Dimaggio and Powell [19], it highlights the creation of a collective identity (producers and consumers) around the development of social enterprises [22,23]. Unfortunately, according to the entrepreneurs interviewed, public policies to support this type of enterprise have not yet been implemented.

4.1.2. Promotion and Governmental Support for Collaboration Between Ecological Companies in the Agro-Livestock Sector

In relation to this issue, the consensus (65%) of the interviewees is that the government of the state of Yucatan does not have a policy to promote and support the social network of the agroecological producers/marketers. Therefore, it is unable to encourage collaboration between these companies. As Schwentesius et al. [3] asserted, agroecology in Mexico has developed fundamentally through the effort of the producers themselves. In view of this dynamic, the public administration's failure to provide support due to its inability to assimilate the changes (*institutional inertia*) has become evident [8]. In this regard, some of the informants' comments confirm these facts:

> I6: *"Yes, they have it; no, they don't apply it. We'll have gone to two or three fairs where the municipal president congratulates us … and walks away".*
>
> I12: *"In fact, there was a desire to organize the organic production system … There are intentions, but nothing's consolidated yet".*
>
> I19: *"I've been here for 6 years, and I've never been invited to an ecological producers' meeting; from my perspective, I don't think that promotion policy exists".*

From these statements, one can observe the lack of confidence in relations with public administrations, especially when it comes to providing entrepreneurs in this sector with the essential and necessary support for collaboration and coworking among themselves, as Sanagustín-Fons and Brunet-Icart [29] indicated.

4.1.3. Do Yucatecan Social and Cultural Norms Favor Agroecological Enterprises and Consumption?

It is also interesting to understand what the small entrepreneurs think about Yucatecan society, in order to evaluate if the social and cultural norms that guide their habits and traditions do favor this type of initiative. In this sense, the panorama presented by their opinions is quite pessimistic, since 60% of them argue that they do not favor them "at all" and 30% believe that social norms favor them "somewhat", both in organic consumption and production.

> I1: *"What I have modified, as a social or cultural norm is saying that it's Yucatecan production … promoting local consumption. 5 years ago, I was in an association called 'Merida Verde' … and I worked in the area of responsible consumption in schools, and the answer was that it's very expensive, I'm not going to stop eating a pork sandwich because you tell me that it harms me … ".*
>
> I3: *"No, no, no. Not at all … At least 90% of the production involves agrochemicals. And a very small fraction of it is organic, and it's the same for the population … My son just came from Europe. He was working there, and he came back. … yesterday he said: 'we're having salad', and I said: 'hey where are my beans and my tortillas?' He said that there were some for me, but for them, just natural stuff … ".*

The above demonstrates the way in which Yucatecan habits and traditions represent a huge obstacle to incorporating different food consumption habits based on an awareness of how, how much, when and where we consume. In turn, this results in nearly non-existent concern for the abandonment of traditional and healthy diets. As argued by Díaz Méndez and Gómez Benito [36], together with the great influence of fast and unhealthy food advertising, these issues (that are and have been the subject of study in the Sociology of Food) de facto greatly hinder the development of agroecological entrepreneurial initiatives.

On the other hand, tourist development linked to local gastronomy (based on an appreciation of each region's cultural assets) can be an encouraging factor. This implies the dissemination of culinary traditions, identifying the experiential component of the food as a tourist product and as the principal attraction of a destination [37].

4.1.4. Entrepreneurs' Self-Evaluation of Their Agroecological Entrepreneurial Training and the Areas in Which They Detect Greatest Training Deficiencies

As argued by Kantis et al. [27], the development of skills or competencies is a crucial activity for the entrepreneur in the gestation stage of the project (see Figure 1). When analyzing the production and marketing training of entrepreneurs for these agroecological initiatives, it is significant to consider that when they self-evaluate, or assess fellow entrepreneurs in the Yucatecan sector, 80% of them admit that their training is insufficient and that there are many deficiencies in different aspects of their training: [I13: *"Mexico had, many many years ago, agroecological production. Now the new generations, with the introduction of agrochemicals and technological packages, no longer have the same training as former producers. SAGARPA (Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food) tells them: 'here's your technological package and we'll support you if, and only if, you buy these agrochemicals from us'. Then, lifelong farmers, they all ... didn't use pesticides ... and what happened? ... the way they worked the land was changed"*; I19: *"In the Faculty of Agronomy you are taught organic agriculture by the same teacher who teaches chemistry, and that they don't have experience producing organics ... "*]. That is, it is confirmed by these declarations that the conditions and factors that public administrations make possible in entrepreneurial projects are associated with the entrepreneurs' formation. Therefore, if the State further encourages aids for agrochemical production, evidently most entrepreneurs will educate themselves in traditional production and will not acquire knowledge in organic production.

Now, regarding the areas in which the main formative deficiencies are detected, it is evident that there is a generalized problem among the agroecological producers of the area, since they pointed out deficits in all of the issues contemplated in this research. As previously noted [35], this training is linked to ecological agriculture and at the same time, is enriched with the use of ICTs and modern marketing techniques and studies on Good Agricultural Practices, along with training in Agri-food Biotechnology, Agricultural Engineering, Agri-food, Organization and Control of Crop Operations and in Crop Techniques. According to the producers', their least developed training area is ICT Management and Handling Techniques (80%), followed by Marketing Techniques (75%), and lastly, knowledge about Producer Support Programs (70%). Only slightly more than half of the interviewees (55%) referred to a lack of knowledge in Production Techniques. Their interesting statements testify as follows:

> I12: *"As far as production techniques are concerned ... most of the current producers only know how to mix agrochemicals... They lack knowledge in informational techniques; although currently, many are supported by their children. I believe that the producer, as such, does not use them much: email, social networks, etc. I think they also lack knowledge about the support channels for the producer and this is an important issue. Because they are more reactive than proactive ... ".*

> I10: *"They lack knowledge about the support channels for producers and ... this would be due to a lack of infrastructure, sometimes the network crashes and makes it very difficult for them to access these channels".*

I14: *"I've occasionally heard of support calls launched by the government and then . . . they don't know where to go or where they can request it"*.

I19: *"In terms of knowledge about support channels for producers . . . I lack information and I guess the rest of us do too"*.

After examining the above statements, the absence of government support is corroborated by: (a) The aforementioned "institutional inertia" when faced with applying strategies that, far from favoring, worsen the environmental and socioeconomic problems of traditional agricultural techniques such as the Mayan milpa in the rural sector [45]; and (b) insufficient transparency in informing producers about possible aid for their agroecological ventures [29].

4.1.5. On the Existence or Lack of Adequate Distribution Channels for Agroecological Products

Kantis et al. [27] emphasized that market entry is a key aspect for entrepreneurs in the initial stages of their projects (see Figure 1), which implies identifying distribution channels for their products. Astier et al. [10] indicated that, in Mexico, the small-farming systems deal with the lack of markets and opportunities for commercialization. In this sense, the issue with distribution channels for this type of product was found to be more serious in urban areas, with the exception of large cities such as the capital of the country. In light of the data provided by the informants, in small cities such as Merida there are no organically specialized supermarkets, just a few stores. This, in addition to the low demand for agroecological produce makes it impossible to cover large volumes of products, which in turn makes it difficult for producers to supply these products to the entire population. In this regard, 60% of our informants think that the distribution channels of agroecological products are inadequate [I12: *"Most of the organic production will be able to develop more in the rural area, but how do you get the products into the city? Sometimes it has happened to me that . . . I have to send the product by bus and not everyone is willing to absorb the cost of transportation; and then the distribution . . . "*; I13: *" . . . only in the big cities are there organic 'supers'... In the southeast there aren't proper channels"*; I15: *"As there isn't enough demand, few channels remain, and two or three other stores have the same as I do . . . "*; I18: *"No, because the channels are too closed . . . So, everything ecological and organic is . . . labeled as expensive"*; I19: *"There are very few stores and they aren't well prepared to receive these products (refrigeration systems, etc.)"*].

On the other hand, 35% of the interviewees think that there are adequate distribution channels, although some of them point to the fact that despite being adequate, they are insufficient [I3: *"Well, they are few, let's say adequate, perhaps, but insufficient . . . "*; I8: *"The Slow Food market is the only one. There are very few stores and groups that have this kind of products that are big and don't let the little ones in. In my product distribution, most of the sales are direct... I have a Facebook page and there are stores interested in selling my products, but what about the stores?... I give leaflets to the stores, but . . . the employee . . . doesn't care if the product is sold or not. I mean, we have to fight . . . "*; I20: *"I can say that there are channels, but not enough . . . As a consumer, six years ago . . . there were no flea markets, there was nothing, and now . . . I can buy vegetables in this or that market... the movement has already started, but it's not enough yet"*].

4.1.6. Relation between the Population's Income and the Consumption of Agroecological Products

The population's income has also been considered a key factor in furthering the consumption of agroecological products. As Kantis et al. [27] stated, it is related to the identification of business opportunities in the gestation stage of the project (Figure 1). In this regard, the informants believe that income is fundamental for the consumption of these products, especially in the area under study and nearby municipalities. Indeed, national competitiveness has become a central concern, both in advanced and developing countries, particularly in the face of the challenges of an increasingly open and integrated world economy [49]. The modernization of economies and their employment markets are the decisive factors that allow the creation of wealth, which will in turn determine the different incomes of the population. It is important to note this, since it has an impact on the choice, within the processes of change in the agro-alimentary system, between consuming natural products from ecological agriculture, and products from modern industrial agriculture. On this point, a quarter of the interviewees think that in Yucatan the income of the population is rather low and does not favor the said consumption at all, with 70% of the answers leaning towards it being slightly favorable, but not much.

It is pertinent to remember that the population's income varies depending on the specific zone within the study area. This means that the consumption of said goods will develop further in those areas where acquisitive power is higher, rather than in other areas which suffer a much poorer economic level. Moreover, the amount of organic production—which is much lower than the conventional production—increases the price of these products much more, making it difficult for a large part of the population to consume them. For example, a significant consumer sector of the said produce is foreign residents living in the state, who can afford to buy these products more often because of their income, unlike the local population. On this subject, the entrepreneurs corroborate this with their statements:

> I1: *"Merida is divided in two; If we're speaking about the north zone yes, if we talk about the south zone, it is of very low purchasing power".*

> I20: *"I think that some. In Merida, for example, my market is divided a lot into north, south and . . . , People from the north don't pay attention to the price and other things. In my store I try to compare the prices of non-organic products and from those prices my organic products will remain reasonably priced for the majority . . . There are middle class people who can access my products, because they say: 'it's not that different from the normal product and I can pay the extra cost'".*

> I5: *"No, because organic products are expensive, and our level is pretty low. The majority of the public is low-income locals. The people who come here are people who have money or are foreigners with a different cultural level as well".*

However, in some cases entrepreneurs alluded to the existence of sufficient purchasing power to buy these products, which is, however, wasted on the consumption of unnecessary and sometimes unhealthy goods due to a cultural issue:

> I19: *"Yes, but they buy Coca-Cola. I think that the power exists, I mean, you decide what to eat. I'm not a millionaire and I can do it, but, why? Because I don't spend on other things: I don't have Skype, I don't have . . . ".*

4.1.7. Relationship between the Population's Environmental Awareness and Agroecological Product Consumption

Another important indicator would be to know if the environmental awareness of the population also favors the consumption of agroecological products. If that is the case, then logically, as argued by Sassatelli and Davollio [11], and Díaz Méndez and Gómez Benito [36], it would be a favorable factor for agroecological entrepreneurship, for the adoption of different and beneficial food consumption habits, for raising awareness of the abandonment of traditional and healthy diets, as well as for the valorization of local gastronomic tourism. These benefits would be expressed in a new economic model linked to the cycles of nature, where the sustainable management of products is prioritized, turning them into ecological and tourist products while at the same time respecting the environment [41,42]. In fact, more than half of those interviewed conclude that the population's level of environmental awareness favors the consumption of these products slightly, while 30% think that it does not. There is much work to be done in order to create environmental awareness among Yucatecans: Often they consume in imitation of foreigners, not because they really believe in these principles:

> I4: "... Since many locals see that there are foreigners buying here, they say: 'it must be good'... It's more of an imitation..."

> I3: *"It doesn't favor it, but the younger generations are integrating more and more. It's small but growing".*

I19: *"No, they're still cutting down trees. I mean, they're just getting started, but it's 1% of the population"*.

I18: *"A little, nothing more. Because most consumers of this type of product, here in Yucatan, are not Yucatecans, perhaps 30% are, but the vast majority of consumers are foreigners"*.

I20: *"Just a little. It's awake, but we're still missing it. There are people who, out of conscience, do care where the food comes from … and that it is not transgenic"*.

4.1.8. Existence of Bureaucratic Obstacles to the Agroecological Enterprise

Sassatelli and Davollio [11] noted that the lack of institutional support for agroecological companies translates into numerous bureaucratic obstacles faced by small-farming systems, which is confirmed by the testimonies of the interviewees. The vast majority of small entrepreneurs (65%) agree that there are many bureaucratic obstacles in the entrepreneurial process when it comes to creating this type of business (whether they are producers or marketers of agroecological products). These considerations are also an important generator of either obstacles to or support for organic production and consumption, since it is understood that bureaucratic obstacles hinder the creation and development of companies in this sector. Here, we are referring to the transparency and trust that public administrations should demonstrate in order to provide a solid support that generates dynamism in the processes of entrepreneurship [29], while at the same time generating support through funding and training mechanisms [30]. In this regard, entrepreneurs highlight these obstacles:

I4: *"There are obstacles: you need contacts in the government to get that financial facility or to get that loan; not just anyone gets that chance … I've heard that a lady was given the opportunity to put her habanero peppers there and she subleased that land, and she just gets money from another company that's giving its own money"*.

I15: *"I'll give you an example: my husband has a farm where he's planting. It's sustainable land where there's land conservation and planting, and for this there are procedures and more procedures. So, every so often you put in your papers to ask for support, and maybe one year they'll give it to you, but maybe next year, when you've already gathered everything, they will tell you: 'I'm not going to give it to you, because a series of steps weren't fulfilled' … and they hold you back"*.

In other cases, informants state that, rather than government obstacles, there is a lack of interest in and concern for this type of activity, since traditional agrochemical production is more profitable.

I10: *"Well, I'd say that there's no interest, that is, the government doesn't encourage it and that's an obstacle in some way. The government supports big initiatives like a wind farm, but if you say: 'we're going to plant millions of hectares of organic … ', it says: 'ah, well, I don't have any money', right?"*.

I13: *" … just no information, no support for ecological production, no organic culture, no initiative. SAGARPA isn't organized, there's no organic department … "*

4.1.9. The Role of Legislation in the Creation of Agroecological Enterprises

Pulido Secundino and Chapela y Mendoza [9] point out that although in Mexico there exists a robust legal framework for agroecological matters, the existing regulations have not crystallized into the necessary institutional support. This is confirmed by the informants' opinions. The majority of those interviewed (75%) believe that the laws and regulations of Mexico and the state of Yucatan in particular, do not favor the launching of these businesses in any way.

I2: *"Laws facilitate conventional production more, obviously, but the law doesn't say I'm going to provide agrochemicals for the farmers and transgenic seeds … that's politics. It's government policies"*.

I5: *"No. I studied certifications and all that for a while, and I think it gets too complex for anyone"*.

I12: *"Right now legislation is changing, but in the direction of sustainable production policies that avoid deforestation, not so much towards organic production".*

I14: *"No, regulation is only done under pressure from the U.S. So, the only reason why a Mexican official lifts a finger is because of pressure from other countries, because if the FDA had not pushed Mexico to have legislation regarding its products, the domestic product would have stagnated ... so, basically they did it out of necessity ... not out of ecological interest in taking care of our land; they don't care and the only reason they give support ... is because if they don't give the people crumbs, they are going to rise up, and that doesn't suit them".*

4.1.10. Are Young People Encouraged to Pursue Agroecological Entrepreneurship?

Among the factors that generate support or create obstacles to agroecological production, whether or not to promote the initiation of young people in this type of enterprise is a question of special relevance. It has been stated that one of the relevant aspects that should prevail in the promotion of entrepreneurship by public administrations is support for female entrepreneurial leadership [31,32], but in addition, it is considered equally necessary to support youth leadership in ecological entrepreneurship. This is because the new techniques of production and cultivation of these products require fresh labor, new ways of thinking, and minds trained in the new skills required by these agroecological activities, since we are talking about quality products and higher demands due to an increasingly competitive and environmentally committed setting.

From the opinions expressed by the interviewees, it seems that their views regarding this aspect are more positive, as 35% of them think that the involvement of young people is very much favored and 45% say it is somewhat favored. Some arguments corroborate these percentages:

I1: *"Yes, now the state government is starting. For two years now, it has been working with the IYEM (Yucatecan Institute of the Entrepreneur) and is pulling in many young people. In fact, Montse (one of the interviewees) participated a year or two ago".*

I2: *" ... I'd say yes. Almost everyone who's starting out is young".*

I12: *"Yes. I think so, somewhat. It's an alternative that supports the field, because, unfortunately, the average age of producers is well over 60, so the young people should inherit it".*

Other testimonies suggest that entrepreneurship is being encouraged, but at a general level and not specifically in the ecological sector:

I3: *"Fortunately, entrepreneurship in general has been increasing... ecological entrepreneurship less so. This is because there is already an institute that's about ten years old that promotes calls for entrepreneurship from any type of company, but happily, there is a small part of those entrepreneurships (10% or 20%) that are ecological".*

I20: *"There's a lot for them to entrepreneur, but in general, and in terms of ecological issues, it's very limited. There are, rather, entrepreneurial forums, and yes there have been success stories like Blanca's (informant)".*

Finally, a few opinions state that aid does exist to favor entrepreneurship, but, at the same time, there is a greater abandonment of the countryside by young people in the search for jobs in the service sector and in more urban environments.

I10: *"Yes, it's very favored. Right now, there's a lot of support until the age of 29. But the young people aren't interested in the countryside, there's a total detachment from it".*

I14: *"Yes. The Mexican countryside has been abandoned little by little because there has been more education in the rural areas, so ... people go to the cities, little by little they leave the countryside.*

From Piste to Quintana Roo, all the little towns are practically empty of young men in the countryside because they go to Cancun and Playa del Carmen to work in the hotels or go to the U.S. to work. So, all this is caused by consumerism and public mismanagement in our field, because the opportunities were very unequal".

These opinions suggest that the public administration is promoting entrepreneurship among young people, but not specifically for projects to create agroecological businesses. Once again, this inaction pushes different organizations and movements, such as the Milpa Collective (to which one of our informants belongs), to take the initiative in promoting agroecological practices for the cultivation of endemic species in Yucatan, as well as the exchange of knowledge and products among farmers and friends [44].

4.1.11. Frequency of Fairs and Events Organized by Public Institutions for the Exhibition and Sale of Agroecological Entrepreneurs' Products

On this subject, we have analyzed how often events (fairs, exhibitions, etc.) are organized by public institutions, considering them as support mechanisms for agroecological entrepreneurs to publicize their products, boost their sales possibilities, and market penetration. On this occasion, only a quarter of those interviewed stated that this type of event is organized frequently, as opposed to almost three quarters of them who thought that these events were held, but only occasionally. Furthermore, although some recognize their frequency, these events are not exclusively related to the production and consumption of organics, due to the strong presence of conventional products, techniques, and machinery used for agrochemical production, which is the most developed in current agricultural markets. The interviewees also reported a lack of commitment to this type of product and, therefore, the lack of involvement in finding ways to reach new markets and customers [I2: *"Yes, there are fairs, which are not very successful, because they are lousy, as they are dedicated to inviting producers and charging them. They are not dedicated to advertising, to finding key clients, key entrepreneurs, places where a new production can be started, where the producer can meet the consumer. They put a spectacular ad on the radio, and they sell it to you as the business opportunity of a lifetime; it costs a fortune to put a stand in a fair"*; I19: *"There is the Expo Campo, but it has one pavilion, for organic, and it has the whole convention center for tractors, machines, agrochemicals*, etc. *In fact, an organic fair, organized by the Government, has never existed!"*].

5. Discussion

In this research, Yucatecan producers and farmers feel that the government does not support them enough. This opinion is in line with the study conducted by Valdés et al. [50] in the same Mexican region. This demonstrates that, although efforts have been made in many countries to support small producers' participation in the ecological agriculture market, here there is widespread skepticism among the population. To improve the producers' chances of accessing larger markets, cooperatives or farmers' organizations have been recommended and established, often with the support of the government or non-governmental organizations (NGO). The purpose of this research is to fill a gap: To give a voice to the most important social actors, and to record their perception of the lack of institutional support for agroecological entrepreneurship.

Similarly, the results that come from the analysis contained in this paper highlight the role played by some associations and networks, but our interviewees say that the results are unsatisfactory, because the support provided and the competitiveness achieved are not sufficient. Zabala [51] has also worked on the process of building a national agroecology plan in Uruguay 2002–2016, which is both a challenge and a matrix of change for family-produced products, the population's health, and environmental awareness. In this new scenario, family producers are establishing alliances with different NGOs and national and international Civil society organizations to defend their rights and traditions.

A study developed by Fisher [52] shows that, over the past few centuries in Yucatan, Mayan farmers have practiced milpa agriculture (i.e., slash and burn) in ways that have the potential to be either sustainable or unsustainable, depending on whether or not the leaders' policies created institutional support for farmers to implement a full range of traditional ecological knowledge. These findings are consistent with this inquiry's conclusion that some support programs are only related to the will of the government, not to the real needs of Yucatecan farmers. What Yucatecans really need is more support to learn technologies and open markets, rather than ecological, traditional agriculture. The situation in regards to the entrepreneurial training of the interviewees is very deficient, since the State promotes aid for traditional production, but not for organic production. On another note, *female* and *youth entrepreneurship* are more likely to be promoted by Public Administrations in ecological enterprises. The aforesaid highlights the importance of entrepreneurship-oriented training for local administrations in Spain, such as the Alcorcon City Council—Madrid, which offers courses for entrepreneurs in ecological farming [53]; or the Barcelona Provincial Council, which supports and cooperates with municipalities working in social agriculture [54]. As in this research, researchers such as Keleman [55], have shown that, in other Mexican territories such as southern Sonora, agricultural support is mainly oriented towards high-tech production, and that there are structural barriers to small farmers' access to research and development institutions.

The *social and cultural norms* of the Yucatecan population studied here have little influence on entrepreneurship and are a barrier to the incorporation of healthy consumer habits, making it difficult to develop entrepreneurial projects in agroecological products intended for this population. Now, the *environmental awareness* level of the population in general and of producers in particular, and the *consumption of agroecological products* are perceived as favorable for consumption and entrepreneurship, although there is a long way to go before achieving this mentality. On this subject, Pietrykowski [56] and Gómez Cruz [57] revealed the value of agroecological products, and the development of the domestic market just as an organic movement gets consolidated, for example, in the EU in the 1990s. Interest in the production of agroecological (particularly organic) products and the development of the *Slow Food* market assisted in the defense of food biodiversity and gastronomic culture, in which Mexico is beginning to stand out as a producer and exporter.

In tune with our research, we also stress the value of the agri-food sector and the environmental awareness that is being emphasized by the COVID-19 crisis [58]. In these times a new sustainable socioeconomic model is being imposed: One that interweaves individual responsibilities with ecology and is capable of promoting the agricultural, livestock, and fishing sectors, so as to avoid the risk of a crisis in food stocks and in rural life [59].

Finally, the rather *low-income level* in the city of Merida influences the consumption of ecological farming products, the latter being higher at upper economic levels and lower at low levels. This reality alludes to Pierre Bourdieu's theory of the fields [60], where each field is constituted as a space of conflict between subjects who are confronted by the goods offered by that field, generating different schemes of behavior and social practices [61].

Valdés et al. [50], with whom our research agrees, proposed that due to the socio-economic profile of Yucatan and the social structure of agriculture, this region is suitable for investigating the potential of ecological agriculture for offering profitable employment to smallholders. Then, this becomes the basis for adequately conceptualizing support policies.

Paths are being created for further research and in-depth study of the issues addressed, for two reasons: (i) Firstly, because of the high agricultural potential of the Yucatan peninsula, which provides the relevant bioclimatic space for the foundation of a possible specific biodiversity laboratory, which would also include an analysis of its social system, and (ii) secondly, because of its complex and unequal socio-political structure, which necessitates an improvement of its governance networks in the specific field of agroecological entrepreneurship, especially taking into account the growing role of women and the incorporation of young people as powerful agents of change and socio-economic consolidation.

6. Conclusions

As a result of this research and other similar studies, it has been detected that within a consumer trend called *Slow Food*, since 2008, a movement has been developing in the Mexican state of Yucatan. This social movement is propelled by local entrepreneurs who offer natural products, incorporate a vision of sustainability, and consequently can be classified as agroecological. These are entrepreneurial initiatives whose aim is not to compete in large production circuits, but to establish themselves in a market niche represented by a different consumer profile from the traditional one, a profile which forms part of the well-known trend of *responsible consumption*.

Based on this reality, and mindful of the objective of this research, the entrepreneurs involved were asked for their point of view regarding the existence of public policies to support sustainable business initiatives that contribute to the development of rural areas and their population. Here, we have provided a response to a serious social problem generated by poverty which is caused, among other reasons, by lack of water in a particular geographical area, as is the case in the state of Yucatan. This study illustrated, through the theory of New Institutionalism (NI) based on social actors, how such rural development is promoted, based on informal and bottom-up groups action. A conceptual model depicted in Figure 5 shows how these groups (entrepreneurs who come together weekly in a pseudo-organized *Slow Food* market in Merida) are aligned in a model for governance. The institutional inertia of public bodies, in terms of their tendency to resist change, has led to the emergence of agroecological entrepreneurship initiatives in response to a significant social concern. Therefore, we have given a platform to the protagonists, whose most substantial comments have been set out in the results.

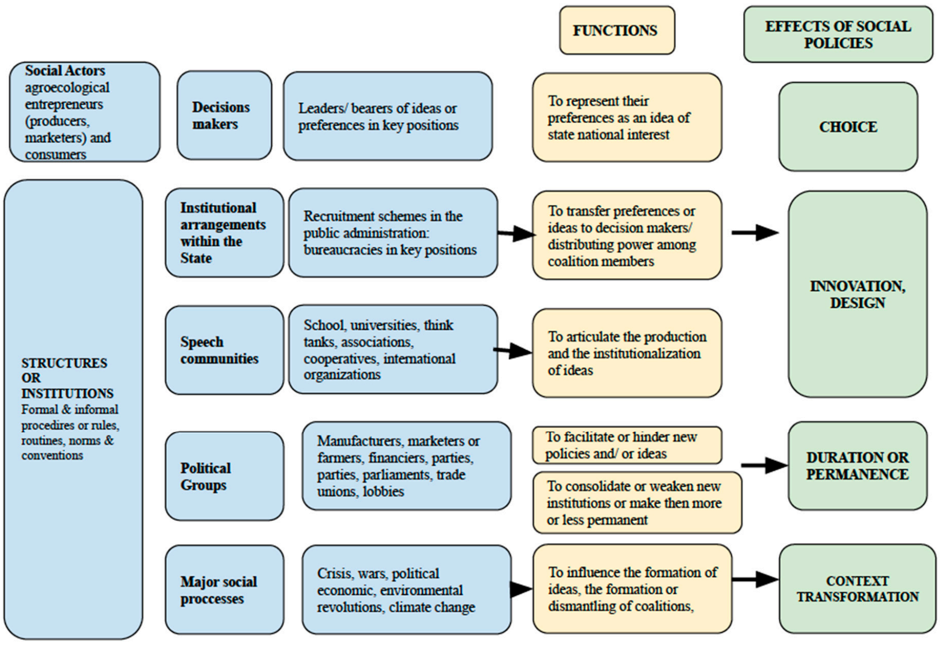

Figure 5. Conceptual model of new institutionalism and public policies. Source: The authors, adapted from [16].

The entrepreneurs who participated in the research have described, from their perspective, the role that public institutions play in promoting wealth generation and sustainable development in less developed areas, as is the case in most Yucatecan municipalities. In this regard, a series of conclusions have been drawn:

There is clearly a policy of little support for this type of production, due to the existence of other political priorities and inadequate management, which prevents the consolidation of certain structures needed to support agroecological entrepreneurship, and which our informants find absent. The generalized feeling is that few events are held in the state (fairs, exhibitions, etc.) and they are not exclusively focused on organic farming but primarily on conventional production. This situation indicates a lack of commitment from the institutions to agroecological entrepreneurs in finding potential markets and clients for them.

We also detect a lack of confidence in the government of the state of Yucatan, which does not have a policy to promote and support the social network of producers/marketers of agroecological products, and therefore does not encourage collaboration between different companies.

There are great difficulties facing the development of entrepreneurial initiatives in agroecological products, which are caused by social and cultural norms related to food consumption, along with the low level of income among the citizens in general. At the same time, it is necessary to mention another aspect linked to the consumer, and that is the lack of environmental awareness as a contributing factor to the fact that there is still much to be done to increase the consumption of this type of product.

On the other hand, many entrepreneurs themselves argue that there are numerous deficiencies in training or knowledge regarding ecological agriculture (covering the areas of management, ICT management, marketing or production support channels, and production techniques). These are caused by the lack of government support for this form of production. Such a situation leads to entrepreneurs who are more educated in conventional agricultural production, in which there is more support and backing from institutions.

Regarding the supply chain, the general feeling is that there are no adequate distribution channels for agroecological products, and those that do exist are insufficient for the distribution of products to a large majority of the population.

Finally, a major obstacle for the start-ups is the number of bureaucratic barriers reported by entrepreneurs in the sector. They exhibit a lack of trust in public administrations, which is reinforced by legislation that significantly hinders the processes of business creation. However, in the opinion of the informants, it should be noted that there is a commitment to youth entrepreneurship (although not exclusively in the agroecological sector). This is perhaps due to the growing abandonment of the countryside by young people who prefer to see their future in an urban environment, often focused more on the service sector.

Yucatan is a state with a great potential for sustainable rural development based on agroecological production. Having heard the informants' voices, our recommendation to public institutions is to make a firm and efficient commitment to this sector, if it is to become a reality.

The limitations of this study are defined by the need for a deeper, qualitative look at the discourse of those who develop public policies to support entrepreneurs, in order both to observe the phenomenon in a holistic manner, and also to establish differences in terms of the relevance and real influence of said policies.

The study's own limitations suggest future lines of research. In addition to considering entrepreneurship from a gender perspective, right from the beginning of the research, social research techniques could be used to achieve relevant and conclusive results in connection with this issue. Finally, the authors propose to continue studying in detail the demand for agricultural products, an issue that has been addressed rather tangentially, and which is a determining factor in the design, implementation, and evaluation of public policies.

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Appendix A

Table A1. Characterization of the agro-ecological entrepreneurs interviewed in Yucatan.

No.	Year Company Was Created	Legal Constitution	Municipality	Informant's Business Activity	Gender of the Entrepreneur/ Informant	Main Products it Produces and/or Markets	No. Employees (Including the Informant)	Weekly Sales (Mexican $)
1	2004	YES—Individual Person	Merida	Marketer	F	Food, body, and cleanliness	1	More than $2.000
2	2009	NO	Cholul	Marketer and Producer	F	Tomato, egg, bean, dill, arugula, sprouts, bean	4–5 (4)	More than $2.000
3	1997	YES—SPR de RL (Agricultural company)	Tizimin	Producer	M	Turmeric, cassava, ginger, neem leaf, alternative medicine products	2–3 (3)	$1.000–2.000
4	2014	NO	Merida	Marketer and Producer	F	Jams, nut butter, and seeds	2–3 (2)	$1.000–2.000
5	2007	NO	Merida	Marketer and Producer	M	Tamales, prepared food	1	More than $2.000
6	2012	YES	Merida	Marketer and Producer	F	Lettuce, arugula, tomato, coriander, seasonal fruit, and beet	4–5	More than $2.000
7	2015	NO	Tecoh	Marketer and Producer	F	Salad leaves, seasonal herbs, Japanese ferment for fertilization, bio-insecticides, and seeds	2–3	More than $2.000
8	2014	YES—Individual Person	Merida	Marketer and Producer	M	Capsules of moringa, neem, neem bark, graviola, turmeric, and artichoke	2–3	More than $2.000
9	2015	NO	Hunucma	Marketer and Producer	M	Papasul, sikilpak seed, shredded coconut, chaya, spinach, and pitaya	2–3	Less than $1.000
10	1997	YES	Merida	Marketer	F	Organic coffee, neem products, seeds, cereals, honey, and nutrients	2–3	More than $2.000
11	2011	YES	Merida	Marketer and Producer	F	Pasta, sauces, aubergine, canned vegetables	2–3	More than $2.000
12	2011	YES	Oxkutzcab	Marketer and Producer	F	Honey, cassava flour, ginger, and turmeric powder, fresh products	More than 5 (8)	More than $2.000

Table A1. *Cont.*

No.	Year Company Was Created	Legal Constitution	Municipality	Informant's Business Activity	Gender of the Entrepreneur/ Informant	Main Products it Produces and/or Markets	No. Employees (Including the Informant)	Weekly Sales (Mexican $)
13	2012	YES—SPR of RL (Agricultural company)	Merida	Marketer and Producer	M	Green leaf Stevia, ground Stevia powder, and tea blends	More than (30)	More than $2.000
14	2011	YES	Merida	Marketer and Producer	M	Sourdough bread, gluten-free bread, organic seed bread, and pretzel	4–5	More than $2.000
15	2011	YES	Merida	Marketer	F	Egg, cereal, sweetener, personal care, and coffee	4–5	More than $2.000
16	2014	NO	Caucel	Marketer and Producer	F	Lentil burgers, sprouts, sweet potato, yucca, dog biscuits, and raw brownies	1	$1.000–2.000
17	2014	YES	Izamal	Marketer	M	Ferments, cambucha (probiotics), kefir, and onion bread	2–3	More than $2.000
18	2013	YES	Tepakan	Marketer and Producer	M	Goat roller cheese, panela, manchego, and yogurt	More than 5 (7)	More than $2.000
19	2010	YES	Cholul	Marketer and Producer	M	Egg, seeds, fertilizer, kale, and arugula	4–5	More than $2.000
20	2009	YES	Merida	Marketer	F	Legumes, API honey, seeds	1	More than $2.000

Source: [62].

References

1. Pérez Rubio, J.A. *Los Intangibles en el Desarrollo Rural*; Universidad de Extremadura: Cáceres, España, 2007; ISBN 978-84-7723-773-0.
2. Sánchez, A.B. *Informe Sobre Sostenibilidad en España 2016*; Fundación Alternativas: Madrid, España, 2016; ISBN 978-84-15860-54-9.
3. Schwentesius Rindermann, R.; Gómez Cruz, M.A.; Ortigoza Rufino, J.; Gómez Tovar, L. México orgánico. Situación y perspectivas. *Agroecología* **2017**, *9*, 7–15. Available online: https://revistas.um.es/agroecologia/article/view/300571 (accessed on 15 August 2020).
4. Gliessman, S. Defining Agroecology. *Agroecol. Sustain. Food Syst.* **2018**, *42*, 599–600. [CrossRef]
5. González, H. Agroecological reconfiguration: Local alternatives to environmental degradation in Mexico. *J. Agrar. Chang.* **2012**, *12*, 484–502. Available online: https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1471-0366.2012.00357.x (accessed on 16 August 2020). [CrossRef]
6. Blanco-Gregory, R.; López-Canto, L.E. Proceso de creación de empresas de productos agroecológicos y consumo responsable en Yucatán. *Rev. Int. Organ.* **2020**, *24*, 13–39. [CrossRef]
7. SAGARPA. *Ley de Productos Orgánicos*; Diario Oficial de la Federación; México, D.F., 7 February 2006. Available online: http://www.diputados.gob.mx/LeyesBiblio/ref/lpo/LPO_orig_07feb06.pdf (accessed on 28 September 2020).
8. Munck af Rosenschöld, J.; Rozema, J.G.; Frye-Levine, L.A. Institutional inertia and climate change: A review of the new institutionalist literature. *Wiley Interdiscip. Rev.: Clim. Chang.* **2014**, *5*, 639–648. [CrossRef]
9. Pulido Secundino, J.; Chapela y Mendoza, G. Agroecología en México. Marco de políticas públicas. In *Políticas Públicas a Favor de la Agroecología en América Latina y El Caribe*, 1st ed.; Eric Sabourin, E., Patrouilleau, M.M., Le Coq, J.F., Vásquez, L., Niederle, P.A., Eds.; Red PP-AL: FAO; Evangraf/Criaçao Humana: Porto Alegre, Brasil, 2017; pp. 263–310. ISBN 978-85-86880-60-5.
10. Astier, M.; Quetzal Argueta, J.; Orozco-Ramírez, Q.; González, M.V.; Morales, J.; Gerritsen, P.R.W.; Escalona, M.A.; Rosado-May, F.J.; Sánchez-Escudero, J.; Martínez Saldaña, T.; et al. Back to the roots: Understanding current agroecological movement, science, and practice in Mexico. *Agroecol. Sustain. Food Syst.* **2017**, *41*, 329–348. [CrossRef]
11. Sassatelli, R.; Davolio, F. Consumption, pleasure and politics. Slow Food and the político-aesthetic problematization of food. *J. Consum. Cult.* **2010**, *10*, 202–232. [CrossRef]
12. Lotti, A. The commoditization of products and taste: Slow Food and the conservation of agrobiodiversity. *Agric. Hum. Values* **2008**, *27*, 71–83. [CrossRef]
13. Tencati, A.; Zsolnai, L. Collaborative Enterprise and Sustainability: The Case of Slow Food. *J. Bus. Ethics* **2012**, *110*, 345–354. [CrossRef]
14. March, J.G.; Olsen, J.P. New institutionalism: Organizational factors in political life. *Am. Political Sci. Rev.* **1984**, *78*, 734–749. [CrossRef]
15. Peters, B.G. *El Nuevo Institucionalismo: Teoría Institucional en Ciencia Política*; Gedisa: Barcelona, Spain, 2003; ISBN 9788474328875.
16. Farfán-Mendoza, G. El nuevo institucionalismo histórico y las políticas sociales. *Polis* **2007**, *3*, 87–124.
17. Torres-Espinosa, E. El nuevo institucionalismo: Hacia un nuevo paradigma? *Estudios Políticos* **2015**, *34*, 117–137. [CrossRef]
18. Van Bommel, K.; Spicer, A. Hail the Snail: Hegemonic Struggles in the Slow Food Movement. *Organ. Stud.* **2011**, *32*, 1717–1744. [CrossRef]
19. DiMaggio, P.J.; Powell, W.W. The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *Am. Sociol. Rev.* **1983**, *48*, 147–160. [CrossRef]
20. Smallbone, D. Políticas de espíritu empresarial y desarrollo de pyme, con referencia en particular a economías de transición. In *Desarrollo, Innovación y Cultura Empresarial*; Varela, R., Ed.; Universidad ICESI: Cali, Colombia, 2011; Volume 3, pp. 15–43.
21. Aldrich, H. *Organizations Evolving*; Sage: London, UK, 2006; ISBN 9781412910477.
22. Clamp, C.A.; Alhamis, I. Social Entrepreneurship in the Mondragon Co-operative Corporation and the Challenges of Successful Replication. *J. Entrep.* **2010**, *19*, 149–177. [CrossRef]
23. Bacq, S.; Janssen, F. The multiple faces of social entrepreneurship: A review of definitional issues based on geographical and thematic criteria. *Entrep. Reg. Dev.: An Int. J.* **2011**, *23*, 373–403. [CrossRef]

24. Klofsten, M. Training entrepreneurship at universities: A Swedish case. *J. Eur. Ind. Train.* **2000**, *24*, 337–344. [CrossRef]
25. Filion, L.J. *Entrepreneurs et Propriétaires-Dirigeants de PME*; École des Hautes Études Commerciales (HEC): Montreal, QC, Canada, 2001; Cahier de recherche no. 2001-03; ISSN 0840-853X.
26. Ucbasaran, D.; Gestead, P.; Wright, M. The focus of entrepreneurial research. Contextual and process issues. *Entrep. Theory Pract.* **2001**, *25*, 57–80. [CrossRef]
27. Kantis, H.; Ishida, M.; Komori, M. *Empresarialidad en Economías Emergentes: Creación y Desarrollo de Nuevas Empresas en América Latina y el Este de Asia*; Banco Interamericano de Desarrollo: Whashington, DC, USA, 2002; Available online: https://publications.iadb.org/publications/spanish/document/Empresarialidad-en-econom%C3%ADas-emergentes-Creaci%C3%B3n-y-desarrollo-de-nuevas-empresas-en-Am%C3%A9rica-Latina-y-el-Este-de-Asia.pdf (accessed on 10 March 2020).
28. Davies, J.; Hides, M.; Powell, J. Defining the development needs of entrepreneurs in SMEs. *Educ. Train.* **2002**, *44*, 406–412. [CrossRef]
29. Sanagustín-Fons, M.V.; Brunet-Icart, I. Modelo de innovación socio-institucional en la administración pública. *RIO. Rev. Int. Organ.* **2017**, *19*, 93–116.
30. Ramírez Angulo, N.; Mungaray Lagarda, A.; Aguilar Barceló, J.G.; Flores Anaya, Y.Z. Microemprendimientos como instrumento de combate a la pobreza: Una evaluación social para el caso mexicano. *Innovar* **2017**, *27*, 63–74. [CrossRef]
31. Puyal Español, E.; Sanagustín-Fons, M.V. El liderazgo empresarial femenino: Reflexiones y paradojas. *Trab.: Rev. Andal. Relac. Labor.* **2006**, *17*, 169–186. [CrossRef]
32. Montaño Armendáriz, A.; Pérez Concha, J.C. Microemprendimiento de mujeres en Los Cabos, BCS: Una experiencia para el impulso del desarrollo local. In Proceedings of the XX Congreso Internacional de Contaduría, Administración e Informática, México, D.F., Mexico, 7–9 October 2015.
33. Sánchez Sierra, J.; Busto Alkain, U. Comunidad Luraki, las nuevas tecnologías al servicio del productor-Proyecto Luraki. In Proceedings of the Actas del XI Congreso de SEAE: "Agricultura Ecológica Familiar", Vitoria Gasteiz (Álava), Spain, 1–4 October 2014; pp. 1119–1131.
34. TRAXCO. *Emprendedores en el Sector Agrícola*. 2012. Available online: https://www.traxco.es/blog/noticias-agricolas/emprendedores-agricultura (accessed on 25 April 2020).
35. Greenpeace. *Agricultura Industrial*. 2002. Available online: http://archivo-es.greenpeace.org/espana/es/Trabajamos-en/Transgenicos/Agricultura-industrial/index.html (accessed on 26 April 2020).
36. Díaz Méndez, C.; Gómez Benito, C. (Eds.) *Alimentación, Consumo y Salud*; Fundación La Caixa: Barcelona, Spain, 2008; Colección Estudios Sociales 24.
37. Martínez-Quintana, V. *Perspectiva Sociológica Turística en las Sociedades del Ocio*; Sanz y Torres: Madrid, Spain, 2019; ISBN 978-84-17765-24-8.
38. Naciones Unidas. RIO+20. Conferencia de las Naciones Unidas. El futuro que Queremos; Río de Janeiro, Brasil, 2012. Available online: https://www.uncsd2012.org (accessed on 2 May 2020).
39. Junta de Extremadura; Gobierno de España; UE. *Plan Estratégico de Apoyo al Medio Rural en Extremadura 2016–2020. Extremadura 2030*; 2016. Available online: http://www.juntaex.es/filescms/con03/uploaded_files/SectoresTematicos/DesarrolloRural/DiversificacionYDesarrolloRural/PlanEstrategicoDeApoyoAlMedioRuralEnExtremadura.pdf (accessed on 2 May 2020).
40. Lupo, E. Slow Design: Cultivar cultura y sensorialidad en la forma y en el uso de los artefactos. *Temes de Disseny* **2012**, *28*, 44–55. Available online: https://www.raco.cat/index.php/Temes/article/view/263096/350532 (accessed on 3 May 2020).
41. Martínez-Quintana, V.; Blanco-Gregory, R. Hacia una gestión sostenible de las actividades turísticas en los espacios rurales y naturales. *RIO. Rev. Int. Organ.* **2013**, *10*, 131–155.
42. Martínez-Quintana, V. El turismo de naturaleza: Un producto turístico sostenible. *Arbor* **2017**, *193*, a396. [CrossRef]
43. OECD. *The New Rural Paradigm. Policies and Governance*; OECD Rural Policy Reviews; OECD Publishing: Paris, France, 2006. [CrossRef]
44. López Barreto, M. Resistencias agroecológicas en Yucatán, México. *Rev. Ecol. Política—Cuad. Debate Int.* **2015**, *49*, 116–118.

45. Moya García, X.; Caamal, A.; Ku Ku, B.; Chan Xool, E.; Armendáriz, I.; Flores, J.; Moguel, J.; Noh Poot, M.; Rosales, M.; Xool Domínguez, J. La agricultura campesina de los mayas en Yucatán. *LEISA Rev. Agroecol.* **2003**, *19*, 7–17, Edición especial Ocho estudios de caso.
46. Lector, M.X. *"Slow Food", Tendencia que Cobra Fuerza en Mérida*. 2018. Available online: http://lectormx.com/2018/02/17/slow-food-cobra-fuerza-en-merida/ (accessed on 28 September 2020).
47. Slow Food. *México tiene su segundo Mercado de la Tierra*. 2017. Available online: https://www.slowfood.com/es/mexico-segundo-mercado-la-tierra/ (accessed on 28 September 2020).
48. Cárcamo, H. Hermenéutica y análisis cualitativo. *Cint. Moebio. Rev. Epistemol. Cienc. Soc.* **2005**, *23*, 204–216.
49. Solleiro, J.L.; Castañón, R. Competitividad y sistemas de innovación: Los retos para la inserción de México en el contexto global. *Rev. Iberoam.* **2005**, *5*, 165–197.
50. Valdés, N.L.; Knerr, B.; Jiménez, J.J. Organic Agriculture as a Potential Income Source for Smallholders in Yucatán. In *Traditional Smallholder Farmers in a Growing Economy and a Globalized World: Evidence from the State of Yucatan*, 1st ed.; Knerr, B., Becerril García, J., Eds.; Kassel University Press: Kassel, Germany, 2019; pp. 99–133. ISBN 978-3-86219-906-8.
51. Zabala, L. Apuntes sobre el proceso de construcción del plan nacional de agroecología, en Uruguay, entre los años 2002–2016. In Proceedings of the XVIII Jornadas de Investigación: La Producción de Conocimiento Durante los Procesos de Enseñanza de Grado y Posgrado de la Facultad de Ciencias Sociales, Montevideo, Uruguay, 10–11 October 2019; Volume 78.
52. Fisher, C. Maize Politics and Maya Farmers' Traditional Ecological Knowledge in Yucatán, 1450–1600. *Hum. Ecol.* **2020**, *48*, 33–45. [CrossRef]
53. Vivirediciones. *Curso de Agricultura Ecológica Para Emprender*. 2018. Available online: https://vivirediciones.es/curso-de-agricultura-ecologica-para-emprendedores/ (accessed on 5 June 2020).
54. Evard, C.; Rancaño, M. *La Agricultura Social Como Estrategia Para el Desarrollo Local*; Diputación de Barcelona, Fundación CEDRICAT: Barcelona, Spain, 2015.
55. Keleman, A. Institutional support and in situ conservation in Mexico: Biases against small-scale maize farmers in post-NAFTA agricultural policy. *Agric. Hum. Values* **2010**, *27*, 13–28. [CrossRef]
56. Pietrykowski, B. You Are What You Eat: The Social Economy of the Slow Food Movement. *Rev. Soc. Econ.* **2004**, *62*, 307–321. [CrossRef]
57. Gómez Cruz, M.Á. Agricultura orgánica de México: Situación, retos y tendencias 2005. 2007. Available online: http://vinculando.org/organicos/directorio_de_agricultores_organicos_en_mexico/agricultura_organica_de_mexico_situacion_retos_tendencias.html (accessed on 26 April 2020).
58. Soto, M.A. *De la Gran Recesión a la Crisis del COVID-19: Lecciones aprendidas*. Greenpeace. 2020. Available online: https://es.greenpeace.org/es/wp-content/uploads/sites/3/2020/04/Lecciones-aprendidas.pdf (accessed on 5 June 2020).
59. Aparicio, L. Cuatro Historias del Campo y del Mar en Tiempos del Coronavirus. 2020. Available online: https://es.greenpeace.org/es/noticias/4-historias-del-campo-y-del-mar-en-tiempos-de-coronavirus/ (accessed on 6 June 2020).
60. Bourdieu, P. *Cuestiones de Sociología*; Akal: Barcelona, Spain, 2008; ISBN 978-84-460-2987-8.
61. Amparán, A.C. La teoría de los campos en Pierre Bourdieu. *Rev. Polis Anu. Sociol.* **1998**, *98*, 179–200. Available online: https://polismexico.izt.uam.mx/index.php/rp/article/view/345 (accessed on 6 June 2020).
62. Blanco-Gregory, R.; Martínez-Quintana, V.; Sanagustín-Fons, M.V. Microemprendimientos en agricultura ecológica y mercado Slow Food. *Rev. Int. Organ.* **2020**, *24*, 159–182. [CrossRef]

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Intangibles of Rural Development. The Case Study of La Vera (Extremadura, Spain)

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Abstract: In the early 1990s, with the Leader Initiative, the European Commission intended to apply a new development model in order to encourage the economic diversification of the rural world. The expectations raised by the first Leader Initiative motivated Spain to approve the Proder Program to allow those regions that had not been beneficiaries of the aforementioned initiative to put similar projects into practice. This kind of program has various characteristics, which have been widely studied from a theoretical point of view. Nevertheless, empirical studies that analyze the relevance of those characteristics (especially the intangible ones) are less frequent. The main objective of this research is, precisely, to study how these intangibles materialize in the implementation of a rural development strategy. For this, a qualitative methodology based on a case study of the La Vera region is adopted. The results show that these intangible characteristics obtain a disparate valuation from the local promoters. While aspects such as the management system or the contribution of these programs to regional identity are well valued, others, such as the participation of the population in development processes, do not seem to reach the expectations. This study gives some proposals for the evaluation of these characteristics.

Keywords: Proder Program; management system; economic diversification; bottom-up approach; regional identity

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1. Rural Development Programs as Study Area: Context, Novelty and Objectives of the Research

The European Commission's concern about Rural Development Programs must be framed in the context of the imminent loss of relevance in rural areas that agriculture had previously maintained. In the early 1980s, the European Commission [1,2] proposed deep reforms in the Common Agricultural Policy (CAP). Furthermore, on the basis of several documents, especially "The Future of Rural Society" [3], it simultaneously promoted a debate about rural development policies and the necessity of rural areas to advance from a model based on agricultural development to another oriented around economic diversification.

In the early 1990's, that debate considered the first Leader Initiative [4], whereby a development model was validated that, based on modest investments, would promote development and economic diversification in rural areas. Although such initiatives had a very limited budget, the expectations generated in European rural areas made that these kinds of programs continue to the present day. For this, the European Commission made use of different instruments. In the first stage, the Leader maintained its Common Initiative condition through Leader II [5] and Leader + [6]. Because of these two editions, the implementation of the Leader approach caused a qualitative jump in the form of a fivefold increase in the number of Local Action Group (LAGs) beneficiaries [7] and notable territorial expansion (more than a half of the European Union's territory). In the 2007–2013 period, the creation of the European Agricultural Fund for Rural Development (EAFRD) [8] and its articulation through Regulations 1698/2005 [9] and 1974/2006 [10] implied the execution and funding of endogenous programs of rural development as an another axis of the aforementioned Fund.

The large mobilization of European rural areas in order to have options in the granting of Leader funds implied that, during the second part of this Initiative, part of the presented proposals did not get passed the selection process. In order to give a response to these territories, some European countries, such as Spain, designed Rural Development Programs following the Leader's model and objectives. This is how the Proder I [11] and Proder II [12] Programs arose, with the objective of the Spanish regions classified as Objective 1 being excluded from the Leader II (1994–2000) and Leader + (2000–2006) selection processes, respectively, thus being able to implement programs oriented towards economic diversification of rural areas. The changes experienced in the implementation of the Leader Initiative in the period 2007–2013 coincided with the end of the Proder Program and the inclusion of most of the territories that had been managing it in the so-called Leader Approach.

Although they do not perfectly align, in essence, the Proder Program's principles and philosophy are inspired by those proposed by the Leader Initiative. The European Association for Information on Local Development (AEIDL) distinguishes up to seven specialties of the model proposed by Leader [7,13]. Amongst them, Proder shares four: relevance given to LAGs as a managing entity, as well as their multi-sectorial, bottom-up, and territorial approach. Taking into account that the proposed case study refers to a region that saw both editions of the Proder Program, this research focuses its analysis regarding these four characteristics. Regarding its community Initiative condition, the European Commission defined three more characteristics in the design of the Leader Initiative (the innovative character of the action, introduction of networking, and transnational cooperation) that do not appear in the Proder Program due to its national character.

Departing from the management model characterized by a decentralized funding system, the LAG appears as the highest decision-making body in the definition of development strategies and awarding grants. Understanding of the relevance of LAGs requires knowledge of every task developed by one of its key parts: The Rural Development Centers (CEDER). Integrated by technical personnel, these structures are responsible for the administration of the program, for the implementation of the agreements adopted by the decision-making bodies, and for advising promoters.

The multi-sectorial character of the Rural Development Programs has a lot to do with the objective of economic diversification. This implies the implementation of activities in several economic sectors, as well as the integration of all of them into a single development strategy oriented towards the creation and conservation in the territory of the highest possible added value.

Local participation, based on including social collectives into the development strategies, is another one of the Rural Development Program's characteristics. Unlike the developmentalist model, which is based on the execution of large-scale action designed and implemented by outsider agents and institutions, the bottom-up approach is centered around development processes that are activated "from bottom to top" and can count on wide social support. LAGs must channel people's participation in these processes, aiming to become a reflection of the society, and are integrated in three sectors: (a) institutional, with the representation of every town of the Association of Municipalities, (b) entrepreneurial, representing entrepreneurs and economic agents, and (c) associative, where cultural, social, ecologist, etc. associations from the territory are represented.

Finally, it is worth noting that territory delimitation is a highly relevant question for Rural Development Programs. These programs evaluate territory not only as a mere sphere of resources and people, but as a factor whose characteristics condition its own competitiveness [14]. The territorial approach is based on a scope of action: The Association of Municipalities. Between a local level (too small) and a regional one (too wide), Rural Development Programs define the Association of Municipalities as "such a territorial area homogeneous enough for sharing problems and solutions" [15] (p.95). Regarding this, it is easy to understand why this paper uses this same geographic area as a research area.

Despite the importance that the Leader approach gives to these four characteristics, measuring the way Rural Development Programmes contribute to them is a challenge. This is because of their intangible or immaterial nature, and the fact that their implementation in a development strategy follows a principle of mainstreaming which is not linked to the implementation of a particular measure or type of investment. These difficulties have meant that the study of intangibles has been relegated to the lines of research of Rural Development Programmes. Researchers in the field have often preferred to focus on other, more quantifiable aspects.

From a theoretical point of view, Shahab et al. [16] propose the need to measure all the impacts that may be generated by the application of a certain policy. In this effort, these authors propose taking into account other evaluation criteria such as efficiency or equity. Guyadeen and Seasons [17] or Oliveira and Pinho [18], while acknowledging the efforts of the scientific literature to broaden the knowledge of evaluation systems, consider that there are still some aspects that have not been sufficiently studied. This research is based on the premise that, in terms of rural development, intangibles would be one of them. Analysis of those immaterial specificities is very complicated [19] and requires going beyond the systems traditionally used by administrations and consultancies to evaluate the implementation of Rural Development Programs [20]. It is in this context where the main objective of this research arises: to study how these intangibles materialize in the implementation of a rural development strategy. The achievement of this objective is based on the formulation of four research questions relating to each of the intangibles analysed: (1) Is the used management system capable for incentivizing investments?; (2) how is the contribution of these programs to the economic diversification of their territories perceived?; (3) have social groups played a relevant role in the program implementation?; and (4) what valuation deserves the interest of these programs for other actions of territory revaluation?

The way this research aims to achieve its objective is another notable novelty of this work, given that the interviews with the private promoters involved in the implementation of the program are the main source of the used information. This approach turns the promoters into the evaluators of the development program. Very often, the interest of researchers in the figure of the promoter has been limited to quantifying their investments, the jobs created and/or consolidated, etc. However, the opinion of these investors regarding the execution of the program has been discounted. This is paradoxical because they are the privileged witnesses of the dynamics generated by the implementation of the programs under analysis.

Having set out the objective and questions of the research, the following section approaches the theoretical framework. Section 3 justifies the choice of the field of study, and provides details concerning the methodological aspects. Section 5 shows the research results related to contributions made by other authors. Finally, the most relevant conclusions are presented.

2. Literature Review

The materialization of those four intangible characteristics within a rural development strategy cannot be assessed only on the basis of the criteria traditionally used from a quantitative perspective. A review of the literature shows numerous studies that analyze various aspects related to Rural Development Programs based on parameters such as the distribution of investment per inhabitant or per square kilometer, financing by measures, types of promoters, the creation and improvement of employment, incorporation of young people and women into the labor market, etc. In Spain, examples of this type of research can be found that focus on various aspects related to the application of Rural Development Programs in regions such as Cantabria [21], Castilla La Mancha [22], Castilla y León [23], Aragón [24], Andalucía [25], and Extremadura itself [26,27]. Similar studies can also be found in the border areas of Extremadura and Portugal [28] or in other Portuguese regions [29].

On the other hand, the analysis of the impact of Rural Development Programs on the tourism sector constitutes another broad line of research that has usually used quantitative approaches.

In addition, in this case, it is possible find very diverse studies based on the experience of the different Spanish regions such as, the Valencian Community [30,31], Murcia [32], Galicia [33], Andalucía [34,35], Extremadura [36], Castilla La Mancha [37,38], and Castilla y León [39]. Internationally, there are countless investigations focused on the analysis of rural tourism impacts in different countries, such as Portugal [40], Italy [41], and Greece [42,43], to name a few.

Investigating the role that LAGs have in investment activation, the proliferation of non-agrarian economic activities, the implication of social collectives on the development process, and repercussions regarding territorial identity due to program implementation requires the use of other research techniques, given the intangible nature of the elements being studied. Beyond theoretical contributions [44] from various perspectives, the analysis of these intangible characteristics has been studied by various authors.

Pérez Rubio [45] analyzed the relevance of intangibles in the processes of rural development in Extremadura (the region to which La Vera belongs). Saz-Gil and Gómez-Quintero [46] analyzed the relevance of social capital as an element of rural development. Esparcia et al. [47] or Moyano [48–50] study this same question and conclude that aspects related to the social dimension, or the interaction between the different institutions and agents operating in a territory, can be crucial in explaining the success or failure of endogenous development processes in rural areas.

Buciega [51] analyzed the role of LAGs as instruments of development and governance in rural areas. On this subject, Esparcia et al. [52] show the tensions that have arisen in the articulation of the LAGs given the interest of the different groups in taking control of decision-making. Alberdi [53] studied the difficulties of the business sector in becoming involved in the operation of the aforementioned cited LAGs. Garrido and Moyano [54] investigated the participation of the population in the Rural Development Programs (a subject which Navarro et al. [55,56] are very critical of). The involvement of the population in rural development processes and the role of LAGs in this task has been analyzed from a variety of perspectives based on the experience of different European countries, by authors such as Osti [57], Lukic and Obad [58], Chmieliński [59] or Marquardt et al. [60]. Among those international case studies, those from Quaranta et al. [61] or Salvia and Quaranta [62] could be mentioned. These works point out the need to rebuild the social capital of rural areas as a previous step before facing the challenge to start a rural development strategy.

Chevalier et al. [63,64] are critical of the excessive regulation introduced in the latest editions of the Leader Initiative and consider that this has distorted the original principles of this Initiative. In line with Esparcia et al. [52], the analysis by Chevalier et al. [63] on the application of the Leader approach in different European regions detects a tendency of local elites, in this case municipal politicians, trying to monopolise the LAGs' decision-making process. The influence that institutional presence has on the management systems of the Leader approach is also analysed by Bruckmeier [65] who, based lisation of this approach has a negative influence on its capacity for innovation.

Shucksmith [66], in his analysis of the Leader approach in the United Kingdom, concludes that the model applied by the Initiative favours those who hold a position of power in relation with those sectors of the population less involved in these development processes. Konečný [67] highlights the great contrasts in the application of the Leader approach between European countries and suggests that the management systems and the operation of the LAGs are one of the differentiating elements in the results obtained by some groups and others. Like Chmieliński [59] or Salvia and Quaranta [62], Konečný [67] suggests that more territorially and socially cohesive spaces present more advantages when it comes to successfully applying rural development strategies.

Regarding the territorial approach and its commitment to the economic diversification of the rural areas, due to the relevance of tourism investments within the development strategy undertaken by the region of La Vera, it is appropriate to refer to works such as those of Muresan et al. [68,69], Abdollahzadeh and Sharifzadeh [70], or Harun et al. [71] in which the perception of rural residents towards the development of the tourism sector is measured.

3. Research Scope: La Vera as a Case Study

Investigations based on the case study method do not justify their representativeness on the basis of a large number of interviews. This quality cannot be justified in statistical terms because the methodology employed circumscribes the fieldwork to the case under study. As noted by Coller [72] (p.56), the representativeness of case studies must be justified in analytical terms, arguing that "the case is appropriate for the type of theoretical discussion that is to be elucidated by its analysis". In this sense, who defend the usefulness of the case study methodology [72–76] point out various aspects that should be taken into account when justifying its use. Among these, the following points should be highlighted: (a) that the chosen case has clear limits; and (b) that it is valid to compare the issue being studied. La Vera meets these two conditions because:

a) It is a territory with clearly defined borders: located in the northeast of the province of Caceres, bordered to the north by the Sierra de Gredos and Jerte river valley, to the east by the provinces of Avila and Toledo, to the south by the river Tietar, and to the west by the region of Plasencia. With a total area of 885.98 km2 and a total of 19 municipalities, La Vera allows to easily delimit the borders of the case under study (Figure 1). The fact that La Vera is located in Extremadura (Spain) is not insignificant, since authors such as González [77] consider this region to be an ideal area in which to analyze the effects of Rural Development Programs on the territory.

Figure 1. Boundaries and location of La Vera. Source: Own elaboration.

b) La Vera is an excellent example in which to study various aspects related to the implementation of the Rural Development Programs. This is due to the following points:

(b1) The existence of valuable resources with great potential for the development of rural tourism, and therefore, economic diversification. These resources include:

- Natural and landscape resources inherent to the Sierra de Gredos. Depending on their altitude, Gredos possesses emblematic foothills suitable for practicing mountain sports. Their hydrographic network, composed of multiple gorges with pure and crystalline waters, are a major tourist resource in the summer season. Also, the Sierra de Gredos influences the climate of the area creating a microclimate characterized by mild temperatures and abundant humidity that generates a rich landscape.

- Remarkable cultural resources including: (1) festivals declared of regional tourist interest such as Los Empalaos and El Peropalo; (2) a huge religious and cultural heritage of which the Monastery of Yuste is a good example; and (3) an architectural heritage whose best exponents are the five municipalities declared Historic–Artistic Ensembles.

(b2) There is a long tradition of producing products very characteristic of the area, of high quality, and based on the use of the endogenous resources of the territory. Some of these products are paprika, tobacco, and goat's cheese. It should be remembered that one of the strategies by which Rural Development Programs seek to achieve economic diversification is 'agricultural development and marketing' measures, which aims to create and retain the highest possible added value on the basis of local production.

4. Research Methodology

In his works about the case study, Yin [75] recommends applying this methodology in situations in which the question to be studied is interrelated with the study context. This is what happens in the case under analysis: it is not possible to de-link the relevance that intangibles have acquired in the development strategy of La Vera, of the different elements inherent in said space (dynamism of the population, professionalism of the technicians responsible for managing the program, pre-existing territorial structure, etc.). The phenomenon to be studied (intangibles) and the context in which they are studied (La Vera) interrelate and feedback each other. This is the reason why numerous authors [78–82] have resorted to this same methodology to study aspects related to the relevance that local people's participation and social capital can acquire in development processes.

The methodology used is an essential factor to understand this research goal in order to going beyond other studies related with Rural Development Programs. Yin [76] argues that qualitative research tools such as conducting interviews can improve the understanding of the information provided by the interviewee by allowing interaction and for an adequate contextualization of their opinions. Based on these premises, this research uses a qualitative methodology based on a broad fieldwork project in which several sources of information are distinguished:

1. Analysis of the general documentation of the Program: In the first phase of the fieldwork, at the LAG headquarters, a multitude of documents related to the implementation of the program were consulted. This made it possible to configure the "universe" of research, to study the projects implemented under the program, and to locate information that would subsequently provide access to the promoters.
2. Conducting interviews as the main source of information. With respect to the interview model, semi-structured interviews were considered to be the most appropriate model: they were not a closed instrument (unable to incorporate any assessments of interest made by the interviewees), and at the same time, their semi-open nature allowed for the joint analysis and processing of the information obtained. Rural Development Programs have two types of measures: productive and unproductive. Private promoters receive their subsidies from the productive measures. It is therefore on these that the research is focused. The temporal scope of the analysis covers the two editions of the Proder Program. Given the large number of private projects implemented under the productive measures during this period, it was necessary to select a sample of them. To this end, three criteria were applied: (a) that the impulse and the main source of financing were private; (b) that Proder's contribution amounted to a minimum of 12,000 euros; and (c) that this subsidy had a certain relevance in the financing of the project, representing at least 20% of the total investment. Table 1 shows the investments represented by the projects included in the sample and the total resources committed in each of the productive measures.

Table 1. Representativeness of the selected sample according to the investment.

Investment	Tourism	SMEs	Valorization	Total
Sample projects	3,180,385,30	883,561,20	673,160,61	4,737,107,11
Total implementation	4,230,097,15	1,665,948,03	1,369,413,23	7,265,458,41
%	75.18%	53.04%	49.16%	65.20%

Source: Own elaboration.

As shown in the table above, the criteria applied allow for a representative sample of the total productive investments to be obtained. However, it should be clarified that, within these productive measures, some projects with a predominantly public character are also addressed. This type of action involves the investment of 827,905.04 euros. If we deduct this amount from the total investment shown in Table 2, the private projects selected in the sample would represent 73.58% of the private productive investment executed.

There are 44 projects included in the research sample. Of this total, 34 interviews were carried out since seven of the businesses had ceased to operate, two had been transferred (meaning that it was no longer possible to access the original developer), and in only one case was it not possible to carry out the interview due to the promoter's lack of interest.

Table 2. Number of projects in the sample and interviews conducted.

	Tourism	SMEs	Valorization	Total
Sample projects	24	12	8	44
Failed projects	5	2		7
Non-interview projects	1	1	1	3
Total conducted interviews	18	9	7	34

Source: Own elaboration.

The statistical sample is made up of 44 projects of the 79 projects financed in La Vera with private participation in the study period [83]. These 44 projects represent 55% of the total projects. Furthermore, calculating the n-optimal for finite population and with a statistical sample size of 79 (the projects with exclusively private financing), a sampling error of 9.8% is estimated with a confidence level of 95%. Although this is a case study, the statistical sample size can be assumed to be representative due to the results shown above.

The questionnaire that was used for the interview is structured in four blocks. The first one collects general information about the project; it is in this block where questions related to Proder's ability to incentivize investments are asked, with the main goal of obtaining the appraisal of the promoters regarding the management system used. The second block includes two questions related to the contribution of Proder to the economic diversification and the diffusion effect of the made investments. The third section obtains the interviewee's opinion regarding the articulation of their economic sector; it is a question of knowing if in La Vera there are social groups of a sectoral nature, what is the assessment of the promoters regarding the operation of these associations and what has been their role in the dissemination of Proder grants. Finally, a fourth block includes questions regarding Proder's contribution to other cross-cutting aspects related to the development of the area under study. Between these aspects would include regional identity or the recovery of natural and heritage resources.

Each one of those four blocks was made up of five closed questions. Furthermore, to end the interview, the promoters were asked an open-ended question, where they could reflect or make their assessment regarding the Proder Program. So, the questionnaire used for the interview grouping a total of 21 questions, eight of them are referred to the intangible aspects that focus this research and whose results are presented in the next section.

3. On-site assessment of each of the projects in the sample: It was decided to conduct the interviews at the investment site. These trips provided direct contact with the key people in the research and made it possible to understand, first-hand, the objective of the investments, their viability, etc.
4. Triangulation of results: In the final phase of the fieldwork, an attempt was made to correct the possible biases that the interviewees could have incurred. Among these possible biases, it is worth highlighting the influence that the time elapsed between Proder Program execution and the conduct of the research could have had in the promoters' valuations. With cited objective, once the first conclusions were obtained from the interviews, they were "triangulated" by holding working meetings with those responsible for the technical implementation of the program. The purpose of these meetings was to contrast the extent to which the initial results of the research coincided with the opinion of those who, from a technical point of view, had greater knowledge of the program. These meetings were repeated with the final conclusions of the fieldwork.

5. Results and Discussion

5.1. Suitability of the Management System

With regard to this first issue, the research seeks to know whether the management system used is capable for incentivizing investments. For it, the interviews to promoters sought to ascertain their opinion with respect to two questions: (a) to what extent they decided to address their investments based on the grant offered to them by the program; and (b) what is their assessment of the management and processing of their project by the LAG technical team.

Konečný [67] suggests that management systems and the operation of the LAGs are one of the differentiating elements in the results obtained by rural development strategies in different territories. The questions raised by this research to the promoters make it possible to go deeper into some factors that could explain why it is like that.

With regard to the influence that receiving a grant might have had on the realization of their investments, as shown in Figure 2, three quarters of the promoters admitted that they would have tackled their projects without the help of Proder. However, most of them also admitted that their investment would have been more modest and longer term. These promoters considered that the subsidy received was the "incentive, the justification, the excuse", for which they decided to make investments that they had been maturing for some time and considered necessary for the expansion and even survival of their businesses. Almost a quarter of the promoters admitted that, in the absence of the Proder aid, they would not have undertaken their projects. It should be pointed out that the vast majority of those who expressed this view were tourism promoters who had made their investments in the first Proder call, in which the co-financing rate for this type of investment was higher.

With regard to the second question, Figure 3 leaves no doubt as to the assessment of the management system proposed. The promoters highlighted the proximity (both physical and human) of the technical team responsible for implementing the grants. This proximity is inherent to the regional dimension of the program and to the relations of proximity that result from it. Almost 60% of those interviewed valued the intervention of the technicians as very positive, stressing that their involvement went beyond mere bureaucratic/administrative assistance.

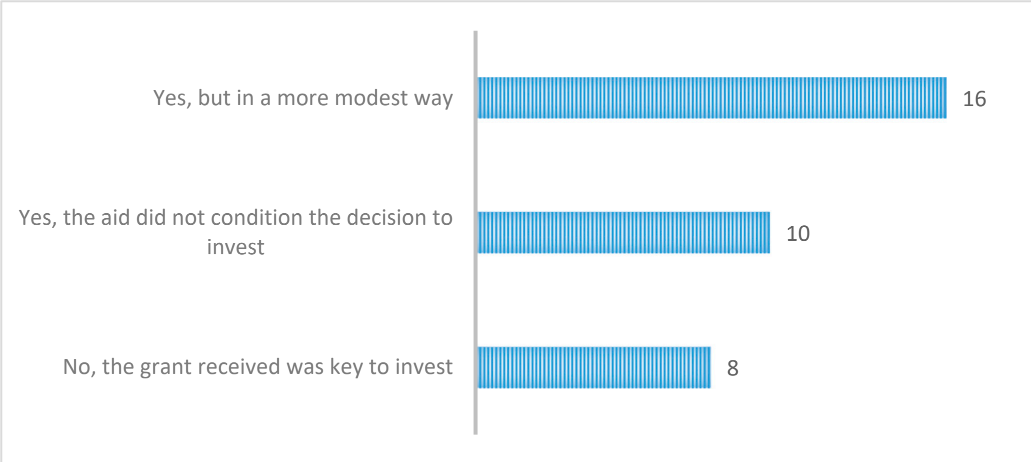

Figure 2. Would you have approached your project without Proder help? Source: Own elaboration.

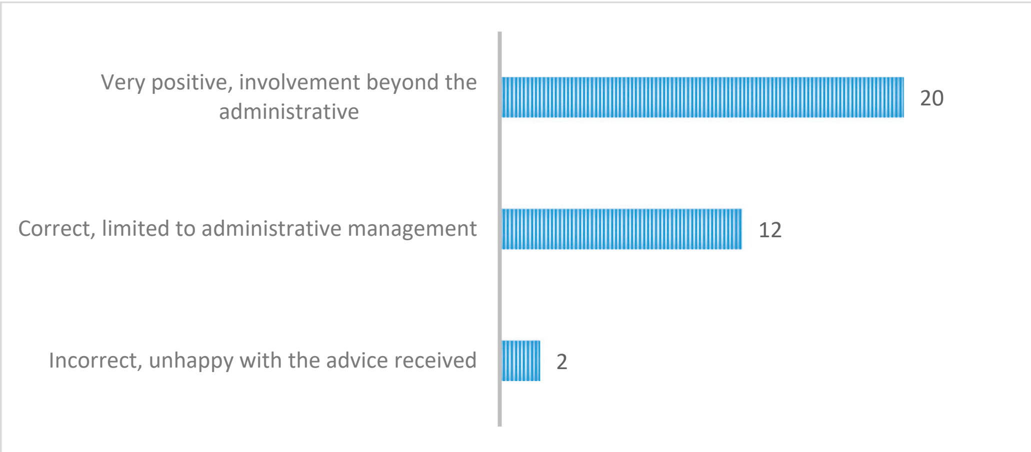

Figure 3. What has CEDER's role been in implementing your project? Source: Own elaboration.

5.2. Multi-sectorial Approach

Through their integrated and multi-sectorial approach, Rural Development Programs raise the need to promote investment in a wide range of economic activities and to integrate all of them within a single development strategy. The clear connection between this approach and the objective of economic diversification has already been noted. The second research question aims to find out how promoters perceive the achieving of this purpose.

The results of the interviews show that a majority of the promoters believed that Proder has contributed to the economic diversification of the area; however, only a small part understood that this was possible given the promotion of investments in various economic sectors. As shown in Figure 4, the vast majority of those who responded positively to the question justified their answer on the basis of Proder's investments in a single economic sector: rural tourism.

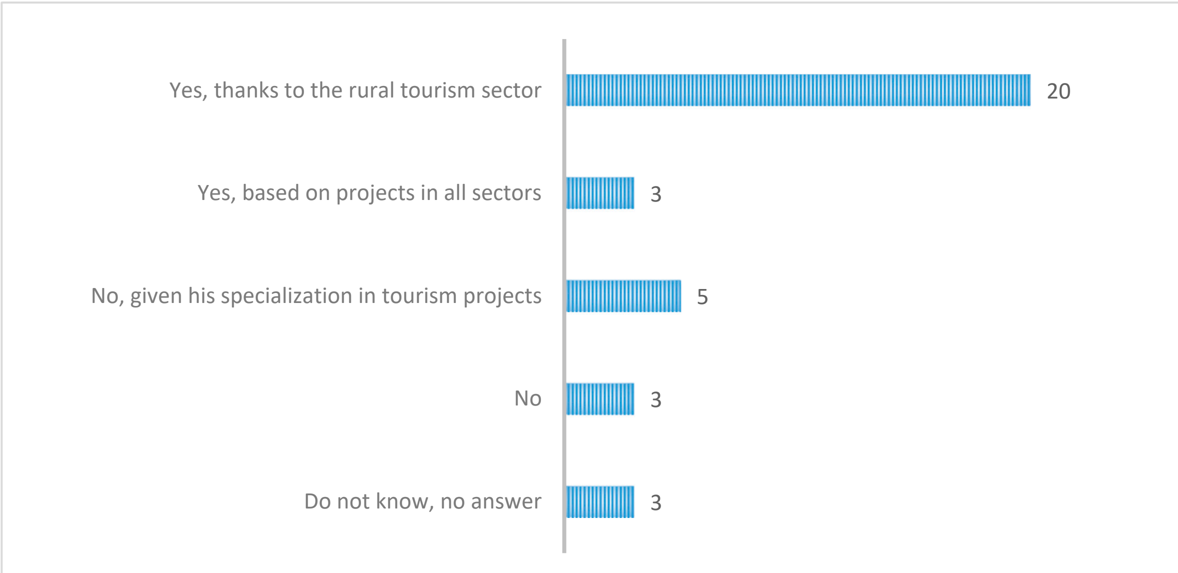

Figure 4. Do you think Proder has contributed to the economic diversification of the region? Through which sectors? Source: Own elaboration.

Closely linked to the multi-sectorial approach, the dissemination effect refers to the capacity of development programs to ensure that the investments made serve as an example and enable other entrepreneurs to undertake new projects. The existence of this dissemination effect is widely perceived by the promoters. It is even significant that most of the interviewees responded positively to the question posed (Figure 5), even though they were not able to give any examples.

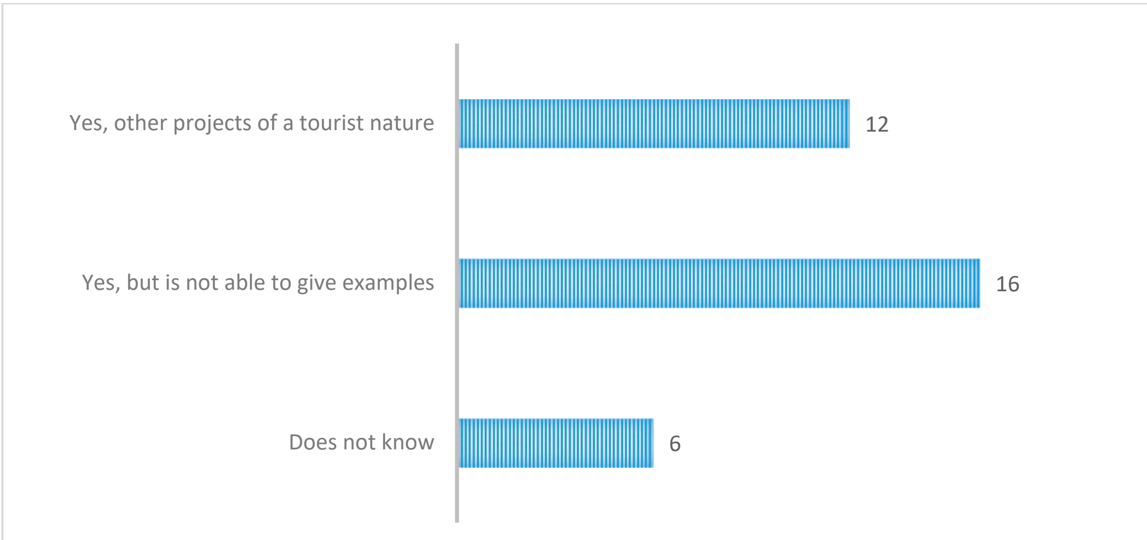

Figure 5. Do you think Proder has been able to encourage other people to undertake projects similar to yours? Examples? Source: Own elaboration.

In the two questions posed regarding this intangible, the only sector to which the interviewees refer is the tourism sector. In line with the results obtained from other research [68–71], it seems that in La Vera the perception of the promoters with respect to tourism development is positive. As shown in Figure 4, among the promoters, it seems to be a general perception that Proder's projects and investments were concentrated in this sector. Obviously, this concentration of resources in an economic activity is precisely the opposite of what the multi-sectorial approach aims at (in fact, who believed that Proder did not contributed to economic diversification criticized the program's excessive specialization in tourism projects), but this does not prevent the majority of interviewees from positively evaluating Proder's contribution to economic diversification. Therefore, it seems that promoters perceive tourism investments as an element of development and, as shown in Figure 5, to a not insignificant extent, they understand that, in this sector, Proder's investments have had a multiplier effect.

5.3. Bottom-up Approach

In their analysis of the relevance of social capital in local development processes, Esparcia et al. [47] warn of the need to undertake case studies that will allow a deeper understanding of the issue, especially in those rural areas with a weaker productive fabric. This research could be considered a contribution along these lines. As mentioned, the bottom-up approach seeks to encourage the participation of the population in development processes. Social groups are the agents entrusted with this task. The questions posed with respect to this intangible try to evaluate the role that these groups had in the dissemination and implementation of Proder aid. As shown in Figure 6, the majority of the promoters became aware of the existence of the aid through their own means or thanks to the advice of the Local Development Agents (LDA) of the Local Councils of the zone. The LDAs are municipal technicians who, among other tasks, are in charge of managing the local employment boards developing a brokerage work, as well as advising those other people who try to start a business and need information about the available lines of help.

Only four promoters acknowledged having had knowledge of the Proder subsidies through a social group: Vera Tourism Association (ATURIVE). However, it should be noted that those who accessed the subsidies through this channel were managers or direct relatives of the managers of the aforementioned association.

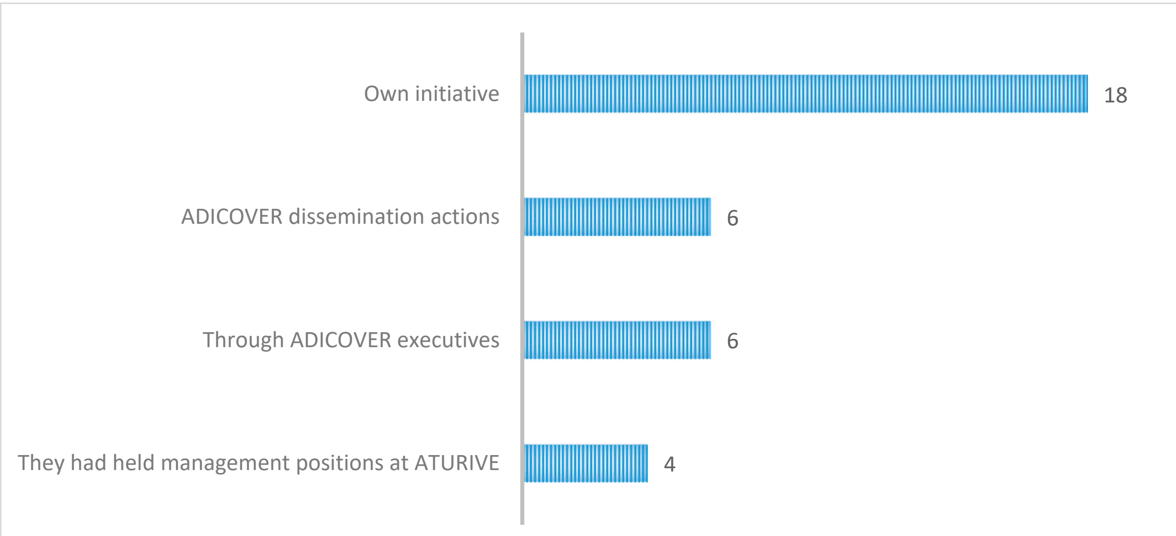

Figure 6. How did you find out about the existence of Proder aid? Source: Own elaboration.

Of the three productive measures, the only one in which there was an entity of a regional nature with the vocation of representing the interests of its sector was that of promoting rural tourism. Most of the tourist entrepreneurs are recognize as being members of ATURIVE. However, Figure 7 shows that only a small part of those interviewed (the association's leaders) consider its operation to be good. On the contrary, the vast majority of the tourism promoters qualify the work carried out by ATURIVE as regular or bad. There were also interviewees were not even able to evaluate the activity of an entity that, in theory, should have stood up and defended its interests.

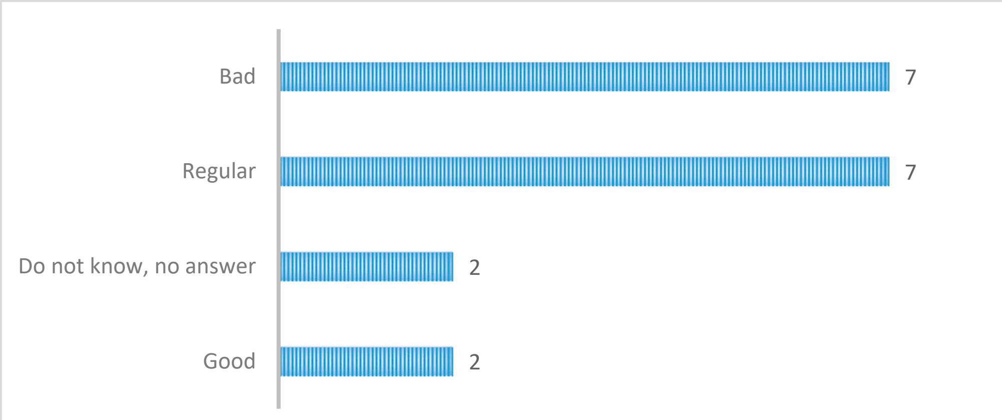

Figure 7. How do you value the operation of ATURIVE? Source: Own elaboration.

The scarce valuation of the tourist promoters with respect to the operation of ATURIVE, the anecdotal role of this association as a promoter of the Proder aids, added to the fact that it is their directors (or their direct relatives), the only ones who recognize having had knowledge of the aids through it, put into question the role of this group in the development process. It might be asked whether this is not one of those situations denounced by Esparcia et al. [52] or Chevalier et al. [63] in their study about the application of the institutional model of the Leader approach in various European regions. As it seems happening with La Vera tourist association, these authors denounce the tendency of local elites to "monopolize" the implementation of the development strategies in their respective territories. Results obtained show the difficulties encountered in implementing a bottom-up development model in La Vera. These conclusions would be in line with those obtained by Guiberteau [15], Navarro et al. [55,56], or Cejudo et al. [84], who show a critical position regarding the capacity of LAGs to implement a truly participatory rural development model.

It seems that the fact that businessmen and mayors of the region belong to the decision-making body ADICOVER is a factor in the dissemination of Proder aid. However, thought should be given to the need to establish control mechanisms to ensure that this does not become an element of 'exclusion' for other promoters who, not being part of these LAG management bodies or not having direct relations with the people who do belong to them, wish to have access to the aid on equal terms.

5.4. Contribution of These Programs to Other Aspects of Territorial Revaluation

As Figure 8 shown, a clear majority of promoters positively valued the effects of Proder on the feeling of belonging to the Association of Municipalities. Often, in the justification of their answers, the interviewees alluded to the promotion campaigns carried out under the rural tourism measure. Also worthy of mention is the recognized contribution of the program to the regional identity, but they point out that this existed prior to Proder. Those who are pronounced in this sense are corroborating some of the arguments used in the methodology section to justify the choice of the La Vera as the case study area.

It was not easy for the private promoters to evaluate Proder's contribution to the conservation of the natural resources and heritage. Almost 40% did not value this issue (Figure 9). Perhaps, the low level of involvement of the promoters in the development strategy is one of the causes that can explain their difficulty to value this issues of general interest linked to the philosophy of the program.

On the other hand, those who considered that Proder had contributed to these aspects highlighted its role in the recovery and signposting of hiking routes, as well as in other actions such as the recovery of small public spaces, the creation of viewpoints, and the adaptation of clean points. Some of those interviewed also highlighted the positive consequences for rural heritage of many of the tourist investments undertaken, given that they involved the restoration of buildings, the recovery of farms, etc.

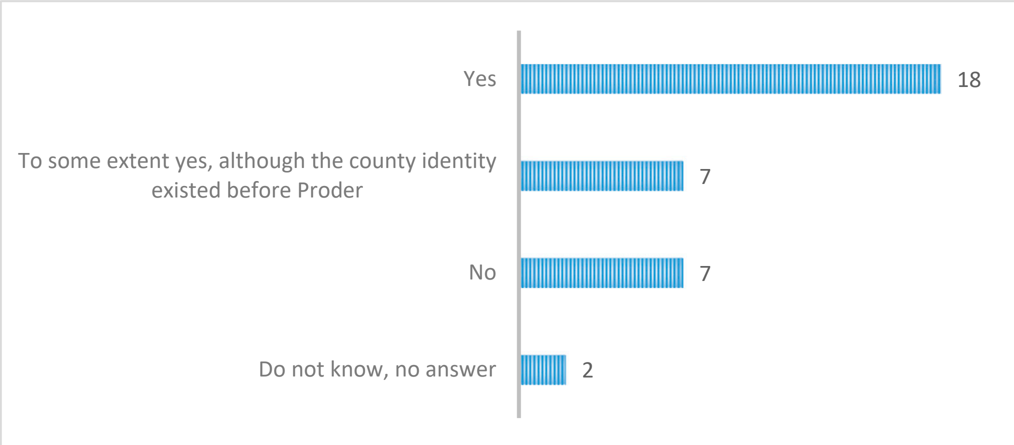

Figure 8. Do you think Proder has reinforced the regional identity? Source: Own elaboration.

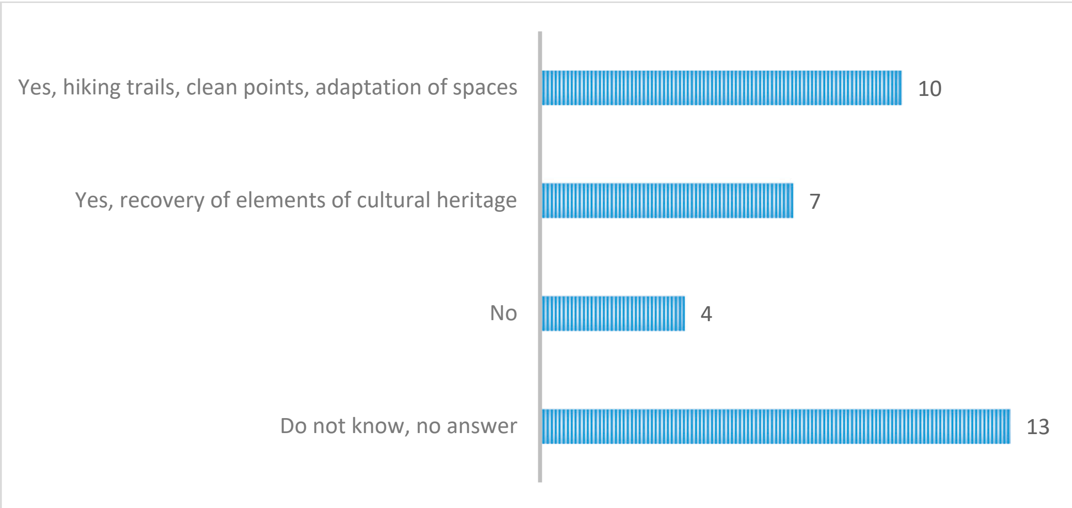

Figure 9. Do you think Proder has contributed to conserving the region's heritage and natural resources? Source: Own elaboration.

6. Conclusions

When relating the results of the investigation with those obtained by other authors, it must be kept in mind that the ideas set forth in the previous section are conditioned by the methodology used. This research is a case study, and this constitutes its main limitation, because it limits the analysis of intangibles to a specific area whose characteristics, in turn, influence the phenomenon under study.

Rural Development Programs are an interesting tool for activating and promoting investments in the rural environment; almost half of the interviewees acknowledged that Proder aid was the element that made them decide to make investments that they had been considering for some time. Among the factors that could explain this capacity are the regional dimension of their management systems and the relations of geographical and human proximity that result from this. However, on its own, the regional dimension does not explain the favorable opinion of the promoters regarding the management system. The involvement of the technical team is a factor that, to a certain extent, depends on something "intangible" such as the attitude with which they face the implementation of the program. Something that in one region may be very well valued, in another may not be so well valued. There is a human component to this issue; it would be interesting if the evaluation of these programs introduced greater relevance to the internal evaluation systems that would allow the promoters themselves to indicate their degree of satisfaction with the attention received and the work carried out by the LAG technical teams.

This research is committed to ensuring that the implementation of this kind of program incorporates internal audit systems that evaluate the quality of the procedures used in the implementation of the program. To date, most of the evaluation systems implemented have only focused on performance indicators based on investments made.

The perception of Proder's role in the economic diversification of the region seems to be distorted by an excessive concentration of investments in the rural tourism sector. This could compromise the program's intended multi-sectorial approach and call for flexible financial programming instruments so that the LAGs, as they detect an excessive concentration of projects in one sector, can change the co-financing rates for the others. On the other hand, the results of the research seem to show that the diffusion effect of the investments, their capacity to serve as an example to other entrepreneurs and to promote new projects, is part of the common ideology of the interviewed promoters.

The research results question the relevance of the social groups both in the execution of the program and in the dissemination of its lines of assistance. The implementation of a bottom-up approach, with a transparency principle, would make it advisable to periodically evaluate the percentage of subsidies that go to stakeholders who form part of the LAG's decision-making bodies, or the boards of the associations that have a voice and vote about them. In addition, it would be advisable to make the participation of social groups in the management bodies of the LAGs dependent on the correct functioning of these associations, the proper flow of information between their members, and the maintenance of a dynamic agenda of activities aimed at the whole of the sector that they represent.

On the contrary, a good proportion of the promoters point out the role that the LDAs of the different municipalities had in their projects. Bearing this in mind, and that a good part of the region's Town Councils form part of the LAG's decision-making bodies, it would be interesting to study formulas so that, with this participation quota, the opinion of these technicians is taken into account.

The analysis of the territorial approach shows the interrelations between the intangible aspects studied and the structure of the program. The promoters point out various actions by which they believe that Proder has contributed to strengthening the regional identity. Among these, it is worth highlighting the tourism promotion campaigns or the management system used to implement the grants. In any case, with their answers, the promoters showed that we are dealing with a region with well-defined borders and where, before Proder, there was already a feeling of belonging to the territory. These multiple interrelations between the program's structure and its intangible parameters were also detected when interviewees tried to justify the way in which Proder has contributed to the conservation of the region's natural resources. In this case, the investments undertaken as part of the unproductive measures to enhance local and rural heritage are the most frequently mentioned, although some promoters also mention in their replies the enhancement of private heritage resources resulting from the creation of various tourist accommodation projects.

Without forgetting the research limitations pointed out at the beginning of the discussion section, the research results represent an approach to the evaluation of the intangibles of rural development that can be a useful tool for those responsible for the planning, management, and evaluation of Rural Development Programs.

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References

1. European Commission. *Guidelines for European Agriculture*; COM (81) 608 Final; Office for Official Publications of the European Communities: Luxembourg, 1981.
2. European Commission. *Perspectives for the Common Agricultural Policy*; The Green Paper of the Commission; Green Europe News Flash 33, COM (85) 333; Communication of the Commission to the Council and the Parliament: Brussels, Belgium, 1985.
3. European Commission. *The Future of Rural Society*; COM (88) 501; Bulletin of the European Communities, Supplement 4/88; Office for Official Publications of the European Communities: Brussels, Belgium, 1988.
4. European Commission. *Comunicación Por la que se Fijan Las Directrices de Unas Subvenciones Globales Integradas para Las que se Invita a Los Estados Miembros a Presentar Propuestas que Respondan a una Iniciativa Comunitaria de Desarrollo Rural (91/C 73/14)*; Diario Oficial de las Comunidades Europeas, no.73/33; Office for Official Publications of the European Communities: Luxembourg, 1991.
5. European Commission. *Communication Setting out Guidelines for Global Grants to Integrated Operational Programs, for Which States Are Requested to Submit Applications for Assistance within a Community Initiative for Rural Development (94/C 180/12)*; Official Journal of the European Communities; Office for Official Publications of the European Communities: Luxembourg, 1994.
6. European Commission. *Communication to the Member States, Laying Down Guidelines for the Community Initiative for Rural Development (Leader +) (2000/C 139/05)*; Official Journal of the European Communities: Office for Official Publications of the European Communities: Luxembourg, 2000.
7. Asociación Europea de Información sobre el Desarrollo Local (AEDL). *La Financiación Local en Los Territorios Rurales*; Cuaderno no.9; Observatorio Europeo Leader: Bruselas, Bélgica, 2000.
8. Consejo Europeo. *Reglamento (CE) no.1290/2005, Sobre la Financiación de la Política Agrícola Común*; Diario Oficial de la UE L/209; Oficina de Publicaciones de la Unión Europea: Luxemburgo, 2005.
9. Consejo Europeo. *Reglamento (CE) no.1698/2005, Relativo a la ayuda al Desarrollo Rural Través del Fondo Europeo Agrícola de Desarrollo Rural (FEADER)*; Diario Oficial de la UE L/277; Oficina de Publicaciones de la Unión Europea: Luxemburgo, 2005.
10. Comisión Europea. *Reglamento (CE) no.1974/2006, por el que se Establecen Disposiciones de Aplicación del Reglamento (CE) no.1698/2005, Relativo a la Ayuda al Desarrollo Rural a Través del Fondo Europeo Agrícola de Desarrollo Rural (FEADER)*; Diario Oficial de la Unión Europea L/368; Oficina de Publicaciones de la Unión Europea: Luxemburgo, 2006.
11. Ministerio de Agricultura Pesca y Alimentación. *Programa Nacional Proder I*; MAPA: Madrid, España, 1996.
12. Ministerio de Agricultura Pesca y Alimentación. *Real Decreto 2/2002, de 11 de Enero, Por el que se Regula la Aplicación de la Iniciativa Comunitaria "Leader Plus" y Los Programas Operativos Integrados y en Los Programas de Desarrollo Rural (PRODER)*; BOE, no.11, de 12 de enero de 2002, MAPA: Madrid, España, 2002.
13. Asociación Europea de Información sobre el Desarrollo Local (AEDL). *Evaluar el Valor Añadido del Enfoque Leader*; Cuaderno no.4; Observatorio Europeo Leader: Bruselas, Bélgica, 1999.
14. Esparcia, J.; Noguera, J. Reflexiones en torno al territorio y al desarrollo rural. In *El Desarrollo Rural en la Agenda 2000*; Ramos, E., Ed.; MAPA: Madrid, España, 1999; pp. 9–44.
15. Guibertau, A. Fortalezas y debilidades del modelo de desarrollo rural por los actores locales. In *Nuevos Horizontes en el Desarrollo Rural*; Márquez, D., Ed.; AKAL: Madrid, España, 2002; pp. 87–104.
16. Shahab, S.; Clinch, J.P.; O'Neill, E. Impact-based planning evaluation: Advancing normative criteria for policy analysis. *Environ. Plannig B Urban Anal. City Sci.* **2019**, *46*, 534–550. [CrossRef]
17. Guyadeen, D.; Seasons, M. Plan Evaluation: Challenges and Directions for Future Research. *Plan. Pract. Res.* **2016**, *31*, 215–228. [CrossRef]
18. Oliveira, V.; Pinho, P. Bridging the gap between planning evaluation and programme evaluation: The contribution of the PPR methodology. *Evaluation* **2011**, *17*, 293–307. [CrossRef]
19. Esparcia, J. Las políticas de desarrollo rural: Evaluación de resultados y debate en torno a sus orientaciones futuras. In *El Mundo Rural en la Era de la Globalización: Incertidumbres y Potencialidades*; García, F., Ed.; Ministerio de Agricultura, Pesca y Alimentación: Madrid, España, 2001; pp. 267–309.
20. Delgado, M.T.; Ramos, E.; Gallardo, R.; Ramos, F. De las nuevas tendencias en la evaluación a su aplicación en las iniciativas europeas de desarrollo rural. In *El Desarrollo Rural en la Agenda 2000*; Ramos, E., Ed.; Ministerio de Agricultura, Pesca y Alimentación: Madrid, España, 1999; pp. 323–344.

21. Delgado, C.; De la Fuente, M.T. Las estrategias de desarrollo rural: Una valoración del PRODER en Cantabria. In *Actas del X Coloquio de Geografía Rural*; Asociación de Geógrafos Españoles, Grupo de Geografía Rural: Ciudad Real, España, 2000; pp. 623–634.
22. Vargas, M.; Mondéjar, J.A. Análisis de la inversión de los Fondos Europeos para el Desarrollo rural en Castilla-La Mancha. *Rev. Económica Castilla Mancha* **2006**, *9*, 189–238.
23. Alario, M.; Baraja, E. Políticas públicas de desarrollo rural en Castilla y León: ¿Sostenibilidad consciente o falta de opciones? LEADER II. *Boletín Asoc. Geógrafos Españoles* **2006**, *41*, 267–293.
24. Ruíz, E.; Frutos, L.M.; Climent, E. La iniciativa comunitaria LEADER II y el desarrollo rural: El caso de Aragón. *Geographicalia* **2000**, *38*, 71–84.
25. Cejudo, E.; Navarro, F.A. La inversión en los programas de desarrollo rural. Su reparto territorial en la provincia de Granada. *An. Geogr. Univ. Complut.* **2009**, *29*, 37–64.
26. Nieto, A.; Cárdenas, G. The Rural Development Policy in Extremadura (SW Spain): Spatial Location Analysis of Leader Projects. *ISPRS Int. J. Geo Inf.* **2018**, *7*, 76. [CrossRef]
27. Mejías, F.; Dolores, C. *Desarrollo en el Medio Rural: 101 Proyectos Singulares de Los Grupos de Acción Local de Extremadura: 1995–2006*; Red Extremeña de Desarrollo Rural: Badajoz, España, 2007.
28. Nieto, A.; Cárdenas, G.; Costa, L.M. Principal Component Analysis of the LEADER Approach (2007–2013) in South Western Europe (Extremadura and Alentejo). *Sustainability* **2019**, *11*, 4034. [CrossRef]
29. Carvalho, P.; Fernandez, J.L. Iniciativas de desenvolvimiento local no espaço rural portugués. In *Território, Inovaçao e Trajectorias de Desenvolvimiento*; Caetano, L., Ed.; Centro de Estudios Geográficos da Fluc: Coimbra, Portugal, 2001; pp. 241–272.
30. Candela, A.R.; García, M.M.; Such, M.P. La potenciación del turismo rural a través del programa LEADER: La Montaña de Alicante. *Investig. Geográficas* **1995**, *14*, 77–98. [CrossRef]
31. Hernández, M.; Moltó, E.A.; Rico, A.M. Las actividades turístico-residenciales en las montañas valencianas. *Eria* **2008**, *75*, 77–97.
32. García, R. Turismo y desarrollo rural en la comarca del Noroeste de la región de Murcia: Los programas europeos LEADER. *Cuad. Tur.* **2011**, *27*, 419–435.
33. Pérez, M.; López, E. La contribución del turismo a la diversificación de actividades en un espacio rural periférico. Análisis del impacto de la iniciativa LEADER en Galicia. *Estud. Agrosoc. Pesq.* **2005**, *206*, 111–135.
34. Toledano, N.; Gessa, A. El turismo rural en la provincia de Huelva. Un análisis de las nuevas iniciativas creadas al amparo de los programas Leader II y Proder. *Rev. Desarro. Rural. Coop. Agrar.* **2002**, *6*, 107–122.
35. Márquez, D.; Foronda, C.; Galindo, L.; García, A. Eficacia y eficiencia de Leader II en Andalucía. Aproximación a un índice-resultado en materia de turismo rural. *Geographicalia* **2005**, *47*, 137–142.
36. Nieto, A.; Cárdenas, G. 25 años de políticas europeas en Extremadura: Turismo rural y método Leader. *Cuad. Tur.* **2017**, *39*, 389–416. [CrossRef]
37. Mondéjar, J.A.; Mondéjar, J.; Vargas, M. Análisis del turismo cultural en Castilla-La Mancha (España). El impacto de los programas europeos de desarrollo rural LEADER y PRODER. *Estud. Perspect. Tur.* **2008**, *17*, 359–370.
38. Pillet, F. Del turismo rural a la plurifuncionalidad en los territorios LEADER y PRODER de Castilla-La Mancha. In *Turismo Rural y Desarrollo Local*; Cebrián, F., Ed.; Universidad de Castilla-La Mancha: Cuenca, España, 2008; pp. 187–198.
39. García, M.; De la Calle, M. Turismo en el medio rural: Conformación y evaluación de un sector productivo en plena transformación. El caso del Valle del Tiétar (Ávila). *Cuad. Tur.* **2006**, *17*, 75–101.
40. Marques, H. Searching for complementarities between agriculture and tourism: The demarcated Wine-producing regions of northern Portugal. *Tour. Econ.* **2006**, *12*, 147–155. [CrossRef]
41. Gatti, S.; Incerti, F.; Ravagli, M. Wine and tourism: New perspectives for vineyard areas in Emilia-Romagna. *Cah. Econ. Sociol. Rural.* **2002**, *62*, 97–117.
42. Iakovidou, O.; Koutsouris, A.; Partalidou, M. The development of rural tourism in Greece, through the initiative Leader II: The case of northern and central Chalkidiki. *Mediterr. J. Econ. Agric. Environ.* **2002**, *4*, 32–38.
43. Varvaressos, S.; Soteriadis, M. Rural tourism's planning into the framework of European initiative LEADER Plus. *Arch. Econ. Hist.* **2002**, *14*, 191–213.
44. Cebrián, A.; García, R. El Modelo LEADER, base del ordenamiento rural en el Unión Europea. *Ágora* **2008**, *14*, 22–48.

45. Pérez Rubio, J.A. *Los Intangibles en el Desarrollo Rural*; Universidad de Extremadura: Cáceres, España, 2007.
46. Saz-Gil, M.I.; Gómez-Quintero, J.D. Una aproximación a la cuantificación del capital social: Una variable relevante en el desarrollo de la provincia de Teruel, España. *EURE* **2015**, *41*, 29–51. [CrossRef]
47. Esparcia, J.; Escribano, J.; Serrano, J. Una aproximación al enfoque del capital social y a su contribución al estudio de los procesos de desarrollo local. *Investig. Reg.* **2016**, *34*, 49–71.
48. Moyano, E. Capital social, gobernanza y desarrollo en áreas rurales. *Ambienta* **2009**, *88*, 112–126.
49. Moyano, E. El concepto de capital social y su utilidad para el análisis de las dinámicas del desarrollo. *Rev. Fom. Soc.* **2001**, *56*, 35–63.
50. Moyano, E. Capital social y acción colectiva en el sector agrario. *Rev. Española Sociol.* **2008**, *10*, 15–37.
51. Buciega, A. *Capital Social en el Marco de Los Grupos para el Desarrollo Rural Leader: Análisis de Casos en la Provincia de Valencia*; Universitat de València, Instituto Interuniversitario de Desarrollo Local: Valencia, España, 2009.
52. Esparcia, J.; Noguera, J.; Pitarch, M.D. LEADER en España: Desarrollo rural, poder, legitimación aprendizaje y nuevas estructuras. *Doc. Anal. Geogr.* **2000**, *37*, 95–113.
53. Alberdi, J.C. El medio rural en la agenda empresarial: La difícil tarea de hacer partícipe a la empresa en el desarrollo rural. *Investig. Geográficas* **2008**, *45*, 63–91. [CrossRef]
54. Garrido, F.; Moyano, E. Capital social y desarrollo en zonas rurales: Un análisis de los programas Leader II y Proder en Andalucía. *Rev. Int. Sociol.* **2002**, *60*, 67–96. [CrossRef]
55. Navarro, F.; Cejudo, E.; Maroto, J.C. Reflexiones en torno a la participación en el desarrollo rural. ¿Reparto social o reforzamiento del poder? LEADER y PRODER en el sur de España. *EURE* **2014**, *40*, 203–224. [CrossRef]
56. Navarro, F.A.; Woods, M.; Cejudo, E. The LEADER Initiative has been a Victim of Its Own Success. The Decline of the Bottom-Up Approach in Rural Development Programmes. The Cases of Wales and Andalusia. *Sociol. Rural.* **2016**, *56*, 270–288. [CrossRef]
57. Osti, G. LEADER and Partnerships: The Case of Italy. *Sociol. Rural.* **2000**, *40*, 172–180. [CrossRef]
58. Lukic, A.; Obad, O. New Actors in Rural Development—The LEADER Approach and Projectification in Rural Croatia. *Sociol. Space* **2016**, *1*, 71–90.
59. Chmieliński, P. On community involevement in rural development—A case of Leader Programme in Poland. *Econ. Sociol.* **2011**, *4*, 120–128. [CrossRef]
60. Marquardt, D.; Möllers, J.; Buchenrieder, G. Social networks and rural development: LEADER in Romania. *Sociol. Rural.* **2012**, *52*, 398–431. [CrossRef]
61. Quaranta, G.; Citro, E.; Salvia, R. Economic and Social Sustainable Synergies to Promote Innovations in Rural Tourism and Local Development. *Sustainability* **2016**, *8*, 668. [CrossRef]
62. Salvia, R.; Quaranta, G. Place-based rural development and resilence: A lesson from a small community. *Sustainability* **2017**, *9*, 889. [CrossRef]
63. Chevalier, P.; Mačiulyté, J.; Razafimahefa, L.; Dedeire, M. The Leader Programme as a model of institutional transfer: Learning from its local implementation in France and Lithuania. *Eur. Countrys.* **2017**, *2*, 317–341. [CrossRef]
64. Chevalier, P.; Dedeire, M. Application du programme leader selon les principes de base du développement local. *Econ. Rural.* **2014**, *342*, 9–25. [CrossRef]
65. Bruckmeier, K. Leader in Germany and the discourse of autonomous regional development. *Sociol. Rural.* **2002**, *40*, 219–227. [CrossRef]
66. Shucksmith, M. Endogenous development, social capital, and social inclusion: Perspectives from Leader in the UK. *Sociol. Rural.* **2002**, *40*, 208–218. [CrossRef]
67. Konečný, O. The Leader Approach across the European Union: One method of rural development, many forms of implementation. *Eur. Countrys.* **2019**, *11*, 1–16. [CrossRef]
68. Muresan, I.C.; Oroian, C.; Harun, R.; Arion, F.; Porutiu, A.; Chiciudean, G.; Todea, A.; Lile, R. Local Residents Attitude toward Sustainable Rural Tourism Development. *Sustainability* **2016**, *8*, 100. [CrossRef]
69. Muresan, I.C.; Harun, R.; Arion, F.; Oroian, C.; Dumitras, D.; Mihai, V.; Ilea, M.; Chiciudean, D.; Gliga, I.; Chiciudean, G. Residents´ perception of destination quality: Key factors for sustainable rural development. *Sustainability* **2019**, *11*, 2594. [CrossRef]
70. Abdollahzadeh, G.; Sharifzadeh, A. Rural residents´perceptions toward tourism development: A study from Iran. *Int. J. Tour. Res.* **2014**, *16*, 126–136. [CrossRef]

71. Harun, R.; Chiciudean, G.; Sirwan, K.; Arion, F.; Muresan, I. Attitudes and perceptions of the local community towards sustainable tourism development in Kurdistan Regional Goberment. *Sustainability* **2018**, *10*, 2991. [CrossRef]
72. Coller, X. *Estudio de Casos. Colección Cuadernos Metodológicos*; CIS: Madrid, España, 2000.
73. Durán, M. Estudio de Caso en investigación cualitativa. *Rev. Adm.* **2012**, *3*, 121–134. [CrossRef]
74. Jiménez, V.; Comet, C. Los Estudios de Caso como enfoque metodológico. *Rev. Investig. Cienc. Soc. Humanid.* **2016**, *3*, 1–11.
75. Yin, R. *Case Study Research and Applications: Design and Methods*; SAGE: Los Angeles, CA, USA, 2018.
76. Yin, R. *Qualitative Research from Start to Finish*; The Guilford Press: New York, NY, USA, 2016.
77. González, J. (Ed.) El método Leader: Un instrumento territorial para un desarrollo rural sostenible. El caso de Extremadura. In *Desarrollo Rural de Base Territorial: Extremadura (España)*; MAPA y Consejería de Desarrollo Rural de la Junta de Extremadura: Badajoz, España, 2006; pp. 13–90.
78. Cheevapattananuwong, P.; Baldwin, C.; Lathouras, A.; Ike, N. Social Capital in Community Organizing for Land Protection and Food Security. *Land* **2020**, *9*, 69. [CrossRef]
79. Vecchio, Y.; Iddrisu, A.; Adinolfi, F.; De Rosa, M. Geographical Indication to Build up Resilient Rural Economies: A Case Study from Ghana. *Sustainability* **2020**, *12*, 2052. [CrossRef]
80. Vukomanovic, J.; Skrip, M.; Meentemeyer, R. Making It Spatial Makes It Personal: Engaging Stakeholders with Geospatial Participatory Modeling. *Land* **2019**, *8*, 38. [CrossRef]
81. Castro-Pardo, M.; Pérez-Rodríguez, F.; Martín-Martín, J.; Azevedo, J. Planning for Democracy in Protected Rural Areas: Application of a Voting Method in a Spanish-Portuguese Reserve. *Land* **2019**, *8*, 145. [CrossRef]
82. Brankov, J.; Jojić, T.; Milanović, A.; Petrović, M.; Tretiakova, T. Resident's Perceptions of Tourism Impact on Community in National Parks in Serbia. *Eur. Countrys.* **2019**, *11*, 124–142. [CrossRef]
83. Castellano-Álvarez, F.J.; Del Río Rama, M.C.; Álvarez-García, J.; Durán-Sánchez, A. Limitations of Rural Tourism as an Economic Diversification and Regional Development Instrument. The Case Study of the Region of La Vera. *Sustainability* **2019**, *11*, 3309. [CrossRef]
84. Cejudo, E.; Navarro, F.; Camacho, J. Perfil de los beneficiarios de los Programas de desarrollo rural en Andalucía. Leader + y Proder II (2000–2006). *Cuad. Geográficos* **2017**, *56*, 155–175.

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Entrepreneurs and Territorial Diversity: Success and Failure in Andalusia 2007–2015

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Abstract: Rural Europe today cannot be understood without considering the impact of the EU's Liaisons Entre Actions de Developpement de l'Economie Rurale (LEADER) rural development programme. Although in general it has had a positive impact, research has also revealed spatial and social disparities in the distribution of funds. Our primary source was the files for all the LEADER projects processed in Andalusia between 2007 and 2015. In addition to successfully executed projects, we also focused on "unfunded" projects, those in which, although promoters had initiated the application procedure, a grant was never ultimately obtained. Project failure must be studied so as to avoid biased findings. We then classified these projects within the different types of rural area and analysed the behaviour of the different promoters in these areas. Relevant findings include: project success or failure varies according to the different types of rural area, as does the behaviour of the different promoters; the degree of rurality can hinder project success; young and female entrepreneurs were more likely to fail; the type of promoter is strongly influenced by the distance to cities in that companies and Individual Entrepreneurs tend to invest in periurban spaces, while public sector promoters such as Local Councils are more prominent in remote rural areas.

Keywords: neo-endogenous rural development; LEADER approach; rural areas; classification and types of rural areas; good practices; rural depopulation and aging; young and female entrepreneurs; entrepreneurship; funded and unfunded projects; Andalusia

1. Introduction: State of the Art

The current situation of rural areas cannot be fully understood without taking into account the impact of the LEADER programme. LEADER, an acronym for its French title "Liaisons Entre Actions de Developpement de l´Economie Rurale", has been applied throughout the rural areas of the European Union (EU). It was created as a "laboratory" for innovation which could strengthen local capacities and help solve problems in rural areas, via a strongly territorial, "bottom-up" approach. Since it was first established at the beginning of the 1990s, it has become the most emblematic practical application of the recent theories of neo-endogenous rural development on which it is based. The aim of LEADER is to plant the seeds for strong, self-sustaining rural development. The main specificities of this approach are: to promote innovation, above all social innovation; the integrated, multi-sector nature of the projects; the territorial perspective; networking; economic diversification; the bottom-up approach; local decision-making. Originally established as an European Economic Community (EEC) Initiative (1991–2006) implemented through Local Action Groups (LAGs) made up of entrepreneurs, public institutions and civic associations, it was later integrated (since 2007) into the corresponding national and regional Rural Development Programmes, with specific LEADER actions.

Its implementation, with varying degrees of success [1–3], has revealed among other things: the unequal territorial distribution of LEADER funds [4–8]; the development of important social innovation processes in rural areas [9,10]; the varying participation of the different stakeholders as promoters of LEADER projects [11,12]; the vital importance of social capital in rural development processes [13–17]; and the importance for rural development of the promotion and enhancement of natural and cultural heritage, both as cohesive elements of local identity that must be protected and as hugely powerful assets for enhancing rural tourism. These are both emblematic aspects of the LEADER programme. On these lines, various articles have examined the impact of LEADER on for example ways of combining traditional agricultural and livestock practices with agritourism [18,19] wine tourism [20,21], olive oil tourism [22], dehesa grasslands [23], landscapes [24], local skills, knowledge and festivals [25] or the impact on the structure of the rural tourism sector produced by LEADER-related actions, which resulted in an excess supply of accommodation, which was often of poor quality [26]. Other research has focused on the role of LEADER in halting the depopulation of rural areas [27–29], strengthening their level of resilience [30] or simply, as a new methodology for intervention in the development of rural areas [31,32], known as the LEADER approach [33,34].

Both these and many other articles that could be cited centre on LEADER projects that have been successfully carried out and tend to ignore those other projects in which although the promoters had begun the LEADER grant application procedure, a grant was never ultimately obtained. In this article, we will be referring to these projects as unfunded projects. In other words, research on the LEADER programme has tended to focus on funded projects and has largely ignored the projects that applied for but did not finally receive financial support from the programme. We believe, together with Rodríguez et al. [35] (pp. 103–104), that it is also necessary to study issues such as failure, inefficiency and the incapacity to foresee change, so as to avoid biased explanations of social action that tend to marginalise those who do not fit into prevailing success-linked models.

This is why the only research in the literature that deals with the question of unfunded projects, does so indirectly. Dargan and Shucksmith [36] (p. 285) talked about a "project class" made up above all of members of the LAG and well-positioned actors in the public and private sector with substantial financial resources, knowledge and innovation capacity, who control and are well informed about LEADER investments. At the other end of the scale, there are other groups including young people and women, who are less involved even though their projects enjoy certain advantages in the selection and funding process. The authors of [37–40] also made it clear that women are less likely to become rural entrepreneurs, even though they are less afraid of business failure. In spite of this, the LEADER programme has contributed, together with other initiatives, to the creation of new identities and social representations of rural women, which have made them more visible [41] and have enhanced social inclusion in a context in which new socioeconomic and spatial realities are emerging in rural areas of Europe [42,43]. This will lead to the progressive empowerment of women in the personal, family, social and political spheres [44].

Our past research on projects of this kind in Andalusia for the programme period 2000–2006 [45–47] revealed first of all that there was a need to improve management and to update the criteria and the processes for the selection and monitoring of projects. We also found that the number of unfunded projects varies greatly from one territory to the next, a fact which was reflected, in an extreme case, in the considerable number of municipalities in which none of the proposed projects were funded. Another weakness of the LEADER approach was that it did not establish specific measures for areas with low population density to combat the problems arising from depopulation. In general in these areas, neo-endogenous rural development action has not achieved the desired results and at times has even proved unsuitable, missing important opportunities to help reverse depopulation. Finally, the typical profile of the promoters of unfunded projects was that of a young person, and in particular a young woman, who was trying to set up a business. The most common legal forms within which these businesses were established were as self-employed workers, limited companies or business partnerships.

Our proposed field of study is therefore quite original, not only because the subject that we have chosen, namely unfunded projects, has rarely been studied in our field of research, as mentioned above, but also due to the level of detail of the information on which our research is based, the individual files for each project, in a territory like Andalusia, a large region with a population of about 8.5 million people.

In this research our aim is to analyse both the unfunded and the successfully executed projects by looking at the number of projects, and the territories in which they implemented or sought to implement these projects, according to different territorial typologies that enable us to assess and compare their behaviour. Our initial hypotheses are that, on the basis of our previous research studies, the groups with the greatest limitations when it comes to starting a business, including among others individual entrepreneurs and the smallest, most vulnerable companies, will be those least likely to try to set up businesses and most likely to fail. In addition, the participation of the different stakeholders will vary according to the territory in question, with the public sector playing a greater role in less developed areas, and private investors dominating in the areas with more dynamic economies.

2. Sources, Methodology and Study Area

The basic source we used was the list of projects for which grant applications were processed (12,855) under the LEADER programme between 2007 and 2015. This information was provided by the Department of Agriculture, Fishing and Rural Development of the Regional Government of Andalusia. For comparison purposes, we have separated the projects into executed projects (6225) and unfunded projects (6630). Unfunded projects were considered to be those which, after a grant application had been made and a file had been opened, were ultimately not executed with LEADER funds. This does not necessarily mean that these projects were never carried out as on occasions the promoters decided to renounce LEADER funds so as to qualify for finance from other programmes.

There are various problems involved in working with this source, especially when analysing unfunded projects: missing information as the forms have numerous uncompleted boxes; countless typing errors, mistakes in the coding of some of the variables, etc. We are therefore working with projects in which the information was often not fully filled in or contained errors, only some of which can be corrected, and in the case of the unfunded projects, which were either never carried out or if they were carried out were done so without LEADER funds.

The types of promoters in this study (as listed below in Table 2) are those described in the source and the analysed variable was the number of funded/unfunded projects.

The results of the statistical analysis were input into a Geographic Information System, ARCGIS 10.6, which produced graphic outputs in the form of vectorial plans that were exported to jpg format. We were unable to perform a qualitative analysis regarding the reasons why the promoters of unfunded projects decided not to continue with them.

Although our analyses were conducted at the municipal scale, they were based on individual files, which means that we only studied those municipalities in which files were opened in relation to applications for LEADER grants. Those projects in which it was not absolutely clear in which municipality the project was intended to be carried out were excluded. The results were then aggregated at the regional level in line with the different types of territory established for Andalusia. Adjacent municipalities of the same type were joined together on the map.

The enormous difficulties inherent in establishing a typology of rural spaces in Spain, or in the OECD in general [48], are due to questions such as the availability and reliability of current and historic sources, the scales with which one decides to work, the variables that are used to establish the different typologies (rural, intermediate or urban) or the thresholds which are set to distinguish between them. The Spanish National Statistics Institute (Instituto Nacional de Estadística) uses the total population as a defining variable, establishing a threshold of up to 2000 inhabitants for rural municipalities and up to 10,000 for medium-sized. Municipalities with over 10,000 inhabitants are regarded as urban. This classification is widely used because of the availability and reliability over time of the data, although certain doubts have also been raised because of the constant need to increase the thresholds to take into account that a municipality may contain various separate centres of population [49]. However, this typology does not always adapt to the peculiarities of the territorial structure, as happens in our study area, Andalusia, in which the typology adapts poorly to a region in which "agri-towns" [50–52] or intermediate towns [53,54] play a very important role.

Following the recommendations of the OECD [55], the European Union established three large territorial categories (mainly rural regions, intermediate regions and mainly urban regions) on the basis of a benchmark population density figure of 100 inhab/km^2 used to distinguish rural municipalities from urban ones. Under this system, the mainly rural regions are those in which over 50% of the population live in rural municipalities; the intermediate regions are those in which between 15% and 50% live in rural municipalities; meanwhile, the mainly urban regions are those in which less than 15% of the regional population live in rural municipalities. This classification could be applicable to NUTS 3 regions. In recent years, interesting proposals have emerged in this regard at the local level. Firstly, Molinero [56] established a rural typology in which population density was the main criterion. This is because population density is a key factor in any rural development policy and since the 1990s has been the most frequently used criterion by the OECD, the EU and the Spanish Ministry of Agriculture, as well as by geographers and territorial planners. This classification developed from Law 45/2007 on the Sustainable Development of Rural Areas promoted by the Ministry of Agriculture, which classified as rural all those municipalities with less than 30,000 inhabitants and less than 100 inhabitants/km^2. This group was then subdivided into three types of rural municipality: deep < 5 inhab/km^2; stagnant "5" to "24.9"; and dynamic "25" to "99.9" inhab/km^2. The application of this classification in rural spaces in Andalusia could be problematic due, as mentioned earlier, to the socio-territorial importance of agri-towns in the region.

Secondly, de Cos and Reques (2019) [57] proposed a typology of spaces based on their territorial and demographic vulnerability using cartographic sources available in GIS format, taking advantage of new European and Spanish legislation enabling access to official cartographic databases in digital format. For this typology, a multi-criterion analysis involving a weighted linear combination was applied. Although the methodology and the resources used appeared to us to involve a very important qualitative leap in an attempt to go beyond classifications based on population or density, the resulting aggregation of results in nine categories according to the degree of vulnerability would be difficult to apply in this research study. In addition, while the notion of territorial vulnerability fits quite well with the real situation in Andalusia, that of demographic vulnerability does not provide such a good fit.

One of the most widely cited proposals for the classification of rural areas in Spain was presented by Reig, Goerlich and Cantarino (2016) [58]. These authors based their proposal on the classification made by the OECD and the EU, which was itself based on population variables such as density, and took the 1 km^2 grid as a spatial reference for analysis. The use of newly available georeferenced data as to exactly where each inhabitant lived within the municipality enabled them to avoid all the distortions caused by calculating the population density on the basis of the total area of the different municipalities, in which there are often large areas with little or no population. They also included, in line with other research work being conducted in the EU, accessibility to urban centres and to services, considering for this purpose the closest towns or cities with a population of over 50,000 people [59]. They also looked at land uses in order to classify intermediate and urban areas into closed and open spaces, and used the time taken to access services to classify rural territories into near (up to 45 min) and remote (more than 45 min). On the basis of this classification and taking into account that our analysis focuses above all on rural areas in that it examines projects linked to the LEADER programme, we decided to modify this classification system, applying as a discriminatory variable the time taken to access services. On this basis, the intermediate municipalities were divided into near and remote, depending on whether or not they were over 30 min from a city (as most are situated in parts of the Guadalquivir Valley with a high population density). In rural areas, a third category was established due to the widely diverse range of situations observed in the different municipalities. These were divided into "near"—those less than 45 min away from a city—, "remote"—between 45 and 60 min—, and "deep"—60 or more min away—(Figure 1). We believe that with the aforementioned modifications, this is the classification that best adapts to the real situation in Andalusia.

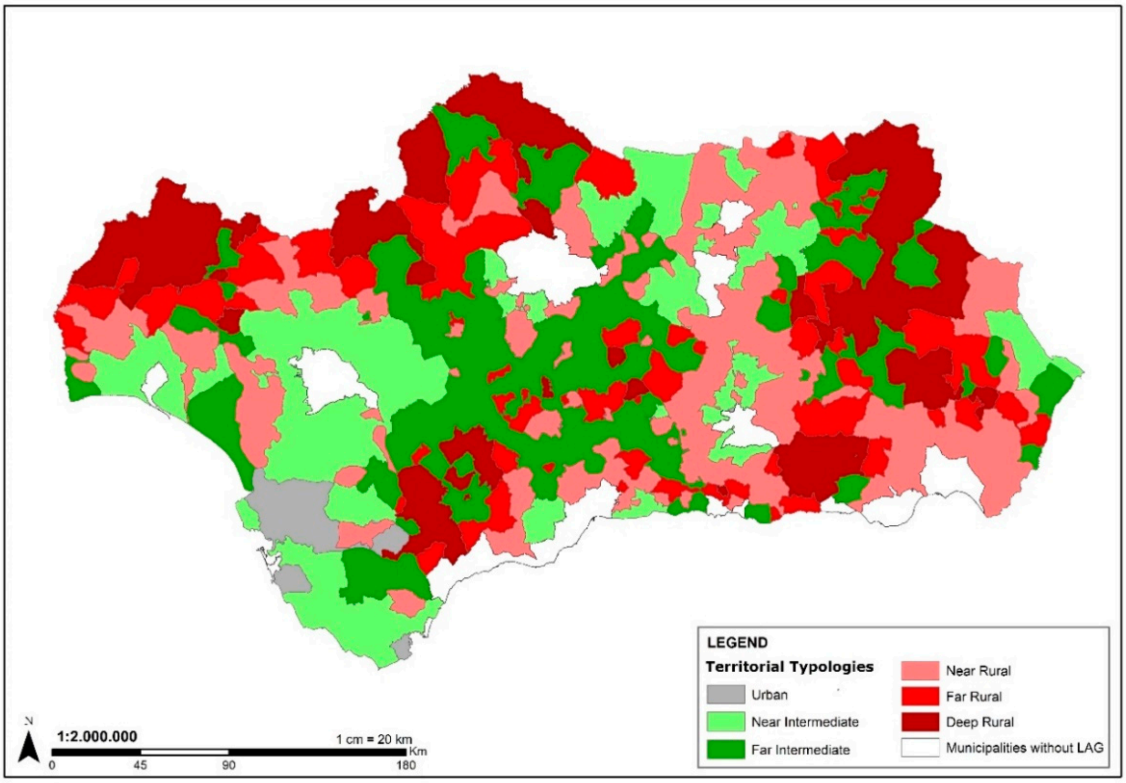

Figure 1. Territorial typology of Andalusia (Reig et al.) [58], adapted by the authors.

Table 1 presents various synthetic indicators of sociodemographic aspects of the different typologies. The table was drawn up using data from 2011. This year was chosen as a reference because it falls halfway through the study period (2007–2015) and because census and local registration information is readily available.

After a brief analysis of the data presented, we found that in 2011, 5.9% of the municipalities in Andalusia were urban areas. These covered 6.7% of the total surface area and were home to almost 50% of the population, with very high densities. The population of these municipalities continued to rise over the study period, increasing by 168,940 inhabitants, 48.3% of the total increase across the region. This trend continues the pattern which first appeared in Spain in the 1960s as witnessed by the fact that the population in these municipalities rose by over 40% between 1961 and 2011. These municipalities are generally situated in flat areas at an average altitude of less than 260 m and are very close to areas that provide services at a distance of just 4 min. They have the lowest average age population and a relatively high proportion of the population are over 65. The agricultural sector is relatively insignificant, as can be seen from the number of people affiliated to the agrarian section of the Social Security system, who account for less than 4% of the population in open urban areas.

By contrast, 66.1% of the municipalities are classified as rural. These cover 52.7% of the territory and house 12% of the population (2011). In demographic terms, over the period 2007–2015 the population of these municipalities fell by 1825 people, although the greatest losses were in the regions furthest away from service centres (Regions 6 and 7, Types 6 and 7 of Table 1), and in fact there were gains in the nearest areas (Region 5, Table 1), although these were not sufficient to make up for the losses in the more remote areas. A trend shared by all three types of rural municipality was that their population in 2011 was less than that in 1961 with accumulated losses of over 22.3%. The decline was more intense the more remote the municipality, as can be seen by the fact that almost half the loss of population took place in Category 7 areas (Table 1). The rural municipalities are normally situated at higher altitudes of between 518 and 718 metres on average and tend to be further away (between 30 and 70 min) from the services provided by towns and cities with populations of over 50,000 inhabitants. These rural municipalities also have the oldest populations with an average age of 46 years old and well over 20% of the total population aged 65 years old or over. Perhaps the most serious statistic in the villages in Category 7 (Table 1) is the aging rate (the ratio between people aged 65 or over and people aged under 15), which is twice the regional average (183 compared to the regional average of 93). As might be expected, the figures for affiliation to the Social Security system clearly reflect the continued dominance of the farming sector, as can also be seen from the number of people claiming the Agricultural Unemployment Subsidy and the Agrarian Income Supplement, benefits received by temporary farmworkers in Andalusia and Extremadura [60–62].

Finally, and so as not to extend this territorial presentation unnecessarily, the intermediate municipalities accounted for 27.9% of the total, 40.6% of the surface area and 38.4% of the population. In general, the variables for the intermediate municipalities range between the other two categories, although we should also highlight Category 4, Remote Intermediate, a category which normally coincides with the agri-towns, located at some distance from the services provided by the city (on average 45 min away). These towns act as capitals of their respective subregions and perform a key function in the provision of basic services and facilities, both public and private, that are highly essential in rural Andalusia.

Table 1. Socioeconomic indicators according to territorial typologies.

	Urban		**Intermediate**		**Rural**			**Total**
	Closed	**Open**	**Near**	**Remote**	**Near**	**Remote**	**Deep**	
	Type_1	**Type_2**	**Type_3**	**Type_4**	**Type_5**	**Type_6**	**Type_7**	
Nº municipalities	28	18	125	91	228	132	151	773
Area km^2	826	5071	16,500	19,170	18,895	12,138	15,186	87,786
Population_2011	2,086,485	2,071,715	1,997,533	1,225,614	555,114	238,687	214,696	8,389,844
Density_2011	2.527	409	121	64	29	20	14	96
Travel time	3.8	3.4	17.3	45.0	30.3	51.7	73.3	40.4
Altitude	256	264	267	381	518	631	718	504
Pop_Women	51.7	51.3	49.4	50.1	49.0	49.3	49.3	50.5
Pop_Men	48.3	48.7	50.6	49.9	51.0	50.7	50.7	49.5
Pop/Municipality	74,517	115,095	15,980	13,468	2435	1808	1422	10,854
Pop. Growth_2007–2015	88,402	80,538	182,781	2659	20,825	−8123	−14,527	352,555
Pop. Growth_2011–1961	43.3	41.9	36.7	1.3	−6.6	−7.1	−9.6	100.0
Pop._0–14 years	15.9	16.8	17.8	16.0	14.5	12.8	12.6	16.3
Pop._15–64 years	68.9	68.9	69.6	67.5	66.7	65.4	64.2	68.5
Pop._≥ 65 years	15.2	14.3	12.6	16.5	18.9	21.8	23.2	15.2
Aging rate	95.7	85.4	71.1	103.3	130.3	171.0	183.3	93.3
Average age	37.9	37.7	38.1	40.4	43.3	45.7	46.0	42.7
Affil. General Reg.	81.0	78.8	50.3	40.8	30.0	29.8	28.3	62.7
Affil_Agrarian Reg.	1.2	3.6	26.5	37.4	51.1	50.3	49.2	17.7

Source: Instituto de Estadística de Andalucía. The authors.

3. Results

It is important to remember that we only included those projects in which a particular municipality was mentioned as the place where the project was to be carried out. All projects without a specific location were excluded as were those that were intended to be executed at the sub-regional rather than the municipal scale. This explains why although 12,855 projects commenced the application procedure, in this study we only analysed 11,104 or 86.4% of the total. Of the 1751 projects that were not included in our study, 1271 were unfunded projects and 480 were successfully executed. Another interesting statistic is that 94.6% of the funded projects were promoted by associations including the Local Action Groups (LAG) (This category includes promoter types G, G14 and J (this classification is followed in Tables 2 and 3).). Associations were also the body that initiated the largest number of unfunded projects at 427, or 33.6% of the total. This was followed by Individual Entrepreneurs with 365 unfunded projects and various different types of private companies (This category includes promoter types A, B, E and F (this classification is followed in Tables 2 and 3).) with 324. Non-profit making associations such as LAGs were therefore the promoter most affected by our decision to analyse the projects at a municipal scale and are therefore somewhat underrepresented in our results. This is because a lot of the projects presented by these kinds of associations were organised at a sub-regional level rather than a municipal level. This under-recording is substantially less significant in the other variables analysed, although it should also be taken into account. Lastly, the results will be discussed on the basis of five large categories of promoters: Private companies (see note 2); Non-profit making associations (see note 1); Local Councils (code P); Individual Entrepreneurs (code PF) and others (This category includes promoter types Q, R, S and U (this classification is followed in Tables 2 and 3)). Later, we will be looking at some of the components of these large categories in more detail.

3.1. Funded and Unfunded Projects. An Overview

The first variable to analyse was the number of projects in which the application procedure for a LEADER grant was initiated. This was done by the type of promoter and by the type of territory, as established above. The initial objective was to answer the following questions: Do the different kinds of promoter act in the same way? Do participation levels vary from one type of territory to the next? Do the different types of promoter have the same probability of success or failure at the outset of the project? Does this vary according to the territory in which the project is to be carried out? In order to help answer these questions, we created Table 2, which contains the data referring to all the projects initiated and Table 3, which shows the ratios between funded and unfunded projects according to the promoter and territory.

Table 2. Total number of funded and unfunded projects.

Promoter	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	Type 7	Total
A	0	11	51	44	24	4	13	147
B	1	64	792	680	439	292	296	2564
E	0	7	37	50	27	18	16	155
F	1	25	133	122	132	76	69	558
Private companies	***2***	***107***	***1013***	***896***	***622***	***390***	***394***	***3424***
G	1	41	203	259	105	84	80	773
G14	0	1	71	100	128	21	36	357
J	0	4	62	32	34	14	9	155
Associations	***1***	***46***	***336***	***391***	***267***	***119***	***125***	***1285***
P	***1***	***29***	***472***	***541***	***842***	***511***	***570***	***2966***
PF	***6***	***138***	***943***	***774***	***655***	***392***	***394***	***3302***
Q	0	1	6	20	6	0	3	36
R	0	2	22	28	11	13	12	88
S	0	0	0	1	0	0	0	1
U	0	0	1	0	0	0	1	2
Total	**10**	**323**	**2793**	**2651**	**2403**	**1425**	**1499**	**11,104**

A. PLCs, B. Limited Companies, E. Business Partnerships, F. Cooperatives, G. Associations and Foundations, G14. LAGs; J. Civil Societies, P. Local Councils, PF. Individual entrepreneurs, Q. Public Bodies. R. Religious Congregations and Institutions, S. Departments of Central and Regional Governments, U. Others. Source: Junta de Andalucía. Consejería de Agricultura, Pesca y Desarrollo Rural. The authors.

As regards the number of projects commenced (Table 3), we observed that these were shared out at roughly a third each between three main promoters: Private Companies, 30.8%, Individual Entrepreneurs 29.7% and Local Councils 26.7%. The "Others" category was almost irrelevant at 1.1%, while that of Associations came to 11.6%; although as mentioned earlier, this category was clearly underrepresented. Within private companies, limited companies, often regarded as the poor relations within this group, play a central role as they are responsible for initiating the highest number of projects with 23.1% of the total. Another trend worth noting was the increasing importance of Cooperatives, although this was less obvious in terms of the number of projects, in which they accounted for just 5%.

If we take the above information about all 11,104 projects and we break it down into executed and unfunded projects, can any differences be observed in terms of the way the different promoters acted in the different territories? In order to answer this question, we have drawn up Table 3, which shows the ratio between funded and unfunded products multiplied by 100 so as to make it easier to understand.

Table 3. Ratio of funded to unfunded projects.

Promoter	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	Type 7	Total
A	0	57	82	132	140	0	86	96
B	0	83	99	86	101	67	74	88
E	0	133	147	138	125	100	220	138
F	0	150	217	213	238	145	156	195
Private companies	***0***	***95***	***110***	***101***	***123***	***78***	***89***	***102***
G	0	71	81	106	98	83	111	93
G14	0	0	407	335	191	950	260	280
J	0	100	100	52	70	100	80	80
Associations	***0***	***68***	***117***	***141***	***140***	***119***	***142***	***129***
P	***0***	***21***	***106***	***103***	***190***	***134***	***118***	***130***
PF	***100***	***106***	***89***	***85***	***85***	***102***	***91***	***90***
Q	0	0	20	67	100	0	50	57
R	0	100	144	300	175	117	140	175
S	0	0	0	0	0	0	0	0
U	0	0	0	0	0	0	0	0
Total	**67**	**85**	**102**	**101**	**130**	**106**	**104**	**107**

A. PLCs, B. Limited Companies, E. Business Partnerships, F. Cooperatives, G. Associations and Foundations, G14. LAGs; J. Civil Societies, P. Local Councils, PF. Individual Entrepreneurs, Q. Public Bodies. R. Religious Congregations and Institutions, S. Departments of Central and Regional Governments, U. Others. Source: Junta de Andalucía. Consejería de Agricultura, Pesca y Desarrollo Rural. The authors.

For Andalusia as a whole this ratio is 107, which means that slightly more projects were implemented than were not. When these values are analysed by a promoter, important differences emerge. The promoters that achieved above average rates of implementation and could therefore be considered as being better funded are Cooperatives, LAGs and Local Councils (P). The difference between these groups is important in quantitative terms. Cooperatives and LAGs obtained ratios that were double the average value while the ratio for Local Councils was 21% above average. At the opposite end of the scale, in which there were more unfunded projects than funded ones, the Individual Entrepreneurs and Limited Companies stood out with 17 and 19 percentage points less than the average for Andalusia, respectively. These are private investors, who are vitally important in terms of the number of projects they promoted and above all in terms of the amounts invested and of the associated employment. They are also the ones that take the biggest risks in terms of investment as they are investing their own capital and because they receive proportionally smaller grants compared for example to Local Councils and LAGs.

If we carry out a more in-depth analysis of the behaviour of the promoters according to the different types of territory, various interesting questions come to light. The success/failure ratios for Individual Entrepreneurs were below the regional average of 107 in all the different types of territory, a very clear sign of the weakness of this group when it comes to implementing a project. Their highest levels of failure were located in the intermediate regions, especially Remote Intermediate areas, and in Near Rural areas. These areas were also the ones in which most projects were started. The ratios were higher at the extremes, in particular in Remote and Deep Rural areas in which the fact that there was a small number of projects and of promoters seemed to help more solid business proposals to come to fruition. At the opposite end of the scale in Urban areas, the higher ratio was due to the more dynamic economic environment and to the fact that a relatively small number of projects (144) were commenced. The other large category in which there was a majority of unfunded projects was in private companies, in which there were important internal differences as mentioned earlier. If we look at private companies in general, we observe that the most important differences in their results are due more to remoteness/nearness than to the distinction between rural, intermediate and urban areas. The Near Intermediate municipalities obtained a score of 110 compared to 101 for the remote areas, while in the rural areas the maximum value was 123 for the Near Rural municipalities compared to 78 and 89 for the Remote and Deep Rural areas, respectively. Within this category, limited companies started by far the highest number of projects. They established a general trend but with lower values in all the different types of territories, such that they only surpassed a ratio of 100 in Near Rural areas and even then by very little (101). For their part, PLCs had high levels of success in the execution of their projects in Remote Intermediate and Near Rural areas with 134 and 140, respectively, while their scores were over 50 points lower in all the other types of territory.

In three types of promoters, the number of funded projects was far in excess of that of unfunded projects. These included Cooperatives, linked above all to the farming sector, in which there were twice as many funded projects as unfunded projects with values that were much higher in intermediate and Near Rural areas than the already high average for this category of 195. In Remote and Deep Rural areas the scores were below the average for Cooperatives but were still 40 points above the regional average for all projects (107). The average value for the LAGs was almost 3 times the regional average of 107 and varied enormously between the different types of territories, something which can be explained in part by the small number of projects initiated. In addition, many of their projects were only activated at the end of the programming period, on quite a number of occasions so as to make up for the absence of other promoters by turning to a "reserve stock" of solidly constructed projects for which finance was assured. Lastly, Local Councils showed their highest levels of success in all three types of rural area, reaching their maximum in Near Rural in which there were almost twice as many funded as unfunded projects. This value was notably lower in Remote Rural areas (134) and Deep Rural areas (118), and far lower in the intermediate regions, at just over 100.

In summary, for most of the actors involved, the remoteness and the degree of rurality of the municipalities proved a handicap that made it more difficult for the projects commenced under the aegis of the LEADER programme to be successfully executed; the exception to this rule was Individual Entrepreneurs, an important finding that must be borne in mind.

3.2. Geographical Distribution across Andalusia of the Different Types of Area

As can be seen in Figure 1, the classification of rural spaces in Andalusia according to the nomenclature proposed by Reig et al. (2016) [58] adapts quite accurately to a territorial structure in which the mountain areas are quite different from those situated in the valleys. The eastern side of the region is dominated by rural areas (Near, Remote and Deep), in sharp contrast to the flat plain traversed by the River Guadalquivir, which is dominated by intermediate regions and even a few urban areas. The latter are mostly situated around the Cádiz metropolitan area and Algeciras.

By contrast, the most strongly rural areas (in their different categories) can be seen in practically all of Sierra Morena, with the exception of a few slightly larger municipalities in the Valle de los Pedroches and Andújar. The rural area covered by the Baetic and Sub-Baetic Cordilleras is also easily distinguishable because it dominates the eastern half of Andalusia.

Calculating the ratio between funded projects and unfunded projects is a way of assessing how effectively the LEADER projects have been managed. The results set out in Figure 2 in relation to Individual Entrepreneurs as promoters can only be described as "disappointing". In practically all types of territories and regardless of their geographic location, there were more unfunded projects (those initiated and processed but ultimately never executed) than funded or executed projects. An even balance between unfunded and funded projects was only observed in Remote Rural areas, in which the ratio was around one, and in the areas classified as Urban, in which it was 1.06.

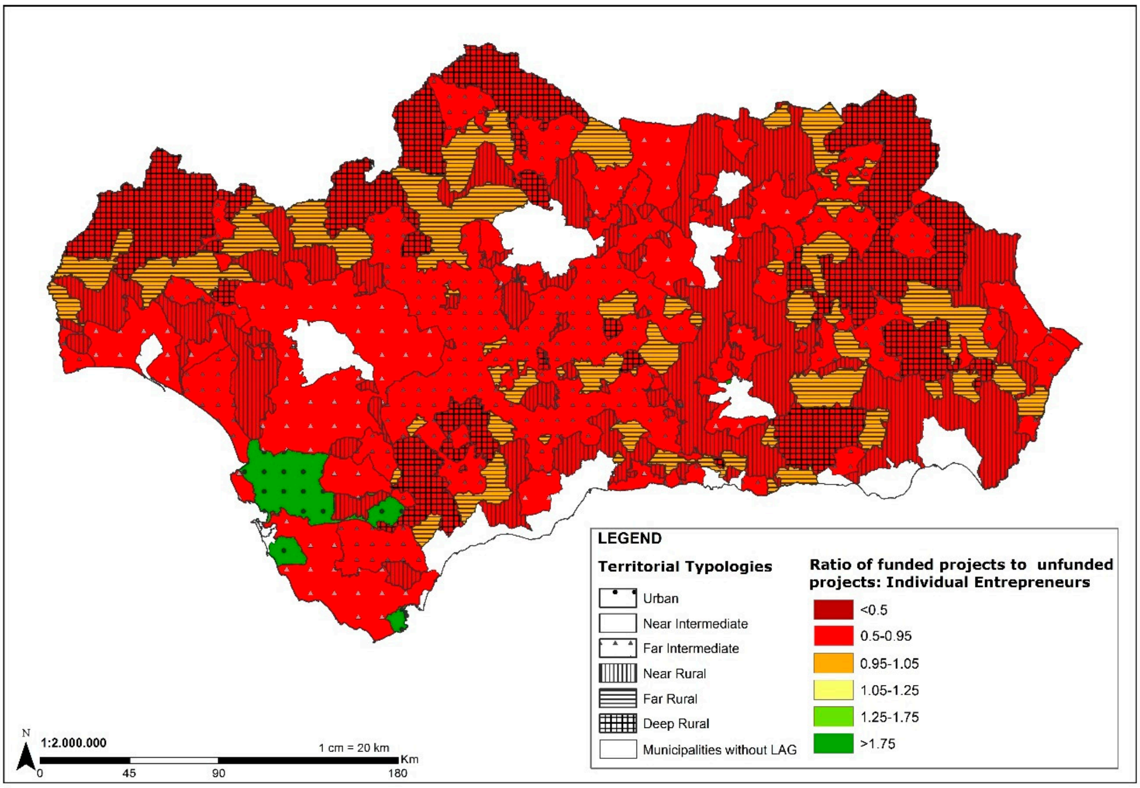

Figure 2. Ratio between the number of funded/unfunded projects initiated by Individual Entrepreneurs according to territorial typology. Source: Junta de Andalucía. Consejería de Agricultura, Pesca y Desarrollo Rural. The authors.

This means that in all the territories, regardless of their degree of "rurality", it was self-employed promoters (and within them young people and women), who found it most difficult to implement their projects due to administrative problems, lack of finance, etc.

Figure 3, which refers to public promoters, highlights a completely different situation to that described above. Town Councils promoted more funded projects than unfunded ones. In Near Rural areas the former almost doubled the latter, while in Remote Rural areas, the difference was slightly lower. However, and this is very significant, very similar ratios were observed in Deep Rural areas, often the most depressed regions with worse social and territorial conditions for the funded establishment of private businesses. In these areas in which public investment is urgently required, the proportion of unfunded and funded projects was very similar, as happened in the Near Intermediate areas. In Urban areas there were more unfunded projects than funded ones. This was followed by Remote Intermediate areas, although in the latter the ratio values were very close to 1.

The behaviour of private companies (Figure 4) is clearly associated with the degree of "rurality" of the area in question. The more rural the area is, the higher the proportion of unfunded projects. For Andalusia as a whole, the ratios vary from 0.78 in Remote Rural areas to 1.23 in Near Rural. This confirms once again that proximity to cities is an important factor in the success of LEADER projects. Similarly, in remote inaccessible areas it seems more difficult to bring projects to funded fruition. This map highlights once again the differences between the Guadalquivir Valley and the mountainous areas of Andalusia.

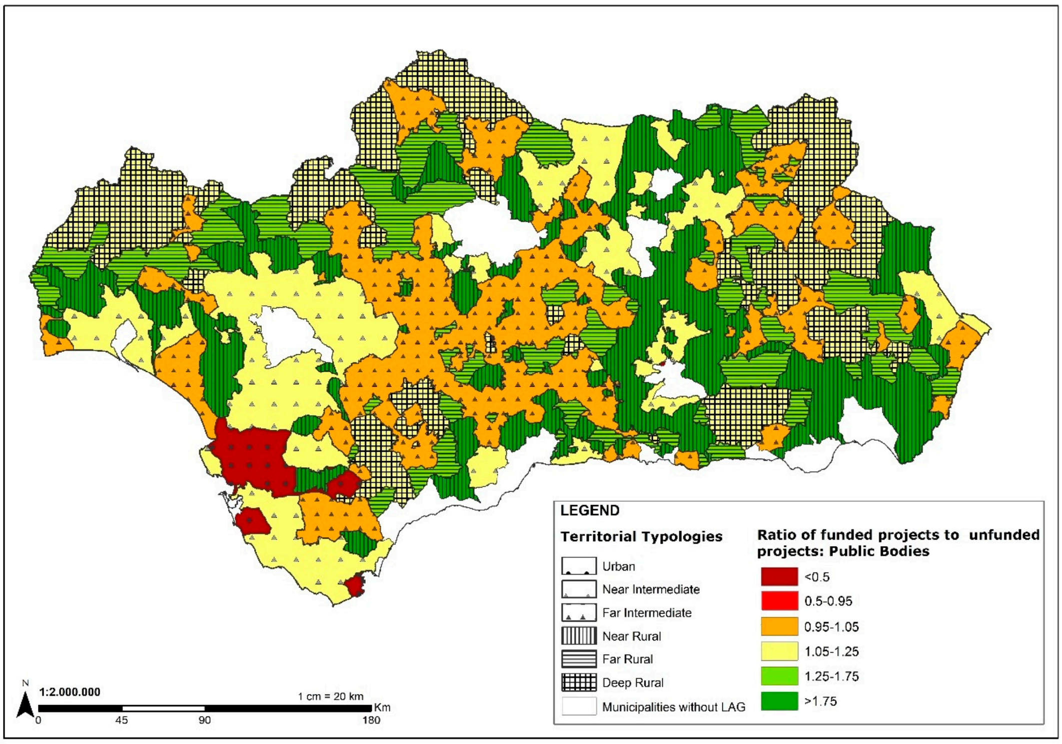

Figure 3. Ratio between the number of funded/unfunded projects initiated by Public Bodies according to territorial typology. Source: Junta de Andalucía. Consejería de Agricultura, Pesca y Desarrollo Rural. The authors.

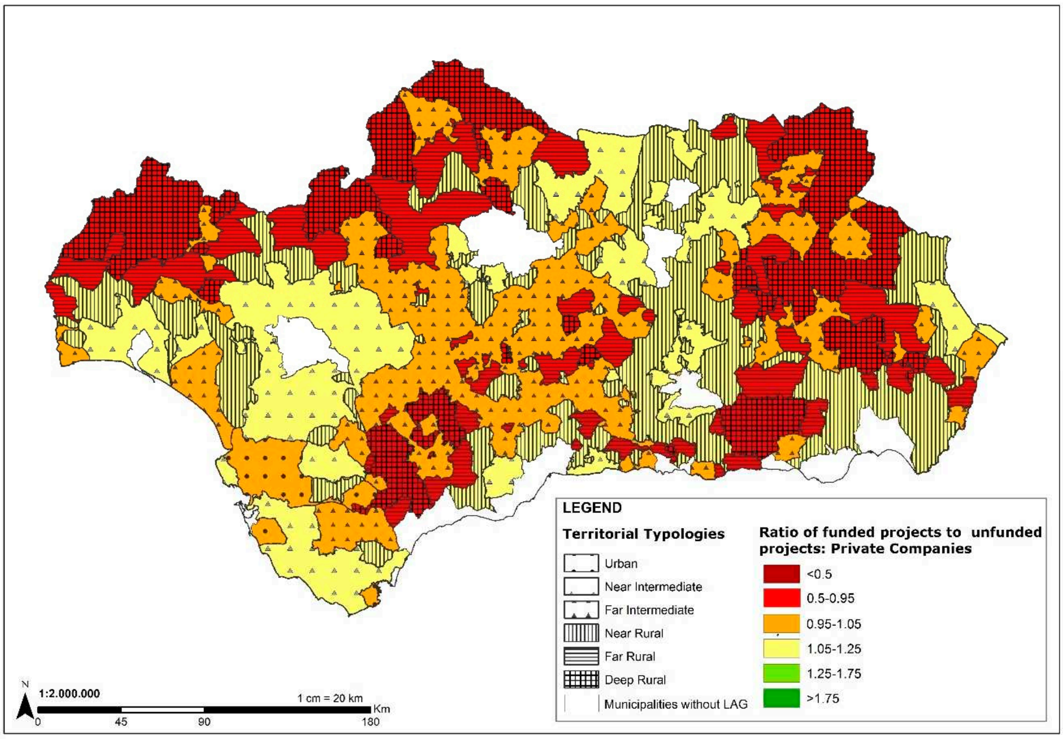

Figure 4. Ratio between the number of funded/unfunded projects initiated by private companies according to territorial typology. Source: Junta de Andalucía. Consejería de Agricultura, Pesca y Desarrollo Rural. The authors.

4. Discussion and Conclusions

This study, which analyses all LEADER projects for the period 2007–2015, both funded [63] and unfunded, taking projects at the municipal level as a reference, has confirmed previous findings that the participation of the different promoters of LEADER projects varied greatly within the Andalusia region. In addition, and this is the most novel aspect of our research, their intervention varied according to the type of project and the different types of area established. Our results show that the remoteness and rurality of some of the territories made it more difficult for most promoters to successfully conclude the projects they initiated under the LEADER programme, although not all were affected in the same way or to the same degree. Our findings also confirmed that nearness to cities also has a strong influence on country areas in terms of economic activity and income [64]. This is especially evident amongst private sector actors such as companies and Individual Entrepreneurs, who tend to invest in these areas, while the opposite is true for public sector promoters such as Local Councils.

Another important conclusion ratified in this research is the territorial complexity of Andalusia, which is difficult to fit into any general territorial classification system designed for Spain as a whole. This is due above all to the presence of large numbers of medium-sized towns with a strong rural/farming component, known as “agri-towns”, so confirming the position defended by Sánchez [54] (p. 189) who argued that these towns are “first and foremost, an opportunity for the territorial development of Andalusia” because they strengthen the hierarchical, balanced structure required for regional development due to their broad spatial distribution and their enormous functional and social diversity, which results in spaces that are highly favourable for business investment and offer a high quality of life for local residents whose numbers continue to grow, so reinforcing the trends that favour the flat areas compared to the mountains, the large compared to the small and the coast compared to inland regions [65,66]. In spite of this, the classification proposed by Reig et al. [58], which we have slightly amended, adapts well to the territorial structure of Andalusia, which is clearly marked by the divide between the mountain areas in the Eastern half in which there are a majority of rural areas with relatively small villages and the flat plain dominated by the Guadalquivir Valley, where most of the intermediate areas, many of which are agri-towns, are located (in general the coastal areas of Andalusia are not considered rural and are not covered by the LEADER programme).

The execution of the LEADER programme (2007–2015) was affected by the economic and financial crisis that erupted in 2008 and continued throughout the programme period. This resulted in a final investment in Andalusia of 514.1 million euros and a subsidy of 209.1 million, a mere 55.4% and 60.2% of the amounts spent during the previous programme period (2000–2006). Likewise, the total number of projects was only 75.8% of those carried out in the previous period. The average investment per project of almost 82,600 euros was also 27% lower.

The difficulties faced by both public and private investors resulted in constant changes in the National Strategic Plan (PEN) and in the different Rural Development Programmes (there were 10 different versions in Andalusia). Some of these changes were forced upon them by changes in European legislation or due to alterations in LEADER Axes 3 and 4 in which the EAFRD funds initially allocated to LEADER (10%) were reduced to the new minimum of 5% established by the EU in 2012 [67]. These issues were also noted by the Court of Auditors of the European Union in its 2010 report [68] on the implementation of LEADER at the beginning of the mainstreaming period. The economic crisis also damaged the capacity of the welfare state to combat poverty and inequality. This had serious effects in Mediterranean areas, which contain some of the most vulnerable social groups and territories in Europe [69]. The austerity conditions imposed on the most affected countries, Spain included, and the preference at European level for flexibility in the labour market, referred to as “flexisecurity”, made businesspeople vulnerable to economic flows. At the same time, workers had the moral duty to empower themselves by acquiring the capacity to adapt [70], which, depending on a series of contextual and individual factors, led many salaried workers to become “entrepreneurs out of need” [71].

Our research has also highlighted the importance of PLCs and of limited companies when it comes to promoting rural development. In Spain, limited companies can be set up with less initial share capital (€3000) than PLCs which require a minimum share capital of €60,000, €15,000 of which must be paid up on incorporation of the company; the bureaucratic procedure required to set up a limited company is more flexible, enabling a more family-based ownership structure with relatively few shareholders. Limited Companies are therefore the type of company that best adapts to the socioeconomic reality of intermediate and rural areas. However, for these same reasons they are more likely to fail than PLCs. It could therefore be argued that the patterns observed over the period 2000–2006 have been repeated [12]. These companies have a much greater presence in intermediate areas and in Near and Remote Rural territories, and are less evident in Deep Rural areas. They take advantage of the dynamism associated with urban areas, but the fact that they are easy to set up and do not require much stock capital means that they also top the bill in terms of investment and employment in all the different types of territory.

The role of Cooperatives is also worth highlighting. Firstly, because their results for several variables meant that they were second in importance within the group of private companies, a long way ahead of PLCs. As regards the level of success of the projects they started (as measured by the funded/unfunded projects ratio), Cooperatives came second only to LAGs, the promoters with the highest success ratio, which indicates the firm, solid grounding of their business proposals. Secondly, because of the social, mutually beneficial intentions of these ventures, which enhance the activation and consolidation of social capital, an essential feature of rural development processes [16,72,73]. Finally, because this is evidence of the crucial role in rural development that the modernization and enhanced competitiveness of the farming and agro-industrial sectors have been acquiring since the programme period of 2007–2013 [74]. This has also been reflected in international trade and in key sectors at the national and Andalusian levels, such as fruit, vegetables and vegetable oils—and in particular olive oil—[75] and even in innovation in the rural world [76]. This is manifested for example by the fact that the Gross Value Added (GVA) of the farming sector in Andalusia in 2018 represented 5.9% of GDP, compared to 2.5% in Spain and 1.1% in the EU 28, respectively, and 31.4% of the GVA produced by the farming sector in all of Spain. In addition, the value of agro-industrial production in Andalusia accounted for 25.7% of the total for the industrial sector in the region, which is five percentage points higher than the national figure for Spain as a whole. Similar patterns can be observed in farming employment, which at 8.3% of the total was twice the national and EU28 average, while Andalusia's agro-industry accounted for 24.3% of jobs in the region's industrial sector (Junta de Andalucía, 2019). All these statistics highlight the strong territorial, essentially rural implementation of these sectors. In short, the investments linked to the farming and agro-industrial sector (Measure 411 of the LEADER axes) carried out by Limited Companies, Cooperatives and to a lesser extent Individual Entrepreneurs have proved to be a key factor in rural development in Andalusia over the period 2007–2013, above all due to their strong presence in the inland and mountainous areas of the Penibaetic and Sub-Baetic Cordilleras and at the expense of the Guadalquivir Valley [63].

The dynamizing and rebalancing role that should be played by the LAGs through their initiatives, although very limited by the rules applied during this programme period, was almost irrelevant in the least dynamic areas that most required this kind of intervention. This confirms questions that have already been raised such as the increasingly bureaucratic procedures and the very limited citizen participation in these bodies [77–79], the shortages and frequent turnover of staff, as well as the interference from regional government bodies in the performance of their functions [80], so restricting one of their basic principles, namely subsidiarity [26]. All the above does not release the LAGs themselves from their share of responsibility especially as regards greater inclusion within their decision-making bodies (the General Assembly and the Governing Board) of underrepresented groups such as women and young people [37] and of production sectors such as the farming and agro-industrial sector (Matthews, 2005), which can contribute to the dynamizing role that the LAGs have traditionally performed [81]. It is also important to remember the administrative instability that various LAGs in Andalusia have experienced during this programme period, in which two

LAGs have been wound up (Ronda-Málaga and Almanzora-Almería) and the manager of a third (Apromontes-Granada) has been accused in criminal proceedings.

The crucial role played by public sector actors in rural development is undeniable, especially in rural territories and above all in Remote and Deep Rural areas. However, these public sector players will not be sufficient by themselves to revive the fortunes of these territories. Local Councils, although poorly equipped in terms of economic and human resources, can have an enormous impact on the quality of life in their towns and villages in the sense that they have direct, in-depth knowledge and a comprehensive, overall view of the problems in their communities. On election, most take on a commitment to act to resolve these issues, which at least potentially could make them agents or catalysts for innovation, especially in small and medium-sized municipalities [82,83].

Small municipalities have a potential for innovation that many do not fully materialise. These opportunities include for example soft and intangible innovations, the wellbeing of local communities, skills development for local people, smart specialization strategies, bio-economy, eco-economy, social and cultural innovation, community projects, a territorial approach, linkages between agriculture and the wider economy and the promotion of natural resources [84]. In theory, small municipalities are suitable spaces for innovation but this potential is often frustrated by the very limited capacity of the engines that drive innovation. The end results in terms of innovation are very modest. Improvements could be made by recognising that we are interdependent and extending and enhancing networks based on relationships, exchanges and dialogues that foster ideas and learning; it is also vital to improve local leadership that is capable of bringing together and listening to the different stakeholders and generating synergies between them, a situation in which Local Councils or LAGs could act as bridges between people to multiply ideas and create innovation. Finally, it is essential to encourage a feeling of community, so helping create a more cohesive society that is open to people from outside [85].

Small local councils must assume a key role in the development process, focusing local strategies on discovery rather than on individual innovations. They must also offer their own vision about the particular form of development to be pursued, as to how the economic structure should evolve and the changes required to open up the economy to a new field of opportunities. It is clear that no single municipal government can manage the global challenges of aging population, unemployment and social inequalities by itself. Interaction with other tiers of government must therefore be taken into account when designing a governance structure for local policy. The improvement of public service delivery and the creation of multifunctional and mobile services must also be priority objectives [86]. Finally, institutional support must be given to rural development initiatives and possible strategic alignments must be sought between local, regional, national and supra-national policy agendas, with a view to developing a range of complementary policies [84].

While the participation in rural development of the actors mentioned above is important, the participation of individual entrepreneurs is absolutely essential. As private agents of development, they are more often to be found in the most dynamic areas which have the greatest, most certain investment opportunities. However, we believe that the important thing is their constant presence in rural areas with near average or above average values, even in Remote and Deep Rural areas. A fact that should be emphasised given that these areas are the most vulnerable, least dynamic and generally most neglected by promoters of LEADER projects [4,6,87]. They are also areas in which the population is not only poorer but feels poorer, a fact that highlights the need for territorial policies to take into account the heterogeneous nature of municipalities [88] in the design of these policies in which a greater role must be given to the variables of economic geography [89].

Although it was beyond the scope of this analysis, other recent research studies point to the fact that in addition to the typical profile of a mature woman with a low level of training/education, who is running a family business and has family responsibilities and loyalties that can impinge upon business performance [90] and of the “entrepreneur out of need” to whom we referred earlier, new forms of women entrepreneurs are emerging with links to professional services and rural tourism [91]. These combine with a generation of highly trained young women who have returned to rural areas of

Spain with good communication infrastructures, which they see as suitable places for production and innovation in an effort to halt or mitigate depopulation [92].

However, these encouraging signs should not make us overlook the fact that women and young people are the groups that benefit least from these initiatives. Firstly, they have to overcome a large number of obstacles when trying to start up new businesses within the LEADER programme [93]: they carry out far less projects than their adult, male counterparts; they receive smaller average grants per project and the grants they receive make up a smaller percentage of the total amounts invested. They also have a much lower ratio of funded/unfunded projects. In addition, the traditional division of gender roles remains strong in many rural areas, such that women continue to bear the burden of housework and childcare even when they are the only breadwinners in the family unit [94,95]. These traditional gender roles also tend to channel the projects proposed by women investment into sectors such as tourism, food, social care services and handicraft-related activities. A final, very serious issue in Spanish society today is that the increasingly precarious job market and salary system are no longer the exception and have now become the rule for the majority of the population, especially if you are young and/or a woman [96], a fact that is often reflected in LEADER projects, in which precarious jobs tend to be held by women and young people. These questions in relation to depopulation, women, gender and young entrepreneurs need to be addressed in more extensive future research, in which each issue can be analysed separately.

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References

1. Dax, T.; Strahl, W.; Kirwan, J.; Maye, D. The Leader programme 2007–2013: Enabling or disabling social innovation and neo-endogenous development? Insights from Austria and Ireland. *Eur. Urban Reg. Stud.* **2016**, *23*, 56–68. [CrossRef]
2. Granberg, L.; Andersson, K.; Kovách, I. Introduction: LEADER as an Experiment in Grass-Roots Democracy. In *Evaluating the European Approach to Rural Development, Grass-Roots Experiences of the LEADER Programme*; Granberg, L., Andersson, K., Eds.; Routledge: London, UK, 2015; pp. 1–12. ISBN 978-1-315-58119-4.
3. Papadopoulou, E.; Hasanagas, N.; Harvey, D. Analysis of rural development policy networks in Greece: Is LEADER really different? *Land Use Policy* **2011**, *28*, 663–673. [CrossRef]
4. Cañete, J.; Navarro, F.; Cejudo, E. Territorially unequal rural development: The cases of the LEADER Initiative and the PRODER Programme in Andalusia (Spain). *Eur. Plan. Stud.* **2018**, *26*, 1–19. [CrossRef]
5. Cañete, J.; Nieto Masot, A.; Cejudo, E.; Cárdenas Alonso, G. Territorial Distribution of Projects within the LEADER Approach (2007–2013) in Extremadura and Andalusia. In *Neoendogenous Development in European Rural Areas. Results and Lesson*; Springer: Cham, Switzerland, 2020; pp. 87–109. ISBN 978-3-030-33462-8.
6. Cárdenas Alonso, G.; Nieto Masot, A. Towards Rural Sustainable Development? Contributions of the EAFRD 2007–2013 in Low Demographic Density Territories: The Case of Extremadura (SW Spain). *Sustainability* **2017**, *9*, 1173. [CrossRef]
7. ECORYS. *Study on Employment, Growth and Innovation in Rural Areas (SEGIRA)*; Main Report; European Commission, Directorate-General for Agriculture and Rural Development: Brussels, Belgium, 2010.

8. Shucksmith, M.; Thomsom, K.; Roberts, D. The CAP and the Regions: The Territorial Impact of the Common Agricultural Policy. *EuroChoices* **2006**, *5*, 42–44. [CrossRef]
9. Labianca, M.; De Rubertis, S.; Belliggiano, A.; Salento, A. Innovation in rural development in Puglia, Italy: Critical issues and potentialities starting from empirical evidence. *Stud. Agric. Econ.* **2016**, *118*, 1–9. [CrossRef]
10. Lacquement, G. Penser l'innovation dans les régions rurales défavorisées d'Allemagne orientale. Bulletin de l'association de géographes français. *Géographies* **2016**, *93*, 145–164. [CrossRef]
11. Lukić, A.; Obad, O. New Actors in Rural Development—The LEADER Approach and Projectification in Rural Croatia. *Sociol. I Prost.* **2016**, *54*, 71–90. [CrossRef]
12. Cejudo García, E.; Navarro Valverde, F.A.; Camacho Ballesta, J.A. Perfil y características de los beneficiarios finales de los Programas de Desarrollo Rural en Andalucía. LEADER+ y PRODER2 (2000–2006). *Cuad. Geográficos* **2017**, *56*, 155–175. [CrossRef]
13. Shortall, S. Are rural development programmes socially inclusive? Social inclusion, civic engagement, participation, and social capital: Exploring the differences. *J. Rural Stud.* **2008**, *24*, 450–457. [CrossRef]
14. Nardone, G.; Sisto, R.; Lopolito, A. Social Capital in the LEADER Initiative: A methodological approach. *J. Rural Stud.* **2010**, *26*, 63–72. [CrossRef]
15. Teilmann, K. Measuring Social Capital Accumulation in Rural Development. *J. Rural Stud.* **2012**, *28*, 458–465. [CrossRef]
16. Esparcia, J.; Escribano, J.; Buciega, A. *Evaluating the LEADER Approach to Rural Development. Grass-Roots Experiences of the LEADER Programme*; Ashgate: Farnham, UK, 2015; pp. 33–51.
17. Foronda Robles, C. Experiencias investigadoras en capital social. In *Territorio y Desarrollo Rural: Aportaciones Desde el Ámbito Investigador*; Leco Berrocal, F., Ed.; Junta de Extremadura: Municipality of Mérida, Spain, 2016; pp. 69–86. ISBN 978-84-944087-3-1.
18. Hernández Mogollón, J.; Campon-Cerro, A.-M.; Leco, F.; Perez-Diaz, A. Agricultural diversification and the sustainability of agricultural systems: Possibilities for the development of agrotourism. *Environ. Eng. Manag. J.* **2011**, *10*, 1911–1921. [CrossRef]
19. LaPan, C.; Barbieri, C. The role of agritourism in heritage preservation. *Curr. Issues Tour.* **2014**, *17*, 666–673. [CrossRef]
20. Plaza Tabasco, J.J.; del Cañizares Ruiz, M.C.; Ruiz Pulpón, Á.R. Heritage, vineyard and tourism: Specific resources to innovate the territorial development of Castilla-La Mancha. *Cuad. Tur.* **2017**, *40*, 547–722. [CrossRef]
21. Baraja Rodríguez, E.; Herrero Luque, D.; Martínez Arnáiz, M.; Plaza Gutiérrez, J.I. Turismo y desarrollo vitivinícola en espacios de montaña con "alta densidad patrimonial". *Cuad. Tur.* **2019**, *43*, 97–122. [CrossRef]
22. Orgaz Agüera, F.; Cuadra, S.M.; Lopez-Guzman, T.; Cañero Morales, P. Study of the demand on the olive-oil tourism. Case of andalusia. *Cuad. Tur.* **2017**, 677–680.
23. Silva Pérez, R.; Fernández Salinas, V. Claves para el reconocimiento de la dehesa como "paisaje cultural" de Unesco. *An. Geogr. Univ. Complut.* **2015**, *35*, 121–142. [CrossRef]
24. Molinero, F.; Tort, J. *Paisajes Patrimoniales de España*; Ministerio de Agricultura, Pesca y Alimentación, Ministerio para la Transición Ecológica—UAM Ediciones: Madrid, Spain, 2018, ISBN 978-84-491-1517-2.
25. Gómez Pellón, E. Sostenibilidad del medio rural y patrimonio inmaterial: A propósito de los conocimientos tradicionales de las plantas. *Scr. Nova. Rev. Electrón. Geogr. Cienc. Soc.* **2018**, *22*, 49033. [CrossRef]
26. Tirado Ballesteros, J.G.; Hernández Hernández, M. Promoting tourism through the EU LEADER programme: Understanding Local Action Group governance. *Eur. Plan. Stud.* **2019**, *27*, 396–414. [CrossRef]
27. Maroto, J.C.; Pinos, A. ¿El turismo rural freno de la despoblación? El caso del sur de España. In *Despoblación y Transformaciones Sociodemográficas de Los Territorios Rurales: Los Casos de España, Italia y Francia*; Cejudo, E., Navarro, F.A., Eds.; Universidad de Salento: Lecce, Italy, 2020; pp. 327–374. ISBN 978-88-8305-157-9.
28. Maroto-Martos, J.C.; Voth, A.; Pinos-Navarrete, A. The Importance of Tourism in Rural Development in Spain and Germany. In *Neoendogenous Development in European Rural Areas: Results and Lessons*; Cejudo, E., Navarro, F., Eds.; Springer International Publishing: Cham, Switzerland, 2020; pp. 181–205. ISBN 978-3-030-33463-5.
29. Copus, A. *European Shrinking Rural Areas: Challenges, Actions and Perspectives for Territorial Governance (ESCAPE)*; Interim Report; ESPON: Brussels, Belgium, 2020.
30. Sánchez-Zamora, P.; Gallardo-Cobos, R.; Ceña-Delgado, F. Rural areas face the economic crisis: Analyzing the determinants of successful territorial dynamics. *J. Rural Stud.* **2014**, *35*, 11–25. [CrossRef]

31. Alario, M.; Baraja, E. Políticas públicas de desarrollo rural en Castilla y León: ¿sostenibilidad consciente o falta de opciones? LEADER II. *Boletín Asoc. Geógrafos Españoles* **2006**, *41*, 267–294.
32. Márquez Fernandez, D.; Foronda Robles, C.; García López, A.; de Pérez Arpilla, L.G. El precio de la sostenibilidad rural en Andalucía: El valor de LEADER II. *Boletín Asoc. Geógrafos Españoles* **2006**, *41*, 295–313.
33. European Commission. *Directorate-General for Agriculture and Rural Development. The Leader Approach: A Basic Guide*; Publications Office: Luxembourg, 2006, ISBN 978-92-79-02044-5.
34. High, C.; Nemes, G. Social Learning in LEADER: Exogenous, Endogenous and Hybrid Evaluation in Rural Development. *Sociol. Rural.* **2007**, *47*, 103–119. [CrossRef]
35. Rodríguez Fouz, M.; Tejero Villalobos, Ó.; Sanchez de la Yncera, I. Contingencia y crisis. Apuntes para una sociología atenta al fracaso y a lo imprevisto/Contingency and Crisis. Notes On a Sociology Considering Failure and the Unforeseen. *Rev. Española Investig. Sociológicas* **2014**, *147*, 89–106. [CrossRef]
36. Dargan, L.; Shucksmith, M. LEADER and Innovation. *Sociol. Rural.* **2008**, *48*, 274–291. [CrossRef]
37. Viladomiu Canela, L.; Rosell Foxà, J.; Francès Tudel, G. Factores determinantes de la participacion de la mujer como promotoras de proyectos Leader+. *Rev. Española Estud. Agrosoc. Y Pesq.* **2010**, *226*, 1–30.
38. Savall, N.V.; Pizarro, J.E.; Valero, D.E. Models de vida femenins en el medi rural. Un cas d'estudi a la Sierra del Segura (Albacete). *Doc. d'Anàlisi Geogràfica* **2019**, *65*, 139–161. [CrossRef]
39. Shucksmith, M. *How to Promote the Role of Youth in Rural Areas of Europe? Report for European Parliament*; Directorate General for Internal Policies, Policy Department B: Structural and Cohesion Policies: Brussels, Belgium, 2010.
40. Jentsch, B.; Shucksmith, M. *Young People in Rural Areas of Europe*; Ashgate: Farnham, UK, 2004, ISBN 0-7546-3478-7.
41. Pallares-Barbera, M.; Casellas, A. Social networks as the backbone of women's work in the Catalan Pyrenees. *Eur. Urban Reg. Stud.* **2019**, *26*, 65–79. [CrossRef]
42. Salamaña, I.; Baylina, M.; Ramon, M.D.G.; Porto, A.M.; Villarino, M. Dones, trajectòries de vida i noves ruralitats. *Doc. D'Anàlisi Geogràfica* **2016**, *62*, 661–681. [CrossRef]
43. Nogué, J. El reencuentro con el lugar: Nuevas ruralidades, nuevos paisajes y cambio de paradigma. *Doc. D'Anàlisi Geogràfica* **2016**, *62*, 489–502. [CrossRef]
44. Cherayi, S.; Jose, J.P. Empowerment and social inclusion of Muslim women: Towards a new conceptual model. *J. Rural Stud.* **2016**, *45*, 243–251. [CrossRef]
45. Cañete Pérez, J.A.; Cejudo García, E.; Navarro Valverde, F.A. Proyectos fallidos de desarrollo rural en Andalucía. *BAGE* **2018**, *78*, 270–301. [CrossRef]
46. Navarro Valverde, F.A.; Cejudo García, E.; Cañete Pérez, J.A. Emprendedores y proyectos fallidos de LEADER y PRODER en Andalucía en el periodo 2000-2006. Perfil y motivos de desistimiento. *Estud. Geográficos* **2018**, *79*, 141–166. [CrossRef]
47. Navarro, F.; Cejudo, E. Failed projects. Initiatives and did not receive funding from the LEADER programme. In *Neoendogenous Development in European Rural Areas. Results and Lesson*; Cejudo, E., Navarro, F., Eds.; Springer: Cham, Switzerland, 2020; pp. 283–300. ISBN 978-3-030-33462-8.
48. Fadic, M.; Garcilazo, J.E.; Monroy, A.M.; Veneri, P. Classifying small (TL3) regions based on metropolitan population, low density and remoteness. *OECD Reg. Dev. Work. Pap.* **2019**, *6*, 28.
49. Sancho Comíns, J.; Reinoso Moreno, D. La delimitación del ámbito rural: Una cuestión clave en los programas de desarrollo rural. *Estud. Geográficos* **2012**, *73*, 599–624. [CrossRef]
50. López Ontiveros, A. La agrociudad andaluza: Caracterización, estructura y problemática. *Rev. Estud. Reg.* **1994**, *2*, 59–91.
51. Rodríguez Martínez, F. Las ciudades medias andaluzas. Cambios básicos durante el último medio siglo. In *Homenaje a Joaquín Bosque Maurel: Secretario General de la Real Sociedad Geográfica (1983–2008)*; Real Sociedad Geográfica: Madrid, Spain, 2008; pp. 199–238. ISBN 978-84-612-4463-8.
52. Sánchez Escolano, L. Las redes de ciudades medias en la provincia de Granada: Transformaciones recientes y nuevas tipologías (1950-2008). *Cuad. Geogr. Univ. Andes Merida* **2010**, *46*, 111–138. [CrossRef]
53. Navarro-Serrano, F. La ciudad media en Andalucía. Una aproximación a las agrociudades y la influencia de la Globalización. In Proceedings of the XIV Colóquio Ibérico de Geografia/XIV Coloquio Ibérico de Geografía, Guimaraes, Portugal, 11–14 November 2014.
54. Sánchez Escolano, L.M. Ciudades Medias y Articulación Espacial en el Litoral Mediterráneo Andaluz (1950-2014). Nuevas Tipologías Urbanas para el Diagnóstico y el Desarrollo Territorial. Ph.D. Thesis, Universidad de Granada, Granada, Spain, March 2016.

55. OECD. *OECD Regional Typology*; OECD Publishing: Paris, France, 2010.
56. Molinero Hernando, F. El espacio rural de España: Evolución, delimitación y clasificación. *Cuad. Geográficos* **2019**, *58*, 19–56. [CrossRef]
57. De Cos Guerra, O.; Reques Velasco, P. Vulnerabilidad territorial y demográfica en España. Posibilidades del análisis multicriterio y la lógica difusa para la definición de patrones espaciales. *Investig. Reg. J. Reg. Res.* **2019**, *45*, 201–225.
58. Reig Martínez, E.; Goerlich Gisbert, F.J.; Cantarino Martí, I. *Delimitación de Áreas Rurales y Urbanas a Nivel Local: Demografía, Coberturas del Suelo y Accesibilidad*; Fundación BBVA: Bilbao, Spain, 2016.
59. Brezzi, M.; Dijkstra, L.; Ruiz, V. OECD Extended Regional Typology: The Economic Performance of Remote Rural Regions. *OECD Reg. Dev. Work. Pap.* **2011**, *6*, 1–21. [CrossRef]
60. Cejudo García, E.; Navarro Valverde, F.; Cañete Pérez, J.A. Evolución y distribución territorial de los trabajadores eventuales agrarios subsidiados en Andalucía Boletín de la Asociación de Geógrafos Españoles. *BAGE* **2016**, *72*, 117–147. [CrossRef]
61. Cejudo García, E.; Navarro Valverde, F.A.; Maroto Martos, J.C. Perceptores del subsidio y de la renta agraria en el sur de España: Evolución, diferencias territoriales y estructura por edad y sexo. *AGER. Rev. Estud. Sobre Despoblación Y Desarro. Rural* **2016**, *20*, 32–72.
62. Cejudo, E.; Labianca, M.; Augustyn, A.M.; Belliggiano, A.; Cañete, J.; Chevalier, P.; Dax, T.; De Rubertis, S.; Fiori, M.; Lacquement, G.; et al. *Politiche di Sviluppo Rurale. Metodi, Strategie ed Esperienze Internazionali a Confronto*; Wip Edizioni: Bari, Italy, 2017, ISBN 978-88-8459-420-4.
63. Cejudo, E.; De Rubertis, S.; Cañete, J.A. Beneficiarios finales del eje LEADER en Andalucía 2007–2013 ¿Cómo les ha afectado la crisis según tipologías? In *Nuevas Realidades Rurales en Tiempos de Crisis: Territorios, Actores, Procesos Y Políticas*; Cejudo, E., Navarro, F., Camacho, J.A., Eds.; Universidad de Granada: Granada, Spain, 2018; pp. 551–564. ISBN 978-84-338-63-1.
64. Dijkstra, L.; Garcilazo, E.; McCann, P. The effects of the global financial crisis on European regions and cities. *J. Econ. Geogr.* **2015**, *15*, 935–949. [CrossRef]
65. Esteve Secall, E. Evolución moderna de la dinámica demográfica en el territorio andaluz. In *Ciencia Regional Y Andalucía a Partir de la Visión del Geógrafo Gabriel Marco Cano García. Un Homenaje a su Vida Y Obra*; Márquez Domínguez, J.A., Jordá Borrel, R., Eds.; Editorial Universidad de Sevilla: Sevilla, Spain, 2018; pp. 499–518. ISBN 978-84-472-1929-2.
66. Larrubia Vargas, R.; Natera Rivas, J.J. Envejecimiento y masculinización de la población rural andaluza. In *Despoblación Y Transformaciones Sociodemográficas de los Territorios Rurales: Los Casos de España, Italia Y Francia*; Cejudo, E., Navarro, F.A., Eds.; Universidad de Salento: Lecce, Italy, 2020; pp. 121–152. ISBN 978-88-8305-157-9.
67. Ministerio de Agricultura, Pesca, Alimentación y Medioambiente (MAPAMA). *Plan Estratégico Nacional de Desarrollo Rural 2007–2013*; MAPAMA: Madrid, Spain, 2012.
68. European Court of Auditors. *Implementation of the LEADER Approach for Rural Development*; European Court of Auditors: Luxembourg, 2010; Volume 5, ISBN 978-92-9207-883-6. Available online: https://www.eca.europa.eu/Lists/ECADocuments/SR10_05/SR10_05_EN.PDF (accessed on 5 August 2020).
69. Martín Martín, M.; de Castro Pericacho, C.; Calderón Gómez, D. Welfare Citizenship in the Shadow of the Recession in Spain: The Case of Households in Hardship. *REIS* **2020**, *169*, 85–102. [CrossRef]
70. Martín, P.; Tovar, F.J. Desmontando la seguridad en las políticas de empleo: La propuesta europea de flexiguridad. *Rev. Int. Sociol.* **2019**, *77*, e124. [CrossRef]
71. Alvarez-Sousa, A. Necessity Entrepreneurs. Determining Factors. *REIS* **2019**, *166*, 3–24. [CrossRef]
72. Esparcia, J.; Abassi, F. Territorial Governance and Rural Development: Challenge or Reality? In *Neoendogenous Development in European Rural Areas. Results and Lesson*; Cejudo, E., Navarro, F., Eds.; Springer: Cham, Switzerland, 2020; pp. 33–60. ISBN 978-3-030-33462-8.
73. Moreno, R.; Gallach, H.; Blanco, I.; Salazar, Y. La innovación social, ¿prácticas para producir autonomía, empoderamiento y nueva institucionalidad? *Rev. Int. Sociol.* **2019**, *77*, 126. [CrossRef]
74. Belliggiano, A.; Cejudo, E.; De Rubertis, S. The Role of Agriculture in Rural Development in Spain and Italy within the Framework of the LEADER 2007–2013 Programming Period. In *Neoendogenous Development in European Rural Areas. Results and Lesson*; Cejudo, E., Navarro, F., Eds.; Springer: Cham, Switzerland, 2020; pp. 149–180. ISBN 978-3-030-33462-8.
75. García Grande, M.J.; López Morales, J.M. Contribución de la agroalimentación española al comercio mundial: Evolución y factores explicativos. *Rev. Española Estud. Agrosoc. Y Pesq.* **2016**, *243*, 15–44.

76. Unión de Pequeños Agricultores (UPA). *Agricultura Familiar en España. Anuario 2017*; Fundación de Estudios Rurales y MAPAMA: Madrid, Spain, 2017.
77. Augustyn, A.M.; Nemes, G. Catching up with the West? Europeanisation of Rural Policies in Hungary and Poland. *Stud. Agric. Econ.* **2014**, *116*, 114–121. [CrossRef]
78. Bosworth, G.; Rizzo, F.; Marquardt, D.; Strijker, D.; Haartsen, T.; Thuesen, A.A. Identifying social innovations in European local rural Development initiatives. *Innov. Eur. J. Soc. Sci. Res.* **2016**, *29*, 442–461. [CrossRef]
79. Bosworth, G.; Price, L.; Hakulinen, V.; Marango, S. Rural Social Innovation and Neo-endogenous Rural Development. In *Neoendogenous Development in European Rural Areas. Results and Lessons*; Cejudo, E., Navarro, F., Eds.; Springer: Cham, Switzerland, 2020; pp. 21–32. ISBN 978-3-030-33462-8.
80. Navarro, F.; Woods, M.; Cejudo, E. The LEADER Initiative has been a Victim of Its Own Success. The Decline of the Bottom-Up Approach in Rural Development Programmes. The Cases of Wales and Andalusia. *Sociol. Rural.* **2015**, *56*, 270–288. [CrossRef]
81. Sacristán López, H.; Martínez Arroyo, F.; Yagüe Blanco, J.L. Los órganos de decisión de los grupos de acción local en el periodo 2007-2013 en España: Relaciones entre los actores del medio rural. *Rev. Española Estud. Agrosoc. Y Pesq.* **2016**, *245*, 47–66.
82. OECD. *The New Rural Paradigm: Policies and Governance*; OECD Publishing: Paris, France, 2006.
83. Neumeier, S. Social innovation in rural development: Identifying the key factors of success. *Geogr. J.* **2016**, *183*, 1–27. [CrossRef]
84. da Rosa Pires, A.; Pertoldi, M.; Edwards, J.; Hegyi, F.B. Smart Specialisation and Innovation in Rural Areas. *S3 Policy Brief Ser.* **2014**, *9*, 1–23.
85. Carrera, E.; Brugué, Q.; Casademont, X.; Serra, M. The Innovative Potential of Small Municipalities: From Theory to Practice. *Rev. Española Investig. Sociológicas* **2019**, *168*, 3–20. [CrossRef]
86. OECD. *Innovation and Modernising the Rural Economy 2014*; OECD Publishing: Paris, France, 2014.
87. Cuadrado Roura, J.R. *Las Políticas de Desarrollo Regional y el Conflicto Eficiencia-Equidad*; Naciones Unidas Comisión Económica para América Latina y el Caribe (CEPAL): Santiago, Chile, 2012.
88. Esparcia Pérez, J.; Escribano Pizarro, J. La dimensión territorial en la programación comunitaria y el nuevo marco de políticas públicas: Desarrollo rural territorial, reforma de la PAC y nuevo LEADER. *AGUC* **2012**, *32*, 227–252. [CrossRef]
89. García-Carro, B.; Sánchez-Sellero, M.C. Medición de la pobreza subjetiva en España y su localización espacial. *Rev. Española Investig. Sociológicas* **2019**, *165*, 83–100. [CrossRef]
90. Sampedro Gallego, R.; Camarero Rioja, L. Mujeres empresarias en la España rural. El sujeto pendiente del desarrollo. *Rev. Int. Sociol.* **2007**, *65*, 121–146. [CrossRef]
91. Alario Trigueros, M.; Morales Prieto, E. Iniciativas de las mujeres: Emprendimiento y oportunidades en el espacio rural de Castilla y León. *Doc. D'Anàlisi Geogràfica* **2016**, *62*, 613–637. [CrossRef]
92. Baylina Ferrè, M. La mujer como eje vertebrador de la nueva ruralidad. Un estado de la cuestión. In *Despoblación y Transformaciones Sociodemográficas de los Territorios Rurales: Los Casos de España, Italia y Francia*; Cejudo, E., Navarro, F., Eds.; Universidad de Salento: Lecce, Italy, 2019; pp. 153–176. ISBN 978-88-8305-157-9.
93. Cejudo, E.; Navarro, F.; Cañete, J.A. Young and women entrepreneurs in neo-endogenous development. In *Neoendogenous Development in European Rural Areas. Results and Lessons*; Springer: Cham, Switzerland, 2020; pp. 209–234.
94. Baylina, M.; Villarino, M.; Garcia Ramon, M.D.; Mosteiro, M.J.; Porto, A.M.; Salamaña, I. Género e innovación en los nuevos procesos de re-ruralización en España. *Finisterra. Rev. Port. Geogr.* **2019**, *54*, 75–91. [CrossRef]
95. García Román, J. La división de los roles de género en las parejas en las que solo trabaja la mujer en Estados Unidos y España. *Rev. Española Investig. Sociológicas* **2020**, *170*, 73–94. [CrossRef]
96. Muñoz Rodríguez, D.; Santos Ortega, A. *En las Cárceles del Capital Humano. Nuevas Precariedades y Subjetivación de los Procesos Contemporáneos de Precarización*; Zambra/Baladre: Málaga, Spain, 2018, ISBN 978-84-945975-7-2.

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Assessing Sustainable Rural Development Based on Ecosystem Services Vulnerability

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Abstract: Sustainable Rural Development is essential to maintain active local communities and avoid depopulation and degradation of rural areas. Proper assessment of development in these territories is necessary to improve decision-making and to inform public policy, while ensuring biodiversity conservation and ecosystem services supply. Rural areas include high ecological value systems but the vulnerability of environmental components in development indicators has not been sufficiently pinpointed. The main objective of this work was to propose a new sustainable rural development composite indicator (nSRDI) while considering an environmental dimension indicator based on ecosystem services vulnerability and social and economic dimension indicators established using a sequentially Benefit of the Doubt-Data Envelopment Analysis (BoD-DEA) model. It aimed also to test effects of weighting methods on nSRDI. The composite indicator was applied to 10 regions (*comarcas*) in the Huesca province, Spain, producing a ranking of regions accordingly. The indicator was further tested through the analysis of the effect of an equal and optimum weighting method on scores and rankings of regions. Results showed substantial differences in nSRDI scores/rankings when vulnerability was added to the process, suggesting that the environmental dimension and the perspective from which it is conceived and applied matters when addressing sustainable rural development.

Keywords: sustainable rural development; regional composite indicators; vulnerability; ecosystem services; goal programming; analytic hierarchy process; data envelopment analysis; Spain

1. Introduction

Depopulation of rural areas is a major development challenge in Europe. Rural regions currently account for 28% of Europe's population (cities account for 40%; towns and suburbs account for 32%) [1] but, by 2050, more than 50% of the population of Europe will live in urban areas due to an expected increase of 24.1 million persons, as the population of rural regions is predicted to decrease by 7.9 million [2]. These demographic processes are not, however, homogeneous across Europe. The strength and persistence of rural depopulation trends in recent decades in countries in the south of Europe such as Portugal, Spain and Italy, has increased the number of rural regions of low population density in these countries. Until the 1990s, the major direct cause of depopulation was immigration to other countries (the Americas, Central Europe) and within-country rural-to-urban migration but since then, aging became the main cause of rural depopulation. The Spanish provinces of Aragon, Extremadura and Castilla-León, for example, have experienced levels of depopulation so severe that several villages are now uninhabited, while rates of aging and population loss in other provinces jeopardize their future [3]. The recent return of migrants and newcomers in rural areas, in particular during the 2010–2014 financial crisis and the current COVID-19 pandemic, is insufficient to mitigate ongoing depopulation.

In addition to social, economic and cultural effects, rural depopulation has negative consequences over nature conservation. In South European countries, one of the major effects of depopulation, while simultaneously affecting biodiversity, supply of ecosystem services and environmental quality, is an increase in wildfire hazards. Land abandonment related to depopulation changes the vertical and horizontal fuel structure in ecosystems and landscapes, thereby increasing fire hazards [4]. Abandoned landscapes tend to exhibit higher fire spread and intensity due to the spatial pattern of fuel load and to the reduction of fuel breaks (managed areas) in the landscape [5,6]. The consequences of fires of higher severity in abandoned landscapes becomes an even more serious issue when these landscapes contain systems of high ecological value which have been maintained through moderate levels of management intensity over periods of centuries to thousands of years. Several reports show a recent increase in forest fires in conservation areas. During the summer of 2009, approximately 30% of the burned areas in Europe were in Natura 2000 sites that were seriously affected and now face great challenges of recovering the original conditions [7].

Rural areas globally suffer from endemic poverty. International Fund for Agricultural Development—IFAD [8] estimated that over 60% of the poor will still be in rural areas, even in 2025. Rural poverty is perpetuated by the lack of access to essential assets like basic infrastructure, education or knowledge to access technologies and markets that could improve their productivity and income [9]. In Europe poverty is not exclusive to rural areas, but most of its poverty is found in rural areas [1]. Both poverty and degradation of high ecological value sites in rural areas need to be taken into account when rethinking rural development and defining the priority criteria to be considered in the development of tools to support rural regions and the corresponding improved assessment mechanisms in order to preserve biodiversity and increase welfare in local communities.

In Europe, the reversion of degradation processes, such as those mentioned above, and the development of rural areas have become important objectives in policy-making. Although support to low productivity agriculture dates back to 1972, strong efforts oriented towards rural development have been put forward by European institutions since early 1990s, assuming the most relevance in terms of financial support from Common Agricultural Policy (CAP) measures and the corresponding European Structural and Investment funds [10]. From a conservation perspective, European Union policies, such as CAP, have been progressively reformed, increasingly stressing goals directly and indirectly related to biodiversity and the environment. In early stages, CAP encouraged intensive farming and this caused the loss of habitats and species during the 20th century [11]. The first agri-environmental payments were introduced by the McSharry reform in 1992 [12]. However, it was not until the 2013 CAP reform that substantial changes were introduced. These were oriented towards conservation of nature, such as greening payments, to support sustainable farming, sustainable management of natural resources, climate action and balanced territorial development focused on rural areas with expected impacts on semi-natural habitats and wild species across Europe [13]. Other European Union initiatives, such as LEADER, INTERREG or LIFE programs have channeled important investments towards vulnerable regions of low productivity and low income agriculture, weak industry and weak services sectors, all of which are highly dependent on public policy [14,15]. Although these efforts have apparently been well directed and their effects positive [10], socioeconomic and conservation goals in EU policy have not always been easy to integrate. Conflicts between stakeholders with different interests in rural areas make it difficult to establish locally consensual and coordinated planning and management instruments [16] and this difficulty also affects European policies and their application. Despite efforts, integration of goals has not been sufficiently achieved [17], which requires methodological developments in particular to pinpoint and consider environmental components in decision-making processes.

The complexity and multi-functionality of rural socioecological systems, including latent and active conflicts among actors and stakeholders, make decision-making in rural areas difficult. In this context, composite indicators (CIs) can provide powerful tools to aid decision-making processes [18]. However, the way CIs are structured and built is relevant to these processes and choices concerning the right models to use depend chiefly on the desires and preferences of the analyst [19]. For this reason, it is important that the decision-maker has the possibility to choose from several indicator alternatives according to the most suitable method to apply in different decisional contexts. In this work, we aim to overcome challenges discussed early regarding the assessment of sustainable development in complex rural systems.

The objective of this paper is twofold: (i) to propose a new sustainable rural development index (nSRDI) considering vulnerability of ecosystem services as part of its environmental dimension and using a sequential BoD-DEA model for its development; and (ii) to test the effect of different weighting methods on sustainable rural development index scores and rankings resulting from its application.

The added value of this study lies on providing a composite indicator to improve assessment and decision-making processes in sustainable rural development policies, allowing ranking regions according to social and economic aspects while considering environmental value according to the vulnerability of ecosystem services.

2. Background and Hypotheses

Rural development is "the set of activities and actions of diverse actors that taken together leads to progress in rural areas" [20]. The term progress, in its diverse meanings, is in this definition key to understand the evolution of the concept and practice of rural development over time and can be used as a reference to classify the different composite indicators proposed so far. Rural development has changed considerably from its origins in early 1900s up to the 1990s, when it was guided mostly by profitability according to a technocratic and technical, exclusive, big corporation oriented model, to the late 20th century concept(s) directed to sustainability of agriculture and other activities and based on a holistic, inclusive and participatory local and territorial model [21,22]. Rural policy has changed accordingly and the conceptual framework supporting rural development has also been reviewed in the last two decades, in close connection with the development and implementation of the concept of sustainability in political and sectorial areas. Over time, rural policies have been changing from a unifunctional agricultural model focused on food production to a multifunctional agricultural model producing a range of private and public goods, (positive) environmental and cultural impacts, agreeable landscapes and quality and safe products [22]. This new model integrates agriculture and the environment.

Today, making agriculture sustainable is a global challenge and European institutions have provided scope for enhanced sustainability in instruments like the CAP. In the draft of the European Green Deal (EGD) one of the fields proposed for improvement was related to the insufficient set of indicators available and the development of indicators addressing nature conservation [23]. To align CAP with the principles of sustainability, multifunctionality and payments for public goods, 10 urgent action points were proposed in the EGD. Action 7, 8, 9 and 10 are related to the review of indicators, strengthening environmental monitoring, identification and addressing global impacts of the CAP as well as improving the governance of the CAP and its reforms [24]. Regarding the improvement of indicators, the EGD makes a particular mention to the relevance to maintaining conceptual references such as the Sustainable High Nature Value (HNV) Farming framework. One of the specific measures in Action 7 ("Revise the set of indicators") is to "reintroduce the HNV indicator". Sustainable High Nature Value (HNV) Farming is based on the importance that some rural/agriculture landscapes have for biodiversity conservation and identify, as key elements of sustainable HNV farming: socio-economic typology of HNV farmers, sustainable agricultural systems, aspects related with communities of NHV farmers as identity, motivation or social recognition and finally, the economic concept of profitability [25].

Numerous indicators have been proposed to assess "development" and "rural development". The World Bank and the OECD are among the international institutions that have dedicated efforts to measuring progress of rural areas [26] through the establishment and use of comprehensive systems of indicators. The OECD grouped a set of basic indicators in four development dimensions: Population and migration, Social well-being and equity, Economic structure and performance and Environment and sustainability [22]. The most important issues regarding rural development by the OECD tended to discard the Environmental and sustainability group and selected all the other three dimensions as key groups to define rural development indicators [22]. This has, however, changed with the adoption of new concepts regarding rural development, such as the OECD Rural Policy 3.0 framework, and the use of indicators such as the Green Development index [27].

The World Bank [28] uses a core set of indicators that captures a myriad of components of rural development and poverty. These indicators are classified in five dimensions: Basic data, Enabling environment for rural development, Broad based economic growth for rural poverty reduction, Natural resource management and biodiversity and Social well-being. This system includes a specific dimension related to natural resources.

Few works address specifically the design of indicators related to the environmental domain in the construction of rural development CIs that use vulnerability as part of environmental indicators. Environmental indicators have been defined in multiple ways and used from diverse approaches in the construction of sustainability CIs. The broad definition of sustainable development of the Brundtland Report in 1987, based on an intergenerational equity principle, and sustainability sciences based on the social dependence on natural resources but not exactly specifying ways of operationalization [29,30] have opened the field for a high variety of composite indicators developed and tested with the goal of measuring sustainability from different approaches [18,19,31–36]

The Ecosystem Service (ES) approach sets the foundations for a new way of assessing sustainability emphasizing the rational exploitation of the environment and resources vs the most strict non-use conservation idea [37]. This citation of [29] effectively describes the role of the ES science in dealing with sustainability: "In much of the world, conserving nature out of moral obligation is a luxury most simply cannot afford. Nevertheless, human well-being is intimately linked to the immediate environment and natural capital is a vital part of the economic base. In the face of a sea of poverty, demonstrating the ignored links between nature and elements of well-being safe drinking water, food, fuel, flood control, and aesthetic and cultural benefits that contribute to dignity and satisfaction, is the key to making conservation relevant and, if we are lucky, possible". In recent years ES-based indicators have been developed and applied to address sustainability. Mononen et al. [37] described the process of establishing a national ES indicator framework for Finland directed to social-ecological sustainability. Chen et al. [38] proposed an ecosystem service-based sustainability CI for the urban agglomeration of the Lake Biwa region in Japan based on 22 indicators. Díaz-Balteiro et al. [39] proposed a methodology to the dynamic aggregation of indicators of sustainable forest management based on six climate change scenarios considering five ESs: timber production, carbon sequestration, habitat and biodiversity conservation, recreation and game habitat quality in Central Spain. Chen et al. (2020) proposed a method to develop a CI to assess sustainability in eight ESs (soil retention, biodiversity maintenance, food provision, raw-material production, climate regulation, hydrological regulation, recreation services and landscape aesthetics) through value, vulnerability and spatial scale analyzing of the effect of different calculation methods on the index behavior.

Some studies remarked specifically on the importance of vulnerability of ecological components to assess sustainability [31,39–41] but only a few recent works consider specific measures of vulnerability to develop sustainability composite indicators. Li et al. [42] proposed a sustainability CI based on livelihood considering indicators of natural capital, such as land capital or drinking water quality, to develop an evaluation index system of livelihood sustainability in rural destinations in the Wuhan area in China. To identify weights of sub-indicators they used a degree of coupling between livelihood and ecosystems. After that, they used a weighted summation to aggregate each livelihood dimension and the entropy method used to weight them.

From a theoretical perspective, all previous research has added relevant value to the background of CI in the context of sustainability and it can be assumed, from the literature, that multifunctionality as part of the rural development concept and its assessment requires consideration of environmental aspects when constructing rural development indicators. The vulnerability of these environmental aspects has not been included in this type of CIs.

From an operational/methodological perspective, it is also necessary to emphasize the great diversity of approaches and methods used in the development of sustainability CIs. Singh et al. [43] found 18 different schemes of weighting indicators and 16 different aggregation methods in 41 studies to construct sustainability CIs. Díaz-Balteiro et al. [39] and Giménez et al. [32] used Goal Programming methods to rank sustainability of forest plantations in Spain. They proposed four Goal Programming models to aggregate sustainability indicators considering preferences of decision makers using a pairwise survey and applied them to rank 30 industrial forest plantations. Castellani et al. [44] applied a Sustainable Performance Index to measure welfare and development at local scales under the framework of the European Charter for Sustainable Tourism in Protected Areas. This CI was defined as the sum of the values of 20 indicators in six groups: population, housing, services, economy and labor and finally environment and tourism. Caschili et al. [45] proposed the Composite Index of Rurality (CIR) to assess rurality in the region of Sardinia (Italy) firstly studying accessibility using an indicator constructed by a doubly constrained spatial interaction model and then proposing CIR to evaluate rurality in a regional setting employing multivariate analysis. CIR was obtained as an unweighted sum of descriptors of three pillars: demography, economics and settlement.

One of the most significant challenges in sustainable development planning is to obtain information economically, ensuring that it is thematically, spatially and temporally relevant to support policy analysis and decision-making [46]. The usefulness of CIs to improve the management of complex problems and support decision-making processes has been demonstrated in different contexts, particularly in cases related to environmental problems [18,47]. CIs based on sustainability and ecosystem services have been commonly used in the assessment of complex problems related to rural development [47]. However, the development of CIs is not straightforward. CIs development faces methodological challenges related to the process of aggregating heterogeneous information. The use of different aggregation methods can lead to very different outputs. Thereby, an erroneous decision regarding aggregation methods can fundamentally alter how CIs perform. To aggregate simple indicators, weights are often used as measures of perceived importance of each analyzed subgroup. However, due to the lack of available information about subgroup importance and unwillingness to prioritize one subgroup above another, it is common to use equal weight methods. Although this procedure is seen as being neutral, it is still a weighting decision [47].

In connection to the objectives of this research, and based on the previous literature review and the identified research gaps related to the addition of vulnerability of environmental issues in rural development assessments and the effects of weighting methods on the behavior of composite indices, two hypotheses were tested:

1. The inclusion of vulnerability of ecosystem services in a new sustainable rural development index (nSRDI) affects the way as regions (*comarcas*) score and rank in terms of sustainable rural development.
2. The process of aggregation of sustainability components of rural development affects the ranking of regions according to their level of rural development and can emphasize divergences among regions.

Testing these hypotheses can indicate whether vulnerability should be included in the assessment of rural development and whether weighting methods can substantially impact regional rural development rankings. The first hypothesis deals with a conceptual challenge regarding the role of environmental components in the assessment of sustainable rural development and the second hypothesis with a weighting methodological issue.

3. Materials and Methods

3.1. Study Area

This research was applied in Huesca, a province of Spain located in the autonomous community of Aragon in the northeast of the country. The province comprises 202 municipalities distributed over 10 *comarcas*: Alto Gallego, Bajo Cinca, Cinca Medio, Hoya of Huesca, La Jacetania, La Litera, La Ribagorza, Los Monegros, Sobrarbe and Somontano de Barbastro (Figure 1). Overall, population density (220,000 inhabitants, 15,626 km^2) is 14 inhabitants per km^2 but many municipalities show densities much lower than average. Absolute population per municipality ranges from 100 to 500 inhabitants in 48% of the area of the province. Only 13 municipalities out of 202 present population levels higher than 2000 inhabitants. In this study, only the rural municipalities with a population density lower than 150 inhabitants per km^2 following OECD criteria were addressed [48]. Moreover, only municipalities with less than 2000 inhabitants were considered to deal with the problem of definition of rural areas in some Spanish municipalities. Indicators were collected or calculated at the rural municipality level, later grouped into *comarcas*. The rural municipalities cover 1,236,976 ha, which represents 79.16% of the area of the province [49].

Although the majority of the area comprised by *comarcas* corresponds to rural municipalities, rural municipalities represent just a small proportion of the population of *comarcas*. Depopulation is a major socio-economic problem of these rural areas [50]. High and constant rates of depopulation have led numerous rural municipalities to extremely low demographic densities [3], currently less than 4 inhabitants/km^2 in many of these. A rural exodus in the 20th century and consequent land abandonment have contributed to the current landscape structure and functioning in these rural areas. One of the consequences of depopulation/abandonment was the decline of traditional land-use/land-cover systems and the expansion of shrubland and forest regeneration systems and the impoverishment of cultural landscapes, among others [50].

In general, Huesca can be characterized by a high degree of rurality and a high ecological value. The economy of the rural areas in the region is based on agriculture, cattle raising and nature tourism. Farmland in the rural area is around 661,600 ha, which represents 42.3% of the area of Huesca. Irrigated crops, such as alfalfa, corn and fruit tree orchards, are very important in La Litera, Cinca Medio and Bajo Cinca *comarcas* while in Somontano and Monegros vineyards, fruit tree orchards and forage crops are the dominant systems. Rural municipalities contain 63,460 ha of grasslands supporting extensive cattle and sheep grazing systems, i.e., 5.13% of their area [49]. In addition to grazing, grasslands provide a multitude of environmental services, such as carbon sequestration and storage or regulation of the water cycle [51]. Although sheep are more important in terms of the number of animals, in recent years they have declined in favor of cattle. In mountainous areas, cattle still persist extensively based in meadows. Today, local communities in rural areas are strongly dependent of tourism, as the main activity of families or as the secondary activity of farmers, breeders and small entrepreneurs whose activity is focused on local products.

Mountains dominate the landscape in Huesca to a large extent. Most of the area of the province is located in the Aragonese Pyrenees, to the north, and the Iberian System to the south. In the south of the province forests of conifers are abundant and small woodlands of *Juniperus sabina* and *Quercus ilex* emerge in semi-arid areas with crops and extensive meadows. Overall, forest and shrubland cover in the Huesca province is around 714,500 ha including 567,750 ha (45.90%) in the rural municipalities addressed in this study [49].

Regarding natural value, 25.24% of the area of the Huesca province has been classified as Sites of Community Importance (SCI) and 23.64% as Special Protection Areas (SPA) [49] under the Natura 2000 network, and nearly 9% of the province has also been classified as protected areas under national and regional conservation systems [48]. These figures are still more relevant when presented in terms of rural area of *comarcas*. For instance, 67.67% of the rural area in the *comarca* of La Jacetania is SCI, of which 44.66% is protected area, and 50.69% of the rural area of Sobrarbe is SCI, of which 30.06% is protected area [49]. One of the most important protected areas in the study area is the Ordesa and Monte Perdido National Park (OMPNP). Located in the Sobrarbe *comarca* (municipalities of Bielsa, Broto, Fanlo, Puértolas, Tella-Sin and Torla), the OMPNP was established in 1918 and expanded in 1982 to its present limits. The National Park comprises a core area of 15,608 ha and a buffer zone of 19,679 ha. This National Park includes the most singular and representative ecological values in the study area and for this reason it was selected as the reference area for the assessment of vulnerability of ecosystem services in this study.

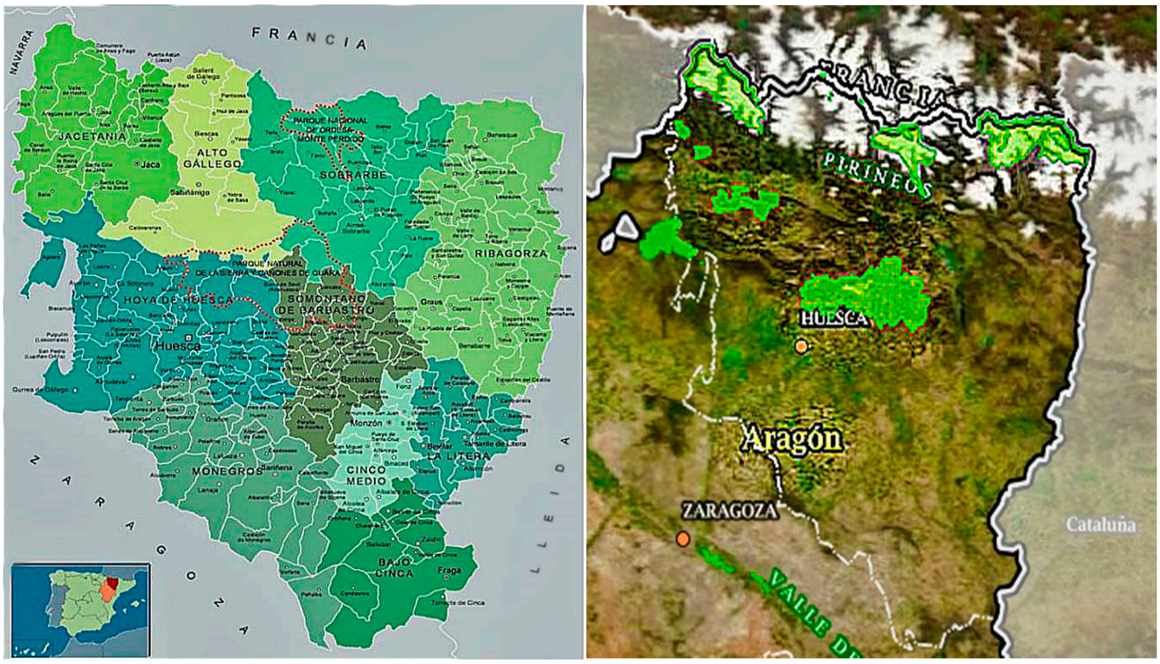

Figure 1. *Comarcas* in Huesca and location of Huesca province in Spain and in the autonomous community of Aragon (**left**), Source: [52]; Protected areas in the Huesca province (**right**), Source: [49].

3.2. Indicators

Initially, a set of 21 indicators distributed by the three sustainability dimensions (social, economic and environmental) were selected for this study (Table 1) based on the published data available for the Huesca province, taking into consideration the dimensions of sustainability and the use of sustainability indicators of sustainable rural development in the literature, following the extensive review in Section 2. These indicators were classified according to impacts on sustainable development in two forms: indicators with a positive impact (+) and indicators with negative impact (−). All indicators were positively related to sustainable development, with the exception of the Aging Index and Burned area that were considered to be negatively related to social and economic development indicators and some environmental indicators (I12, I13, I15, I16, I20 and I21) were collected from the Government of the Aragón database [49]. Indicator I14 was obtained from a review of terrestrial vertebrate species registered on the Terrestrial Vertebrate Database of the Ministry of Environment of the Government of Spain [53], I15 from the CSIC herbarium and Government of Aragon spatial databases [54], I18 from the CORINE Land Cover database in Aragon [49], and I19 was calculated using Equation (1):

$$ECr = 1 - \frac{\left(\frac{\sum_{i=1}^{n} LS_i * 100}{\sum_{i=1}^{n} ES_i}\right)}{100} \quad (1)$$

where EC_r is the erosion control index in *comarca* r, LS_i is the area (ha) with more than 25 t/ha/y of soil loss in municipality I and ES_i is the erodible soil in municipality i when *comarca* r is formed by n municipalities. LS and ES were calculated from data of the National Inventory of Soil Erosion in Spain [55].

The selection of the environmental indicators was supported by the identification of key ecosystem services in the Ordesa y Monte Perdido National Park (OMPNP) by [49] based on a coarse correspondence established as follows: Cultivated terrestrial plants represented by I12; Reared animals by I13; Wild animals and Genetic material for animals, grouped in a single class (ESs provided by wild animals), by I14; Wild plants and Genetic material for plants, grouped in a single class (ESs provided by wild plants), by I15; Surface water and Ground water grouped in the class Water, by I16; Regulation of extreme events by I17; Bioremediation, Mediation of nuisances, Lifecycle maintenance, Water conditions and Atmospheric conditions, grouped in a single class (Regulation ESs provided by natural environments), by I18; Soil quality by I19; Physical, Intellectual and Spiritual interactions, grouped in the class Leisure of nature, by I20; and Non-use value (landscape) by I21. The correspondence between ecosystem services and the selected indicators is supported by ecosystem functions and services classification systems and indicators established for their assessment [56,57].

Table 1. Description of indicators used for *comarcas* in the Huesca province by dimension and type.

Code	Dimension	Indicator	Description	Type
I1	Social	Aging Index (%)	Ratio of the population 65 years or older to population 15 year older or younger	−
I2	Social	Cumulative population growth rate (%)	Cumulative growth rate of the population during the last decade	+
I3	Social	Medium-high education ratio (%)	Ratio of the population with medium or higher education to the overall population	+
I4	Social	Schools/libraries per inhabitant (%)	Number of schools and libraries over total population	+
I5	Social	Health centers per inhabitant (%)	Number of health centers over total population	+
I6	Social	Workers in the commerce sector (%)	Workers in the retail and wholesale trade sector over total population	+
I7	Social	Vacancies in nursing homes (%)	Number of vacancies available in nursing homes over total population	+
I8	Economic	Employment rate (%)	Ratio of number of workers to labor force	+
I9	Economic	Activity rate (%)	Ratio of active to total population	+
I10	Economic	Area of retail trades (m^2)	Area assigned to retail trades	+
I11	Economic	Working licenses on the services sector (%)	Ratio of working licenses in the services sector to total population	+
I12	Environmental	Agriculture cover (%)	Ratio of agriculture land uses to the total area	+
I13	Environmental	Number of reared animals (number)	Absolute number of reared animals	+
I14	Environmental	Animal richness (number)	Average number of animal species by 10×10 km UTM grid cell	+
I15	Environmental	Plant richness (number)	Average number of vascular plant species by 10×10 km UTM grid cell	+
I16	Environmental	Water bodies (ha)	Summation of areas of all water bodies	+
I17	Environmental	Burned area (ha)	Total burned area due to wildfires	−
I18	Environmental	Forest area (ha)	Area of all forests land uses	+
I19	Environmental	Erosion control index (unitless)	Calculated according to Equation (1)	+
I20	Environmental	Protected Areas (%)	Ratio of area of protected areas to total area	+
I21	Environmental	SCI area (%)	Ratio of area of Sites of Community Importance to total area	+

3.3. Aggregation

The new Sustainable Rural Development Index (nSRDI) proposed in this work was obtained in a sequential process. The first step consisted of aggregating individual indicators in independent dimension indicators (DI) for the social and economic dimensions of sustainability based on an efficiency approach using a Benefit of Doubt-Data Envelopment Analysis (BoD-DEA) model. For the environmental dimension, aggregation was based on a vulnerability approach. The second step consisted of aggregating social, economic and environmental dimension indicators into single composite index using a modified BoD-DEA model. Aggregation was conducted after a correlation analysis with the set of indicators in Table 1 was performed to look for possible linear relationships between pairs of indicators [19]. When correlations were statistically significant, one of the indicators was removed from the analysis, reducing the dimensionality of the data. Calculations were made in SPSS v15.0 (SPSS Inc., Chicago, IL, USA) (correlation analysis) and Lingo v18.0 (Lindo Systems Inc., Chicago, IL, USA) (BoD-DEA models).

3.3.1. Social and Economic Dimension Indicators

The construction of composite indicators requires a multidimensional approach to aggregate heterogeneous information in a structured manner. Data Envelopment Analysis (DEA) is used to optimize variables in complex scenarios based on efficiency. It is a linear programing technique used to assess a set of productive units using input and output variables in an uncertainty context, where the weights of these variables and the production function that relates them are unknown. There is conceptual similarity between that problem and the construction of CIs, in which quantitative sub-indicators are available but the actual knowledge of weights is not [58]. Therefore, DEA can be applied in the construction of CIs from the Benefit of the Doubt approach (BoD) [58]. The main objective of BoD models is to obtain the most suitable weights to each compared assessment of a decision unit from the available data for each unit [59]. Thus, BoD models assess the performance of each decision unit regarding other decision units, therefore allowing the definition of the most suitable weights for each unit. The only difference between BoD models and traditional DEA models is that the only fixed variables are output variables, considering only one dummy input variable that assumes the value 1 for each decision unit. This approach has been used frequently in the construction of CIs (e.g., [58,60]). In particular, Cherchye et al. [61] used a BoD model to construct sustainability CIs.

In the case of this research, the underlying idea is that a good relative performance of a particular *comarca* in one specific dimension indicator indicates that for that *comarca*, this dimension is relatively important. The model proposed here to aggregate a set of selected individual indicators into each of the sustainability dimension indicators is formulated as described in Equations (2)–(5):

$$DIc = max \sum\nolimits_{i=1}^{m} w_{c,i} I_{c,i} \tag{2}$$

s.t.,

$$\sum\nolimits_{i=1}^{m} w_{c,i} I_{j,i} \ \leq \ 1 \tag{3}$$

(n constraints, one for each *comarca* j),

$$\frac{w_i I_{j,i}}{\sum_{i=1}^{m} w_i I_{j,i}} \geq \alpha_i \tag{4}$$

$$w_{c,i} \ \geq \ 0 \tag{5}$$

(m constraints, one for each indicator i),

where $j = 1, 2, \ldots\ldots, n$ and $I = 1, 2, \ldots\ldots, m$, DI_c is the dimension indicator of decision unit c, $w_{c,i}$ is the weight of the decision unit c regarding indicator i, $I_{c,i}$ is the indicator i for each decision unit c, $I_{j,i}$ is the indicator i for each *comarca* j and $\propto_i$ is a bound parameter that represents the contribution of indicator i to each *comarca* j, regarding all indicators. This constraint was added to improve the discriminatory power of the model and to avoid extreme results. The use of proportions has been successfully applied in DEA-models to avoid extreme scenarios, i.e., that all the relative weight can be assigned to a single CI, which would contribute exclusively to the overall performance value, while the other indicators would assume zero as their relative weight [58]. This process was applied to the social and economic dimensions, resulting in two independent dimension indicators.

3.3.2. Vulnerability Assessment

Vulnerability can be defined as "the degree to which a system, subsystem, or system component is likely to experience harm due to exposure to a hazard, either a perturbation or a stress/stressor" [62]. In essence, vulnerability refers to the potential for loss deriving from natural or other hazards and changes [63]. There is not a consensus regarding the best method to assess vulnerability but there is agreement on the need for using vulnerability to assess environmental components of socio-ecological systems [64]. The quantification of vulnerability is structured in 3 stages:

(i) Selection of participants, design of questionnaire and collection of individual preferences. Participants were selected in the Ordesa and Monte Perdido National Park according to their representativeness and knowledge of the area. Representativeness means the ability of participants to provide the point of view of a group of people with common interests. Participants must have good knowledge of the environment and the territory in order to provide accurate inputs to the process. A panel of experts related to the National Park was formed with this purpose, comprising 5 technicians of the OMPNP, the mayor of one of the main municipalities in the National Park, a delegate of an NGO active in the National Park and a representative of the regional government of Aragón. A Saaty-type paired comparison survey was used to collect inputs for the assessment of the vulnerability of ecosystem services (Supplementary Material S1). Each participant was offered the option of assessing intensity of preference on a Saaty's 1–9 scale [65], for pairs of ecosystem services according to their vulnerability (a score of 1 meaning that two ecosystem services are perceived as having the same vulnerability, while a score of 9 indicated that the vulnerability of one ecosystem over another was the highest possible). The Analytic Hierarchy Process (AHP), a multi-criteria decision-making method based on individual preferences and valuations of the relative importance of criteria via value judgement, was used with the data from the survey to quantify the relative vulnerability of each ecosystem service. AHP is a very commonly used method [66] with many applications in natural resources planning.

(ii) Treatment of inconsistencies in individual ratings. A Consistency Ratio (CR) was calculated for each pairwise matrix once individual assessments were obtained for the reason that AHP requires consistency assessments (CR < 0.10) to aggregate individual results to calculate the relative importance for each criterion [65]. To solve inconsistent primary results, a Goal Programming (GP) model was used. GP is a linear programming technique useful to solve complex problems regarding optimization of natural resources. GP finds compromise solutions that may not fully satisfy all the goals but do reach certain satisfaction levels set by the decision-maker. For this purpose, an objective function and some constraints were defined. The constraints of the model were established by the relationship between each attribute, the achievement level for each attribute and negative and positive deviations of the goal. Additional constraints were applied so that the model could provide real solutions to the problem [67]. The Archimedean GP model based on [68] was applied using Equations (6)–(10).

Let M = $(m_{ij})_{ij}$ be a general matrix of positive numbers m_{ij} representing the importance of an item i over another item j given by a participant. There is a set of positive numbers $w_l \ldots w_n$, such that $m_{ij} = \frac{w_i}{w_j}$ for every $i, j = 1, \ldots, n$.

$$\text{Min } \sum\nolimits_l \left(n_l^{(1)} + p_l^{(1)}\right)^p + \sum\nolimits_s \left(n_s^{(2)} + p_s^{(2)}\right)^p + \sum\nolimits_t \left(n_t^{(3)} + p_t^{(3)}\right)^p \tag{6}$$

s.t.,

$$w_{ij} - m_{ij} + n_l^{(1)} - p_l^{(1)} = 0,\ l = 1,\ 2, \ldots,\ n(n-1), \tag{7}$$

$$w_{ij} w_{ji} + n_s^{(2)} - p_s^{(2)} = 1,\ s = 1, 2, \ldots, \frac{n(n-1)}{2}, \tag{8}$$

$$w_{ij} w_{jk} - w_{ik} + n_t^{(3)} - p_t^{(3)} = 0, \qquad t = 1,\ 2, \ldots.,\ n(n-1)(n-2), \tag{9}$$

$$0.11 \le w_{ij} \le 9\ \ \forall\ i, j. \tag{10}$$

where $n_l^{(1)}$ and $p_l^{(1)}$ are the negative and positive deviations of the goal, respectively, for the constraints that ensure the condition of similarity in the position l; $n_s^{(2)}$ and $p_s^{(2)}$ are the negative and positive deviations of the goal, respectively, for constraints that ensure the condition of reciprocity in the position s; and $n_t^{(3)}$ and $p_t^{(3)}$ are the negative and positive deviations of the goal, respectively, for constraints that ensure the condition of consistency at position t; m_{ij} are the components of the matrix M for each pair of criteria; w_{ij} are the components of matrix W formed by the weights that represent the most similar weights to the components of the original M matrix for each pair of criteria ij.

This model has already been successfully applied to correct inconsistencies in paired matrices for planning in protected areas [16]. After application of the GP model, consistent matrices were obtained that are as similar as possible to the original ones, while ensuring the conditions of similarity, consistency and reciprocity required by matrices built using pairwise comparisons.

(iii) Aggregation. After inconsistency correction, each matrix was normalized and aggregated into a single matrix using a geometric mean. Final weights were obtained using the eigenvalue method. These weights represent the relative vulnerability of each ecosystem service. Once vulnerability weights were quantified, environmental dimension indicators were generated as a weighted sum.

3.3.3. The nSRDI Composite Indicator

The indicator nSRDI is the result of the aggregation of social, economic and environmental dimension indicators obtained in the previous steps of the process (Sections 3.3.1 and 3.3.2), using a modified BoD-DEA model (Equations (11)–(14)). Aggregation follows therefore a mixed efficiency-vulnerability approach, optimizing social and economic weights but fixing the environmental vulnerability dimension indicator ($EVDI_C$). As a result, nSDRI was calculated for each *comarca*, making it possible to rank these territorial units in the entire province of Huesca, as follows:

$$nSRDIc = max \sum_{i=1}^{m} w_{c,i} DI_{c,i} \ + EVDI_c \tag{11}$$

s.t.,

$$\sum_{i=1}^{m} w_{c,i} DI_{j,i} \ \leq \ 1 \tag{12}$$

$$\frac{w_i DI_{j,i}}{\sum_{i=1}^{m} w_i DI_{j,i}} \geq \alpha_i \tag{13}$$

$$w_{c,i} \ \geq \ 0 \tag{14}$$

where j = 1, 2, ..., n and i = 1, 2, ..., m, $DI_{c,i}$ is the socioeconomic dimension indicator i for decision unit c, $EVDI_C$ is the environmental vulnerability dimension indicator for decision unit c, $DI_{j,i}$ is the dimension indicator i for *comarca* j, $w_{c,i}$ is the weight of the decision unit c regarding dimension indicator i, and $\propto_i$ is a bound parameter that represents the contribution of indicator i for *comarca* j, regarding all the indicators.

$DI_{j,i}$ are obtained through Equations (2)–(5). $EVDI_C$ is calculated as:

$$EVDI_{\ c} = \sum_{i=1}^{m} w_i I_{c,i} \tag{15}$$

where w_i is the vulnerability weight related to each ecosystem service and $I_{c,i}$ is the environmental indicator i for decision unit c.

In order to test the effect of adding vulnerability based indicators in nSRDI, the index was also calculated removing vulnerability from the assessment and calculated weights for indicators in Table 1, after removal of redundancy, using two approaches: optimal and equal. In the optimal approach, since vulnerability was not considered, the process described in Section 3.3.2 was not included in the calculation of the index and social, economic and environmental dimension indicators were all obtained from Equation (2). Therefore, the BoD-DEA model applied did not consider a priori fixed weights. In this case, the weights in all the dimensions (social, economic and environmental) are the most efficient in order to achieve the best score of the DI. In the equal approach, an average was applied to aggregate dimension indicators. This is one of the most common aggregation methods used to construct CIs when weights are unknown.

Finally, an inter-*comarca* divergence analysis was conducted to analyze the sensitivity of nSRDI to the weighting method applied. This analysis was based on regional pairwise matrices of Euclidean distances in percentage (Equation (16)) between nSRDI values for the three methods (vulnerability, equal, optimal), resulting in three $n \times n$ diagonal and symmetric matrices when n *comarcas* were compared. Analyses were conducted in Excel 2010.

$$dst = \left(\sqrt{(CI_s - CI_t)^2}\right) \times 100 \quad (16)$$

4. Results and Discussion

4.1. Indicator Selection

As a result of the correlation analysis, I1, I3, I5, I13, I14 and I20 were removed from the set of indicators due to high correlation with other indicators. I1 was correlated with I2 (−0.707; $p < 0.05$), I3 was correlated with I5 (0.935; $p < 0.01$) and I7 (0.746; $p < 0.05$) and I5 was correlated with I7 (0.863; $p < 0.01$). Regarding the environmental dimension, I12 was correlated with I13 (0.832; $p < 0.01$), I14 (−0.778; $p < 0.01$) and I18 (−0.720; $p < 0.05$), I13 was correlated with I14 (−0.947; $p < 0.01$), I18 (−0.766; $p < 0.01$), I20 (0.680; $p < 0.05$) and I21 (−0.641; $p < 0.05$), I14 was correlated with I15 (0.656; $p < 0.05$), I18 (0.637; $p < 0.05$) and I21 (0.684; $p < 0.05$), I18 was correlated with I20 (0.668; $p < 0.05$) and I20 was correlated with I21 (0.765; $p < 0.05$). Selected indicators were then normalized (Min-Max scaling) for each of the *comarcas* (Table 2).

4.2. Vulnerability Weights

As a result of the individual assessment of vulnerability of ecosystem services based on indicators, 64 pairwise comparison matrices were obtained. Of these, 32 were inconsistent and corrected with the GP model described in Equation (3) by recovering 50% of the information, after which weights were calculated for selected indicators. The most vulnerable ecosystem services were Wild plants and Genetic material for plants (ESs provided by wild plants) which correspond to the indicator Plant richness (27.62%) and Bioremediation, Mediation of nuisances, Lifecycle maintenance, Water conditions and Atmospheric conditions, grouped in class Regulation ESs provided by natural environments, represented by indicator Forest Cover (24.76%) while the less vulnerability were Cultivated terrestrial plants represented by indicator Agriculture cover (3.81%) (Table 3).

Table 2. Final indicators by *comarca* and dimension. Sign within parentheses indicates type of indicator: (+) when having a positive impact and (−) when having a negative impact on development. Maximum values are in bold.

Comarca	Social Dimension			Economic Dimension					Environmental Dimension					
	I2(+)	**I4(+)**	**I7(+)**	**I8(+)**	**I9(+)**	**I10(+)**	**I11(+)**	**I12(+)**	**I15(+)**	**I16(+)**	**I17(−)**	**I18(+)**	**I19(+)**	**I21(+)**
C1	0.860	0.723	0.509	0.422	0.295	0.788	**1.000**	0.048	**1.000**	0.258	**1.000**	0.362	0.000	0.431
C2	0.755	0.324	0.131	0.237	0.520	0.395	0.001	0.469	0.248	0.235	0.804	0.033	0.185	0.000
C3	**1.000**	0.366	0.419	**1.000**	0.966	0.644	0.105	0.681	0.456	0.000	0.801	0.000	0.598	0.060
C4	0.926	0.000	0.117	0.150	0.310	0.508	0.000	0.301	0.046	**1.000**	0.654	0.566	0.576	0.194
C5	0.624	0.363	0.211	0.413	0.266	**1.000**	0.560	0.181	0.711	0.300	0.994	0.606	0.283	**1.000**
C6	0.217	**1.000**	0.802	0.000	0.552	0.156	0.134	0.361	0.200	0.104	0.997	0.093	0.693	0.071
C7	0.505	0.371	**1.000**	0.369	**1.000**	0.716	0.912	0.037	0.641	0.597	0.000	0.992	**1.000**	0.202
C8	0.000	0.171	0.000	0.008	0.709	0.931	0.025	**1.000**	0.289	0.015	0.545	0.158	0.554	0.397
C9	0.926	0.506	0.000	0.044	0.000	0.369	0.715	0.000	0.858	0.336	0.961	**1.000**	0.723	0.723
C10	0.529	0.326	0.178	0.163	0.781	0.000	0.229	0.303	0.000	0.136	0.786	0.287	0.723	0.222

Table 3. Environmental indicators and vulnerability weights calculated for Ordesa and Monte Perdido National Park based on expert opinion.

Environmental Indicator	Vulnerability Weight (%)
I15-Plant richness	27.62
I18-Forest area	24.76
I16-Water bodies	14.77
I21-SCI area	13.33
I17-Burned area	08.57
I19-Erosion control index	07.14
I12-Agriculture cover	03.81

4.3. Effect of Vulnerability on the Environmental Dimension

Assessment of the environmental dimension indicator quantified according to the three different weighting methods (vulnerability, equal, optimal) indicates that the process of weighting affects the score of the dimension indicator (Figure 2) as well as the ranking of *comarcas* in Huesca. The application of the process involving vulnerability of ecosystem services ranks Sobrarbe (C9) first, followed by La Jacetania (C5) and La Ribagorza (C7) (Figure 2). Sobrarbe (C9) ranked first also for the other two methods but the order of the remaining regions differs among methods. In terms of scores, the weights assigned through the optimal approach resulted in indicator scores higher than when the other two methods were used. This happens because the optimal approach provides the most favorable values of the weights, while the equal and vulnerability methods share the weights for all the considered indicators. Equal weights assign the same relative importance to each indicator causing divergences between *comarcas* to depend only on the differences of indicator values. When weights are not equal, the relative importance of each indicator can change the score and ranking of *comarcas* above the original indicators. For this reason, the vulnerability approach provides higher divergences than equal weights (see Section 4.4). This effect is more relevant when vulnerability weights rely on few indicators, as is the case in this study. Optimal weights caused the highest differences among *comarcas* due to the benchmarking nature of the optimization process that assign the best punctuation to the most efficient indicators regarding all the others. As such, when the optimal approach was followed, the highest distance observed was between La Jacetania (C5) or Sobrarbe (C9), and Los Monegros (C8), that received the best score. The differences between best and worst scores were very small when equal weights were used. The vulnerability approach provided a balanced solution relative to the other two approaches and produced the largest distance between Sobrarbe and Somontano de Barbastro *comarcas*.

Although, apparently, equal weights produced scores closer to vulnerability than optimum weights, so the regional rankings based on this dimension indicator differ. Alto Gállego (C1) and Hoya de Huesca (C4) swapped positions 4 and 5. Sobrarbe (C9), La Jacetania (C5) and La Ribagorza (C7) *comarcas* were better ranked when vulnerability was added, while Bajo Cinca (C2), Somontano de Barbastro (C10) and La Litera (C6) have lower positions. This is due to the higher weights of indicators that represent high vulnerability regarding forest area and plant richness. When the optimum approach was used, the ranking changed dramatically as compared to the vulnerability approach, although the two best positions were maintained. Considering vulnerability, *comarcas* such as Somontano de Barbastro (C10) dropped from 3th to 9th in the rankings. Contrarily, La Ribagorza (C7) and Los Monegros (C8) climbed from 7th to 3th, and from the last to 6th, respectively. In the case of Sobrarbe, the score is so high that it is not affected by changes in the environmental dimension indicator.

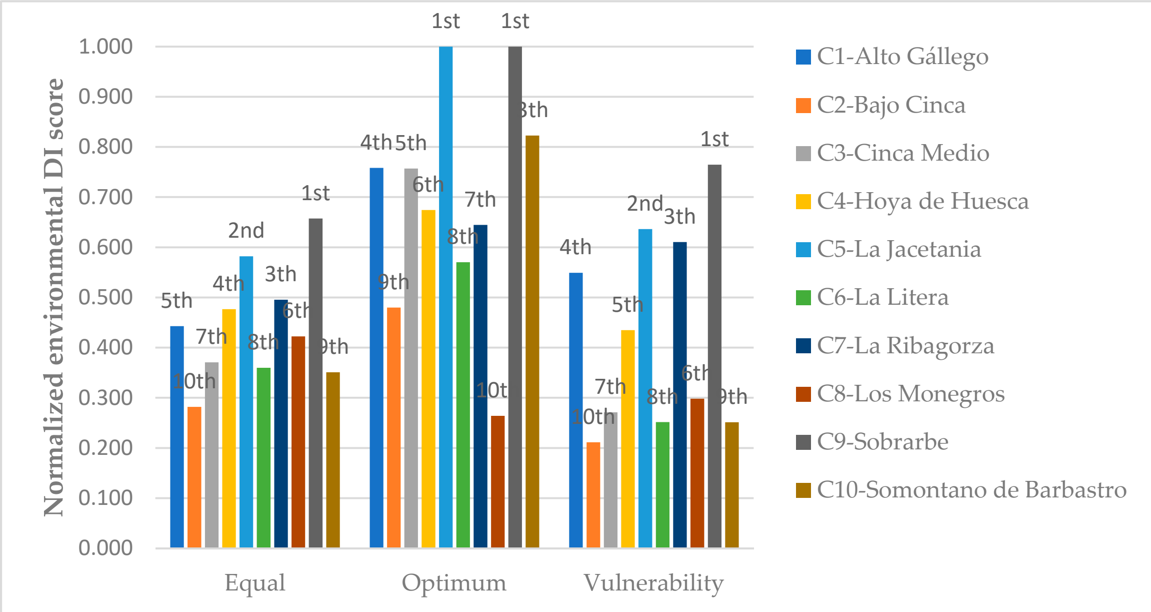

Figure 2. Normalized environmental dimension indicator scores by *comarca* and corresponding ranking position according to the process of calculating weights: vulnerability based weights and equal and optimal approaches.

4.4. Global Ranking Using Optimum, Equal and Vulnerability Weights

Results of the composite indicator (nSRDI) for all sustainability dimensions considering vulnerability weights as part of the environmental dimension indicator showed La Jacetania (C5), Sobrarbe (C9) and La Ribagorza (C7) *comarcas* to be the regions of higher sustainable regional development in the Huesca province (Table 4). These results were obtained through the application of Equations (2)–(5) for the social and economic dimensions with the bound parameter α_i= 0.05 (constraint 4) in a first round followed by a tie break (second round) of the *comarcas* with maximum scores that ranked first (score of 1) with the bound parameter set to α_i= 0.2 to increase the discriminatory power of the model and to solve ties (indicated with asterisk in Table 4).

Table 4. Global new Sustainable Rural Development Index—nSRDI rankings of *comarcas* for weights calculated with the vulnerability, equal and optimal approaches.

Comarca	**Global nSRDI Ranking**		
	Vulnerability	**Optimum**	**Equal**
C1-Alto Gállego	4	2 *	3
C2-Bajo Cinca	9	9	10
C3-Cinca Medio	6	5	5
C4-Hoya de Huesca	5	7	7
C5-La Jacetania	1 *	1 *	2
C6-La Litera	7	6	6
C7-La Ribagorza	3	3 *	1
C8-Los Monegros	10	10	7
C9-Sobrarbe	2 *	4	4
C10-Somontano de Barbastro	8	8	9

* Tied in the first round.

The effect of different weighting methods on nSRDI was assessed comparing *comarca* rankings obtained with the indicator under equal, optimal and vulnerability approaches (Table 4) and by the inter-*comarca* divergence matrices of nSRDI pairwise distances in the first round of the calculation, i.e., before tie-break (Figure 3) calculated with Equation (15), which helped us identifying the most relevant divergences among regions based on weighting method.

Divergences between *comarcas* were identified when vulnerability was added in the calculation of nSRDI. For instance, divergence between C8 and C5 and between C8 and C9 was 64.12%. This means that *comarca* Los Monegros (C8) presented the highest distance in score of nSRDI for these 2 regions when vulnerability was considered as part of the environmental dimension. However, as observed in the previous subsection, the strongest disparities among highest and lowest scores were observed when the optimum approach was applied (Figure 3). The highest distances observed (74.99%) were between C8 and C1, C5 and C7, *comarcas* in the highest positions in the ranking. With this method, the first round of calculations resulted in four ties for the top ranked *comarcas*. Moreover, all *comarcas*, with the exception of C2 and C8, had a score above 0.8, keeping a great distance from other *comarcas*. The lowest divergences occurred when equal weights were used. Here the highest divergence was 25.04% (C2 and C7). As already seen for the environmental indicator, the vulnerability approach provides a balanced solution between the equal and optimum approaches in the calculation of the composite index nSRDI. This means that, after the ties solved, this approach offers nSRDI results with enough discriminatory power to support a useful ranking of sustainable rural development for regions.

Vulnerability	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
C1		49,19	26,12	20,72	9,79	37,02	9,71	54,33	9,79	40,55
C2			23,07	28,47	58,98	12,17	58,90	5,14	58,98	8,64
C3				5,40	35,91	10,90	35,83	28,21	35,91	5,40
C4					30,51	16,30	30,43	33,61	30,51	19,83
C5						46,81	0,08	64,12	0,00	50,34
C6							46,73	17,31	46,81	3,53
C7								64,04	0,08	50,26
C8									64,12	13,78
C9										50,34
C10										
Optimum	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
C1		46,00	0,85	17,16	0,00	5,01	0,00	74,99	0,62	19,47
C2			45,15	28,84	46,00	40,99	46,00	28,99	45,38	26,53
C3				16,31	0,85	4,16	0,85	74,14	0,23	16,31
C4					17,16	12,15	17,16	57,83	16,54	2,31
C5						5,01	0,00	74,99	0,62	19,47
C6							5,01	69,98	4,39	14,46
C7								74,99	0,62	19,47
C8									74,37	55,52
C9										18,85
C10										
Equal	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
C1		19,33	1,94	13,13	2,20	10,37	5,71	13,09	1,32	13,56
C2			17,39	6,20	21,53	8,96	25,04	6,24	18,02	5,77
C3				11,19	4,14	8,44	7,65	11,16	0,62	11,19
C4					15,33	2,75	18,84	0,03	11,81	0,43
C5						12,58	3,51	15,30	3,52	15,76
C6							16,08	2,72	9,06	3,18
C7								18,80	7,03	19,27
C8									11,78	0,46
C9										12,24
C10										

Figure 3. Pairwise *comarca* new Sustainable Rural Development Index—nSRDI divergence matrices by weighting approach (equal, optimal and vulnerability) based on distances between scores of the indicator. Dark red indicates high divergence and dark blue indicates low divergence. Values are in percentages.

4.5. Hypotheses Assessment

Results of this research support the two hypotheses presented initially (Section 2). The first, that the inclusion of vulnerability of ecosystem services in nSRDI affects *comarcas* sustainable rural development score and ranking position, is supported by results in Sections 4.3 and 4.4. This contributes to clarifying the importance of methods of describing and addressing quantitatively the environmental component in constructing composite sustainability indices. When vulnerability was added to the composite index calculation process, the scores of the environmental dimension indicator and nSRDI changed in comparison to the cases where the model excluded vulnerability. Moreover, rural sustainable development rankings also changed which suggest that the changes caused by the introduction of vulnerability were relevant. In particular, the most affected regions in the global ranking were *comarcas* with the highest ecological value in the Huesca province, as is the case of Sobrarbe (C9). This *comarca* was better ranked when vulnerability was considered. Also, La Jacetania (C5) scores were in the highest position when vulnerability was added, in comparison with equal weights, although it was also top with the optimum approach. The two *comarcas* with the highest percentage of SCI area were 67.17% (83,951 ha) in La Jacetania and 50.69% (97,318 ha) in Sobrarbe.

Economic development of rural areas with conservation areas lays mainly on tourism, often related to natural areas or sites with high nature value. Despite opportunity costs derived from land use and land cover limitations, it is likely that rural areas presenting a higher presence of conservation areas show higher levels of development which is related to the tourism industry. In fact, tourism is one of the main economic drivers of rural economies in Europe. Directly and indirectly it accounts for around 10% of European GDP and 20 million jobs [69]. In Spain, rural tourism drew 1.57 million tourists in 2016, growing 86.36% in 11 years [70,71]. In particular, nature-based tourism provides very important sources of income all over the world. Balmford et al. [72] estimated that the world's terrestrial protected areas together receive nearly 8 billion visits a year and these visits generate around US $600 billion per year in direct in-country expenditure and US $250 billion/year in consumer surplus. Vulnerability of ecosystem services in Huesca *comarcas* such as Sobrarbe (C9) or La Jacetania (C5), is particularly important because their main driver of development is tourism with a strongly dependency on nature conservation [73]. Increasing vulnerability jeopardizes the supply of ecosystem services over time and their contribution to local development in particular affects the cases of high ecological value sites.

Changes in the regional rankings due to the inclusion of vulnerability in the evaluation process can affect decisions over rural policies in particular when regions with high ecological value and more vulnerable ecosystem services do not receive enough institutional relevance as other rural areas. Adding vulnerability to the assessment of rural areas can improve the quality of decisions and guide resources management recognizing and boosting development of the rural areas that better provide social and economic development while conserving high ecological value and vulnerable sites.

The second hypothesis addressed, according to which the method of aggregation of sustainability components of rural development affects the ranking of regions according to their level of rural development and can emphasize divergences between regions, received support from results in Sections 4.3 and 4.4, contributing to guide the use of the most suitable decision-making tools regarding rural policies, in particular weighting methods. This hypothesis, more focused on a methodological issue, was put forth in order to analyze the effect of three weighting methods on indicators.

Despite their usefulness and increasing use in assessing complex and multidimensional problems, CIs still generate controversy. The dependency to a preliminary normalization stage and the disagreement among decision-makers on the specific weighting scheme used to aggregate indicators or dimension indicators, are the main problems that analysts face [61]. It is therefore relevant the information that can be extracted from the use of three weighting methods applied in this particular study.

Results showed that the optimum weighting approach produced the lowest discriminatory power among nSRDI scores resulting in three *comarcas* (La Jacetania, La Ribagorza and Alto Gállego) at the top of the corresponding ranking with the highest score. The vulnerability process also showed limited discriminatory power with Sobrarbe and La Jacetania ranking first with the highest index score. The main weakness of the optimization models used for constructing CIs lay in the low discriminatory power and this could be a serious problem with basic BoD-DEA models because their capacity to rank units is weak. Fortunately, [74] found that adding constraints limiting the relative contribution of criteria can solve this problem. By imposing intuitive, widely accepted normative weight bounds, the discriminatory power increases. When these constraints are added, the value of the objective function decrease and only the decision units that have a minimum contribution in all the criteria can reach the maximum score. Thus, the bound parameter α_i can be changed to add or remove flexibility to the model. [58,74] and [75] used this type of extended DEA models in the construction of CIs. In the present case study, the optimum and vulnerability weights were obtained setting the bound parameter α_i to 0.05 for all the criteria (constraints in Equations (4) and (13)). When ties were observed, the model was reapplied over tied regions, increasing the parameter up to 0.2. The equal approach presented the highest discriminatory power. However, this method does not allow considering efficiency to build nSRDI, since it assigns the same weights to all criteria.

In the case of this study, the model proposed fills the information gap in the "right" set of weights by generating flexible BoD-weights for social and economic assessment and expert opinion AHP-GP-weights for the environmental assessment for each *comarca*. The vulnerability approach initially provided ties for the two best positions in the ranking, but, as Figure 3 shows, provided a higher frequency of large distances (red cells) than the equal and optimum approaches. This shows wider regional distances among nSRDI values that represent robust positions in the ranking. Once ties were solved increasing the bound parameter, this method provided a complete ranking which presented the most efficient regions in terms of economic and social elements and vulnerability in terms of ecosystem services, simultaneously.

The assessment of both hypotheses emphasizes the relevance to make efforts to accurately define the relative importance of each assessed component in SRDIs.

The prominence of the resources directed to improve rural areas through the development of national and international policies requires rigorous and reliable tools to support decision-making processes. The challenge is to develop an integrated systems approach to sustainable rural development evaluation systems to support decision-processes that are effective in making sure public policy choices are well informed. The proposed model contributes to the achievement of this objective by providing a novel approach to the accurate assessment of sustainable rural development.

5. Conclusions

In this paper, a novel approach has been provided to accurately assess sustainable rural development with a potential strong contribution in the improvement of integrated system analysis and in the support of effective and informed decision-making processes and public policies.

The weighting method used in the construction of composite indicators was found to be not neutral. The proposed model presented a solution for problems of unknown information regarding weights by generating flexible BoD-weights for social and economic assessment and expert-opinion based AHP-GP-weights based on ecosystem services vulnerability for the environmental assessment.

When vulnerability of ecosystem services was added into the environmental DI, positions in the ranking changed dramatically and only the highest position was maintained. In this study, some *comarcas*, such as La Ribagorza and Los Monegros, obtained a much better score for the environmental DI based on vulnerability. Divergences between *comarcas* were identified when vulnerability was added in the calculation of nSRDI. The highest distances observed were between Los Monegros and Alto Gállego, and between La Jacetania and La Ribagorza. The vulnerability approach developed here provided a balanced solution in comparison to equal and optimum approaches in the calculation of the composite index nSRDI.

The inclusion of vulnerability of ecosystem services in nSRDI affected the *comarcas'* sustainable rural development score and ranking positions. Increasing vulnerability jeopardizes local development, especially in the areas with high ecological value sites, whose development depends greatly on nature-based tourism. Adding vulnerability in the assessment of rural areas can improve the quality of decisions and guide resources management promoting the regions that better address social and economic development while conserving high ecological value and vulnerable sites.

Based on the results obtained in this study, useful recommendations can be presented to institutions in order to improve the assessment of the sustainable rural development. One of the most relevant practical implications of this study is the finding that to obtain information regarding the analyzed indicators it is not only relevant, but also necessary to define accurately the relative importance of the assessed topics. This means that the concept of sustainability should be very well defined and structured in order to assign the proper importance to each of its dimensions: social, economic and environmental. Assigning the same relative importance to all the criteria is not a neutral decision and it may not correspond to the particular objectives of the assessment process or the political strategy, or even the interests of the analyst. Similarly, absolute flexibility regarding the relative importance of components may not be adequate when some criteria need to be limited.

This study showed some limitations related to the availability of quantitative information of vulnerability, which was solved by including expert opinion-based information in the model. This entails the need to carefully select the experts to be involved in the assessment, considering their diversity, know-how and the full knowledge of the analyzed problem. Moreover, future researcher lines should be oriented to the development of models that consider the feedback of stakeholders in different steps of the assessment process, using collaborative/participative methods, such as Delphi, in order to identify conflicts and achieve consensus in decision-making processes.

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References

1. Eurostat. *Urban Europe–Statistics on Cities, Towns and Suburbs*; Publications office of the European Union: Luxembourg, 2016.
2. ESPON. *Shrinking Rural Regions in Europe. Policy Brief. Edit. Ilona Raugze, Gavin Daly, Marjan van Herwijnen*; ESPON EGTC: Luxembourg, 2017.
3. Pinilla, V.; Ayuda, M.I.; Sáez, L.A. Rural depopulation and the migration turnaround in Mediterranean Western Europe: A case study of Aragon. *J. Rural Community Dev.* **2008**, *3*, 1–22.
4. Sil, Â.; Azevedo, J.C.; Fernandes, P.M.; Regos, A.; Vaz, A.S.; Honrado, J.P. (Wild)fire is not an ecosystem service. *Front. Ecol. Environ.* **2019**, *17*, 429–430. [CrossRef]
5. Azevedo, J.C.; Moreira, C.; Castro, J.P.; Loureiro, C. Agriculture abandonment, land use change and fire hazard in mountain landscapes in northerastern Portugal. In *Landscape Ecology in Forest Management and Conservation: Challenges and Solutions for Global Change*; Li, C., Lafortezza, R., Chen, J., Eds.; Springer: New York, NY, USA, 2011; pp. 329–351.

6. Sil, Â.; Fernandes, P.M.; Rodrigues, A.P.; Alonso, J.M.; Honrado, J.P.; Perera, A.; Azevedo, J.C. Farmland abandonment decreases the fire regulation capacity and the fire protection ecosystem service in mountain landscapes. *Ecosyst. Serv.* **2019**, *36*, 100908. [CrossRef]
7. Pereira, P.; Mierauskas, P.; Úbeda, X.; Mataix-Solera, J.; Cerda, A. Fire in protected areas-the effect of protection and importance of fire management. *Environ. Res. Eng. Manag.* **2012**, *59*, 52–62. [CrossRef]
8. IFAD. *Rural Poverty Report 2001: The Challenge of Ending Rural Poverty*; Oxford University Press for IFAD: Oxford, UK, 2001.
9. FAO. 2020. Available online: http://www.fao.org/policy-support/policy-themes/rural-poverty-reduction/en/ (accessed on 1 May 2020).
10. Fernández Martínez, P. Los Fondos Estructurales Europeos y el desarrollo regional. *Informacion Comercial Española* **1997**, *766*, 135–145.
11. Stoate, C.; Báldi, A.; Beja, P.; Boatman, N.D.; Herzon, I.; Van Doorn, A.; de Snoo, G.R.; Rakosy, L.; Ramwell, C. Ecological impacts of early 21st century agricultural change in Europe—A review. *J. Environ. Manag.* **2009**, *91*, 22–46. [CrossRef] [PubMed]
12. Simoncini, R.; De Groot, R.; Correia, T.P. An integrated approach to assess options for multi-functional use of rural areas: Special issue "Regional Environmental Change". *Reg. Environ. Chang.* **2009**, *9*, 139–141. [CrossRef]
13. Concepción, E.D.; Aneva, I.; Jay, M.; Lukanov, S.; Marsden, K.; Moreno, G.; Oppermann, R.; Pardo, A.; Piskol, S.; Rolo, V.; et al. Optimizing biodiversity gain of European agriculture through regional targeting and adaptive management of conservation tools. *Biol. Conserv.* **2020**, *241*, 108384. [CrossRef]
14. Nieto Masot, A.; Gurría Gascón, J.L. El modelo rural y el impacto de los programas LEADER y PRODER en Extremadura (Propuesta metodológica). *Scr. Nova. Rev. Electrónica De Geogr. Y Cienc. Soc.* **2010**, *14*.
15. Nieto Masot, A.; Cárdenas Alonso, G.; Costa Moreno, L.M. Principal Component Analysis of the LEADER Approach (2007–2013) in South Western Europe (Extremadura and Alentejo). *Sustainability* **2019**, *11*, 4034. [CrossRef]
16. De Castro-Pardo, M.; Pérez-Rodríguez, F.; Martín-Martín, J.M.; Azevedo, J.C. Modelling stakeholders' preferences to pinpoint conflicts in the planning of transboundary protected areas. *Land Use Policy* **2019**, *89*, 104233. [CrossRef]
17. Navarro, A.; López-Bao, J.V. Towards a greener common agricultural policy. *Nat. Ecol. Evol.* **2018**, *2*, 1830–1833. [CrossRef]
18. Camaioni, B.; Coderoni, S.; Esposti, R.; Pagliacci, F. Drivers and indicators of the EU rural development expenditure mix across space: Do neighbourhoods matter? *Ecol. Indic.* **2019**, *106*, 105505. [CrossRef]
19. Díaz-Balteiro, L.; Alfranca, O.; González-Pachón, J.; Romero, C. Ranking of industrial forest plantations in terms of sustainability: A multicriteria approach. *J. Environ. Manag.* **2016**, *180*, 123–132. [CrossRef]
20. Shepherd, A. *Sustainable Rural Development*; Macmillan International Higher Education: New York, NY, USA, 1998.
21. Calatrava-Requena, J. Origin and evolution of Rural Development concept and policies: From rural communities to territories. In Proceedings of the Old and New Worlds: The Global Challenges of Rural History, International Conference, Lisbon, Portugal, 27–30 January 2016; Serrão, J.V., Freire, D., Fernández Prieto, L., Santos, R., Eds.; Lisbon, ISCTE-IUL: Lisbon, Portugal, 2016. Available online: https://lisbon2016rh.files.wordpress.com/2015/12/onw-02461.pdf (accessed on 1 May 2020).
22. Bryden, J. Rural development indicators and diversity in the European Union. In Proceedings of the Conference on Measuring Rural Diversity, Washington, DC, USA, 21–22 November 2002. Available online: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.199.4439&rep=rep1&type=pdf (accessed on 1 March 2020).
23. Pe'Er, G.; Zinngrebe, Y.; Moreira, F.; Sirami, C.; Schindler, S.; Müller, R.; Bontzorlos, V.; Clough, D.; Bezák, P.; Bonn, A.; et al. A greener path for the EU Common Agricultural Policy. *Science* **2019**, *365*, 449–451. [CrossRef]
24. Pe'Er, G.; Bonn, A.; Bruelheide, H.; Dieker, P.; Eisenhauer, N.; Feindt, P.H.; Hagedorn, G.; Hansjürgens, B.; Herzon, I.; Lomba, A.; et al. Action needed for the EU Common Agricultural Policy to address sustainability challenges. *People Nat.* **2020**, *2*, 305–316. [CrossRef]
25. EIP-AGRI Focus Group. Sustainable High Nature Value (HNV) Farming (Final Report). Report, Brussels, Belgium. 2016. Available online: https://ec.europa.eu/eip/agriculture/sites/agri-eip/files/eip-agri_fg_hnv_farming_final_report_2016_en.pdf (accessed on 1 March 2020).

26. Bhattacharyya, S.; Burman, R.R.; Sharma, J.P.; Padaria, R.N.; Paul, S.; Singh, A.K. Model Villages Led Rural Development: A Review of Conceptual Framework and Development Indicators. *J. Community Mobilization Sustain. Dev.* **2018**, *13*, 513–526.
27. Zhou, B.; Liu, W.; Lu, W.; Zhao, M.; Li, L. Application of OECD LSE Framework to Assess Spatial Differences in Rural Green Development in the Arid Shaanxi Province, China. *Int. J. Environ. Res. Public Health* **2020**, *17*, 286. [CrossRef]
28. World Bank. *Rural Development Indicators Handbook*; World Bank: Washington, DC, USA, 2000.
29. Armsworth, P.R.; Chan, K.M.; Daily, G.C.; Ehrlich, P.R.; Kremen, C.; Ricketts, T.H.; Sanjayan, M.A. Ecosystem-service science and the way forward for conservation. *Conserv. Biol.* **2007**, *21*, 1383–1384. [CrossRef]
30. Gómez-Baggethun, E.; De Groot, R.; Lomas, P.L.; Montes, C. The history of ecosystem services in economic theory and practice: From early notions to markets and payment schemes. *Ecol. Econ.* **2010**, *69*, 1209–1218. [CrossRef]
31. Chen, H.; Tang, L.; Qiu, Q.; Hou, L.; Wang, B. Construction and case analysis of an index for the sustainability of ecosystem services. *Ecol. Indic.* **2020**, *115*, 106370. [CrossRef]
32. Giménez, J.C.; Bertomeu, M.; Diaz-Balteiro, L.; Romero, C. Optimal harvest scheduling in Eucalyptus plantations under a sustainability perspective. *For. Ecol. Manag.* **2013**, *291*, 367–376. [CrossRef]
33. Gregory, R.D.; Van Strien, A.; Vorisek, P.; Gmelig Meyling, A.W.; Noble, D.G.; Foppen, R.P.; Gibbons, D.W. Developing indicators for European birds. *Philos. Trans. R. Soc. B Biol. Sci.* **2005**, *360*, 269–288. [CrossRef]
34. Reig-Martínez, E.; Gómez-Limón, J.A.; Picazo-Tadeo, A.J. Ranking farms with a composite indicator of sustainability. *Agric. Econ.* **2011**, *42*, 561–575. [CrossRef]
35. Sabiha, N.E.; Salim, R.; Rahman, S.; Rola-Rubzen, M.F. Measuring environmental sustainability in agriculture: A composite environmental impact index approach. *J. Environ. Manag.* **2016**, *166*, 84–93. [CrossRef]
36. Wolfslehner, B.; Vacik, H. Evaluating sustainable forest management strategies with the analytic network process in a pressure-state-response framework. *J. Environ. Manag.* **2008**, *88*, 1–10. [CrossRef]
37. Mononen, L.; Auvinen, A.P.; Ahokumpu, A.L.; Rönkä, M.; Aarras, N.; Tolvanen, H.; Kamppinen, N.; Viirret, E.; Kumpula, T.; Vihervaara, P. National ecosystem service indicators: Measures of social–ecological sustainability. *Ecol. Indic.* **2016**, *61*, 27–37. [CrossRef]
38. Chen, X.; Chen, Y.; Shimizu, T.; Niu, J.; Nakagami, K.I.; Qian, X.; Baoju, J.; Nakajima, J.; Han, J.; Li, J. Water resources management in the urban agglomeration of the Lake Biwa region, Japan: An ecosystem services-based sustainability assessment. *Sci. Total Environ.* **2017**, *586*, 174–187. [CrossRef] [PubMed]
39. Díaz-Balteiro, L.; Alonso, R.; Martínez-Jaúregui, M.; Pardos, M. Selecting the best forest management alternative by aggregating ecosystem services indicators over time: A case study in central Spain. *Ecol. Indic.* **2017**, *72*, 322–329. [CrossRef]
40. Skondras, N.A.; Karavitis, C.A.; Gkotsis, I.I.; Scott, P.J.B.; Kaly, U.L.; Alexandris, S.G. Application and assessment of the Environmental Vulnerability Index in Greece. *Ecol. Indic.* **2011**, *11*, 1699–1706. [CrossRef]
41. Toro, J.; Duarte, O.; Requena, I.; Zamorano, M. Determining vulnerability importance in environmental impact assessment: The case of Colombia. *Environ. Impact Assess. Rev.* **2012**, *32*, 107–117. [CrossRef]
42. Li, H.; Nijkamp, P.; Xie, X.; Liu, J. A New Livelihood Sustainability Index for Rural Revitalization Assessment—A Modelling Study on Smart Tourism Specialization in China. *Sustainability* **2020**, *12*, 3148. [CrossRef]
43. Singh, R.K.; Murty, H.R.; Gupta, S.K.; Dikshit, A.K. An overview of sustainability assessment methodologies. *Ecol. Indic.* **2019**, *9*, 189–212. [CrossRef]
44. Castellani, V.; Sala, S. Sustainable performance index for tourism policy development. *Tour. Manag.* **2010**, *31*, 871–880. [CrossRef]
45. Caschili, S.; De Montis, A.; Trogu, D. Accessibility and rurality indicators for regional development. *Computers, Environ. Urban Syst.* **2015**, *49*, 98–114. [CrossRef]
46. Schultink, G. Critical environmental indicators: Performance indices and assessment models for sustainable rural development planning. *Ecol. Model.* **2000**, *130*, 47–58. [CrossRef]
47. Burgass, M.J.; Halpern, B.S.; Nicholson, E.; Milner-Gulland, E.J. Navigating uncertainty in environmental composite indicators. *Ecol. Indic.* **2017**, *75*, 268–278. [CrossRef]
48. Goerlich, F.J.; Reig, E.; Cantarino, I. Delimitación y características de las áreas rurales españolas. In Proceedings of the International Conference on Regional Science. Thirty years of integration in Europe from a Regional Perspective: Balance and New Challenges, Santiago de Compostela, Spain, 16–18 November 2016.

49. IAEST. Instituto Aragonés de Estadística. 2018. Available online: https://www.aragon.es/ (accessed on 1 March 2020).
50. De Castro-Pardo, M.; Fernández Martínez, P.; Guaita Martínez, J.M.; Martín Martín, J.M. Modelling Natural Capital: A Proposal for a Mixed Multi-criteria Approach to Assign Management Priorities to Ecosystem Services. *Contemp. Econ.* **2020**, *14*, 22–37.
51. García, S. *Beneficios Económicos de la RED NATURA 2000 en España*; Ministerio para la Transición Ecológica: Madrid, Spain, 2019; 366p.
52. Mapa de Comarcas de Huesca. Available online: https://www.mapasmurales.es/municipios-huesca/ (accessed on 2 May 2020).
53. MITECO. Inventario Español de Especies Terestres. 2018. Available online: https://www.miteco.gob.es/es/biodiversidad/temas/inventarios-nacionales/inventario-especies-terrestres/inventario-nacional-de-biodiversidad/bdn-ieet-default.aspx (accessed on 1 March 2020).
54. Gobierno de Aragón, CSIC. Atlas Florístico de Aragón. 2005. Available online: http://floragon.ipe.csic.es (accessed on 1 March 2020).
55. MITECO. Inventario Nacional de Erosión de Suelos. Huesca. 2015. Available online: https://www.mapa.gob.es (accessed on 1 March 2020).
56. Burkhard, B.; Santos-Martín, F.; Nedkov, S.; Maes, J. An operational framework for integrated Mapping and Assessment of Ecosystem and their Services (MAES). *One Ecosyst.* **2018**, *3*, e22831. [CrossRef]
57. Maes, J.; Teller, A.; Erhard, M.; Murphy, P.; Paracchini, M.L.; Barredo, J.I.; Grizzetti, B.; Cardoso, A.; Somma, F.; Petersen, J.E.; et al. *Mapping and Assessment of Ecosystems and their Services: Indicators for Ecosystem Assessment under Action 5 of the EU Biosiversity Strategy to 2020*; Publications office of the European Union: Luxembourg, 2014.
58. Cherchye, L.; Moesen, W.; Rogge, N.; Van Puyenbroeck, T. Constructing composite indicators with imprecise data: A proposal. *Expert Syst. Appl.* **2011**, *38*, 10940–10949. [CrossRef]
59. Cherchye, L.; Moesen, W.; Rogge, N.; Van Puyenbroeck, T. An introduction to 'benefit of the doubt'composite indicators. *Soc. Indic. Res.* **2007**, *82*, 111–145. [CrossRef]
60. Verbunt, P.; Rogge, N. Geometric composite indicators with compromise Benefit-of-the-Doubt weights. *Eur. J. Oper. Res.* **2018**, *264*, 388–401. [CrossRef]
61. Cherchye, L.; Kuosmanen, T. *Benchmarking Sustainable Development: A Synthetic Meta-Index Approach (No. 2004/28)*; WIDER Research Paper UNU-WIDER: Helsinki, Finland, 2004.
62. Kasperson, J.X.; Kasperson, R.E.; Turner, B.L.; Hsieh, W.; Schiller, A. Vulnerability to global environmental change. In *Social Contours of Risk*; Routledge: New York, NY, USA, 2014; pp. 261–301.
63. Cutter, S.L. Vulnerability to environmental hazards. *Prog. Hum. Geogr.* **1996**, *20*, 529–539. [CrossRef]
64. Barnett, J.; Lambert, S.; Fry, I. The hazards of indicators: Insights from the environmental vulnerability index. *Ann. Assoc. Am. Geogr.* **2008**, *98*, 102–119. [CrossRef]
65. Saaty, T.L. Fundamentals of the Analytic Hierarchy Process. In *The Analytic Hierarchy Process in Natural Resource and Environmental Decision Making*; Schmoldt, D.L., Kangas, J., Mendoza, G.A., Pesonen, M., Eds.; Springer: Berlin/Heidelberg, Germany, 2001; pp. 15–35.
66. Cegan, J.C.; Filion, A.M.; Keisler, J.M.; Linkov, I. Trends and applications of multi-criteria decision analysis in environmental sciences: Literature review. *Environ. Syst. Decis.* **2017**, *37*, 123–133. [CrossRef]
67. Jones, D.; Romero, C. Advances and new orientations in Goal Programming. In *New Perspectives in Multiple Criteria Decision Making*; Springer: Cham, Switzerland, 2019; pp. 231–246.
68. González-Pachón, J.; Romero, C. A method for dealing with inconsistencies in pairwise comparisons. *Eur. J. Oper. Res.* **2004**, *158*, 351–361. [CrossRef]
69. Europarc Federation. Sustainable Tourism Working Group 2013–2014. Final Report. 2015. Available online: https://www.europarc.org/library/europarc-events-and-programmes/european-charter-for-sustainable-tourism/ (accessed on 2 May 2020).
70. Guaita, J.M.; Martín, J.M.; Salinas, J.A.; Mogorrón-Guerrero, H. An analysis of the stability of rural tourism as a desired condition for sustainable tourism. *J. Bus. Res.* **2019**, *100*, 165–174. [CrossRef]
71. Martín, J.M.; Salinas, J.A.; Rodríguez, J.A.; Jiménez, J.D. Assessment of the tourism's potential as a sustainable development instrument in terms of annual stability: Application to Spanish rural destinations in process of consolidation. *Sustainability* **2017**, *9*, 1692. [CrossRef]

72. Balmford, A.; Green, J.M.; Anderson, M.; Beresford, J.; Huang, C.; Naidoo, R.; Walpole, M.; Manica, A. Walk on the wild side: Estimating the global magnitude of visits to protected areas. *PLoS Biol.* **2015**, *13*, e1002074. [CrossRef] [PubMed]
73. Gómez Loscos, A.; Horna Jimeno, G. *El Sector Turístico En Las Comarcas Aragonesas*; Documento de trabajo 25/2006; Fundación Economía Aragonesa: Zaragoza, Spain, 2006.
74. Wong, Y.H.; Beasley, J.E. Restricting weight flexibility in data envelopment analysis. *J. Oper. Res. Soc.* **1990**, *41*, 829–835. [CrossRef]
75. Guaita, J.M.; Martín, J.M.; Ostos, M.S.; de Castro-Pardo, M. Constructing knowledge economy composite indicators using an MCA-DEA approach. *Econ. Res.-Ekon. Istraz.* **2020**, in press.

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Sustainable Residential Building Considerations for Rural Areas: A Case Study

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Abstract: Intelligent use of rural residential land and sustainable construction is inexorably linked to cost; however, options exist that are eco-friendly and have a positive return on investment. In 2011, a research residence was built to evaluate various land-use and sustainable components. This Texas house has subsequently been used for both residential and research purposes. The purpose of this case study was to evaluate break-even construction considerations, to assess environmental impacts, and to evaluate qualitatively efficacy of sustainable options incorporated in the research residence. Some of the specific components discussed are home site placement (directional positioning); materiel acquisition (transportation); wood product minimization; rainwater harvesting; wastewater management; grid-tied solar array power; electric car charging via a solar array; geothermal heating and cooling; insulation selection; windows, fixtures, and appliance selection; and on-demand electric water heaters for guest areas. This study seeks to identify the impact of proper land use and sustainable techniques on the environment and return-on-investment in rural areas. Break-even and 15-year Net Present Value (NPV) analysis at 3% and 5% cost of capital were used to evaluate traditional construction, partially sustainable construction, and fully sustainable construction options for the case study house, which was built sustainably. The additional cost of sustainable construction is estimated at \$54,329. At 3%, the analysis suggests a 15-year NPV of \$334,355 (traditional) versus \$250,339 million (sustainable) for a difference of \$84K. At 5% cost of capital, that difference falls to \$63K. The total estimated annual difference in carbon emissions is 4.326 million g/CO_2e for this research residence. The results indicate that good choices for quick return-on-investment in rural construction would be the use of engineered lumber, Icynene foam, and Energy Star windows and doors. Medium-term options include photovoltaic systems (PVS) capable of powering the home and an electric car. Sustainable construction options should positively affect the environment and the pocketbook. Regulations and code should require adoption of short-range, break-even sustainable solutions in residential construction.

Keywords: rural residential construction; rainwater harvesting; solar; spray foam; finger-jointed studs

1. Introduction

Sustainable rural land use requires environmentally sound residential construction [1]. Residential (and commercial) construction options affect the water supply [2], water demand [3,4], electricity demand [5–8], the use of land lumber and other materials [9,10], as well as the entire ecosystem [11]. Improper use of land can accelerate global warming [12,13], have impacts on human health (particularly in regards to disease) [14], lead to eutrophication/acidification of water [15,16], and cause smog formation in urban areas [17,18]. Perhaps unsurprisingly, land-use impacts are most affected by the use of wood products [19]. Sustainable construction begins with planning.

1.1. Planning and Transportation Considerations

When planning for sustainable residential construction, site placement is important to consider predominant winds and facing for solar capture [20,21]. Pre-planning of construction should include a significant sustainability analysis, and techniques such as simulation are helpful to this process [22,23]. Also important is minimizing the transportation costs (a construction waste), which include consciously purchasing materials that are located closer to the construction site [24]. Waste produced during the construction should be minimized and recycled where possible, and a construction waste management plan should include subcontractor incentives [25]. Since lumber waste is the largest contributor to detrimental land-use effects [19], the use of engineered lumber (as well as other resources) are possible solutions [26,27]. The planning for waste management must begin in the design cycle [28].

1.2. Global Warming Potential

Another consideration in pre-planning of residential construction is reducing the impacts on Global Warming Potential (GWP) balanced by a tight residential envelope to reduce requirements for heating and cooling energy. As an example, Icynene foam insulation currently has the lowest possible GWP of 1.0 [29] and provides a tight house envelope, which is a winning combination. Fenestration considerations (e.g., the installation of Energy Star windows and doors) are important to maintain the building envelope according to human and environmental considerations [30]. A residence's thermal mass is vital to achieve reductions in energy demand [31].

1.3. Electricity

Energy demands of residences must be considered prior to construction as well. Photovoltaic systems (PVS), wind energy, and nuclear-power grid energy reduce the carbon footprint of the residence when compared to traditional fossil fuel and sequestration plants. The difference is estimated to be from 78 to 110 gCO_2eq kWh−1 to 3.5 to 12 gCO_2eq kWh−1 [32]. The use of solar water heaters or tankless electric water heaters powered by a PVS are two of many options that may reduce both cost and kWh demand [33]. Further, electric cars charged by PVS that are sized properly for residential and transportation demands may reduce environmental impacts, as will the proper choice of Heating Ventilation and Air Conditioning (HVAC) [9,34].

Some new residential construction has attempted to reduce the demand for grid electricity and slow global warming by Net-Zero (or even Net-Positive) construction, which involves the design of facilities that either consume no net energy (demand less than supply) or that produce more energy than consumption [35,36]. Net-Zero construction may even power user transportation, further reducing the impact of the built environment [37,38]. Net-Zero homes coupled with proper water management and residential construction techniques may mitigate many of the environmental effects associated with residential construction [9].

1.4. Water and Wastewater

Water life-cycle considerations are vital when constructing houses in rural areas, particularly in rule-of-capture states that allow for exploitation of common-use groundwater [39]. The source of water should be responsibly considered (e.g., well water, rainwater harvesting, or municipal water connections, assuming they exist). Well contamination in rural communities is a significant consideration [40–42], and municipal water connections may be unavailable. Rainwater harvesting is then an option, which reduces the overall supply requirements for each gallon demanded when compared to groundwater and which has other beneficial properties including softness [43–45]. Environmentally responsible use of any water source must consider the use of low-flow fixtures. Use of these fixtures resulted in a 22% reduction in average annual household usage from 1999 to 2016 [46]. Further, xeriscaping reduces water requirements, can contribute to the success of construction projects, and should be part of best practices in arid and semiarid regions particularly [47]. Part of the water life cycle requires disposal of black water. In rural areas, no municipal sewage system may exist, so the options are aerobic or anaerobic sewer systems. While aerobic systems break down waste more quickly than anaerobic systems, they are more expensive from both acquisition and maintenance perspectives [48].

1.5. Purpose and Research Questions

This case study analyzes best-practice construction design for both the environment and the consumer based on a rural residence designed in 2011 for research purposes. This residence was the highest-rated house ever certified by the National Association of Home Builders (NAHB) at the time it was built [37]. NAHB sets standards for rating construction based on energy efficiency, water conservation, resource conservation, indoor environmental quality, site design, and homeowner education [49]. The actual standards are available here: [50]. Both construction successes and failures are analyzed with commentary from both the environmental and consumer perspective.

The primary research question addresses which sustainable construction options in this case study would also achieve breakeven (and when) if built today, as well as how sustainable these interventions are in terms of environmental impact. A secondary component of the study investigates the Net Present Value (NPV) of two different construction options that were available for building the research residence: traditional and sustainable. The time horizon investigated was 15 years. Comparing these three building decisions helps inform the value of green construction. Further, qualitative assessments of the sustainable interventions are provided.

1.6. Significance

The study's significance is that it investigates which sustainable options may result in a reasonable break-even period and whether planning of proper land use and application of sustainable construction may produce a return-on-investment while minimizing environmental effects. While this case study is not generalizable, the equations provided to compare both cost and environmental considerations may be applied to any other case, making the study useful. Further, the experiential component of the study spans nearly a decade of lived experience. No literature exists from a researcher in this area who has lived the results of the sustainable experimentation, which makes this study unique.

The study is also significant to increasing use of renewable sources in Texas. The use of solar or wind power solutions becomes increasingly relevant to rural Texans [51], and the state had over 28,871 MW of installed wind capacity at the end of 2019 [52]. Figure 1 shows that, in many areas of rural Texas (identified in Figure 2), the average wind speed would support wind turbine construction. Figure 3 illustrates the solar production potential by state

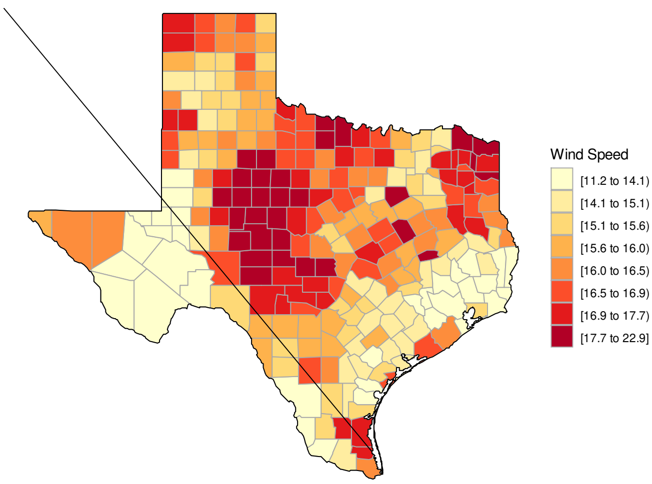

Figure 1. Choropleth map of wind speed by county in Texas.

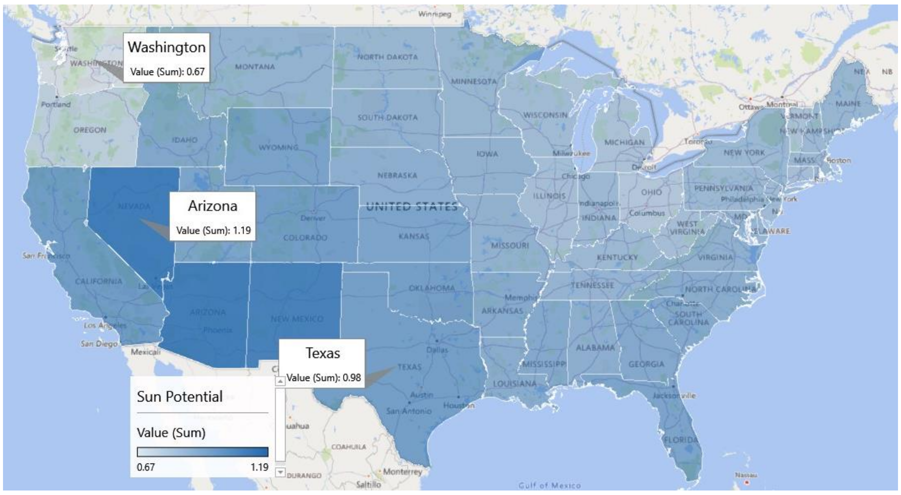

Figure 2. Choropleth of state solar production potential.

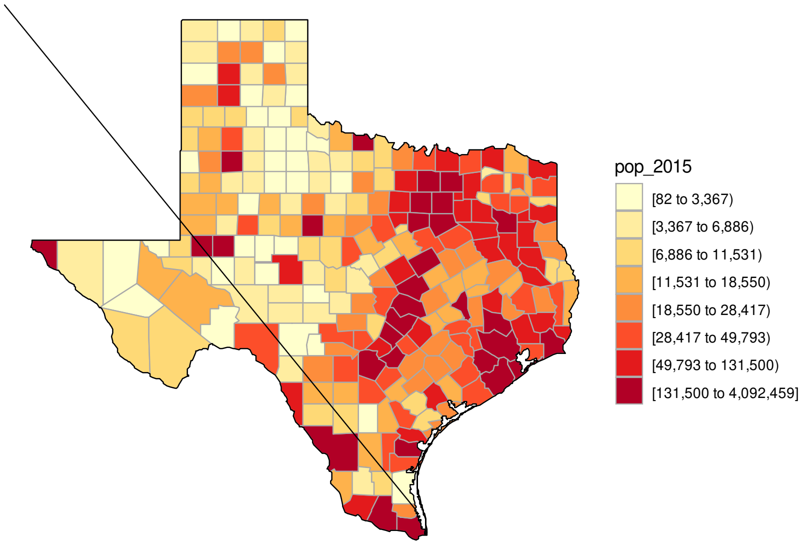

Figure 3. Distribution of Population Intensity in Texas.

1.7. *Generalizability*

While this is a case study, the majority of Texas is actually rural (Census Bureau data, [53]), so the techniques discussed are widely applicable within the state (see Figure 3, mapped in R Statistical Software [54] using the software library "choroplethr" [55]). Further, there is evidence that both new housing as well as renovations and modifications are needed in the rural areas of Texas [56], so this case study is made more important in that it provides some best-practice considerations. The rural areas in Texas often face enormous electrical transmission and distribution rates, sometimes twice the state average [57].

The study proceeds as follows. First, a discussion of Net Present Value (NPV) and break-even analysis is explicated in Section 2. Following this section, Section 3 evaluates the elements of construction included in the sustainable house, which is the subject of the study. After a discussion of these elements, analysis of various constructions based on the study residence are evaluated in terms of both break-even timing and NPV. Finally, ideas and insights are provided in the discussion and conclusion, Sections 4 and 5, respectively.

2. Materials and Methods

In this case study, we evaluated deterministically the environmental impacts, life-cycle costs, and efficacy of multiple sustainable building innovations for rural residences versus more traditional construction. The rural research residence informing this study is an approximately 4800 square foot home (446 square meters) and located in a semiarid environment in Texas. The options used in this construction are compared directly against more traditional options for both cost and environmental effects.

The study evaluates home site placement; materials transportation; reclaimed wood framing; spray-foam insulation; window, fixture, and appliance selection; material recycling; rainwater harvesting design and engineering; aerobic septic system; xeriscaping; grid-tied solar arrays; electric car charging and use; on-demand water heaters; geothermal heating and cooling; and electrical back-up system options. The home has supported between 2 and 3 full-time, middle-aged residents (one adult worker) with seasonal demand of up to 20 individuals during holidays over the last 9 years. The residence was occupied shortly after its construction and has been in constant use.

2.1. Break-Even Analysis

Specific methods used include deterministic break-even analysis for each element evaluated (if one exists) based on acquisition costs of the sustainable option versus one or more other options. Break-even analysis evaluates monetary outflows of residential construction options (as well as any returns) and evaluates at what point (if ever) total costs of both options intersect [58]. The break-even point is determined using Equation (1). The break-even point is then when total costs of one option equal total costs of another option. In this equation, *FC* stands for fixed costs, *VC* represents variable costs (e.g., maintenance and operations), and the index set represents the option number and time index. There are some semi-variable costs (e.g., step functions for item replacements) involved in the construction analysis, and these are included in the variable costs.

$$FC_{1t} + VC_{1t} - FC_{2t} - VC_{2t} = 0 \quad (1)$$

2.2. Net Present Value

As part of the analysis, this case study evaluated three different construction possibilities for the original research residence and their associated profitability using net present value (NPV). Two of the three construction options are at opposite ends of the spectrum (traditional versus sustainable), while the third uses many of the sustainable elements with a positive NPV. NPV is calculated according to Equation (2), where i is the index for the option selected, R_t is the net cash inflow and outflows at time t, A is the accumulation rate (1 + return rate), and n is the number of time periods evaluated [59]. The time period used for NPV analysis is 15 years.

$$NPV_j = \sum_{t=1}^{n} \frac{R_t}{A^t} \quad (2)$$

2.3. Construction Components Evaluated/Data Sources

The case study involves a single structure built in one specific way; however, it also evaluates breakeven and NPV had it been built in alternative ways to provide useful comparisons for the reader. Table 1 provides the category, the items evaluated, the data sources, and the cradle-to-grave cost estimates with comments for those items. Some elements discussed in the case study are not included in the breakeven and NPV analysis, however. These elements (such as site placement) may have an effect in either direction, but the size and directionality are unknown.

Table 1. Construction categories and components evaluated (inflation at 3% per year).

Category	Traditional Option	15-Year Costs	Sustainable Option	15-Year Costs	Environmental Difference
Framing	Lumber	\$52,800	Engineered Lumber	\$53,184	24.5–90 Trees
Insulation	Fiberglass	\$14,4200	Icynene Foam	\$12,460	Reduced CO_2 or PVS
Fenestration	Standard	\$14,457	Energy Star	\$16,625	Reduced CO_2 or PVS
Water	Well	\$33,563	Rainwater Harvesting	\$32,111	Reduced H20 requirement
Wastewater	Anaerobic	\$ 7531	Aerobic	\$14,128	Fewer pollutants
Water Heaters	Electric H20, Tank	\$22,915	Tankless	\$ 3000	Reduced CO_2 or PVS
Electricity	Grid	\$62,834	Solar	\$54,480	Reduced CO_2 or PVS
Vehicle	ICEV (x 2)	\$107,777	BEV (x 2)	\$92,288	Reduced GHG
HVAC	Heat Pump	\$112,383	Geothermal	\$30,644	Reduced CO_2 or PVS
	Total, Traditional	\$428,680	*Total Sustainable*	\$308.920	

Abbreviations: Heating Ventilation Air Conditioning (HVAC), Internal Combustion Engine Vehicle (ICEV), Battery Electric Vehicle (BEV), Greenhouse Gases (GHG), Photovoltaic System (PVS).

In the subsequent sections, the study explicates the acquisition and operations and maintenance (O&M) costs for each of these categories. Data for each of the areas evaluated from breakeven were acquired from peer-reviewed literature where possible and from construction firms where there were no data (e.g., engineered lumber versus traditional studs). Data ranges were sought, and the midpoints of these ranges were used for deterministic calculations.

2.4. Environmental and Qualitative Analysis

When relevant, an analysis of the environmental advantages of sustainable construction versus other options is provided. Relevant research from the literature is extracted to estimate carbon emissions, water quality, etc., similar to Fulton et al. (2020) [9]. Part of the sustainable construction assessment was a qualitative assessment involving elements of the triple bottom line (TBL) [60]. The experience of the research team and home resident augment the data-driven analysis.

2.5. Data and Software

Data for the deterministic breakeven and return on investment (ROI) portions of this case study were garnered from previous research as well as data sources appropriate to the residence itself. All analyses were conducted in Microsoft Office Excel 2016 and R Statistical Software [54].

3. Results

3.1. Initial Considerations

3.1.1. Construction Planning, Permitting, and Analyses

The land was two years prior to construction, as the design process required significant planning, permitting, and modeling. Aside from the typical surveying, permits for operating an on-site sewer facility and (later) driveway placement were required [61]. At the time, the maximum grid-tied PVS array permitted by the utility company was 10 kW, so a waiver was required based on analysis of user consumption. Utility pole transformer size was analyzed and found acceptable without resizing. Further, the utility company regulated the grid-tied interconnection of the backup propane generation system [62]. As an example of analysis conducted prior to building, the sizing of the rainwater harvesting system was estimated through simulation [43]. Construction waste management and recycling required significant preplanning, and the well placement for the geothermal HVAC had to be mapped and approved. The processes described here required approximately six months of lead time, which is a consideration should quicker construction be required. Construction planning, permitting, and analyses are not part of the break-even or NPV analyses.

3.1.2. Site Placement

The rural residence in the study was designed from the ground up to be sustainable, and the design considerations included geographical placement. The home site was selected to be north-facing to maximize solar capture (west-, south-, and east-facing panels) and to leverage predominant local winds (south to north) [20]. Further, the site selected minimized tree removal, reducing cost and effect on the environment. Qualitatively, the placement was a success in this construction, as the solar capture is as expected (discussed later), and the cost as well as the environmental impact of excess tree removal was avoided. Figure 4 is the Google Maps satellite image of the house with various sustainable callouts that are referenced later [63]. Site placement is not per se evaluated in the break-even and NPV analyses.

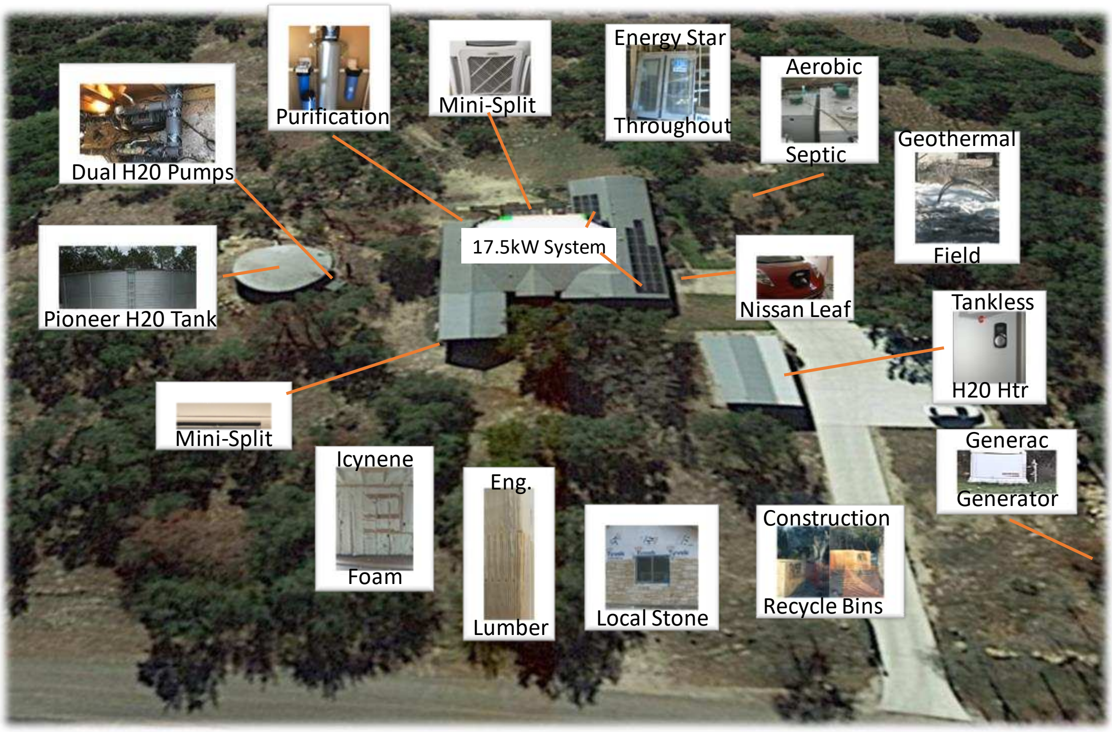

Figure 4. The residence as constructed.

3.1.3. Material Location/Transportation

One of the major sustainability considerations in residential construction is the transportation of materials [64]. As part of the rural residence design, only local materials (those within 50 miles) were selected. For example, local limestone was selected for the exterior. Reducing transportation requirements reduces emissions. One study found a 215% decrease in the amount of energy used in building and a 453% decrease in the impact of transportation when local building supplies were used [65]. The reduction in environmental impact is measurable and significant. Estimating the savings in construction for use of these materials is difficult and omitted from this case study.

3.1.4. Waste Collection and Recycling

During construction, bins for waste were used to recycle materials as appropriate (Figure 4). Metals, plastic, and glass were recycled, congruent with previous research [64]. Doing so allowed for reclaimed wood to be fabricated into engineered lumber and for used paper and metal to be used in other capacities. While this has little to no bearing on cost (perhaps 2.5% back to the builder [66]), it does have an effect on the environment. In terms of Global Warming Potential, recycling has the greatest impact versus incineration or landfill options [67]. This is the last element that is not included in the break-even and NPV analyses.

3.2. Engineered Lumber/Finger-Jointed Studs

Reclaimed wood (specifically finger-jointed studs) were used in the residential construction (see Figure 4). These studs are also straighter and result in less wood wasted. They neither split nor twist like traditional studs [68]. Further, they have a strong vertical load capability, with evidence that many species (including pine) have better structural properties when finger-jointed, although that evidence is mixed [69].

3.2.1. Environmental Considerations

A 20″ diameter tree with 42 feet length of usable wood produces about 260 board feet. The Idaho Forest Products Commission estimated that a typical 2000 square foot house would use 102 trees of that size [70]. Assuming linearity, the rural residence, a 4800 square foot home (446 square meters, would have been estimated to require approximately 245 trees. Assuming an offset of even 25% of the wood requirements results in a reduction of about 61 trees. See Table 2. For this deterministic study, the estimate of trees saved would be between 24.5 and 98 given the size of the house.

Table 2. Estimate of trees saved by using engineered lumber (finger-jointed studs) in this case study.

% Offset of Traditional Lumber	Trees Saved
10%	24.5
15%	36.8
20%	49.0
25%	61.3
30%	73.5
35%	85.8
40%	98.0

3.2.2. Acquisition and 15-Year Operations and Maintenance (O&M) Costs

The cost of finger-jointed studs may be more expensive than regular studs. For example, the retail cost of a 2 × 4 × 104 5/8″ (0.6 × 1.2 × 2.7 meters) regular pine stud versus the same size finger-jointed stud is listed at $3.62 [71] versus $5.59 [72], respectively. This is a 54.4% cost increase for materials (much less than estimated by [69] for pine), which might be offset by lower labor costs due to engineered lumber's straightness.

The cost differential is not atypical, as many engineered lumber products have upcharges between 1.5 and 2 times the cost of traditional lumber [69,72]. One site estimates the total cost of traditional framing between $4 and $10 per square foot for labor and $3 and $6 per square foot for materials [73]. With a 30% reduction in labor costs for engineered lumber, low material costs for standard lumber, and 54.4% higher costs in engineered lumber, there are several ways in which finger-jointed studs might actually save money. Table 3 illustrates those combinations (2020 dollars).

Using the average estimate of $7 for labor and $4 for materials (traditional construction) and 30% reductions in labor ($4.90) with 54.4% increases in materials ($6.18, nontraditional construction) results in comparative estimates of $52,800 (traditional stud construction) and $53,184 (engineered lumber), underlined in Table 3. The total difference in cost is estimated to be nominal, but the environmental impact is not, as it saves old-growth trees [26]. O&M costs are considered nominal for the 15-year NPV analysis.

Table 3. Regular lumber versus finger-jointed studs cost per square foot of construction and total.

Regular Lumber, \$/ft^2			Engineered Lumber, \$/ft^2			Savings
Materials	*Labor*	*A. Total \$ for House*	*Materials*	*Labor*	*B. Total \$ for House*	*A–B*
\$3.00	\$10.00	\$62,400.00	\$4.62	\$7.00	\$55,776.00	\$6624.00
\$3.00	\$9.00	\$57,600.00	\$4.62	\$6.30	\$52,416.00	\$5184.00
\$4.00	\$10.00	\$67,200.00	\$6.16	\$7.00	\$63,168.00	\$4032.00
\$3.00	\$8.00	\$52,800.00	\$4.62	\$5.60	\$49,056.00	\$3744.00
\$4.00	\$9.00	\$62,400.00	\$6.16	\$6.30	\$59,808.00	\$2592.00
\$3.00	\$7.00	\$48,000.00	\$4.62	\$4.90	\$45,696.00	\$2304.00
\$5.00	\$10.00	\$72,000.00	\$7.70	\$7.00	\$70,560.00	\$1440.00
\$4.00	\$8.00	\$57,600.00	\$6.16	\$5.60	\$56,448.00	\$1152.00
\$3.00	\$6.00	\$43,200.00	\$4.62	\$4.20	\$42,336.00	\$864.00
\$5.00	\$9.00	\$67,200.00	\$7.70	\$6.30	\$67,200.00	\$0.00

3.3. Residential Envelope

Residential spray-foam insulation (Figure 4) provides a thermal barrier with exceedingly low conductivity (0.021 W/mK in one study [74]). Icynene spray foam has reasonable hygrothermal properties and is resistant to moisture migration; however, mechanical extraction and humidity controls may need to be installed (as in the case study) because of the tight environmental seal of the house and the requirement to exchange air. The practical relevance of the tight seal around the rural residence is that, during the heat of the summer in this semiarid region (in excess of 100 °F, 38 °C), the observed temperature in the attic spaces does not exceed 80 °F/26.7 °C with the house thermometer set to 76 °F/24.4 °C.

3.3.1. Environmental Considerations

From an environmental perspective, water-blown Icynene spray-foam insulation has a reduced carbon footprint from better HVAC usage [9]. Still, other forms of insulation have better characteristics for insulation, although not necessarily cost profile [75]. In retrospect, alternative materials would probably be used for the case study residence if built now.

3.3.2. Acquisition Costs and 15-Year O&M

The 2020 cost for open-cell spray-foam insulation is about \$0.35 to \$0.55 per board foot [76], which is lower than the cost estimated by Kalhor and Ememinejad [77] (\$0.80 to \$1.30) but nearly identical to the cost found on the manufacturer's website [78] (\$0.40 to \$0.60). To account for regional variation, the information from [76] is used for Icynene foam cost estimates. A 3.5" depth of spray converts to \$1.23 to \$1.93 per square foot or \$13.24 to \$20.77 per square meter. Fiberglass batt insulation runs \$0.64 to \$1.19 per square foot or \$6.89 to \$12.81 per square meter [76]. Assuming average costs of \$1.58 per square foot (spray-foam) and \$0.915 (fiberglass) with 8000 square feet of attic and walls to be insulated (estimated from case study house) results in cost estimates of \$12,640 and \$7320, respectively [79], but the second estimate is not complete.

Spray foam works as an air barrier, vapor barrier, water-resistant barrier, and insulation. There is no need for attic vents, test ductwork, or air-seal attics. When evaluated in this manner, it is actually 10–15% less expensive than traditional construction [79]. Adding 12.5% (the average between 10%-and 15%) to the \$12,640 estimate for spray-foam construction results in an estimate of \$14,420 for insulation, vapor barrier, vents, test duct work, etc. For the break-even analysis, then, the final values used were \$12,460 for the installation of Icynene and \$14,420 for use of fiberglass.

3.3.3. Qualitative Assessment

Spray foam makes the attic space usable in hot weather. While this may be a minor point, it is an important consideration for homeowners considering building options.

3.4. Low Solar Heat Gain Coefficient (SHGC) and U-Factor Windows (Energy Star)

Solar Heat Gain Coefficient (SHGC) is defined as the fraction of incident solar radiation admitted through a window. In warm climates, windows should have solar heat gain coefficients (SHGC) less than 0.25 [80]. Further, the U factor, a factor that expresses the insulative value of windows, should be 0.4 or lower. Low-emissivity windows and doors with SHGC of 0.23 and U-Factor of 0.3 were used throughout the case study house.

3.4.1. Environmental Considerations

The selection of Energy Star windows and doors resulted in a smaller sizing for the PVS system, as the demand for heating and cooling is 17% to 31% less [81]. There is no achievable carbon output reduction by use of these windows on a house that is already 100% reliant on PVS (except for gray energy). (For a traditional grid-powered residence, that savings might be between 246 and 6205 lbs. of CO_2 [81].)

3.4.2. Acquisition and 15-Year O&M Costs

Low-emissivity windows are 10% to 15% more expensive than standard windows [82], although one study indicated that the cost was about $50 more per window [83]. The typical cost range in 2020 dollars is $385 to $785, with an average of $585 [84]. The Department of Energy estimates savings of $125 to $465 dollars a year from replacing windows with new windows that have higher Energy Star ratings [81], which is lower than estimated in [83]. Assuming average cost for Energy Star windows ($585), 15% less expensive traditional windows ($508.70), and a total of 25 windows (based on the case study house construction) results in acquisition costs of $14,625 (Energy Star) versus $12,717.50 (non-Energy Star). Exterior door costs vary greatly depending on type and nature. For the case study facility, one Energy Star double door and single door were installed at a cost of $2000. Assuming a 15% premium (as in the case of the windows), standard doors would be estimated at $1739.13. The total cost for Energy Star versus standard windows and doors is then $16,625 and $14,457, respectively (not including any applicable tax credits if available). No O&M costs are estimated during the 15-year window used for NPV analysis.

3.5. Rainwater Harvesting

The decision to install a rainwater harvesting system (RWH) versus a well or city water is one that is entirely dependent on the environment, the availability of municipal water, the homeowner's wishes, and regulations. In this case study, no city water sources were available. After a cost analysis, it was estimated that the cost for a well and the cost for a rainwater harvesting system (at the time of build) would be nearly identical largely due to well-depth requirements (1200′).

Figure 5 depicts the RWH as currently installed in the rural residence. The system works as follows. Rainwater falls on the roof and is captured by gutters. The guttered water flows to the cistern where ~100 gallons or so is flushed out through a pipe with a ball float to eject the debris on the roof. Once the ball float seals the flushing tube, the water continues into French drain and basket filters and then into a cistern. Parallel on-demand pumps push water towards the house where it is processed through a sediment filter, charcoal regeneration system, and ultraviolet light, which is an effective method for inactivating pathogens through irradiation [85].

Quality considerations for water are significant. Using rainfall for potable house needs requires proper roof selection (ceramic or metal as examples), flushing (first flush), gross filtering (e.g., French drain and basket filters), storage (food-grade butyl rubber), pumping, cleansing (e.g., sediment filter and charcoal regeneration), purifying (ultraviolet purification as one example), and disposal of gray water (aerobic septic system). Baseline quality construction requirements are found in [86].

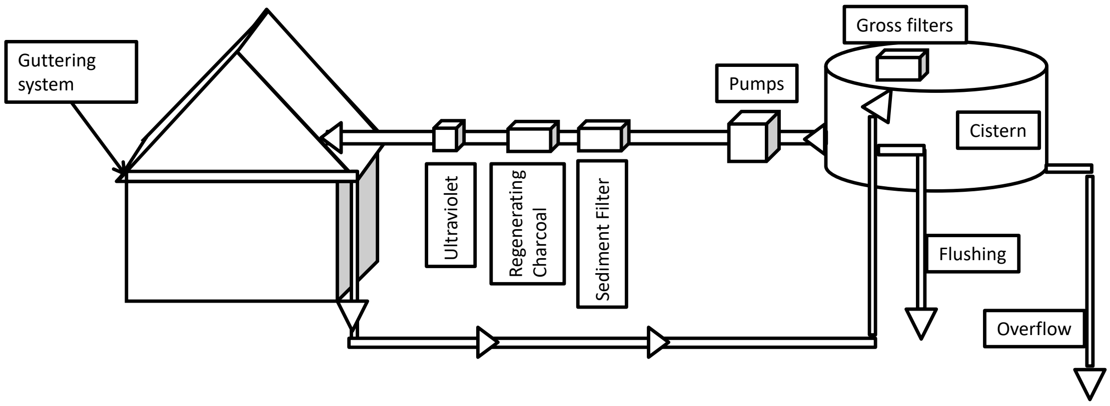

Figure 5. Rainwater harvesting system as designed.

Design of an RWH capable of meeting the needs of an entire household required simulation modeling, so that the distribution of the minimum in the cistern (order statistic) would be strictly greater than zero over all supply and demand considerations and all simulation runs. Details of the simulation are available from [43,45]. The final system selected included 4000 square feet of capture space and a 40,000-gallon cistern.

3.5.1. Environmental Considerations

Rainwater harvesting was selected for both sustainability and quality considerations; however, RWH is not always the least expensive option even given life-cycle costs [9]. From a sustainability perspective, RWH requires far less water for the same aquifer demand. Specifically, runoff, absorption/adsorption, and evaporation/transpiration reduce aquifer resupply by at least 30% [87]. On the other hand, RWH systems capture 75% to 90% of rainwater, depending on design and rainfall [86]. The amount of water pulled from the aquifer to supply one gallon is therefore at least 3.333 gallons, whereas well RWH systems capturing only 75% of the available rainfall require 1.333 gallons. The net savings to the aquifer is 2 gallons of water per 1 gallon demanded. Further, the water quality exceeds local and state requirements at the residence and should at similarly constructed residences when the RWH is constructed properly due to minimization of non-point source pollutants. The life-cycle impact for RWH has shown to be better than municipal water as well [88]. RWH also reduces carbon emissions, as water-related energy uses are significant (e.g., 19% of electricity use in California during the year 2001, [89]).

3.5.2. Acquisition, Operations, and Maintenance (O&M) Costs

Acquisition costs for the rainwater harvesting system (guttering, PVC piping, Pioneer 40K gallon cistern with butyl rubber liner and accessories) cost approximately $25,500 in 2020 [90]. Current well drilling prices in Texas are about $30 to $55 per foot [91]. On this property, a 600′ drilling depth is required. At the average $42.50 per foot, the drilling cost alone would run $25,500 in 2020.

Cost to maintain an RWH is reasonable. Ultraviolet tubes (replaced annually for typical use) as well as sediment filters and other system requirements cost approximately $328 per year [92]. According to the Centers for Disease Control and Prevention, wells should also be inspected annually [93] at a cost of $300 to $500 [94]. The 15-year total costs are then $31,500 (well) versus $30,420 (RWH). When inflated by 3%, the costs are $33,563 (well) and $32,111 (RWH).

3.5.3. Qualitative Assessment

RWH is one of the best features both environmentally and practically. The water purification process results in high-quality, soft water, which is better for water-based appliances like coffee pots and dishwashers. There is additional work required that the consumer must understand (filter replacement, gutter cleaning, etc.).

3.6. Water Fixtures

Selection of appliances and fixtures is important for a sustainable house reliant on 100% rainwater. Toilets, shower heads, and other water fixtures were low flow/high pressure, as the rural residence was only plumbed for rainwater harvesting.

3.6.1. Envrionmental Considerations

Mayer et al. [95] estimate that toilets use 29% of indoor water consumption, while water used for showering/bathing, dishwashing, and laundry consume about 36%, 14%, and 21%, respectively. The Environmental Protection Agency (EPA) shows that high-pressure, low-flow shower heads reduce flow from 2.5 gallons per minute to 2.0 gallons per minute, a 20% reduction [96]. In semiarid regions (such as the location for the case study), the use of low-flow fixtures is vital.

3.6.2. Acquisition and 15-Year O&M Costs

Costs for low-flow fixtures are comparable to standard fixtures, depending on brand. Further, Texas law requires the use of low-flow fixtures in new construction [97], so there are no cost acquisition differences measured among possible construction options. While dual-flush toilets are not required by Texas law, they were installed for additional water savings and at no additional cost. Break-even analysis did not include an analysis of low-flow fixtures, as they are required by law and are approximately equivalent in cost.

3.6.3. Qualitative Assessment

Most of the low-flow appliances work as well or better than traditional fixtures. Selection of dual-flush toilets, however, must be done after consumer research. Dual-flush should not mean "flush twice." These fixtures have underperformed due to improper selection.

3.7. Aerobic Septic

3.7.1. Environmental Considerations

Cradle-to-grave water management requires that black water be treated responsibly and sustainably. In this area, aerobic septic systems are required by regulation. The residence construction included a Jet Biologically Accelerated Treatment (BAT) plant (also termed Biologically Accelerated Wastewater Treatment, BAWT, plant). BAT plants work by treating wastewater physically and biologically in a pre-treatment compartment. Water then flows through the treatment compartment where it is aerated, mixed, and treated by a host of biological organisms (a biomass). The mixture then flows to a settlement compartment where particulate matter settles, returning to the treatment compartment, leaving only odorless and clear liquid (gray water produced by the biomass), which is discharged through sprinkler heads [98]. Figure 4 shows the encased BAT system installed at the rural residence. Aerobic systems break down waste far quicker than anaerobic, due to the nature of the bacteria. The benefits to the environment include that: (1) pumps for transporting water to wastewater treatment plants are not necessary (and the associated energy costs); (2) treated water returned to the environment is cleaner; and (3) electricity for processing water (in this case) is largely, if not entirely, generated by the sun.

3.7.2. Acquisition and O&M Costs

There is a cost penalty for installing such a system at this rural residence. Installing an anerobic system averages $3500, whereas an aerobic system costs about $10,500 [99]. Maintaining the aerobic septic system is about $200 annually [100], which is somewhat more than anaerobic systems [101].

To account for this differential, anaerobic costs were estimated at $180 per year (a 10% discount). The 15-year acquisition and O&M costs for aerobic versus anaerobic systems was then estimated (after 3% inflation for O&M costs) at $7531 (anaerobic) and $14,128 (aerobic).

3.8. Tankless Water Heaters

One of the current additions to this research residence has been the inclusion of an on-demand electric water heater for a guest room, guest kitchen, and guest bathroom. Tankless electric water heaters require less space than tanked versions and do not constantly use energy to keep water warm. Natural gas options were not available for the case study, and electric heaters powered by PVS were as effective as solar water heaters aside from gray energy considerations.

3.8.1. Environmental Considerations

Because any installation would be powered via PVS in the case study residence, there would be only the potential gray energy costs. If operated off of a coal-based grid, tankless electric water heaters would reduce greenhouse gas (GHG) emissions over a tanked system (although a heat pump water heater is even more effective in reducing emissions) [102]. The carbon footprint of tankless electric water heaters is much lower than that of systems with tanks, as it is in operation only when demanded. Tankless water heaters may be 99% efficient [103].

3.8.2. Acquisition and 15-Year O&M Costs

The acquisition cost of an electric tankless heater is largely dependent on size, capability, and brand and may be larger than traditional tank versions; however, the acquisition cost for the installed unit was identical to the tank unit in this case study. Tankless units may also last 1.5 to 2 times as long as tank water heaters (20 years) and save 8% to 34% on water, depending on water demand; however, demand flow for multiple simultaneous operations must be evaluated prior to selection of a device [104].

Comparing the life cycle of a 50-gallon electric water heater with that of a tankless one requires some up-front assumptions. One study indicated that the life-cycle savings over traditional electric storage systems is $3719 Australian dollars (about $2500 US dollars) [105]. However, that study does not consider the possibility that all electrical power needed is generated by solar power.

The acquisition and installation costs for 2 × 50-gallon tank water heaters during initial construction was nearly $3000 in the case study residence. Under coal-based grid power, the yearly costs are $494 per tank or just under $1000 for both systems; however, the case study residence relies on solar and thus avoids these costs. For tankless electric water heaters powered by PVS, the installation and acquisition costs are $3000 for two units (high end) with zero annual costs and zero carbon emissions (other than solar gray power as discussed in the limitations).

The initial tanked systems installed were electric Marathon heaters with a lifetime warranty [106]. While there are likely labor costs associated with this warranty, we assume that they are nominal. Thus, operating and maintenance costs for standard water heaters are estimated at $494 per tank per year for traditional construction with grid power, while the operation costs for tankless water heaters recharged solely by PVS are $0. With identical acquisition costs and (assuming) zero maintenance costs due to warranties, the 15-year total costs are estimated at $22,914 (traditional construction with standard tanked water heaters) versus $3000 (tankless with 100% PVS). An assumption is that both systems will not require replacement during the 15-year horizon.

3.9. Solar Arrays

In a sustainable home located in semiarid regions, solar arrays are an obvious solution for producing energy requirements. This rural residence initially had installed a 7.25 kWh system (32 × 225 watt panels) with a Sunny Boy inverter ($33,600 in 2011) and then subsequently added another 9.585 kWh system (27 × 355 watt panels, $31,317 in 2018) with a Solar Edge inverter after home expansion and capitalization of the original solar power system.

3.9.1. Environmental Considerations

From installation date until 31 January 2020, the initial 7.25 kWh system has produced 90.579 MWh of power in 35,212 hours of operation for 2.57 kWh per hour, saving 153,984 pounds of CO_2 emissions. The 9.585 kWh system has produced 25.86 MWh in about 18,240 hours since installation, saving 40,038.49 pounds of CO_2 emissions and resulting in only 1.4 kWh per hour. (The low result is due to installation in January and a month wait to replace the initial inverter (faulty) in January to February 2018).

The carbon dioxide avoidance by leveraging solar is significant over time. The footprint of solar is 6 g CO_2e/kWh, while coal CCS is 109 g and bioenergy is 98 g. Wind power produces less emissions (4 g each); however, the rural residence location is a low-production wind area [32]. For 3500 kWh per month (or 42 MWh per year), the total annual difference in carbon emissions is 4.326 million g/CO_2e.

3.9.2. Acquisition and 15-Year O&M Costs

The initial cost of both systems was approximately $64.917. After 30% federal tax credits, the total cost was approximately $44,441.90. Initial break-even analysis is based on both acquisition cost and energy cost as if both systems were installed on the expanded house. During the six months of April through September, the residence produced or banked more power than consumed. From October through March, the residence consumed more power than produced. During this month, the residents consumed 1699 kWh and produced only 1226 kWh. There is, however, no delivery or cost of power charge, because during the previous months, the residents produced more than consumed. The total consumption estimate is then about 2925 kWh for a 4800 square foot house in a cool month. When averaged over a single year, total consumption is approximately 3500 kWh per month. This equates to between about 1167 and 1750 kWh per person or 0.73 kWh per square foot.

A non-solar house consuming 3500 kWh per month under traditional utility billing at $0.07 per kWh (cost at locality) with a $14.77 customer charge (utility company determined) results in an annual estimated cost of $3117.24 ($259.77 × 12). The same consumption with 100% solar runs at $33 grid-tied fee × 12 months = $396. Total costs over 15 years with 3% inflation per annum are then $62,834 (grid electricity) versus $54,480 (PVS).

3.9.3. Qualitative Assessment

The PVS arrays are one of the best investments of the residence. There have been no uncovered maintenance costs; the systems are reliable. Coupled with the RWH system, the residence benefits from nearly all weather, gathering water from preciptiation and harvesting the sun during even partially overcast days.

3.10. Electric Car Charging

3.10.1. Environmental Considerations

Electricity generated from PVS was used to charge an electric Nissan Leaf in the case study house. Additional panels were acquired directly for this purpose during the construction. Research suggests that battery electric vehicles (BEVs) may have higher GHG emissions than internal combustion engine vehicles (ICEV) if powered by a grid (at least in China) [107]. Given this research, the only sure way that carbon savings are achieved is charging them through renewable sources.

3.10.2. Acquisition Costs, 15-Year O&M Costs, and Residual

Assuming equivalent acquisition costs for a BEV and ICEV (~$30,000 after tax credits), $2400 annual gasoline and maintenance costs for the ICEV, $1200 annual maintenance for the BEV, identical replacement costs at year 7.5 (~$36,000 after tax credits), and residual values of 22% versus 7% for ICEV and BEV, respectively, results in total costs of $107,770 (ICEV) and $92,288 (BEV). (ICEVs retain about 45% of their value over 4 years, while BEVs retain barely more than 25% on average [6], so using geometric decay over 7.5 years results in about 22% and 7% residual value). This estimate includes 3% inflation for maintenance and gasoline.

3.10.3. Qualitative Assessment

Unfortunately, early Nissan Leaf vehicles suffered from battery issues [108]. The owner divested after 3 years partially due to these issues. Improvements in the batteries of these vehicles as well as extended range models makes this vehicle an attractive option for minimizing gasoline and maintenance costs.

3.11. Geothermal Heating and Cooling

3.11.1. Environmental Considerations

As part of the construction, the rural residence was equipped with a closed-loop, geothermal system (see Figure 4). Vertical, closed-loop geothermal units are heat exchangers that leverage the fact that the temperature 200′ below the Earth remains relatively constant. Geothermal systems may save between 25% and 75% on energy demands [109].

3.11.2. Acquisition and O&M Costs

The cost of the system including wells, unit, and ducting (complete) was $26,500. The tax credit was 30% or $7950, and so the end cost to the resident was $18,550. ClimateMaster (the brand installed) estimates a $1000 savings in electrical costs per year over an electric heat pump ($3135 versus $4169) [32]; however, PVS-powered systems have no directly attributable costs except for gray power. The system was replaced with a 5-ton, 18-seer American Standard Platinum heat pump unit in 2018 at a cost of $16,255, over $10,000 less expensive. (The reason for this replacement is discussed shortly). Assuming equal maintenance costs of $600 per year, 3% inflation of O&M costs, the 15-year total cost for geothermal powered by PVS is $30,644, whereas the cost for a heat pump and associated O&M is $112,383 (grid-power).

3.11.3. Qualitative Assessment

The system operated with limited success for seven years, as the heat exchange and unit were unable to keep up with greater than 100 °F (38 °C) temperatures in its South Texas location, despite multiple attempts to improve the system (including adding an additional 200′ well for heat exchange). This system was the most disappointing, as evidence even post-installation suggested that such a system would be effective in all climates [110]. That was not the experience in this single case study.

3.12. Generator or Other Backup System

The residents sought an eco-friendly solar power storage solution (e.g., Tesla Powerwall or the Chinese BYD B-box 10). All options were expensive (between $80 to $110 per kWh storage per year for 10 years) with decay rates that generate lithium ion battery disposal concerns after 10 years for most products [111]. Since the storage technology is still developing, a 22-kW propane-powered back-up generator, a device sufficient to empower the entire house (Figure 4), was installed. In well or rainwater harvesting systems that leverage pumps, back-up power is necessary to retain water during electrical outages. Propane is a green fuel that, when burned, has nominal effects on the environment [112]. The 1000-gallon propane tank and generator are sufficient to maintain full power to house for about 14 days under reasonable utilization conditions. The cost for this generator, automatic transfer switch, propane tank, underground installation, and connections was $19,668.00. (A large portion of expense involved burying the propane tank in rocky terrain.) While included in the discussion, this item is not part of break-even or NPV analysis.

3.13. Break-Even and NPV Analysis

Sustainable construction can generate a breakeven for the pocketbook and for the environment. Figure 6 illustrates the cost comparisons of the sustainable construction techniques discussed in this paper. Costs are inflated 3% per annum and reflect the previously detailed acquisition and O&M costs. The first matrix in this figure is traditional construction without environmentally intelligent land use. The second reflects the rural residence as designed, and the third matrix reflects sustainable construction without geothermal for the particular locality and residence.

Looking at Figure 6, the break-even year for 2020 construction would be by 2026. The additional cost of sustainable construction is estimated at $54,329, which is much lower than might be expected due to the tax credits associated with solar and geothermal. A 15-year NPV analysis is provided at 3% and 5% cost of capital. At 3%, the analysis suggests a 15-year NPV of $334,355 (traditional) versus $250,339 million (sustainable), for a difference of $84K. At 5% cost of capital, that difference falls to $63K due to opportunity costs of committing capital up front.

3.14. Ongoing Sustainable Improvements

All add-on construction to the rural residence included mini-split HVAC systems (both in-wall and in-roof systems). These systems have more upfront costs but are much more energy efficient, as they do not lose energy through ductwork. Further, they are now inconspicuous and highly effective [113]. Also, these systems allow for better compartmentalization of conditioned air, as they do not rely on a set number of zones. See Figure 4 for pictures of in-roof and in-wall systems installed in the residence. In new construction, these systems should be considered due to their efficiency and elimination of ductwork and other requirements.

Another new construction consideration is the use of wireless multigang light switches. These fixtures can minimize wiring requirements by using a single drop instead of multiple drops. With the advent of 5G, it might be possible to eliminate CAT6 wiring during residential construction in the future as well.

	BLS Inflation	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*
Traditional	**Acquisition**	**O&M 2020**	**O&M 2021**	**O&M 2022**	**O&M 2023**	**O&M 2024**	**O&M 2025**	**O&M 2026**	**O&M 2027**	**O&M 2028**	**O&M 2029**	**O&M 2030**	**O&M 2031**	**O&M 2032**	**O&M 2033**	**O&M 2034**	**O&M 2035**
Framing: Stud	$ (52,800)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Insulation: Fiberglass	$ (14,420)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Windows/Doors: Standard	$ (14,457)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Water: Well	$ (25,500)	$ (400)	$ (412)	$ (424)	$ (437)	$ (450)	$ (464)	$ (478)	$ (492)	$ (507)	$ (522)	$ (538)	$ (554)	$ (570)	$ (587)	$ (605)	$ (623)
Wastewater: Anaerobic	$ (3,500)	$ (200)	$ (206)	$ (212)	$ (219)	$ (225)	$ (232)	$ (239)	$ (246)	$ (253)	$ (261)	$ (269)	$ (277)	$ (285)	$ (294)	$ (303)	$ (312)
Water Heaters: 2 x Tanks	$ (3,000)	$ (988)	$ (1,018)	$ (1,048)	$ (1,080)	$ (1,112)	$ (1,145)	$ (1,180)	$ (1,215)	$ (1,252)	$ (1,289)	$ (1,328)	$ (1,368)	$ (1,409)	$ (1,451)	$ (1,494)	$ (1,539)
Electricity: Grid	$ -	$ (3,117)	$ (3,211)	$ (3,307)	$ (3,406)	$ (3,508)	$ (3,614)	$ (3,722)	$ (3,834)	$ (3,949)	$ (4,067)	$ (4,189)	$ (4,315)	$ (4,444)	$ (4,578)	$ (4,715)	$ (4,857)
Vehicle: Gas	$ (30,000)	$ (2,400)	$ (2,472)	$ (2,546)	$ (2,623)	$ (2,701)	$ (2,782)	$ (2,866)	$ (2,952)	$ (32,440)	$ (3,131)	$ (3,225)	$ (3,322)	$ (3,422)	$ (3,524)	$ (3,630)	$ (3,739)
HVAC: Heat Pump	$ (16,255)	$ (4,769)	$ (4,912)	$ (5,059)	$ (5,211)	$ (5,368)	$ (5,529)	$ (5,694)	$ (5,865)	$ (6,041)	$ (6,222)	$ (6,409)	$ (6,601)	$ (6,799)	$ (7,003)	$ (7,214)	$ (7,430)
Net Cash Flows	$ (159,932)	$ (11,874)	$ (12,230)	$ (12,597)	$ (12,975)	$ (13,365)	$ (13,765)	$ (14,178)	$ (14,604)	$ (15,042)	$ (15,493)	$ (15,958)	$ (16,437)	$ (16,930)	$ (17,438)	$ (17,961)	$ (18,500)
Cumulative Cash Flow	$ (159,932)	$ (171,806)	$ (184,036)	$ (196,634)	$ (209,609)	$ (222,974)	$ (236,739)	$ (250,918)	$ (265,521)	$ (280,563)	$ (296,056)	$ (312,014)	$ (328,451)	$ (345,381)	$ (362,819)	$ (380,780)	$ (399,279)
Net Present Value, 3% Cost	$ (334,355)																
Net Present Value, 5% Cost	$ (302,081)																
Sustainable	**Acquisition**	**O&M 2020**	**O&M 2021**	**O&M 2022**	**O&M 2023**	**O&M 2024**	**O&M 2025**	**O&M 2026**	**O&M 2027**	**O&M 2028**	**O&M 2029**	**O&M 2030**	**O&M 2031**	**O&M 2032**	**O&M 2033**	**O&M 2034**	**O&M 2035**
Framing: Engineered	$ (53,184)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Insulation: Icynene	$ (12,460)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Windows/Doors: Energy Star	$ (16,625)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Water: RWH	$ (25,500)	$ (328)	$ (338)	$ (348)	$ (358)	$ (369)	$ (380)	$ (392)	$ (403)	$ (416)	$ (428)	$ (441)	$ (454)	$ (468)	$ (482)	$ (496)	$ (511)
Wastewater: Aerobic	$ (10,500)	$ (180)	$ (185)	$ (191)	$ (197)	$ (203)	$ (209)	$ (215)	$ (221)	$ (228)	$ (235)	$ (242)	$ (249)	$ (257)	$ (264)	$ (272)	$ (280)
Water Heaters: 2 x Tankless	$ (3,000)		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Electricity: PVS	$ (44,442)	$ (498)	$ (513)	$ (528)	$ (544)	$ (561)	$ (577)	$ (595)	$ (612)	$ (631)	$ (650)	$ (669)	$ (689)	$ (710)	$ (731)	$ (753)	$ (776)
Vehicle: Electric	$ (30,000)	$ (1,200)	$ (1,236)	$ (1,273)	$ (1,311)	$ (1,351)	$ (1,391)	$ (1,433)	$ (1,476)	$ (39,620)	$ (1,566)	$ (1,613)	$ (1,661)	$ (1,711)	$ (1,762)	$ (1,815)	$ (1,870)
HVAC: Geothermal	$ (18,550)	$ (600)	$ (618)	$ (637)	$ (656)	$ (675)	$ (696)	$ (716)	$ (738)	$ (760)	$ (783)	$ (806)	$ (831)	$ (855)	$ (881)	$ (908)	$ (935)
Net Cash Flows	$ (214,261)	$ (2,806)	$ (2,890)	$ (2,977)	$ (3,066)	$ (3,158)	$ (3,253)	$ (3,351)	$ (3,451)	$ (3,555)	$ (3,661)	$ (3,771)	$ (3,884)	$ (4,001)	$ (4,121)	$ (4,244)	$ (4,372)
Cumulative Cash Flow	$ (214,261)	$ (217,067)	$ (219,957)	$ (222,934)	$ (226,000)	$ (229,158)	$ (232,411)	$ (235,762)	$ (239,213)	$ (242,767)	$ (246,429)	$ (250,200)	$ (254,084)	$ (258,084)	$ (262,205)	$ (266,449)	$ (270,821)
Net Present Value, 3% Cost	$ (250,339)																
Net Present Value, 5% Cost	$ (239,449)																

Figure 6. Color-coded break-even and NPV analysis.

4. Discussion

4.1. Break-Even and NPV Analyses

For this case study, the break-even analysis and ROI suggest that sustainable land use and construction efforts can benefit the environment and the bottom line, which is congruent with other research [114]. The initial up-front costs may be quickly offset by savings depending on construction options, but there are upfront costs that must be considered as found in previous research [115]. In the case study here, only seven years were required for breakeven, which is earlier than empirical simulation might have suggested [9], possibly due to synergistic effects of multiple interventions applied simultaneously. This timeframe might be reduced by selecting subsets of options such as energy efficient HVAC versus geothermal HVAC, as in the hybrid ROI option investigated. Aside from the economic considerations, the environmental responsibility issues are clear. Avoiding carbon emissions is responsible construction.

In the break-even analysis, there were several construction options that resulted in near-zero break-even time, including the use of engineered lumber, Icynene foam, and Energy Star doors and windows. Other options such as 100% PVS and the purchase of an electric car saw delayed break-even points. Some sustainable efforts never saw any breakeven, including the aerobic septic system. Geothermal proved ineffective and expensive based on residents' desires and requirements, which runs counter to other evidence suggesting its utility in office buildings in another semiarid climate (Madrid), which does not have quite the same temperature spread as the location in Texas [116].

The additional cost of sustainable construction for the research residence in this case is estimated at $54,329, and the 15-year NPV analysis showed $84K and $63K savings at 3% and 5% cost of capital for sustainable construction, respectively. There may be a positive return on investment for intelligent land use, transportation, and construction. Tax incentives and education are still necessary to encourage smart decisions and incentivize individuals [117]. These findings help inform construction decisions for businesses and for individuals in this region.

4.2. Environmental Findings

Perhaps more importantly, there is a significant environmental offset for this type of construction. Based on reasonable assumptions, the construction of this house saved between 25 and 90 trees due to the use of reclaimed wood [9]. The carbon dioxide avoidance by leveraging solar is significant, although there is a break-even consideration based on economic and environmental trade-offs congruent with other research [118]. The total estimated annual difference in carbon emissions was 4.326 million g/CO_2e for this research residence. Environmental effects of burning gasoline in a vehicle were reduced to near zero by powering a BEV via PVS, and associated savings were achieved as in other research [6].

Further, the total water offset per demanded gallon is 2 gallons of water per 1 gallon demanded. A traditional residence consuming 10,000 gallons would require 33,333 gallons of rainfall to supply the ground water sources, whereas a rainwater system would require only 13,333 gallons. In semiarid regions, that difference is important for sustainability and aquifer preservation [43,45]. This rural residence illustrates that smart land use and sustainable construction save resources.

Aside from the sustainable options discussed in this case study, there are many, many more that might be considered, particularly with engineered performance improvement of materials. One example of this is the use of spent coffee grounds to improve thermal insulation [119]. Another example is the use of a prototype hybrid steel and wood purlins for roof construction rather than pure steel [120]. Materials improvements are likely to reduce environmental impacts of residential construction.

4.3. Policy Implications

There are also policy requirements for sustainable construction. That policy push towards sustainable construction is evolving to a universal mandate with penalties for failure to comply. The prime example is in California, where a new law passed a solar mandate where all new homes built after 1 January 2020 must be equipped with a solar electric system. That system must be sized that it will offset 100% of the home's electricity usage. This mandate is one aspect of the California Energy Commission's initiative to have 50% of the entire State of California's energy production be from a clean energy source by 2030 [121]. Continuing with the California mandates on sustainability mandates, California passed another law recently signed by Gov. Brown that imposes water usage requirements. The law states that all California residents will be restricted to 55 gallons/day water usage by 2022 and is reduced to 50 gallons/day by 2030 [122]. While both initiatives discuss the mandates, neither has shown the penalty for failure to comply or even specifics on implementation. What is clear is that the mandates on both electric and water usage are the wave of the future and appear to be only the start in California, with certainty that other states will adopt similar measures. A proactive approach leveraging the analysis presented here and elsewhere will help both builders and buyers.

4.4. Limitations

This is a single case study of a single rural residence, where some efforts were successful (e.g., solar power arrays and rainwater harvesting) and some were not (e.g., geothermal). The results for this single case study in a semiarid region are not generalizable to other regions. Further, land-use regulations vary from location to location, so what is achievable at this research location may be prohibited elsewhere. The case study is also limited in that complete cradle-to-grave life-cycle costs and impacts are not available for all components and that, as a case study, only one alternative technology was priced and investigated. For every category of construction, there are many available sustainable products. Where possible, we have documented environmental considerations; however, these are not the universe of effects.

Another major limitation of this study is that it does not include complete transaction costs (see [123–125]. Where possible, these are documented; however, they are nontrivial to estimate. Any final analysis should seek to improve these cost estimates.

5. Conclusions

5.1. Key Findings

This case study illustrates that proper rural residential construction and resource use can provide value to the consumer and reduce the impact of the built environment. There is a positive NPV obtainable for many eco-friendly construction options. A reasonable break-even expectation for sustainable construction options based on these construction requirements in this geographical area would be six years without geothermal HVAC, and the cost for the breakeven is $54,329. The NPV suggested that the sustainable option was still the better choice at 3% and 5% cost of capital. Leveraging what works for both the environment and the consumer in a particular region requires dedication and focus of the residential construction industry.

Most important are the environmental offsets. By using sustainable building practices for new houses and renovations which are required in rural areas of Texas [56], carbon offsets and water conservation may be achieved, reducing the impact of the built environment on our planet. The savings for this single research property alone is estimated at 4.326 million g/CO_2e annually. The effect of such sustainable building construction in rural communities may slow climate change.

5.2. Future Research

As a research residence, the design elements are not static. One element of future research includes adding lithium ion battery (LIB) backups for the PVS to achieve total grid separation. Understanding the feasibility, life-cycle costs, and environmental break-even of this effort would inform future engineering considerations, as evidence suggests LIB production has some carbon tail [126]. As part of future research, the team plans on evaluating the reduction of CAT6 Ethernet cables by adopting a true wireless solution and the reduction of electrical wire by using dual-gang wireless light switches and requiring only one wired component.

Aside from the residence interventions, future research will include a metanalysis of rural residential construction literature. Discovering best practices from multiple reports is important for generalizability beyond this case study. Sustainable construction options should positively affect the environment and the pocketbook.

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References

1. Araújo, A.G.; Pereira Carneiro, A.M.; Palha, R.P. Sustainable construction management: A systematic review of the literature with meta-analysis. *J. Clean. Prod.* **2020**, *256*, 120350. [CrossRef]
2. Belayutham, S.; González, V.A.; Yiu, T.W. A cleaner production-pollution prevention based framework for construction site induced water pollution. *J. Clean. Prod.* **2016**, *135*, 1363–1378. [CrossRef]
3. Heravi, G.; Abdolvand, M.M. Assessment of water11virtual water. consumption during production of material and construction phases of residential building projects. *Sustain. Cities Soc.* **2019**, *51*, 101785. [CrossRef]
4. Rahman, M.M.; Rahman, M.A.; Haque, M.M.; Rahman, A. Sustainable Water Use in Construction. In *Sustainable Construction Technologies*; Tam, V.W.Y., Le, K.N., Eds.; Butterworth-Heinemann: Oxford, UK, 2019; Chapter 8; pp. 211–235.
5. Fulton, L. Ownership Cost Comparison of Battery Electric and Non-Plugin Hybrid Vehicles: A Consumer Perspective. *Appl. Sci.* **2018**, *8*, 1487. [CrossRef]
6. Fulton, L. Publicly available simulation of battery electric, hybrid electric, and gasoline vehicles. *Energies* **2020**. In Press.
7. Fulton, L.; Bastian, N. A Fuel Cost Comparison of Electric and Gas-Powered Vehicles. In Proceedings of the 2012 AutumnSim Conference on Energy, Climate and Environmental Modeling & Simulation, San Diego, CA, USA, 28–31 October 2012.
8. Reyna, J.L.; Chester, M.V. Energy efficiency to reduce residential electricity and natural gas use under climate change. *Nat. Commun.* **2017**, *8*, 14916. [CrossRef]
9. Fulton, L.; Bradley, B.; Matthew, B.; Clemens Scott, K.; Lee, K. A Publicly Available Cost Simulation of Sustainable Construction Options for Residential Houses. *Sustainability* **2020**, *12*, 2873. [CrossRef]
10. Buehlmann, U.; Bumgardner, M.; Alderman, D. Recent Developments in US Hardwood Lumber Markets and Linkages to Housing Construction. *Curr. For. Rep.* **2017**, *3*, 213–222. [CrossRef]
11. Li, F.; Liu, X.; Zhang, X.; Zhao, D.; Liu, H.; Zhou, C.; Wang, R. Urban ecological infrastructure: An integrated network for ecosystem services and sustainable urban systems. *J. Clean. Prod.* **2017**, *163*, S12–S18. [CrossRef]
12. Fearnside, P.M.; Lashof, D.A.; Moura-Costa, P. Accounting for time in Mitigating Global Warming through land-use change and forestry. *Mitig. Adapt. Strateg. Glob. Chang.* **2000**, *5*, 239–270. [CrossRef]
13. Hossain, M.U.; Poon, C.S. Global warming potential and energy consumption of temporary works in building construction: A case study in Hong Kong. *Build. Environ.* **2018**, *142*, 171–179. [CrossRef]
14. Patz, J.; Norris, D. Land Use Change and Human Health. In *Ecosystems and Land Use Change*; AGU: Washington, DC, USA, 2004; pp. 159–167. [CrossRef]
15. Rodríguez-Gallego, L.; Achkar, M.; Defeo, O.; Vidal, L.; Meerhoff, E.; Conde, D. Effects of land use changes on eutrophication indicators in five coastal lagoons of the Southwestern Atlantic Ocean. *Estuar. Coast. Shelf Sci.* **2017**, *188*, 116–126. [CrossRef]
16. Křeček, J.; Palán, L.; Stuchlík, E. Impacts of land use policy on the recovery of mountain catchments from acidification. *Land Use Policy* **2019**, *80*, 439–448. [CrossRef]
17. Yong, L.; Hans Peter, H.A.; Xiaodong, S.; Yu, S. Research on the relationship between urban form and urban smog in China. *Environ. Plan. B Plan. Des.* **2016**, *44*. [CrossRef]

18. Kardinal Jusuf, S.; Wong, N.H.; Hagen, E.; Anggoro, R.; Hong, Y. The influence of land use on the urban heat island in Singapore. *Habitat Int.* **2007**, *31*, 232–242. [CrossRef]
19. Suh, S.; Tomar, S.; Leighton, M.; Kneifel, J. Environmental Performance of Green Building Code and Certification Systems. *Environ. Sci. Technol.* **2014**, *48*, 2551–2560. [CrossRef]
20. Wald, M. Why More Solar Panels Should Be Facing West, Not South. *New York Times*, 1 December 2014.
21. Gromicko, N. Building Orientation for Optimum Energy. Available online: https://www.nachi.org/building-orientation-optimum-energy.htm (accessed on 21 April 2020).
22. Ahn, C.; Pan, W.; Lee, S.; Peña-Mora, F.A. Lessons learned from utilizing discrete-event simulation modeling for quantifying construction emissions in pre-planning phase. In Proceedings of the 2010 Winter Simulation Conference, Baltimore, MD, USA, 5–8 December 2010; pp. 3170–3176.
23. Erol, H.; Dikmen, I.; Birgonul, M.T. Measuring the impact of lean construction practices on project duration and variability: A simulation-based study on residential buildings. *J. Civ. Eng. Manag.* **2017**, *23*, 241–251. [CrossRef]
24. Bossink, B.A.G.; Brouwers, H.J.H. Construction Waste: Quantification and Source Evaluation. *J. Constr. Eng. Manag.* **1996**, *122*, 55–60. [CrossRef]
25. Johnston, H.; Mincks, W.R. Cost-effective waste minimization for construction managers: A Publication of the American Association of Cost Engineers a Publication of the American Association of Cost Engineers. *Cost Eng.* **1995**, *37*, 31.
26. Mon, R. Engineered lumber: An alternative to old-growth resources. *J. For.* **1993**, *91*, 9–12.
27. Harte, A.M. Mass timber – the emergence of a modern construction material. *J. Struct. Integr. Maint.* **2017**, *2*, 121–132. [CrossRef]
28. Ajayi, S. Design, Procurement and Construction Strategies for Minimizing Waste in Construction Projects. Ph.D. Thesis, University of the West of England, Bristol, UK, 2020.
29. Icynene. What You Need to Know About Spray Foam Insulation. Available online: https://www.icynene.com/en-us/blog/what-you-need-know-about-spray-foam-insulation (accessed on 20 April 2020).
30. Sadineni, S.B.; Madala, S.; Boehm, R.F. Passive building energy savings: A review of building envelope components. *Renew. Sustain. Energy Rev.* **2011**, *15*, 3617–3631. [CrossRef]
31. Kuczyński, T.; Staszczuk, A. Experimental study of the influence of thermal mass on thermal comfort and cooling energy demand in residential buildings. *Energy* **2020**, *195*, 116984. [CrossRef]
32. Pehl, M.; Arvesen, A.; Humpenöder, F.; Popp, A.; Hertwich, E.G.; Luderer, G. Understanding future emissions from low-carbon power systems by integration of life-cycle assessment and integrated energy modelling. *Nat. Energy* **2017**, *2*, 939–945. [CrossRef]
33. Hohne, P.A.; Kusakana, K.; Numbi, B.P. A review of water heating technologies: An application to the South African context. *Energy Rep.* **2019**, *5*, 1–19. [CrossRef]
34. Coffman, M.; Bernstein, P.; Wee, S. Integrating electric vehicles and residential solar PV. *Transp. Policy* **2017**, *53*, 30–38. [CrossRef]
35. Jain, M.; Hoppe, T.; Bressers, H. A Governance Perspective on Net Zero Energy Building Niche Development in India: The Case of New Delhi. *Energies* **2017**, *10*, 1144. [CrossRef]
36. Connelly, D. Net Positive Energy Building. *ASHRAE J.* **2016**, *58*, 56.
37. Browne, S. The 'Greenest' Home in Texas. Available online: https://www.ksat.com/weather/2012/02/09/the-greenest-home-in-texas/ (accessed on 21 April 2020).
38. Doroudchi, E.; Alanne, K.; Okur, Ö.; Kyyrä, J.; Lehtonen, M. Approaching net zero energy housing through integrated EV. *Sustain. Cities Soc.* **2018**, *38*, 534–542. [CrossRef]
39. Wagner, M.W.; Kreuter, U.P. Groundwater Supply in Texas: Private Land Considerations in a Rule-of-Capture State. *Soc. Nat. Resour.* **2004**, *17*, 349–357. [CrossRef]
40. Zheng, Y.; Flanagan, S.V. The Case for Universal Screening of Private Well Water Quality in the U.S. and Testing Requirements to Achieve It: Evidence from Arsenic. *Environ. Health Perspect.* **2017**, *125*, 085002. [CrossRef] [PubMed]
41. Kross, B.C.; Hallberg, G.R.; Bruner, D.R.; Cherryholmes, K.; Johnson, J.K. The nitrate contamination of private well water in Iowa. *Am. J. Public Health* **1993**, *83*, 270–272. [CrossRef] [PubMed]
42. Kross, B.C.; Selim, M.I.; Hallberg, G.R.; Bruner, D.R.; Cherryholmes, K. Pesticide contamination of private well water, a growing rural health concern. *Environ. Int.* **1992**, *18*, 231–241. [CrossRef]

43. Fulton, L.V.; Nathaniel, D.B.; Francis, A.M.; Muzaffer, R. Rainwater harvesting system using a non-parametric stochastic rainfall generator. *Simulation* **2013**, *89*, 693–702. [CrossRef]
44. Fulton, L.V. A Simulation of Rainwater Harvesting Design and Demand-Side Controls for Large Hospitals. *Sustainability* **2018**, *10*, 1659. [CrossRef]
45. Fulton, L.; Musal, R.; Mendez-Mediavilla, F. Construction analysis of rainwater harvesting systems. In Proceedings of the Winter Simulation Conference, Berlin, Germany, 9–12 December 2012; pp. 1–11.
46. DeOreao, W.B.M.P.; Dziegielewski, B.; Kiefe, J. Residential End Uses of Water, Version 2. Available online: https://www.circleofblue.org/wp-content/uploads/2016/04/WRF_REU2016.pdf (accessed on 21 April 2020).
47. Asgarzadeh, M.; Vahdati, K.; Lotfi, M.; Arab, M.; Babaei, A.; Naderi, F.; Pir Soufi, M.; Rouhani, G. Plant selection method for urban landscapes of semi-arid cities (a case study of Tehran). *Urban For. Urban Green.* **2014**, *13*, 450–458. [CrossRef]
48. Show, K.Y.; Lee, D.J. 8—Anaerobic Treatment Versus Aerobic Treatment. In *Current Developments in Biotechnology and Bioengineering*; Lee, D.-J., Jegatheesan, V., Ngo, H.H., Hallenbeck, P.C., Pandey, A., Eds.; Elsevier: Amsterdam, The Netherlands, 2017; pp. 205–230.
49. Sustainability & Green Building. Available online: https://www.nahb.org/Advocacy/Industry-Issues/Sustainability-and-Green-Building (accessed on 21 April 2020).
50. NAHB Model Green Home Buiding Checklist. Available online: https://americanolean.com/pdfs/leed/NAHBChecklist.pdf (accessed on 21 April 2020).
51. Renewables on the Rise 2019. Available online: https://environmenttexas.org/reports/txe/renewables-rise-2019 (accessed on 23 April 2020).
52. Wind Energy in Texas. Available online: https://www.awea.org/Awea/media/Resources/StateFactSheets/Texas.pdf (accessed on 21 April 2020).
53. Census Bureau. *County Population by Characteristics: 2010–2018*; Census Bureau: Washington, DC, USA, 2020.
54. R Development Core Team. *R: A Language and Environment for Statistical Computing*; R Core Team: Vienna, Austria, 2018.
55. Lamstein, A. choroplethr: Simplify the Creation of Choropleth Maps in R. Available online: https://CRAN.R-project.org/package=choroplethr (accessed on 21 April 2020).
56. Bowen National Research, L.L.C. *Texas Statewide Rural Housing Analysis*; Texas Department of Housing and Community Affairs: Austin, TX, USA.
57. Malewitz, J. High Power Rates Spark Outrage in Rural Texas. Available online: https://www.texastribune.org/2016/01/23/sky-high-rates-spark-power-outrage-rural-texas/ (accessed on 23 April 2020).
58. Schmidt, M. Find Break Even Point, Volume, in 5 Steps from Costs and Revenues. Available online: https://www.business-case-analysis.com/break-even-analysis.html (accessed on 21 April 2020).
59. Baker, S. Perils of the Internal Rate of Return. Available online: http://sambaker.com/econ/invest/invest.html (accessed on 21 April 2020).
60. Goel, A.; Ganesh, L.S.; Kaur, A. Sustainability assessment of construction practices in India using inductive content analysis of research literature. *Int. J. Constr. Manag.* **2019**, 1–14. [CrossRef]
61. CCEO | Required Permits. Available online: https://cceo.org/mainpage/buildingreqs (accessed on 23 April 2020).
62. New Braunfels Utilities Electrical Connection Policy. Available online: http://www.nbutexas.com/Commercial/New-Commercial-Construction/Electrical-Connection-Policy (accessed on 23 April 2020).
63. Google. Google Maps Imagery@2020 CAPCOG Maxar Technologies. Available online: https://www.currentresults.com/Weather/US/average-annual-state-sunshine.php (accessed on 23 April 2020).
64. De Magalhães, R.F.; Danilevicz, Â.d.M.F.; Saurin, T.A. Reducing construction waste: A study of urban infrastructure projects. *Waste Manag.* **2017**, *67*, 265–277. [CrossRef]
65. Morel, J.C.; Mesbah, A.; Oggero, M.; Walker, P. Building houses with local materials: Means to drastically reduce the environmental impact of construction. *Build. Environ.* **2001**, *36*, 1119–1126. [CrossRef]
66. Begum, R.A.; Siwar, C.; Pereira, J.J.; Jaafar, A.H. A benefit–cost analysis on the economic feasibility of construction waste minimisation: The case of Malaysia. *Resour. Conserv. Recycl.* **2006**, *48*, 86–98. [CrossRef]
67. Ortiz, O.; Pasqualino, J.C.; Castells, F. Environmental performance of construction waste: Comparing three scenarios from a case study in Catalonia, Spain. *Waste Manag.* **2010**, *30*, 646–654. [CrossRef] [PubMed]
68. Friedman, A. Constructing a Home. In *Fundamentals of Sustainable Dwellings*; Island Press/Center for Resource Economics: Washington, DC, USA, 2012; pp. 65–81.

69. De Silva, S.; Liyanage, V. Suitability of finger jointed structural timber for construction. *J. Struct. Eng. Appl. Mech.* **2010**, *2*, 131–142. [CrossRef]
70. Bradshaw, S. McMansions Are not Eco-Friendly. Available online: https://www.seattletimes.com/business/real-estate/mcmansions-are-not-eco-friendly/ (accessed on 21 April 2020).
71. 2 × 4 × 104-5/8″ Pre-Cut Stud Construction/Framing Lumber. Available online: https://www.menards.com/main/building-materials/lumber-boards/dimensional-lumber/2-x-4-pre-cut-stud-construction-framing-lumber/1021305/p-1444422686698.htm (accessed on 14 April 2020).
72. 2 × 4 × 104 5/8″ Finger Joint Pre-Cut Stud Construction/Framing Lumber. Available online: https://www.menards.com/main/building-materials/lumber-boards/dimensional-lumber/2-x-4-finger-joint-pre-cut-stud-construction-framing-lumber/1021111/p-1444422419687.htm (accessed on 1 April 2020).
73. Learn How Much It Costs to Install Carpentry Framing. Available online: https://www.homeadvisor.com/cost/walls-and-ceilings/install-carpentry-framing/ (accessed on 1 April 2020).
74. Li, Y.; Yu, H.; Sharmin, T.; Awad, H.; Gül, M. Towards energy-Efficient homes: Evaluating the hygrothermal performance of different wall assemblies through long-term field monitoring. *Energy Build.* **2016**, *121*, 43–56. [CrossRef]
75. Kunič, R. Carbon footprint of thermal insulation materials in building envelopes. *Energy Effic.* **2017**, *10*, 1511–1528. [CrossRef]
76. Learn About the Cost of Projects in the Insulation Category. Available online: https://www.homeadvisor.com/cost/insulation/ (accessed on 1 April 2020).
77. Kalhor, K.; Ememinejad, N. Qualitative and quantitative optimization of thermal insulation materials: Insights from the market and energy codes. *J. Build. Eng.* **2020**, *30*, 101275. [CrossRef]
78. How Much Does Spray Foam Insulation Cost? Available online: https://www.icynene.com/en-us/blog/how-much-does-spray-foam-insulation-cost-1 (accessed on 2 May 2020).
79. Foam Insulation vs. Fiberglass, Cellulose: Which Is the Right Choice? Available online: https://www.probuilder.com/insulation-choices-fiberglass-cellulose-or-foam (accessed on 1 April 2020).
80. What Makes It ENERGY STAR? Available online: https://www.energystar.gov/products/building_products/residential_windows_doors_and_skylights/key_product_criteria (accessed on 1 April 2020).
81. Benefits of ENERGY STAR Qualified Windows, Doors, and Skylights. Available online: https://www.energystar.gov/products/building_products/residential_windows_doors_and_skylights/benefits (accessed on 4 May 2020).
82. Rodriguez, J. Home Builders: What You Need to Know about Low-E Windows? Available online: https://www.thebalancesmb.com/uses-of-low-e-windows-844755 (accessed on 1 April 2020).
83. Bruegge, C.; Carrión-Flores, C.; Pope, J.C. Does the housing market value energy efficient homes? Evidence from the energy star program. *Reg. Sci. Urban Econ.* **2016**, *57*, 63–76. [CrossRef]
84. Modernize. Energy Efficient Window Costs—2020 Prices Guide—Modernize. Available online: https://modernize.com/windows/energy-efficient (accessed on 21 April 2020).
85. Sisti, M.; Schiavano, G.F.; Santi, M.D.; Brandi, G. Ultraviolet germicidal irradiation in tap water contaminated by *Aspergillus* spp. *J. Prev. Med. Hyg.* **2017**, *58*, E315–E319. [CrossRef]
86. Krishna, H.J.; Brown, C.; Gerston, J.; Colley, S. *The Texas Manual on Rainwater Harvesting*, 3rd ed.; Texas Water Development Board: Austin, TX, USA, 2005.
87. Rain and Precipitation. Available online: https://www.usgs.gov/special-topic/water-science-school/science/rain-and-precipitation?qt-science_center_objects=0#qt-science_center_objects (accessed on 21 April 2020).
88. Ghimire, S.R.; Johnston, J.M.; Ingwersen, W.W.; Sojka, S. Life cycle assessment of a commercial rainwater harvesting system compared with a municipal water supply system. *J. Clean. Prod.* **2017**, *151*, 74–86. [CrossRef]
89. Klein, G. *California's Water-Energy Relationship*; California Energy Commission: Sacramento, CA, USA, 2005.
90. Above Ground Rainwater Collection Tanks by Rain Ranchers. Available online: https://rainranchers.com/above-ground-rainwater-collection-tanks/ (accessed on 1 April 2020).
91. Learn How Much It Costs to Drill a Well. Available online: https://www.homeadvisor.com/cost/landscape/drill-a-well/ (accessed on 1 April 2020).
92. Solloway, C. *Rainwater Harvesting*; EPA-841-R-13-002; U.S. Environmental Protection Agency (EPA): Washington, DC, USA, 2013.
93. Well Maintenance | Wells | Private Water Systems | Drinking Water | Healthy Water | CDC. Available online: https://www.cdc.gov/healthywater/drinking/private/wells/maintenance.html (accessed on 1 April 2020).

94. 2020 Average Well Inspection Cost (with Price Factors). Available online: https://www.thumbtack.com/p/well-inspection-cost (accessed on 1 April 2020).
95. WaterResearch. Residential, Commercial, and Institutional End Uses of Water. Available online: https://www.waterrf.org/research/projects/residential-commercial-and-institutional-end-uses-water (accessed on 1 April 2020).
96. US Environmental Protection Agency. Showerheads. Available online: https://www.epa.gov/watersense/showerheads (accessed on 1 April 2020).
97. Plumbing Fixtures: Water Saving Standards. Available online: https://www.tceq.texas.gov/permitting/water_rights/wr_technical-resources/plumbing-fixtures (accessed on 1 April 2020).
98. Jet Aeration System. Available online: http://jetprecast.com/jet-aeration-system.html (accessed on 1 April 2020).
99. 2020 Septic Tank System Installation Costs & Replacement Prices. Available online: https://homeguide.com/costs/septic-tank-system-cost (accessed on 1 April 2020).
100. Cost of an Aerobic vs. Anaerobic Septic System (2020)—How Much Does Septic Tank Installation Cost? Price Comparison. Available online: https://www.kompareit.com/homeandgarden/plumbing-compare-aerobic-vs-anaerobic-septic-system.html (accessed on 1 April 2020).
101. Basics for Septic Systems. Available online: https://www.tceq.texas.gov/assistance/water/fyiossfs.html (accessed on 1 April 2020).
102. Hong, B.; Howarth, R.W. Greenhouse gas emissions from domestic hot water: Heat pumps compared to most commonly used systems. *Energy Sci. Eng.* **2016**, *4*, 123–133. [CrossRef]
103. Sustainability Society. Available online: http://www.eemax.com/2016/01/11/3-environmental-and-economic-benefits-of-tankless-water-heaters/ (accessed on 1 April 2020).
104. Tankless or Demand-Type Water Heaters. Available online: https://www.energy.gov/energysaver/heat-and-cool/water-heating/tankless-or-demand-type-water-heaters (accessed on 1 April 2020).
105. Kumar, N.M.; Mathew, M. Comparative life-cycle cost and GHG emission analysis of five different water heating systems for residential buildings in Australia. *Beni Suef Univ. J. Basic Appl. Sci.* **2018**, *7*, 748–751. [CrossRef]
106. Marathon Water Heaters—Consumers Power Inc. Available online: https://www.cpi.coop/home-energy-use/water-heaters/marathon-water-heaters/ (accessed on 2 April 2020).
107. Li, Y.L.; Ningning, H.; Tingting. Research on Carbon Emissions of Electric Vehicles throughout the Life Cycle Assessment Taking into Vehicle Weight and Grid Mix Composition. *Energies* **2019**, *12*, 3612. [CrossRef]
108. Vinkhuyzen, M. Nissan's Long Strange Trip with LEAF Batteries. Available online: https://cleantechnica.com/2018/09/29/nissans-long-strange-trip-with-leaf-batteries/ (accessed on 1 April 2020).
109. Pinto, A.; Rodrigues, F.; Mota, A. Geothermal contribution on southern Europe climate for energy efficiency of university buildings. Winter season. *Energy Procedia* **2017**, *134*, 181–191. [CrossRef]
110. Choudhury, A. HVAC vs. Geothermal Heat Pump. *Open J. Energy Effic.* **2013**, *2*, 42–45. [CrossRef]
111. Complete Solar Battery Review—Clean Energy Reviews. Available online: https://www.cleanenergyreviews.info/blog/2015/11/19/complete-battery-storage-comparison-and-review (accessed on 1 April 2020).
112. The Homeowners' Guide to Propane vs. Natural Gas: A Comparison of Differences, Cost, Efficiency and Safety | Petro Home Service. Available online: https://www.petro.com/resource-center/propane-vs-natural-gas-cost-efficiency-safety (accessed on 1 April 2020).
113. Appliance, C. Mini-Split Heat Pumps: The Advantages & Disadvantages. Available online: https://learn.compactappliance.com/mini-split-heat-pumps/ (accessed on 1 April 2020).
114. Hu, M. Does zero energy building cost more?—An empirical comparison of the construction costs for zero energy education building in United States. *Sustain. Cities Soc.* **2019**, *45*, 324–334. [CrossRef]
115. Ade, R.; Rehm, M. Reaching for the stars: Green construction cost premiums for Homestar certification. *Constr. Manag. Econ.* **2020**, *38*, 570–580. [CrossRef]
116. Alañón, J.I.V.; Alberto, V.; Arteaga, I.d.; Roberto, Q.; Alejandro. A Comparative Energy and Economic Analysis between a Low Enthalpy Geothermal Design and Gas, Diesel and Biomass Technologies for a HVAC System Installed in an Office Building. *Energies* **2019**, *12*, 870. [CrossRef]
117. Martek, I.; Hosseini, M.R.; Shrestha, A.; Edwards, D.J.; Durdyev, S. Barriers inhibiting the transition to sustainability within the Australian construction industry: An investigation of technical and social interactions. *J. Clean. Prod.* **2019**, *211*, 281–292. [CrossRef]

118. Ren, M.; Mitchell, C.R.; Mo, W. Dynamic life cycle economic and environmental assessment of residential solar photovoltaic systems. *Sci. Total Environ.* **2020**, *722*, 137932. [CrossRef]
119. Lachheb, A.; Allouhi, A.; El Marhoune, M.; Saadani, R.; Kousksou, T.; Jamil, A.; Rahmoune, M.; Oussouaddi, O. Thermal insulation improvement in construction materials by adding spent coffee grounds: An experimental and simulation study. *J. Clean. Prod.* **2019**, *209*, 1411–1419. [CrossRef]
120. Osa, H.G.; Mikel, Z.; Jesús, C.; Juan, L. Sustainability Improvement in the Design of Lightweight Roofs: A New Prototype of Hybrid Steel and Wood Purlins. *Sustainability* **2018**, *11*, 39. [CrossRef]
121. Bach, N. California Becomes 1st State to Require Solar Panels on New Homes. Available online: https://fortune.com/2018/12/06/california-solar-panels-new-homes/ (accessed on 1 April 2020).
122. Luna, T.; Koseff, A. Get ready to save water: Permanent California restrictions approved by Gov. Jerry Brown. Available online: https://www.sacbee.com/news/politics-government/capitol-alert/article211333594.html (accessed on 1 April 2020).
123. Buitelaar, E. A Transaction-cost Analysis of the Land Development Process. *Urban Stud.* **2004**, *41*, 2539–2553. [CrossRef]
124. Shahab, S.; Clinch, J.P.; O'Neill, E. Accounting for transaction costs in planning policy evaluation. *Land Use Policy* **2018**, *70*, 263–272. [CrossRef]
125. McCann, L. Transaction costs and environmental policy design. *Ecol. Econ.* **2013**, *88*, 253–262. [CrossRef]
126. Tang, Y.W.; Yajuan, Y.; Kai, H.; Baojun. From the Perspective of Battery Production: Energy–Environment–Economy (3E) Analysis of Lithium-Ion Batteries in China. *Sustainability* **2019**, *11*, 6941. [CrossRef]

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Transformations in the Agricultural and Scenic Landscapes in the Northwest of the Region of Murcia (Spain): Moving towards Long Awaited (Un)Sustainability

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Abstract: Since the middle of the 20th century, irrigation in the southeast of Spain has displayed significant productive growth based on the intensive use of the scarce water resources in the area and the contribution of river flows from the hydrographic basin of the Tagus River to the hydrographic basin of the Segura River. Despite high levels of efficiency in the water use from the new irrigation systems, the water deficit has only intensified in recent years. The most dynamically irrigated areas (Campo de Cartagena, Valle del Guadalentín, Vega Alta del Segura and the southern coast of the Region of Murcia), were faced with a complex and trying future, resulting in numerous companies (agribusinesses) relocating to lease and acquire land in the northwest of Murcia to develop their intensive crops. The general objective of this article lies in the analysis of widespread landscape dynamics, and of agricultural dynamics in particular, in the rural environment of the northwest Region of Murcia (Spain). For this, an exhaustive analysis of the land cover and use transformations is carried out for the periods of time 1990–2000–2012–2018. The data studied come from the Corine Land Cover (CLC) project, carried out by the European Environment Agency (EEA). These spatial data are treated with geographical information systems (GISs) and represented by statistical and cartographic analyses and cross-tabulation matrices that indicate the dynamics of changes, loss and land gain. As the main result, we find that the areas occupied by new intensive irrigation on old rainfed farmland in the northwest Region of Murcia have increased in the last 30 years. Traditional irrigation is disappearing, and the environmental consequences (overexploitation of aquifers and decreased flows from natural sources), among others, are dire.

Keywords: rural landscape; intensive agriculture; landscape transformation; socioeconomic and environmental impacts

1. Introduction

Agriculture is the sector that consumes the most water and at the same time is the most affected by the scarcity of water in many places; it represents 70.0% of the world's freshwater withdrawals and more than 90.0% of its consumption [1,2]. Agriculture is responsible for just over 80.0% of the hydrological footprint in Spain [3]. According to United Nations forecasts, by 2030, freshwater resources will decrease by 40.0% [4]. This fact, together with the increase in the world population, could generate a global water crisis. In this way, policies must be directed towards the sustainability of agricultural activities and the reduction in water consumption by crops [5].

The southeast of the Iberian Peninsula is undoubtedly the climatic region in Spain where avant-garde agriculture is most significant [6–8]. Throughout the second half of the 20th century, and particularly over the last three decades, innovation and new technologies have made overcoming the disadvantages of the climate possible. Scarce and irregular rainfall have led to a shortage of its own water resources. Today, those who follow new agricultural production systems, whether in greenhouses or in the open air, with high-frequency localised irrigation, crave water brought in from considerable distances (The Tajo–Segura Aqueduct), but not rain in situ, which stains the fruit, favours pests or causes damage in greenhouses. Thus, from this perspective, the scarcity of rain becomes an advantage for this new agriculture [9]. However, the water deficit has intensified in recent years, as irrigated areas continue to increase [10].

The scarcity of water resources has predominantly been defined as an emergency situation in the Spanish Southeast, a climatic region with semiarid characteristics which is in agreement with an overall traditional approach to water policies. It is also true that more or less at the same time as the WFD (Water Framework Directive) was published, a new, albeit limited in scope, trend started emerging. This new approach integrates the scarcity of water resources into planning policies and incorporates risk assessment as one possible scenario. The context within which this new approach developed was no longer characterised only by the traditional water policy paradigm reflected in the LPHN (National Hydrological Plan Law) (Ley 10/2001, de 5 de julio), the most emblematic infrastructure of which was the so-called "Ebro water transfer" [11,12]. During the late 1990s, a regionalist paradigm—characterised by the political use of water resources by different regional governments (Region of Murcia, among other Autonomous Communities), and a new water culture paradigm, which aimed to change traditional policies—also emerged [13,14], facilitating a change in the general direction of water policy [15], as represented by the publication of the AGUA (Actions for the Management and Use of Water) programme in 2004 [16–18]. Without abandoning the traditional objective—the generation of new resources, the programme stresses the importance of water treatment, reuse and the construction of large desalinisation plants, instead of large hydraulic infrastructures that promote inter-regional conflict. Despite the different policies and actions, the demands for water resources exceed the supply generated [19].

New irrigation methods, carried out primarily in localised irrigation, position southeast peninsular Spain among the areas with the highest agricultural income in Europe [10], although the aforementioned cultivation procedures have had a major impact on the economy and the landscape [20].

This avant-garde agriculture, which includes horticultural and fruit production, has radiated from the coastline to inland areas [8]. Procedures of this nature, with the notable participation of agricultural transformation societies (agribusinesses), have caused radical changes in the rural landscape, agricultural structures and farming systems of the affected areas, with the spread of advanced techniques and the introduction of new species and varieties [20–22].

A noteworthy aspect to mention is the unfavourable environmental impact of avant-garde agriculture. In the areas analysed, one of the impacts with the greatest repercussions may be the deterioration of groundwater due to the overexploitation of aquifers [23], but the damage caused to the soil by the fertigation system is also notable [24,25]. A solution to the problem of the elimination of waste materials, especially plastics, due to their nonbiodegradable nature is needed [26].

Current water policy and how this unfolds into the concentration of water rights in the southeast of Spain is a particular manifestation of what Harvey [27] calls accumulation by dispossession. His thesis is driven by two observations: (i) first, the chronic tendency within capitalism to produce crises of overaccumulation (to absorb surplus, capital pre-existing but hither to untapped markets are targeted, or new markets created); (ii) second, because capital continuously seeks to expand, and it needs territory. In agreement with Harvey, the neoliberal compulsion to privatize, liberalize, and deregulate shows that a new round of "enclosures of the commons" is a clear objective of policies [28].

According to Ahlers [29], "water management involves not only an understanding of its quantity and quality, but of the complex relationship between the social, economic, and political context with its biophysical materiality". Water scarcity may be induced by biophysical changes in the hydrological cycle [30] but is also a consequence of the historic and contemporary social relations and transformation in the struggle for control over water [31,32]. Human activity and nature form a process of negotiation, shaping landscapes which are dynamic and continuously contested because the process is constituted by, and simultaneously constitutes, the political economy of access and control over resources [33].

On the other hand, and according to Subra [34], we can consider some local conflicts as a global geopolitical conflicts. In many cases, local conflicts are the effect of ecological discourse, which constantly connects the local and the global levels (*think globally*, *act locally*). Of course, the dimensions of the territory concerned, or its scale, plays an important role. However, a geopolitical conflict occurring in a small territory could effectively be classified as external or international geopolitics in the most striking sense of the term, as is the case of the numerous conflicts generated in southeastern Spain due to the scarcity of water resources, the increase in the irrigated area and the constant demand for water resources from other hydrographic basins with an international character (Tajo river basin) [35–37]. In these cases, the economic value of a small territory could make it an international issue. The intensity of geopolitical rivalries over a territory therefore has little to do with its surface area, except in cases where the small size of the territory is used as an argument to justify a geopolitical strategy. In the case study that concerns us, the excellent quality of groundwater attracts international companies to expand their irrigated lands, since their traditional irrigated areas are under enormous ecological and sociopolitical pressure [38–40]. Land use changes towards intensive uses constitute one of the dimensions of global change linking the local, regional and global levels. Although the loss of natural ecosystems has been the main concern, the disappearance of traditional agrosystems and cultural landscapes as a consequence of urban sprawl, growth of infrastructures and intensive irrigation is receiving increasing attention [41]. However, to tackle these losses of ecosystem services, work must be done locally. In this sense, and according to Alcon et al. [42], to increase the acceptability of a more ecological policy would imply translating to the farmers good and simple information to reduce the gap between the real and perceived cost of the specific agricultural measures that should be established in each case.

The regional economic development model cannot be understood without taking into account irrigated agriculture and its binding relationship with water availability [43]. In this mainly semiarid territory, the need to guarantee efficiency in agricultural water uses has been a constant that has led to the progressive modernisation of irrigation systems [44]. However, the total demand for water in the Segura River Basin has increased to exceed the limits of existing natural resources, leading to a structural water deficit with an unsustainable trend [45].

The most apparent territorial consequence of the agricultural development discourse in the Region of Murcia is summed up by the rapid expansion of the surface area conditioned to establish irrigated crops [46,47]. New reconditioning for irrigation has been carried out in territories where low-intensity rainfed agriculture was practised or remained uncultivated, so that the new use requires important reconditioning for plains and foothills, creating an artificial topography according to its requirements. New intensive farming landscapes quickly replace traditional farming landscapes [48]. This is the case for the lands dedicated to open-air crops in sectors of the northwest of Murcia, which are particularly mobile.

That said, in the northwest of the Region of Murcia, not everything is reduced to physiognomic modifications, because they manifest new and varied socioeconomic dynamics. First of all, the new irrigated areas have very tough competition regarding traditional orchards, whose smallholding structures have not been able to compete with the new highly technical farms [49]. Gradually, the presence of large agricultural production and marketing companies, mainly Spanish capital, have established themselves. It could be thought, in principle, that these new agricultural economies contribute significantly to the growth in income and jobs, as has happened in other nearby coastal and pre-coastal areas. However, this has not been the case. The labour needs were initially met with native workers, but soon they were gradually replaced by contingents of immigrants (mainly from the Maghreb and Ibero-America) residing in nearby cities such as Lorca, Totana, Fuente Álamo, or Cartagena who come by bus and return at the end of their working day [50]. Additionally, companies do not pay high taxes for the exploited farms, since for the most part the occupied lands continue to be registered as rainfed farms in the land register records.

1.1. Objective

The general objective of this study is to reveal the transformation of the landscape in the northwest Region of Murcia over the last three decades (1990–2018), especially as a consequence of the installation and increase in intensive irrigated crops. This study focuses, in essence, on analyzing the recent evolution of coverage and land use in the northwest of the Region of Murcia during the indicated period, the transitions and spatial dynamics between the coverage and land use, and the evolution of temporary irrigation crops.

1.2. Justification and Interest in the Investigation

It is clear that in this territory, as well as a continued growth of new irrigated areas, there has also been a disappearance of traditional orchards. In this sense, there is a recognition and a growing social demand regarding the need to conserve these traditional irrigation systems for their productive, environmental and cultural values [51–53].

Recently (March 2018), representatives of the four main original irrigation zones in the Segura river expressed their discontent to the then Minister of Agriculture for the creation of new intensively exploited farms that monopolise water resources in an opaque way[1]. This situation can collapse large areas of social irrigation, where family farms are abandoning agricultural activity.

The controversy generated in the northwest region about the disappearance and/or decrease in the river flows from their sources and springs also justifies the proposed investigation [23]. This dynamic is creating numerous conflicts with the farmers and the inhabitants of towns in the northwest of Murcia, who refuse to be "the emergency solution" of predatory regional socioeconomic development with its underground water resources [54,55]. Many examples of these protests come from ARECA (The Association of Irrigators of Caravaca)[2]. In a recently published article in "El Noroeste al Día" (Collaborative Portal of Northwest Murcia and the River Mula Counties (Murcia Region))[3], this association expresses the following:

"The extraction of groundwater and the unstoppable illegal or uncontrolled transformation of rainfed to irrigated land, can destroy the sources and springs of the northwest. The overexploitation of the water reserves of the northwest of Murcia is already very evident, the consequence is the gradual decrease in the river flows in all its water sources, which have lost around 60.0% compared to the river flows existing in the early 1990s".

Furthermore, on 18 April 2018, in the regional newspaper La Verdad the following news was published: The farmers will create a Council for the Defense of the northwest of Murcia, whose objective will be to "safeguard the natural heritage"[4]. ARECA denounces that the illegal transformation of rainfed land to intensive irrigation "has been especially high since 1990. All in all, we could be talking about estimates of more than 2000 hectares, without any type of control".

We cannot forget that according to numerous models, the consequences of climate change could aggravate the deficit of available water resources. The effects of climate change are increasingly evident throughout the world, with regions experiencing water shortages presenting the greatest vulnerability.

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1 Summary of the manifesto in Diario la Crónica Independiente (22 March 2018). Available at: http://lacronicaindependiente.com/2018/03/segura-transparente-exige-a-la-ministra-de-agricultura-que-ponga-por-fin-orden-en-la-cuenca/.
2 Caravaca: municipality of the Region of Murcia located in the Northwest region.
3 Available at: https://www.elnoroestealdia.com/index.php?option=com_content&task=view&id=31309&Itemid=253.
4 Diario (Newspaper) La Verdad (18 April 2018): http://soydecaravaca.laverdad.es/actualidad/denuncian-transformacion-2000-20180418010843-ntvo.html.

The Mediterranean area is expected to be highly vulnerable given its unbalanced distribution between the availability of water resources and the existing demands [56–61]. In this context, the notable increase in irrigated areas in recent decades leads to an increase in the existing water deficit and numerous problems regarding the overexploitation of aquifers [61].

In short, it seems opportune that during the current hydrological planning cycle (2015–2021)[5], efforts are increased to reverse these trends of expansion of the surfaces of new irrigated areas, forcing a reduction in the quantitative and qualitative pressures on bodies of water, and surface and underground water. The new post-2020 CAP (Common Agricultural Policy) should help meet the agricultural and environmental challenges in the short and medium term, to which irrigation must adapt.

2. Materials and Methods

According to Stake [62], there are two main ways to approach an investigation: one oriented to measurements and the other to experience[6], both of which enrich the understanding of the reality analysed. Furthermore, as claimed by Salkind [63], the analysis of data should provide a broad picture of the phenomenon that is interesting to explain, without forgetting that understanding the descriptive nature of an event is as important as understanding the phenomenon itself—for this reason it is not possible to evaluate or appreciate the progress that has been made without understanding the context in which such events took place.

The progress made in recent years by the GIS—geographical information system—together with the opening of geolocated databases, has motivated the development of projects that seek to investigate changes in coverage and land use [64]. The detail and reliability achieved by spatial data, generated through satellite images, make it possible to carry out analyses of territorial and landscape dynamics with a very high degree of precision [65]. The availability of temporary series offered by the main territorial data sources facilitates the comparison of changes in the coverage and land uses experienced in a specific territory [66].

Among the different sources that disseminate geo-referenced spatial information, this study draws on territorial data provided by the European Environment Agency (EEA), in its Corine Land Cover (CLC) project. The reasons for the use of this remote information source are the homogenisation of coverage and the breadth and updating of the space–time series provided.

To analyse the different territorial changes, the project compares the evolution of land cover between different time periods (1990–2000–2012–2018). For this, the spatial information (in vector format) obtained from the CLC project was processed using GIS software (ArcGIS 10.3 and Qgis 3.6.2) (Figure 1). The initial step consisted of filtering the data from the CLC project and thus adapting it to the analysed study area. Once the spatial information corresponding to the study area was obtained, the representation of the data was transformed, going from a vector format (polygons that represent the coverage and land use) to a raster (a board of pixels that acquire a value depending on the coverage or land use that they symbolize). When this geoprocess was executed, the spatial delimitation the study area (in this case the northwest Region of Murcia) was available, fragmented into a mesh of regular cells of a pre-established size (10 × 10 m, 100 m^2).

Later, the 25 classes of land uses initially existing in CLC were grouped into six types in the reclassification process: (1) Artificial, (2) Permanent irrigation, (3) Temporary irrigation, (4) Other agricultural uses, (5) Forest and (6) Bodies of Water. In order to carry out a deep analysis, agricultural uses were divided into three different categories. Category 2 includes permanently irrigated land. Category 3 (temporary irrigation) includes vineyards, fruit trees, rice fields and olive groves. Finally,

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5 Royal Decree 1/2016 of January 8 (BOE of 19 January 2016), which approved the revision of numerous Hydrological Plans of different river basins, including the river basin zone of the Segura river. More information at: http://www.chsegura.es/chs/planificacionydma/planificacion15-21/.

6 Most commonly reported as quantitative and qualitative.

Category 4 (other agricultural products) covers rainfed agricultural land, grassland and heterogeneous agricultural areas.

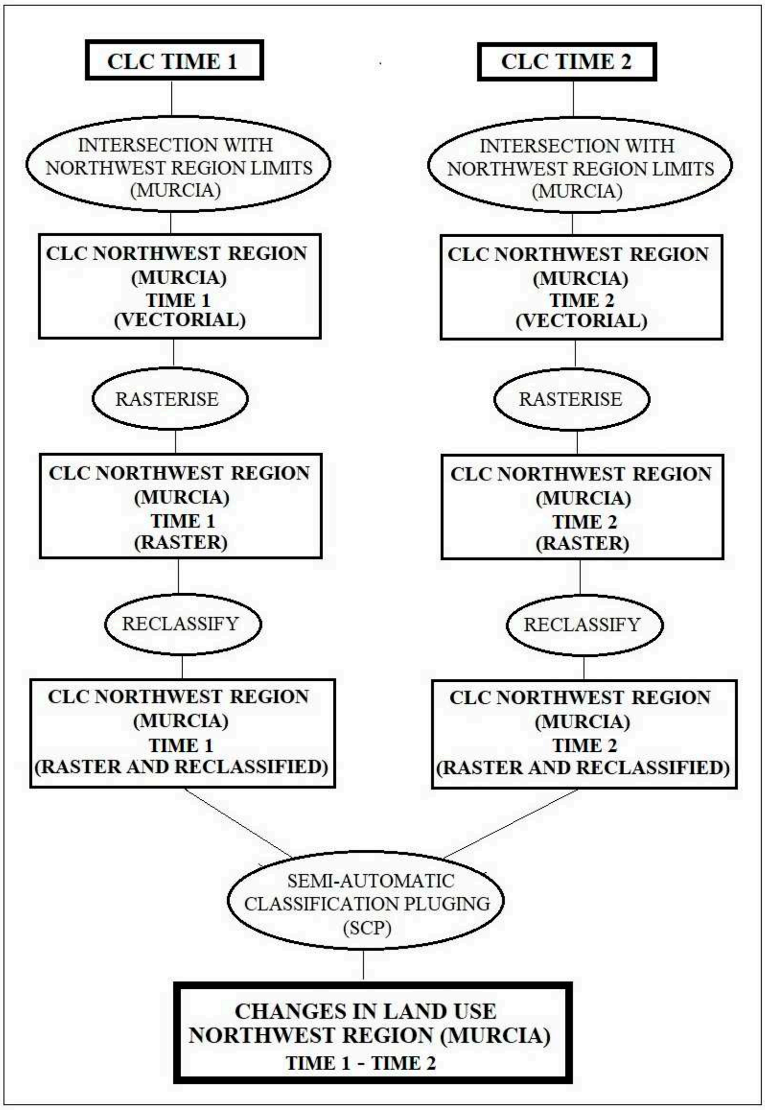

Figure 1. Methodology for the treatment of spatial data (flow diagram). Source: Authors.

Finally, the evolution of the data (rasterized and reclassified) between the different time periods studied was obtained by contrasting them with the Semi-Automatic Classification Plugin (SCP) tool [67].

The information obtained from this process was expressed through the use of cross-tabulation matrices or transition matrices, a method proposed by Pontius et al. [68] to analyse maps of land use among two temporary periods in order to detect the most significant changes between the different land uses (Table 1).

The matrix represents the ground cover during the first period (Time 1) in rows, and those of the second period (Time 2) in columns. Pij represents the proportion of land use that changes from category i to category j. Pjj, on the diagonal, indicates the persistence ratio of category j, while the other cells indicate a transition from category i to a different category j. Furthermore, the losses are expressed as the difference of category i between Time 1 and Time 2. The gains are expressed as the difference of category j between Time 1 and Time 2.

Table 1. Cross-tabulation matrix.

		Time 2			Total Time 1	Loss
		Category 1	**Category 2**	**Category 3**		
Time 1	Category 1	P11	P12	P13	P1+	P1+–P11
	Category 2	P21	P22	P23	P2+	P1+–P22
	Category 3	P31	P32	P33	P3+	P3+–P33
Total Time 2		P + 1	P + 2	P + 3		
Gain		P + 1–P11	P + 2–P22	P + 3–P33		

Source: Pontius et al. (2004).

The described methodology is configured as a powerful instrument of analysis that allows us to understand the spatial transformation experienced between two specific moments in time, and to undertake effective territorial planning policies.

The proposed methodology would help in any other area with similar problems to effectively understand the changes in land use that have occurred, and thus try to make the best possible decisions to achieve a most sustainable development.

3. Study Area

The study area has an area of 2378 km^2. A series of geographic circumstances are decisive in explaining the outstanding diversity of the territorial landscape mosaic in the northwest Region of Murcia, its singularities and its ecological coherence. Undoubtedly, water is, along with large landforms (Figure 2), a defining and identifying element of the landscapes of the territory being studied. Forest landscapes show a greater stability. This is the result of special biogeographic conditions, defined by the location of the territory in an area of climatic transition between the Mediterranean and continental environments, which is combined with great complexity and orographic and lithological diversity. It is pertinent to highlight the ecological value of these forest areas, with vegetation adapted to the particular conditions of the territory. These mountainous lands constitute a fundamental part of the local identity and are highly valued by the resident population.

The area studied presents a very abrupt, steep relief in the area of the headwaters of the main rivers, with the presence of mountain systems that, in the extreme north and northwest, exceed 1500 m in altitude. The average altitude is high, standing at 1050 m above sea level.

The rivers and streams or existing torrents are not only channels of an important natural resource such as water, but they also constitute rich ecosystems with very diverse values: ecological, landscape, cultural, etc. These are mostly sporadic water courses, which bridge steep slopes and transport water after heavy rains. These river landscapes are shaped as intermountain corridors that facilitate the connection between different mountain areas or between these areas and the nearby plains. While maintaining an outstanding natural character, they host a greater number of interventions of anthropic origin.

It is necessary to highlight a recent process, but of clear importance to the landscape: the pressure of agricultural use on land occupied by natural vegetation. The ploughing of nonagricultural lands for plant crops constitutes a transformation that breaks with the dynamics of reduction in the ploughed area that has been seen in recent decades, due to the low profitability of rainfed crops (Figure 3). In fact, in areas not affected by the development of intensive irrigated agriculture, the most frequent have been processes of abandonment of the less productive terraces that have come to be colonised by natural plant formations.

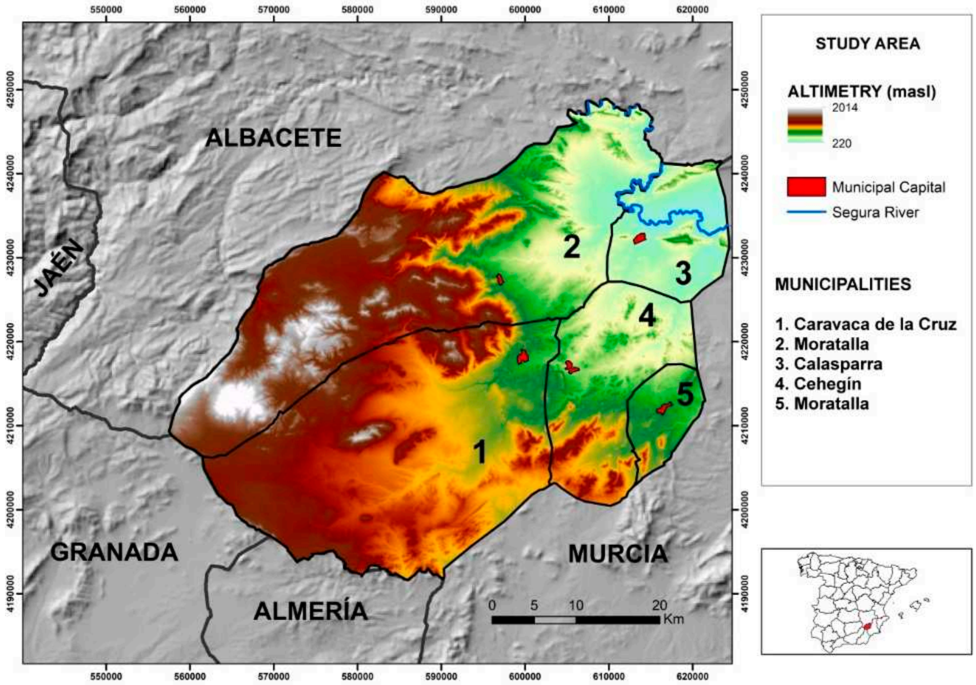

Figure 2. Study area. The northwest Region of Murcia: altimetry, hydrographic network, municipal and provincial limits. Source: Authors.

Figure 3. Surface of almond cultivation in rainfed land (Archivel, Caravaca de la Cruz). An old semiabandoned farmhouse can be seen and, in the background, the Sierra de Mojantes (1615 masl). Source: Authors.

The study area has a large number of springs and seeps of water. The springs constitute fundamental enclaves in the configuration of the landscapes. They reveal the natural drainage points of the aquifers, frequently support wetlands and aquatic ecosystems, and have historically linked numerous settlements that have emerged under their protection, providing basic services such as a water supply to the population. In general, the quality of its water is excellent and the overexploitation of its aquifers has been scarce until a few years ago, unlike what happened with the coastal and pre-coastal hydrogeological units in the Region of Murcia, which are highly overexploited. This low overexploitation is due to the fact that the pressure and intensity of agricultural activities has been less than in other regional areas. Nevertheless, in recent years a clear increase in the irrigated area has been taking place (Figures 4 and 5), which causes a significant negative impact on the aquifers of this territory [69]. The protected natural lands (Site of Community Importance (SCI) and Special Protection Area for wild birds (SPA) (Figure 6) are of great importance in this territory, occupying a total of 691.0 km^2 (29.0% of the territory).

Figure 4. Surface of newly irrigated land (grapes) on the foothills of the Sierra del Gavilán, declared as a Site of Community Interest (LIC) (Archivel, Caravaca de la Cruz). The roads have been conditioned for the entry and exit of heavy load vehicles. Source: Authors.

Figure 5. Old agricultural area of a traditional vegetable plot conditioned for the intensive cultivation of lettuce and broccoli. Archivel, Caravaca de la Cruz. Source: Authors.

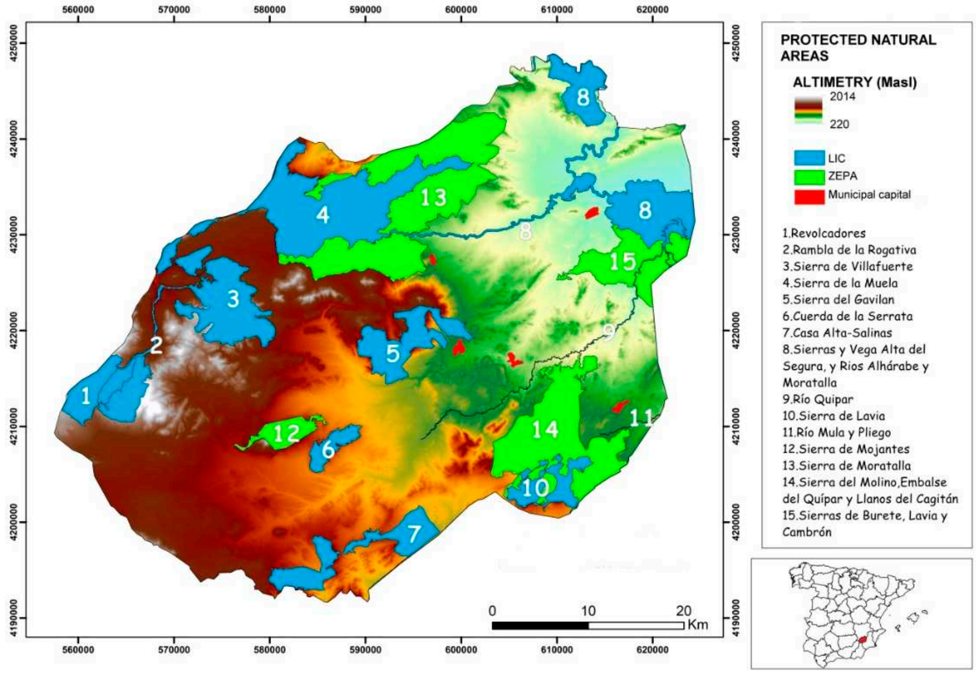

Figure 6. Spatial distribution of protected natural lands. (LIC: Sites of Community Interest, and ZEPA: Area of Special Protection for Birds). Source: Authors.

4. Results

4.1. Recent Evolution of the Coverage and Land Use in the Northwest of the Region of Murcia (1990–2018)

Regarding land use, three main types can be distinguished: natural, agricultural and urban-industrial. The main use is natural (forest), representing around 56.7% of the total area. It is made up of wooded, shrubby and subshrub formations. Agricultural use constitutes around 28.5% of the territory and can be found in the valley areas and in the alluvial fans and glacis of quaternary origin. The proportion of land dedicated to rainfed and irrigated crops is similar, although in recent years, as already mentioned, there has been a notable increase in irrigated areas. Currently, fruit trees (cherry, peach and apricot trees) are the main irrigated crop, as cereals and almonds are on rainfed land. Urban and industrial areas only represent 5.0%.

Firstly, the temporal evolution of land use distribution (Table 2) is presented with the aim of evaluating the transformations that have taken place and in which period they have been most intense. Between 1990 and 2000, the changes are insignificant. The most important changes took place between 2000 and 2012, coinciding with a decade of great economic expansion until the economic crisis started in 2008. During this time period, the most notable increases are shown in the categories of permanent and temporary irrigation, with the increase in the permanent irrigation area that doubles its surface being especially significant. One of the causes of this spectacular growth lies in the transfer of agricultural enterprises from the pre-coastal valleys to the interior lands of the Region of Murcia, taking advantage of the greater availability of water resources in this territory. Between 2012 and 2018, there is a transfer of surface area from permanent to temporary irrigation, which in turn is occupied by fruit trees.

The effects generated by the urban expansion of the pre-existing settlements, the projection of new residential and industrial complexes and, above all, the proliferation of large areas of intensive cultivation, has led to a soil mutation that must be analysed. It is important to highlight that the artificial surface is very small in this territory, in comparison with the nearby municipalities of the Mediterranean coast. In 1990, the northwest of Murcia had just over 10.0 km^2 of artificial soil.

Three quarters of this small area was concentrated in the municipalities of Cehegín and Caravaca de la Cruz (Table 3).

Table 2. Temporal evolution of land use distribution (Corine Land Cover (CLC) 1990, 2000, 2012 and 2018).

		Surface (Km^2)		
Land Use	**1990**	**2000**	**2012**	**2018**
Artificial	10.5	13.7	19.3	20.1
Permanet Irrigation	24.4	41.7	88.4	59.4
Temporary Irrigation	145.3	158.4	204.9	237.9
Other Agricultural	886.8	855.5	725.0	719.8
Forest	1308.4	1306.2	1338.0	1338.1
Bodies of Water	2.5	2.5	2.4	2.4
Total	**2378**	**2378**	**2378**	**2378**

Source: Corine Land Cover.

Table 3. Distribution of coverage and land use by municipalities (1990).

				Surface 1990 (Km^2)		
Land Use	**Caravaca**	**Moratalla**	**Calasparra**	**Cehegín**	**Bullas**	**Total**
Artificial	2.5	0.9	1.3	3.9	1.9	**10.5**
Permanet Irrigation	23.0	1.4	0.0	0.0	0.0	**24.4**
Temporary Irrigation	29.3	47.4	13.2	44.2	11.2	**145.3**
Other Agricultural	429.5	259.3	71.8	76.9	49.3	**886.8**
Forest	373.1	643.7	96.9	175.1	19.5	**1308.4**
Bodies of Water	0.0	0.4	1.4	0.7	0.0	**2.5**
Total	**857.4**	**953.1**	**184.6**	**300.8**	**82.0**	**2378.0**

Source: Corine Land Cover.

The meager spatial dimension of the coverage made up of urban fabric contrasts with the development of agricultural and forest use. This discrepancy shows the marked rural character of the analysed land. In 1990 more than half of the regional land was occupied by forest mass, reaching 67.5% in the Moratalla municipality, 58.2% in Cehegín, and 52.5% in Calasparra (Figure 7).

In 1990, cultivated land occupied 44.4% (1056.5 km^2) of the total area. Among the different agricultural typologies, rainfed agriculture stands out (included in the category "other agriculture"), with a total of 886.8 km^2. This type of cultivation represents 83.9% of all agricultural land and is most clearly developed in Caravaca de la Cruz, a municipality in which, at the end of the last century, occupied half of the local area (429.5 km^2).

The mutation of techniques and contributions in plantations meant that, between 1990 and 2018, the permanently irrigated cultivation area went from 24.4 to 59.6 km^2, and the temporary irrigated area from 145.3 to 237.9 km^2. This development occurred thanks to the occupation of land traditionally cultivated by rainfed plantations. Most of the rainfed land losses are located in the municipality of Bullas, which went from having almost fifty square kilometres occupied by this type of agriculture in 1990, to less than 10.0 km^2 in 2018 (a decrease of almost 80.0%) (Table 4).

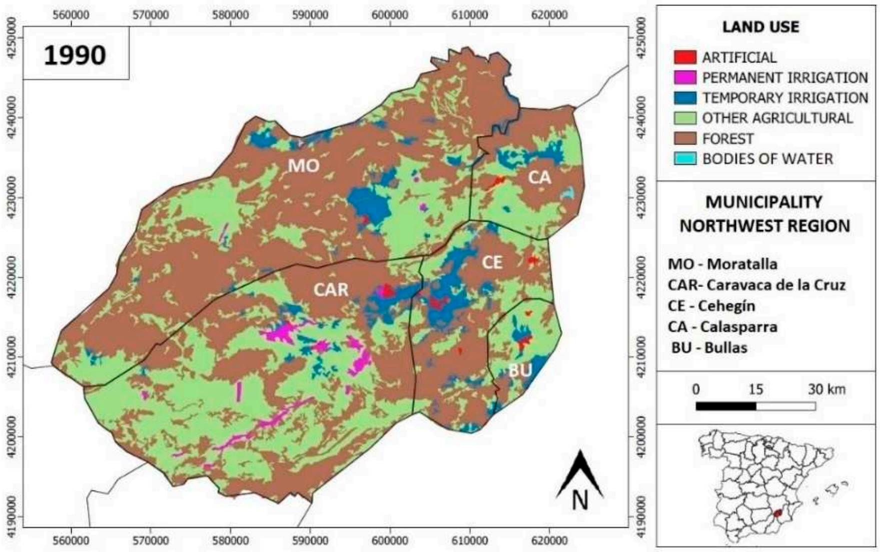

Figure 7. Land use, 1990. Source: Corine Land Cover.

Table 4. Distribution of coverage and land use by municipalities (2018).

	Surface 2018 (Km^2)					
Land Use	**Caravaca**	**Moratalla**	**Calasparra**	**Cehegín**	**Bullas**	**Total**
Artificial	5.3	1.4	4.3	6.5	2.6	**20.1**
Permanent Irrigation	50.0	4.2	2.1	2.6	0.8	**59.6**
Temporary Irrigation	33.7	56.3	37.0	63.7	47.2	**237.9**
Other Agricultural	389.6	233.9	38.0	48.5	9.8	**719.8**
Forest	378.9	657.0	101.9	178.9	21.6	**1338.1**
Bodies of Water	0.0	0.4	1.4	0.7	0.0	**2.4**
Total	**857.4**	**953.1**	**184.6**	**300.8**	**82.0**	**2378.0**

Source: Corine Land Cover.

On the other hand, temporary irrigation shows the greatest increase. Within this category, fruit trees represented the majority of the surface, with a total of 211.3 km^2 in 2018. These are distributed homogeneously in all the municipalities, although they have a greater presence in Bullas, Cehegín and Moratalla. Yet, rice fields make up an area of 8.1 km^2, most of which is located in the municipality of Calasparra, which has one of the three protected designations of origin (PDO) for rice fields in Spain—the PDO Calasparra rice. Vineyards occupy an area of 9.3 km^2, 84.9% of which are located in the municipalities of Bullas and Cehegín, and which are part of the PDO Bullas. Finally, olive groves have an area of 9.1 km^2, with the municipality of Moratalla encompassing a larger area. Between the years 1950 and 1990, the area occupied by olive groves in the Region of Murcia was reduced considerably (−25.0%), but this decline had its lowest incidence in the municipality of Moratalla [70].

Bullas is the municipality with the greatest development of temporarily irrigated plantations, as it represents an increase of 321.4%. Calasparra provides an increase in the temporarily irrigated area of 180.3%, thanks to the presence of the Río Segura river and its traditional rice production (Figure 8). Cehegín also shows a notable increase in the temporary irrigated area (44.1%). Moratalla and Caravaca hardly increase their temporary irrigated area. The climatic and orographic conditions play a fundamental role in this distribution, since due to the higher average altitude, the municipalities of Moratalla and Caravaca are more vulnerable to the risk of frost.

Artificial land doubled its surface, forming the typology that experienced the second greatest increase in relative terms (91.3%). This fact explain, to a large extent, the development in the region of the marble limestone industry, with a dual purpose: extraction, and cutting and preparing the pieces for use by the construction sector [71].

The municipalities most affected by urban development are Calasparra (241.0%) and Caravaca de la Cruz (112.1%). However, one should not disregard the high burden of the artificial surface reached in Cehegín (6.5 km^2). Nevertheless, the Spanish real estate boom, between 1997 and 2007, had little impact in this territory, unlike what happened in the municipalities of the Mediterranean coast and the areas adjacent to the most dynamic cities (Murcia, Cartagena or Lorca).

The area occupied by forest cover and bodies of water has hardly changed. Reforestation, especially in Calasparra and Bullas, has contributed to a slight increase of 2.3% in the surface of this category. For its part, the aforementioned increase in exploitation to which water resources are subjected, together with long periods of low water and the moment in which satellite images are taken, by which spatial data are estimated, determines the slight decrease in the surface occupied by bodies of water (Figure 9).

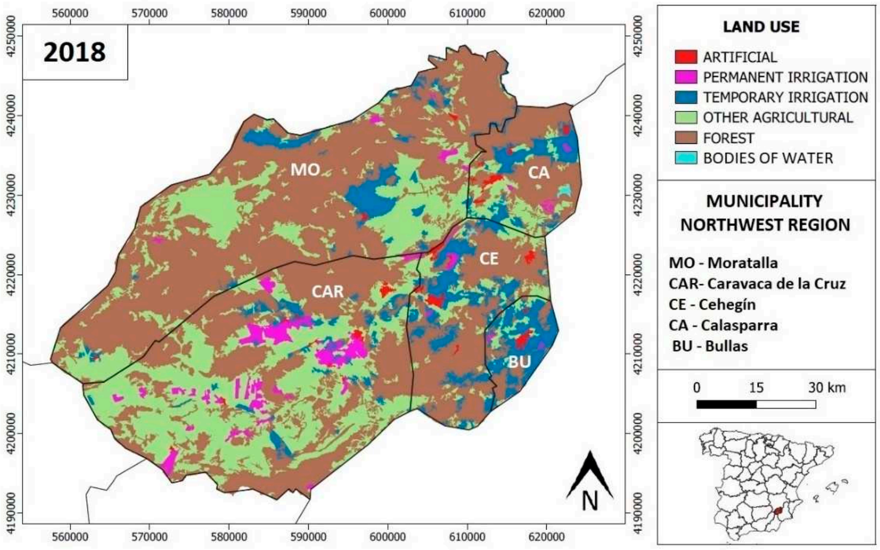

Figure 8. Coverage and land uses 2018. Fuente: Corine Land Cover.

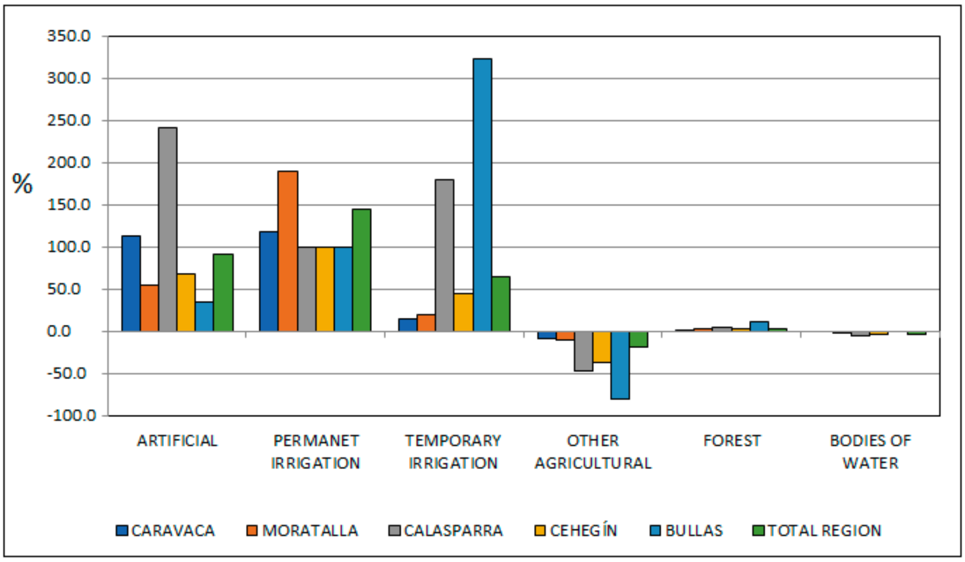

Figure 9. Evolution of the surface occupied by coverage and land use (1990–2018). Source: Corine Land Cover.

4.2. Transitions and Spatial Dynamics between Coverage and Land Use

In this section we contrast the changes that have occurred through a comparison by time pairs. Thanks to the analysis of the cross-tabulation matrix (Table 5), the spatial transitions that have occurred between the different territorial uses are examined: artificial (1), permanently irrigated agriculture (2), temporarily irrigated agriculture (3), other agricultural uses (4), forestry (5) and bodies of water (6). The figures reveal the total area gained and lost by each coverage, obtaining values that are represented cartographically.

Table 5. Hue of change in spatial surface (km^2).

		2018							
		1	**2**	**3**	**4**	**5**	**6**	**Total**	**Losses**
1990	1	8.5	0.1	0.7	0.7	0.5	0.0	10.5	2.0
	2	0.2	12.7	1.0	10.1	0.5	0.0	24.4	11.7
	3	2.0	3.5	95.4	35.4	8.9	0.0	145.3	49.9
	4	5.9	41.6	124.6	614.2	100.4	0.1	886.8	272.6
	5	3.5	1.7	16.1	59.4	1227.5	0.2	1308.4	80.9
	6	0.0	0.0	0.0	0.0	0.3	2.2	2.5	0.4
	Total	20.1	59.6	237.9	719.8	1338.1	2.4	2378.0	417.5
	Gains	11.6	46.9	142.5	105.6	110.6	0.3	417.5	

Source: Authors.

Over the period which was analysed, the urbanised area which occupied 11.6 km^2 only lost 2.0 km^2. In total, 50.9% of the captured artificial surface came from rainfed crops; 30.2% was forest mass; the remaining 18.9% was irrigated agricultural land (regardless of the frequency of water contributions).

Most of the spatial area acquired by forest cover (90.8%) belonged to rainfed plantations (100.4 km^2), both constituting the only categories that have yielded land in favour of the slight expansion of bodies of water (0.3 km^2). This water coverage continued to be stable, persisting with 88.0% (2.2 km^2) of the surface declared in the first year examined (1990).

The entire cultivated area has increased by 295.0 km^2, and more than half is divided between temporarily irrigated land (142.5 km^2) and other crops (105.6 km^2). As previously mentioned, it is worth noting the incredible development of crops with temporary irrigation in the municipality of Bullas (322.1%), and permanently irrigated crops in Caravaca de la Cruz (117.5%). Within the category of temporary irrigation, fruit trees represent the majority of this increase, since between 1990 and 2018 there has been an increase of 91.9 km^2. Calasparra (+358.2%) and Bullas (+314.7%) are the municipalities that show the greatest change. Regarding permanent irrigation, although there has been an increase in all municipalities, it should be noted that the municipality of Caravaca has the majority of this expansion; in this district or municipality there has been a spectacular growth in the surface of horticultural crops (lettuce, broccoli, chard, etc.), with very high water needs and the consequent overexploitation of aquifers.

The meteorological conditions marked by the altitude at which the western area of Moratalla is located, together with the large amount of surface that has some type of Site of Community Importance, SCI, and Special Area of Conservation, SAC, to determine the low presence of intensive crops, an aspect for which the use of traditional rainfed agriculture still prevails and there has been no significant transformations (Figure 10). In fact, the municipality of Moratalla, despite being the largest municipality, is the one that has lost the least area of rainfed crops. In this municipality, rural landscapes are a fundamental tourist resource [72]. In its territorial area, the cultivation of aromatic plants, such as lavendin or lavender, has boomed in recent years. These crops are part of the productive reconversion towards agroecology that is emerging in the northwest Region, which is constituted as a viable alternative to sustainable management in the use of water for irrigation, in a context of a semiarid climate [73].

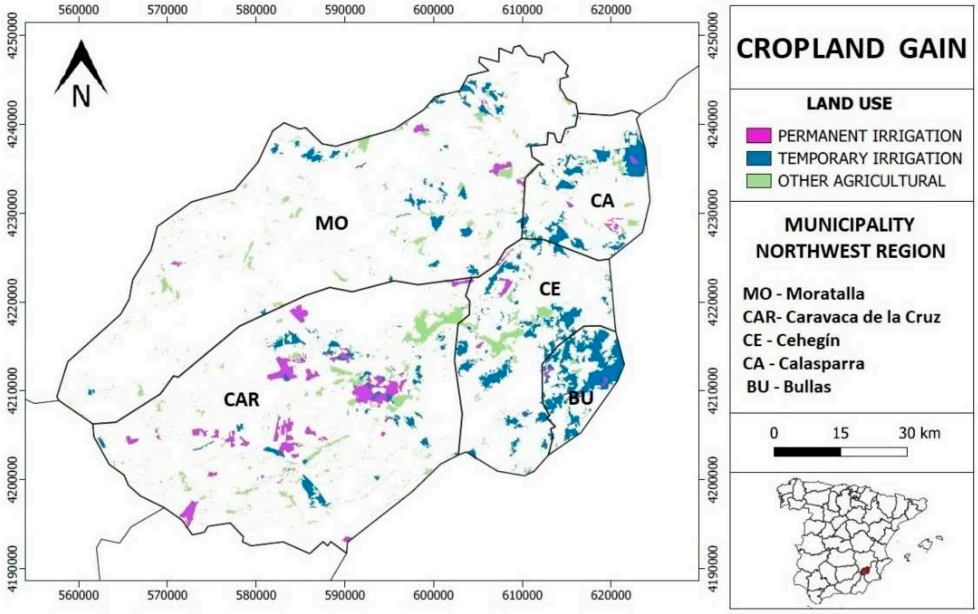

Figure 10. Gains from cultivated areas as a function of agricultural use (1990–2018). Source: Authors.

The notable expansion achieved by plantations with water needs derives from the change in the land exploitation system, with the transformation of 124.6 km^2 from rainfed land to temporary irrigation and 41.6 km^2 from rainfed land to permanent irrigated crop. The sum of these exchanges between agricultural areas causes the rainfed cultivation area to acquire the greatest spatial decline observed (272.6 km^2). This decline is especially noticeable to the south and east of the region (Figure 11).

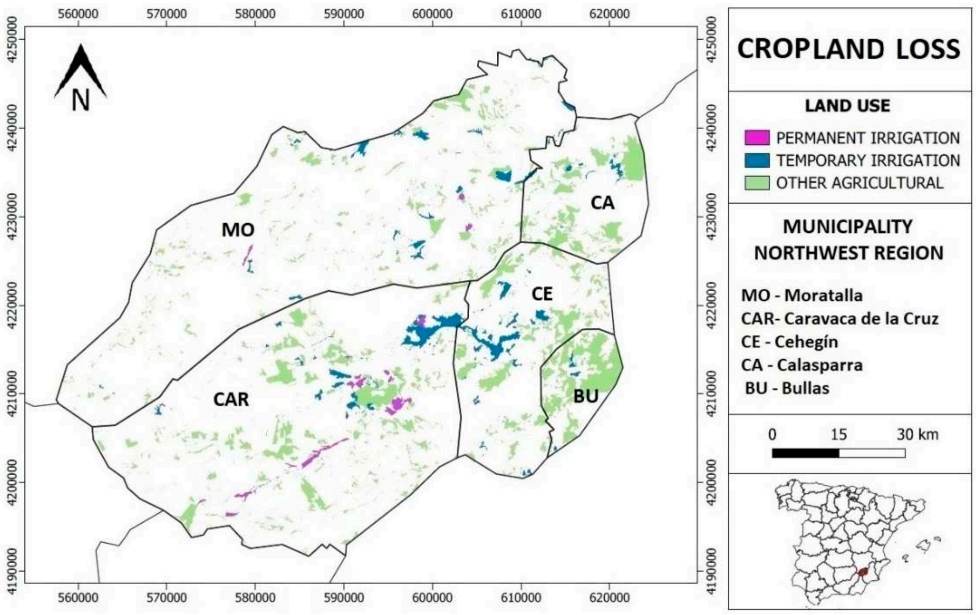

Figure 11. Loss of cultivated area as a function of agricultural use (1990–2018). Source: Authors.

The corresponding graphic represents the total balance of profit and loss and reveals the true development of each one of the analysed categories (Figure 12). In this sense, we can see the huge decline experienced by the category labelled as the rest of agriculture (167.0 km^2). This collapse contrasts with the important gains made by the irrigation crop, especially when staggered (92.6 km^2).

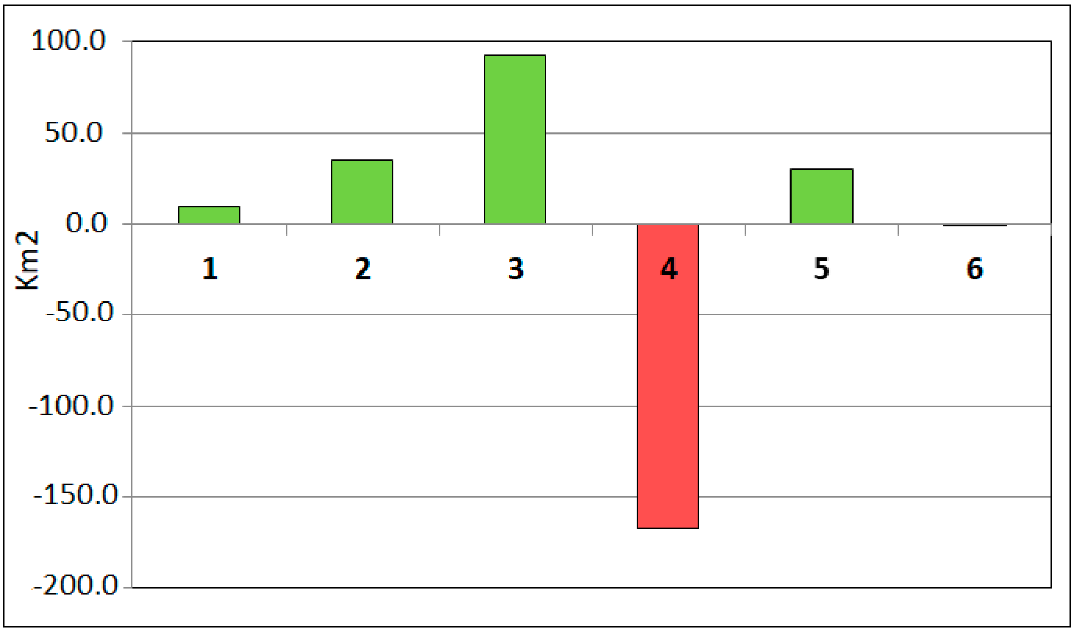

Figure 12. Spatial dynamics of land cover and use according to categories (1990–2018). Source: Authors.

Finally, it is worth noting the significant increase in the area occupied by forest mass (29.7 km^2), the contained evolution of the artificial area (9.6 km^2) and the negligible spatial decline of the bodies of water (0.1 km^2).

4.3. Evolution of Temporary Irrigation Crops

Among the three agricultural categories studied, it is interesting to analyse the evolution experienced, during the last three decades, by the different temporary irrigation crops because it is the category that has experienced the most notable change. In spite of conforming an agricultural typology that lacks the need to maintain a permanent water supply, the water demands requested for the correct development of the production of each of the crops in this category are different. In this sense, the amount of water required to plant fruit trees, rice or vineyards differs from that required for olive trees, which is the type of crop that requires the least amount of water.

The fruit tree is the most widespread type of temporarily irrigated crop in all municipalities. In 2018, this tree category occupies about 88.8% of all the agricultural area temporarily irrigated (211.3 km^2). The development of this crop makes up, throughout the observed time series, practically all of the increase in ephemeral irrigated land (Table 6). Fruit trees are the temporarily irrigated crop that consume the most water and therefore their notable increase in the last three decades leads to an increase in the overexploitation of aquifers.

A third of the fruit trees planted in the study area at the beginning of the last decade of the last century are located in Cehegín. Although the representation exercised by this crop in this municipality loses weight over the years, the town with the largest area of fruit of the treated area (55.9 km^2) was found in 2018. Among the different municipalities where this crop is present, Bullas has experienced the most remarkable spatial expansion, with an increase of more than 33.9 km^2 (320.6%) between 1990 and 2018. One of the facts that contrasts the agricultural data of the two periods taken is the specialization that registers, at the beginning of the series, some municipalities in the production of one or two concrete cultures, and the multiproductive diverisfication that is appraised at the present time. Thus, practically all the temporarily irrigated crops in Caravaca and Bullas (1990) corresponds to fruit trees (Figure 13).

Table 6. Evolution of temporary irrigation crops (1990–2018).

Surface Temporary Irrigation 1990–2018 (km^2)						
		Fruit Free	**Olive Grove**	**Vineyard**	**Rice Field**	**Total**
Caravaca	1990	29.3	0.0	0.0	0.0	**29.3**
	2018	31.3	1.3	1.2	0.0	**33.7**
Moratalla	1990	34.3	10.0	0.0	3.1	**47.4**
	2018	50.5	3.5	0.3	2.0	**56.3**
Calasparra	1990	6.1	0.0	0.0	7.1	**13.2**
	2018	29.2	1.7	0.0	6.1	**36.9**
Cehegín	1990	39.0	0.8	4.4	0.0	**44.2**
	2018	55.9	2.7	5.2	0.0	**63.7**
Bullas	1990	10.6	0.0	0.6	0.0	**11.2**
	2018	44.5	0.0	2.7	0.0	**47.2**
Total	**1990**	**119.4**	**10.7**	**5.0**	**10.3**	**145.3**
	2018	**211.3**	**9.1**	**9.3**	**8.1**	**237.9**

Source: Corine Land Cover.

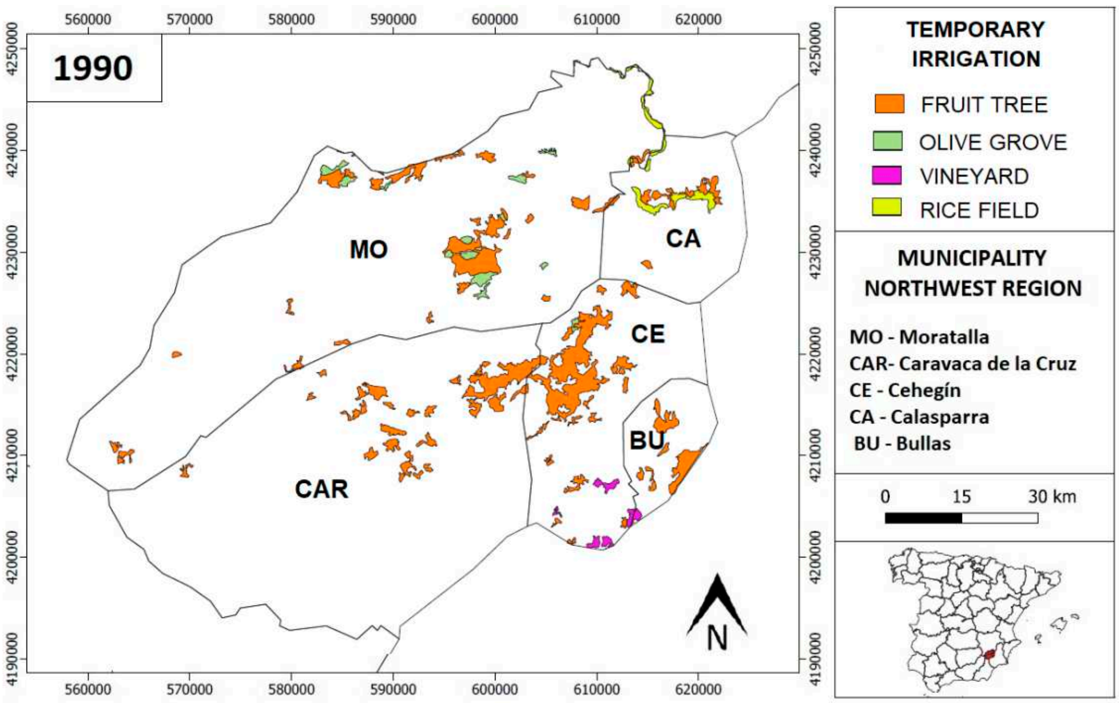

Figure 13. Spatial distribution of temporary irrigation crops (1990). Source: Authors.

Of the crops studied, rice is the one with the greatest need for water, so its territorial opening is very limited and is also limited to the plains of the Segura river only. In this context, rice practically occupies the same area. Thus, the availability and presence of the continuous course of water of the Segura river means that Calasparra and Moratalla constitute the only municipalities with this type of production. However, the production dynamics experienced during the last years by both localities demonstrates the setback that the culture of this food has undergone in Moratalla, and the development acquired in the regional rice municipality par excellence (Calasparra). The impulse noticed in Calasparra has not been sufficient, and the regional surface planted of rice has decreased more than 21.0% in the last decades. Something similar happened with the olive trees, a product that was initially taken care of almost exclusively in Moratalla and, in spite of expanding to the rest of localities (except Bullas), its presence decreased by 15.1% (Figure 14).

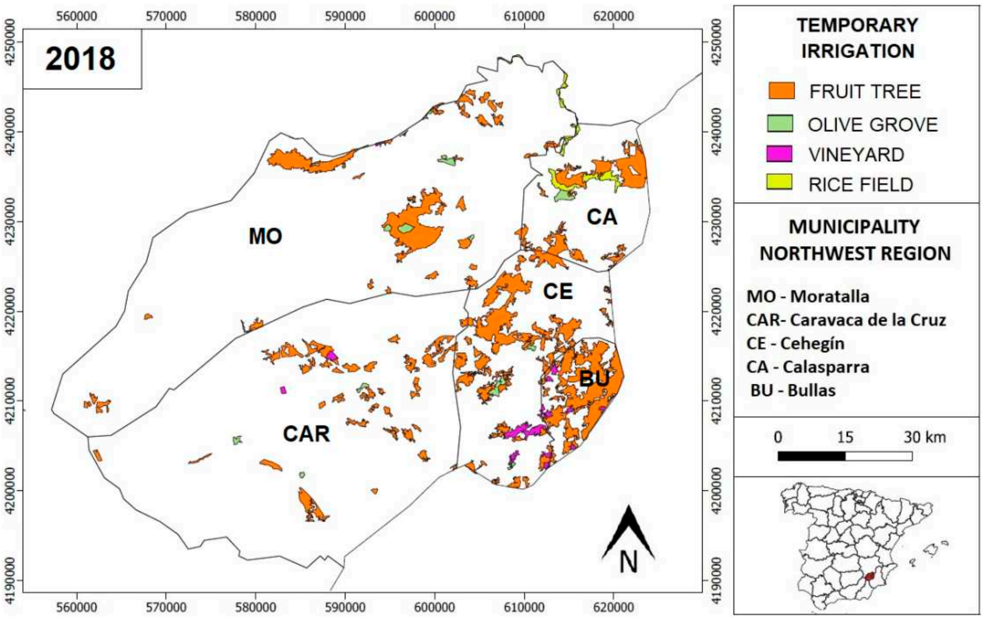

Figure 14. Spatial distribution of temporary irrigation crops (2018). Source: Authors.

Finally, the crop that occupies the smallest area in 1990 (vineyard) almost doubles its extension in 2018, spreading to all municipalities except Calasparra. The present production of vine has been diversified, with varieties oriented as much to the consumption of wine as of table grape. Regarding the fruit trees, the Cehegín host in 1990 had 88.0% of its soil covered by vineyards. The area occupied by this crop in this town increased to over 5.2 km^2 (2018). In spite of this, the representation that supposes the surface of this culture in Cehegín decreased until being placed slightly above 50.0% of the total sowed space.

5. Discussion

The spatial dimension of sustainability is generating increasing interest from both scientific and social perspectives. The northwest of the region has experienced, over the last three decades, an unprecedented process of territorial transformation [74]. The abundant underground water resources and the large extension of undeveloped rural land (in terms of economic profitability) has served as an element of attraction for a large number of agricultural and real estate companies [75]. The presence of companies dedicated to various sectors has generated fierce competition for the control and exploitation of a land used, historically, in the traditional cultivation of orchards and rainfed land [49]. The strength of intensive agriculture has displaced the traditional use of land.

The leasing of land by large agro-export companies encouraged the use of agricultural land, with the insatiable water exploitation of the area. This fact caused a change of scenery, with the indiscriminate spread of crops irrigated permanently and temporarily.

According to [76] the imbalance between the resources and the demand has been caused by the expansion of irrigated areas, the emergence of illegal new irrigated lands and pumping wells, the increase in energy cost and the bad management of water use rights by the public water administration. In addition, climate change and frequent droughts in this semiarid region aggravate the situation. As a consequence, many aquifers are being overexploited [77]. In this sense, the fulfilment of the "good ecological status" objectives set by the Water Framework Directive, with a deadline of 2027, will be a difficult task for water managers.

The increase in new irrigated land is not exclusive to inland areas near the coast [78,79]. Additionally, in practically all cases, farmers, experts and managers are trying to adopt measures to reduce environmental and social impacts, minimizing the loss of agricultural productivity, of course.

The general objective in the analysed cases is to create an integrated and integral management system of the aquifers. Integral management means that both supply and demand management are considered, including the socioeconomic and environmental perspectives. The concept of integrated management implies that the process must involve the majority of economic and social agents affected [80–82].

In the Region of Murcia, [83] developed a new irrigated lands dynamic model, that includes five sectors: Irrigated Lands, Profitability, Available Space, Water Resources and Pollution. The dynamic model simulates the environmental effects regarding water consumption with reference to aquifer levels, natural outflows through springs, piezometric levels and aquifer water salinity. The exploration of scenarios shows that current policies based on the increase in water resources do not eliminate the water deficit problem because the feedback loops of the system lead to a further increase in irrigated land and continuation of the water deficit. In the Southeast of Spain, the increase in irrigated areas does not seem to have an end.

Returning to our concrete case study, mountainous rural communities have traditionally managed their land extensively, resulting in land uses that provide important ecosystem services for both rural and urban areas. According to [84], land use intensification results in economic development but is not enough to prevent population loss, and has a negative impact on both the water supply and on aesthetic services (landscape). The authors conclude that more proactive management policies are needed to mitigate a loss in ecosystem services. They propose a simulation model that may facilitate the choice of land use planning policies, contributing therefore to a more integrative and sustainable management of rural communities.

6. Conclusions

Obviously, the areas occupied by new intensive irrigation on old rainfed farmland in the northwest Region of Murcia have increased in the last 30 years. In the Region of Murcia, there is a traditional ambition (a desire which coincides with the title of this article) for the continuous increase in irrigated areas. However, the success of the new installed fruit and vegetable model is not without contradictions and tensions that are expressed as negative environmental- and social-outsourced needs. In its industrial development, it tends to move towards the reduction in natural biodiversity, dislodging and eliminating forms of life not directly linked to productivity. Its expansionary trend have also led to an unlimited use of basic natural resources such as soil and water, generating social, environmental and political problems. The continuous growth of the water needs of the agro-industrial model, despite improvements in the efficiency of water use, is generating temporary deficits not noticed by traditional farmers until a few years ago.

The development of management tools that can harmonize the exploitation of water resources with the sustainability of the reserves is the objective that the administration and agricultural entrepreneurs must agree on.

Given this conflictive situation, it is necessary to propose strategies for the progressive reduction in these new irrigated areas with little social and environmental commitment. In this sense, we propose a series of criteria to identify where a strategy in irrigation reduction is necessary:

- Water limitation criteria: we propose applying indicators such as the Water Exploitation Index (WEI)[7] and others.
- Profitability criteria: we suggest evaluating the profitability of irrigation after incorporating environmental costs.

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[7] The WEI index (Water Exploitation Index) is used as an indicator of the pressure that water extraction exerts on available water resources, and allows identification of the areas most likely to suffer water stress. This indicator is calculated as the quotient between the average annual freshwater withdrawal and the long-term average of the available resource. A result above 20.0% indicates the presence of water stress, and greater than 40.0% a strong competition for water with difficulty in maintaining associated ecosystems.

- Environmental sustainability criteria: we recommend continuously analysing indicators on the quality status of water bodies, applying the Water Framework Directive. Likewise, we propose constantly examining indicators of circulating flows and even indicators of other impacts related to the energy balance or to the analysis of the life cycle of products.
- Territorial sustainability criteria: we propose identifying irrigation systems located outside their areas of vocation or natural aptitude and to recognise the need to preserve crops with high cultural and environmental values (particularly traditional irrigation systems with a high diversity and mosaic crops). Being located in or not in the territory of the owners of agricultural companies may constitute another factor for the assessment of this territorial dimension.
- The social viability criteria are a more open and complex question. Obviously, it is not easy to precisely define what is considered irrigation for social interest. Therefore, it is perhaps more useful to replace this concept, which may be ambiguous, with more specific operational criteria, such as the impact on local employment, the distribution of costs and benefits, or the identification of irrigated areas with high social conflict. In this sense, irrigation with high environmental costs and a low social profitability (large landowners, little distributed wealth, low-quality temporary employment) would be a candidate for a reduction in the irrigated area.

Finally, we believe that there is an urgent need to update the land registry of agricultural areas in order to carry out a fiscal adjustment of the lands transformed from rainfed land to irrigated and new farms that have emerged in recent years.

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References

1. Arahuetes, A.; Hernández, M.; Rico, A.M. Adaptation strategies of the hydrosocial cycles in the Mediterranean region. *Water* **2018**, *10*, 790. [CrossRef]
2. Ricart, S.; Rico, A.M. Assessing technical and social driving factors of water reuse in agriculture: A review on risks, regulation and the yuck factor. *Agric. Water Manag.* **2019**, *217*, 426–439. [CrossRef]
3. Rodríguez, R.; Garrido, A.; Llamas, M.R.; Varela, C. La huella hidrológica de la agricultura española. *Ing. Agua* **2009**, *16*, 27–40. [CrossRef]
4. WWAP. *The United Nations World Water Development Report 2015: Water for a Sustainable World*; UNESCO: Paris, France, 2015; ISBN 978-92-3-100071-3.
5. Caparrós-Martínez, J.L.; Rueda-Lópe, N.; Milán-García, J.; de Pablo Valenciano, J. Public policies for sustainability and water security: The case of Almeria (Spain). *Glob. Ecol. Conserv.* **2020**, *23*, 1–17. [CrossRef]
6. Morales, A. *Aspectos Geográficos de la Horticultura de ciclo Manipulado en España*; Secretariado de Publicaciones-Universidad de Alicante: Alicante, Spain, 2007; ISBN 978-84-7908-354-0.
7. Morales, A. *Agua y territorio en la Región de Murcia*; Fundación Centro de Estudios Históricos e Investigaciones Locales Región de Murcia: Murcia, Spain, 2001; ISBN 84-921128-7-5.
8. Calvo, F. Les paysages de l'horticulture de cycle forcé en Espagne. *Enquêtes Rural.* **2002**, *8*, 101–117.
9. Morales, A. Escasez y rentabilidad del agua en el Sureste de España: Agricultura de vanguardia, huertas tradicionales, nuevos regadíos y medio ambiente en el valle del Segura. In *Medio Ambiente y Crisis Rural*; Fundación Duques de Soria-Universidad de Valladolid: Valladolid, Spain, 1996; pp. 131–157, ISBN 84-7762-657-X.

10. Gil, A. Agua y agricultura: Transformaciones recientes, problemas medioambientales y socioeconómicos. *Geographicalia* **1997**, *34*, 67–108. [CrossRef]
11. Geteches, H.D. Spain's Ebro River Transfers: Test Case for Water Policy in the European Union. *Water Resour. Dev.* **2003**, *19*, 501–512. [CrossRef]
12. Swyngedouw, E. *Liquid Power: Contested Hydro-Modernities in Twentieth-First Century Spain*; The MIT Press: Cambridge, MA, USA, 2015; ISBN 978026202903213.
13. López, E. Agua para todos: A new regionalist hydraulic paradigm in Spain. *Water Altern.* **2009**, *2*, 370–394.
14. López, E.; De Stefano, L. Between a rock and a hard place: Re-defining water security, decentralisation and the elusive "Water Pact" in Spain. In *Federal Rivers. Managing Water in Multi-Layered Political Systems*; Garrick, D.E., Ed.; Eduard Elgal: Northampton, UK, 2015; pp. 158–176, ISBN 1843393158.
15. Saurí, D.; Del Moral, L. Recent developments in Spanish water policy. Alternatives and conflicts at the end of the hydraulic age. *Geoforum* **2001**, *32*, 351–362. [CrossRef]
16. Rico, A.M. Plan Hidrológico Nacional y Programa A.G.U.A.: Repercusión en las Regiones de Murcia y Valencia. *Investig. Geográficas* **2010**, *51*, 235–267. [CrossRef]
17. Swyngedouw, E. Into the sea: Desalination as hydro-social fix in Spain. *Ann. Assoc. Am. Geogr.* **2013**, *103*, 261–270. [CrossRef]
18. Swyngedouw, E.; Williams, J. From Spain's hydro-deadlock to the desalination fix. *Water Int.* **2016**, *41*, 54–73. [CrossRef]
19. March, H.; Saurí, D.; Rico, A.M. The end of scarcity? Water desalination as the new cornucopia for Mediterranean Spain? *J. Hydrol.* **2014**, *519*, 2642–2651. [CrossRef]
20. Mata, R. Nuevos regadíos y cambio territorial: El caso del levante de Almería. In *Historia, Clima y Paisaje. Estudios geográficos En memoria del profesor Antonio López Gómez*; Universidad de Valencia, Universidad Autónoma de Madrid y Universidad de Alicante: Valencia, Spain, 2005; pp. 513–528, ISBN 84-370-5864-3.
21. Gómez, J.M.; Gil, E.; García, R. *El Antes y Después de la Modernización De Regadíos. la Experiencia de Mula*; Editum: Murcia, Spain, 2006; ISBN 978-84-8371-617-5.
22. Gil, E.; Gómez, J.M. Los paisajes rurales del Campo de Cartagena- Mar Menor. Del riego itinerante a la factoría bajo cubierta. In *Atlas de Los Paisajes Agrarios de España, Ministerio de Agricultura*; Alimentación y Medio Ambiente: Madrid, Spain, 2013; pp. 543–552.
23. Rodríguez, T. Sobreexplotación de acuíferos y desertificación en el Sureste español. In *Aridez, Salinización y agricultura en el Sureste Ibérico*; Gil, A., Morales, A., Torres, F.J., Eds.; Fundación Ramón Areces-Instituto Euromediterráneo de Hidrotecnia: Madrid, Spain, 2004; pp. 105–134, ISBN 84-8004-672-4.
24. Salas, M.C.; Urrestarazu, M.; Valera, D. La contaminación por nitratos en los sistemas agrícolas. *Vida Rural* **2003**, *179*, 38–41.
25. Fernández, E.J. Agricultura, contaminación y protección de acuíferos. In *Gestión y Contaminación de recursos hídricos: Problemas y soluciones*; Pulido, A., Vallejos, A., Eds.; Servicio de Publicaciones-Universidad de Almería: Almería, Spain, 2003; pp. 277–280, ISBN 84-8240-662-0.
26. Caballero Pedraza, A.; Romero Díaz, A.; Espinosa Soto, I. Cambios paisajísticos y efectos medioambientales debidos a la agricultura intensiva en la Comarca de Campo de Cartagena-Mar Menor (Murcia). *Estud. Geográficos* **2015**, *76*, 473–498. [CrossRef]
27. Harvey, D. *The New Imperialism*; Oxford University Press: New York, NY, USA, 2003; ISBN 0-19-926431-7.
28. Ahlers, R. Fixing and nixing: The politics of water privatization. *Rev. Radic. Political Econ.* **2010**, *42*, 213–230. [CrossRef]
29. Harvey, D. *Justice, Nature & the Geography of Difference*; Blackwell Publishers: Cambridge, MA, USA, 1996; ISBN 978-1-557-86681-3.
30. Prieto, F.; Ruiz, P.; Martínez, J. Prospectiva 2030 en los cambios de ocupación del suelo en España y sus impactos en el ciclo hidrológico. 2008. Available online: https://www.zaragoza.es/contenidos/medioambiente/cajaAzul/13S5-P2-PRIETO_RUIZ_ACC.pdf (accessed on 4 July 2020).
31. Gil Olcina, A. La propiedad del agua en los grandes regadíos deficitarios del sureste peninsular: El ejemplo del Guadalentín. *Agric. Y Soc.* **1981**, *35*, 203–231.
32. Alberola-Romá, A. Propiedad, control y gestión del agua en regadíos deficitarios del Sureste español: La Huerta de Alicante durante la Edad Moderna. *Minius* **2015**, *23*, 7–40.
33. Swyngedouw, E. Accumulation by dispossession: Privatizing H2O. *Capital. Nat. Soc.* **2005**, *16*, 81–98. [CrossRef]

34. Subra, P. Geopolitics: A Unique or Multidimensional Concept? Place, Issues and Tools of Local Geopolitics. *Hérodote* **2012**, *3*, 45–70. [CrossRef]
35. Hernández-Mora, N.; Del Moral Ituarte, L.; La-Roca, F.; La Calle, A.; Schmidt, G. Interbasin water transfers in Spain: Interregional conflicts and governance responses. In *Globalized Water*; Springer: Dordrecht, The Netherlands, 2014; pp. 175–194. [CrossRef]
36. Morote, Á.F.; Olcina, J.; Rico, A.M. Challenges and proposals for socio-ecological sustainability of the tagus–segura aqueduct (Spain) under climate change. *Sustainability* **2017**, *9*, 2058. [CrossRef]
37. Morote, A.F.; Hernández, M.; Rico, A.M.; Eslamian, S. Interbasin water transfer conflicts. The case of the Tagus-Segura Aqueduct (Spain). *Int. J. Hydrol. Sci. Technol.* **2020**, *10*, 364–391. [CrossRef]
38. Baños, P.; Pérez, I.; Pedreño, A. Aportaciones desde la investigación social al debate sobre agua y regadío. *Rev. Cienc. Soc.* **2009**, *8*, 83–98.
39. Calatrava, J.; Martínez-Granados, D. El valor del uso del agua en el regadío de la cuenca del Segura y en las zonas regables del trasvase Tajo-Segura. *Econom. Agrari. Y Recur. Nat.* **2012**, *12*, 5–32. [CrossRef]
40. Morote, Á.F.; Olcina, J.; Hernández, M. The use of non-conventional water resources as a means of adaptation to drought and climate change in Semi-Arid Regions: South-Eastern Spain. *Water* **2019**, *11*, 93. [CrossRef]
41. Martínez Fernández, J.M.; Esteve Selma, M.A.; Baños, I.; Carreño, F.; Moreno, A. Dynamics and sustainability of Mediterranean traditional irrigated lands. In *Handbook of Sustainable Development Planning*; Edward Elgar Publishing: Cheltenham, UK, 2013; pp. 245–274, ISBN 9780857932150.
42. Alcon, F.; De-Miguel, M.D.; Martínez-Paz, J.M. Assessment of real and perceived cost-effectiveness to inform agricultural diffuse pollution mitigation policies. *Land Use Policy* **2020**, 104561, in press. [CrossRef]
43. Colino Sueiras, J.; Martínez Paz, J.M. El agua en la agricultura del sureste español: Productividad, precio y demanda. *Mediterr. Económ.* **2002**, *2*, 199–221.
44. Gil Meseguer, E. La Región de Murcia, un laboratorio de experiencias de ahorro y eficiencia en el uso del agua: La modernización de sus regadíos, entre las políticas agraria y ambiental de la Unión Europea. *Papel. Geogr.* **2010**, *51–52*, 131–145.
45. Martínez Fernández, J.; Esteve Selma, M.A. Sequía estructural y algunas externalidades ambientales en los regadíos de la cuenca del Segura. *Ing. Agua* **2020**, *7*, 165–172. [CrossRef]
46. Vivo, J.M.; Callejón, J. Análisis de los sectores productivos en la región de Murcia a partir del Valor Añadido Bruto. *Cuad. Econ. Murc.* **2005**, *16*, 65–76.
47. Calvo, F. Sureste español: Regadío, tecnologías hidráulicas y cambios territoriales. *Scr. Nova. Rev. Electrónica Geogr. Y Cienc. Soc.* **2006**, *10*, 218.
48. Gil, E. Los paisajes agrarios de la Región de Murcia. *Pap. Geogr.* **2006**, *43*, 19–30.
49. García, R. Transformaciones recientes en las pequeñas huertas del noroeste murciano: Espacios de tradición y de gran valor paisajístico y ambiental. *Pap. Geogr.* **2010**, *51*, 105–113.
50. Segura, P.; Pedreño, A. La hortofruticultura intensiva de la Región de Murcia: Un modelo productivo diferenciado. In *La agricultura española en la era de la globalización*; Etxezarreta, Miren (Coordinator); Ministerio de Agricultura, Pesca y Alimentación: Madrid, Spain, 2006; pp. 369–422, ISBN 84-491-0748-2.
51. Krause, C.L. Our visual landscape: Managing the landscape under special consideration of visual aspects. *Landsc. Urban Plan.* **2001**, *54*, 239–254. [CrossRef]
52. Stephenson, J. The Cultural Values Model: An integrated approach to values in landscapes. *Landsc. Urban Plan.* **2008**, *84*, 127–139. [CrossRef]
53. Canales, G.; Ponce, M.D. *Pareceres sobre la Huerta del Bajo Segura. El Poder de la Identidad y la Cultura en la valoración del Paisaje*; Universidad de Alicante: Alicante, Spain, 2016; ISBN 978-84-16724-32-1.
54. Pedreño, A.; Baños, P. Las aguas subterráneas y la política del desconcierto. In *Agricultura familiar en España*; Moyano, E., Coord, Eds.; Fundación de Estudios Rurales y Unión de Pequeños Agricultores: Madrid, Spain, 2006; pp. 106–116.
55. Baños, P.; Pedreño, A.; Pérez, I. Cuando los cultivos de regadío se orientan exitosamente al mercado: Expansión territorial sin límite y efectos ambientales sobre recursos básicos en la Región de Murcia. In *VI Congreso Ibérico sobre Gestión y Planificación del Agua*; Fundación Nueva Cultura del Agua: Vitoria, Spain, 2008; Available online: https://fnca.eu/biblioteca-del-agua/directorio/file/1060-1306271427-ppt-c0303 (accessed on 4 July 2020).
56. Vargas, E.; Pintado, P. The challenge of climate change in Spain. Water resources, agriculture and land. *J. Hidrol.* **2014**, *518*, 243–249. [CrossRef]

57. Senent, J.; Pérez, J.; Bielsa, A.M. Assessment of Sustainability in Semiarid Mediterranean Basins: Case Study of the Segura Basin, Spain. *Tecnol. Y Cienc. Agua* **2016**, *7*, 67–84.
58. Ruiz, V.; Belmonte, F.; García, R. Analysis of precipitations trends in the Region of Murcia (Southeast Spain) over the period 1956–2015. In Proceedings of the 6th International Conference on Meteorology and Climatology of the Mediterranean, Zagreb, Croatia, 20–22 February 2017; pp. 20–22.
59. Miró, J.J.; Estella, M.J.; Caselles, V.; Gómez, I. Spatial and temporal rainfall changes in the Júcar and Segura basins (1955–2016): Fine-scale trends. *Int. J. Clim.* **2018**, *38*, 4699–4722. [CrossRef]
60. Senent, J.; Pérez, J.; Carillo, J.; Soto, J. Using SWAT and Fuzzy TOPSIS to assess the impact of climate change in the headwaters of Segura River Basin (SE Spain). *Water* **2017**, *9*, 149. [CrossRef]
61. García, J.L.; Senent, M.; Martínez, D.; Aragón, R. La sobreexplotación de acuíferos. In *Sobreexplotación de Acuíferos en la Cuenca del Segura. Evaluación y Perspectivas*; Senent, M., García, J.L., Eds.; Instituto Euromediterráneo del Agua: Murcia, Spain, 2014; pp. 63–112, ISBN 978-84-92988-22-8.
62. Stake, R.E. *Evaluación Comprensiva y Evaluación Basada en Estándares*; Editorial Graó-Colección Crítica y Fundamentos: Barcelona, Spain, 2006; ISBN 84-7827-418-9.
63. Salkind, N.J. *Exploring Research*; Pearson Education: London, UK, 2009; ISBN 978-0-205-09381-6.
64. Buzai, G.D.; Baxendale, C. Aportes del análisis geográfico con Sistemas de Información Geográfica como herramienta teórica, metodológica y tecnológica para la práctica del ordenamiento territorial. *Pers. Y Soc.* **2013**, *27*, 113–141.
65. Liverman, D.; Moran, E.F.; Rindfuss, R.R.; Stern, P.C. *People and Pixels*; National Academy Press: Washington, DC, USA, 1998; ISBN 978-0-309-06408-8.
66. Gallardo, M. *Cambios de Usos del Suelo y Simulación de Escenarios en la Comunidad de Madrid*; Universidad Complutense: Madrid, Spain, 2014.
67. Congedo, L. Semi-automatic classification documentation. *Release* **2016**, *4*, 29. [CrossRef]
68. Pontius, R.G.; Shusas, E.; McEachern, M. Detecting important categorical land changes while accounting for persistence. *Agric. Ecosyst. Environ.* **2004**, *101*, 251–268. [CrossRef]
69. López, F.; Quiñonero, J.M.; García, R.; Martín de Valmaseda, E.; Sánchez, M.C.; Chocano, C.; Guerrero, F. *Fuentes y manantiales de la Cuenca del Segura: Región de Murcia*; Instituto Euromediterráneo del Agua and Confederación Hidrográfica del Segura: Murcia, Spain, 2016; ISBN 978-84-92988-24-2.
70. Espejo, C. El olivar. Un cultivo en retroceso en la Región de Murcia. *Pap. Geogr.* **1989**, *15*, 33–42.
71. Andrés, J.L. Significado del distrito industrial de la piedra y el mármol en el desarrollo local. In *Estudios sobre Desarrollo Regional*; Servicio de Publicaciones de la Universidad de Murcia: Murcia, Spain, 2008; pp. 61–94, ISBN 978-84-8371-794-3.
72. Millán, M. Análisis de la dinámica de un municipio impactado por el turismo rural. El ejemplo de Moratalla. *Cuad. Tur.* **1998**, *1*, 99–115.
73. Chocano, C.; Sánchez, C.; López, F. La agroecología como alternativa a la prevención y lucha contra la desertificación en la Región de Murcia: La Comarca del Noroeste. *Agroecología* **2007**, *2*, 75–84.
74. Martínez, C.; Cánovas, F. Identificación de áreas abandonadas en la Región de Murcia. In *Abandono de Cultivos en la Región de Murcia: Consecuencias Ecogeomorfológicas*; Romero, A., Ed.; Universidad de Murcia: Murcia, Spain, 2016; pp. 63–84, ISBN 978-84-16551-37-8.
75. Alonso, F.; Martínez, C.; Serrato, F.; Fernández, M.A. Principales causas del abandono de cultivos en la Región de Murcia. In *Abandono de Cultivos en la Región de Murcia: Consecuencias Ecogeomorfológicas*; Romero, A., Ed.; Universidad de Murcia: Murcia, Spain, 2016; pp. 203–226, ISBN 978-84-16551-37-8.
76. Rupérez-Moreno, C.; Senent-Aparicio, J.; Martínez-Vicente, D.; García-Aróstegui, J.L.; Cabezas Calvo-Rubio, F.; Pérez-Sánchez, J. Sustainability of irrigated agriculture with overexploited aquifers: The case of Segura basin (SE, Spain). *Agric. Water Manag.* **2017**, *182*, 67–76. [CrossRef]
77. López, F.; Sánchez, M.C. Manantiales de la Comarca del Noroeste de la Región de Murcia: Un patrimonio natural amenazado. *Pap. Geogr.* **2010**, *51–52*, 169–188.
78. Martín de Santa Olalla, F.; Brasa Ramos, A.; Fabeiro Cortes, C.; Fernández González, D.; López Córcoles, H. Improvement of irrigation management towards the sustainable use of groundwater in Castilla-La Mancha, Spain. *Agric. Water Manag.* **1999**, *40*, 195–205. [CrossRef]
79. Lecina, S.; Isidoro, D.; Playán, E.; Aragüés, R. Irrigation modernization and water conservation in Spain: The case of Riegos del Alto Aragón. *Agric. Water Manag.* **2010**, *97*, 1663–1675. [CrossRef]

80. Conan, C.; de Marsily, G.; Bouraoui, F.; Bidoglio, G. A long-term hydrological modelling of the Upper Guadiana river basin (Spain). *Phys. Chem. Earth* **2004**, *28*, 193–200. [CrossRef]
81. Ortega, J.F.; De Juan, J.A.; Tarjuelo, J.M. Evaluation of the water cost effect on water resource management: Application to typical crops in a semiarid region. *Agric. Water Manag.* **2004**, *66*, 125–144. [CrossRef]
82. De Santa Olalla, F.M.; Dominguez, A.; Ortega, F.; Artigao, A.; Fabeiro, C. Bayesian networks in planning a large aquifer in Eastern Mancha, Spain. *Environ. Model. Softw.* **2007**, *22*, 1089–1100. [CrossRef]
83. Martínez Fernández, J.; Esteve Selma, M.A. The dynamics of water scarcity on irrigated landscapes: Mazarrón and Aguilas in south-eastern Spain. System Dynamics Review. *J. Syst. Dyn. Soc.* **2004**, *20*, 117–137. [CrossRef]
84. Vidal-Legaz, B.; Martínez-Fernández, J.; Picón, A.S.; Pugnaire, F.I. Trade-offs between maintenance of ecosystem services and socio-economic development in rural mountainous communities in southern Spain: A dynamic simulation approach. *J. Environ. Manag.* **2013**, *131*, 280–297. [CrossRef]

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Commentary

Sustainable Population Growth in Low-Density Areas in a New Technological Era: Prospective Thinking on How to Support Planning Policies Using Complex Spatial Models

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Abstract: Urban development is the result of the interaction between anthropogenic and environmental dimensions. From the perspective of its density, it ranges from high-density populated areas, associated with large cities that concentrate the main economic and social thrust of societies, to low-density populated areas (e.g., rural areas, small–medium-sized cities). Against the backdrop of the new technological and environmental era, this commentary offers insights on how to support spatial planning policies for sustainable urban growth in low-density areas. We propose the integration of technological drivers such as Internet networks, telecommuting, distance-learning education, the use of electric cars, etc. into the complex spatial models to project and thus to identify the best locations for urban development in low-density areas. This understanding can help to mitigate the disparities between high- and low-density populated areas, and to reduce the inequality among regions as promoted in the UN 2030 Agenda for Sustainable Development Goals.

Keywords: low-density populated areas; sustainable urban growth; technological era; complex spatial models; land-use planning

1. Introduction

Human settlements—i.e., locations where people live, work and/or study—are the result of an interrelated set of dimensions [1]. To recognise the uncertainties surrounding future human settlements, different approaches have been used. Among these approaches, we find that complexity science and geography can contribute to a better understanding of where people will live in the future by providing answers to unpredictable changes and describing how local interactions between individuals in the system shall lead to emerging patterns over time [2–4].

Complexity science, which has been around for roughly seventy years, has been steadily advancing in the past few decades. It integrates interdisciplinary subjects, such as fractals— describing and analysing irregularities [5]; self-organising systems—learning the interactions inside the system, leading to the spontaneous emergence of an intelligible spatial structure without exterior coordination, where there is no hierarchy of command and control, and neither internal or external agents to monitor the process [6]; chaos theory—studying the stability of procedures in response to changes in scale [7]; and cybernetic systems—investigating process regulation as a complex system in an accelerated socio-technological evolution [8].

Complexity science and geography have come together to describe, understand, and explain connexions among space-time patterns at multiple scales, linking interactions to nonlinear processes [9]. Hence, they have helped to describe and understand system dynamics, to predict future human behaviour, and they have the advantage of being simple approaches that can incorporate complex analysis. Every stage incorporates complex analysis, involving dynamics, relationships, emergence, and unpredictability. Finding further possibilities for coupling complexity science and geography is one of the most significant challenges that spatial planning needs to face in the future [10]. This engagement has increasingly sparked interest and new knowledge has been established to explore interconnected relationships, unpredictability, and multi-dimension, multi-scale, multi-time, and non-linear thinking [11].

In the past few years, the use of computer simulations employing this two-pronged theoretical approach has been increasing due to its low cost, high speed, and easy reproducibility [12]. Currently, there are plenty of studies indirectly forecasting the growth of human settlements by projecting urban areas, particularly in high-density populated areas contexts, by using complex spatial models, e.g., Fuglsang et al. [13], and Clarke et al. [14]. Nevertheless, in a technological and environmental era, where people can increasingly decide where to live and work [15], and to face to one of the most significant challenges from the spatial planning perspective, the territorial population imbalance between low and high-density areas, there is a lack of the critical thinking needed to study low-density populated areas, identifying different drivers to promote the sustainable urban growth in these areas. Therefore, this commentary casts a light on how using complex spatial models can be effectively applied in land-use planning by promoting new territorial strategies to mitigate the imbalance between high- and low-density populated areas, as support to predict future urban areas growth in low-density populated areas, and to find the most suitable areas. (Figure 1).

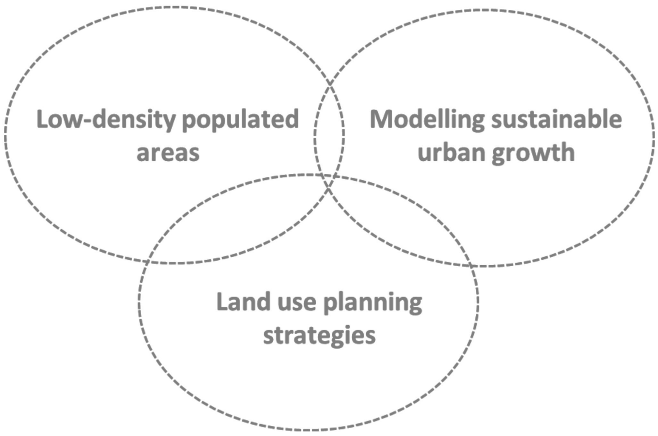

Figure 1. Coupled analysis: low-density populated areas, modelling sustainable urban growth, and land-use planning strategies.

2. Population Dynamics

By 2050, around 70% of the world's population is expected to live in urban areas [16]. Historically, this growth has been associated with urbanisation processes linked to the socio-economic development of the countries [17]. Currently, North America is the region where the most people live in urban areas (82%), followed by Latin America and the Caribbean (80%), and Europe (73%). By country, China has the most prominent urban population (758 million), followed by India (410 million), and the United States of America (263 million). By metropolitan region, Tokyo is the world's largest one with 38 million inhabitants, followed by Shanghai (34 million), and Jakarta (with almost 32 million inhabitants) [16]. Urban population worldwide has overgrown since 1950, from 746 million to 3.9 billion in 2014, and by 2050, it is expected to reach 6.3 billion, where approximately 90% of this growth is expected to occur in Africa and Asia.

Population growth in urban areas throughout history, in different places and stages, has fluctuated both in terms of core and ring. Theoretically, the different stages occur based on four major cycles [18]:

(i) urbanisation: indicates population growth within the city (and associated with a suburbanisation process with low-density settlements in the urban fringe);
(ii) exurbanisation: corresponds to migration away from large cities;
(iii) counterurbanisation, which represents population decrease both within the city and in the urban fringe; and
(iv) reurbanisation: embodies population increase within the city and its decrease in the urban fringe.

These four stages have been identified in different urban areas around the world as a result of a complex interaction between anthropogenic and environmental drivers [19,20], and they have been recognised with different dynamics, morphologies, densities, and spatial locations. For instance, the urbanisation process has been associated with contiguous urban growth around cities, and along highways and roads, connecting suburbs in different forms [21] such as enlarged cities, metapolis, city-regions, and periurban regions. Likewise, from the perspective of morphology, some characteristics have been recognised, such as monocentric (distributed over extensive areas), dispersed (scattered cities), linear (with linear forms of agglomeration), and polycentric urban regions (multiple cities connected) [22]. The urban growth in some of these urban forms leads, frequently, to the emergence of urban sprawl [23], which is defined as a low-density dispersed development outside the compact urban area and beyond the edge of service and employment [24]. Batty [25] defined it in three interconnected concepts of spatial dynamics: the decline of central or core cities; the emergence of edge cities; and the rapid suburbanisation of the peripheries of cities. On the other hand, Torrens [26] refers to it as low-density growing areas along the fringes of metropolitan areas, characterised by their compactness and dispersion. These areas are often identified as the urban expansion into suburban areas and characterised by unplanned [27], uneven growth [28], contiguous suburban growth [29], mixed uses [30], scattered and leapfrog development [26], strip or linear development [31], poly-nucleated nodal development, and both as a state, and a process [32]. Behind these morphological and dynamic changes, different drivers have been identified as the main reasons, such as policy interference and social organisation changes, industrialisation, infrastructure, and a cultural, technological, and/or socioeconomic boost [33].

The urban growth process has implications for land-use sustainability, both from the socioeconomic and environmental perspective [34–36], and they can be both negative and positive. Among the many impacts, the negative ones may be the undesirable effects on public health and quality of life [37], urban pollution increase [38], greater dependence on cars [39], spatial fragmentation [40], and loss of farmlands [41]. The positive ones may be the sense of community between inhabitants [42], more living space [41], decreasing crime rates [39], and the fact that fragmented urban growth has been perceived as an economic expansion [28].

Contrary to the urbanisation–suburbanisation process, exurbanisation represents the mobility of people from large urban areas into rural areas [43]. Exurbanisation as a concept was introduced by Spectorsky [44] and is defined as the ring of wealthy rural communities inhabited by urban professionals, where urban and rural activities are interconnected, and the relocation of residential areas, services, industries, logistic centres, and high-tech zones is the result of a trend towards de-concentration [45]. It represents the area outside the contiguously built-up areas of large cities, outside metropolitan regions, where rural areas are interwoven with small-medium sized cities, and people live by maintaining their urban income [43].

These processes have been led to land-use and land-cover changes and they have been triggered by driving forces. The concept of driving force become well-known in landscape ecology during the 1990s, which was defined as the processes responsible for the landscape changes [46]. Therefore, it can be categorised into the three following stages:

(i) underlying drivers: such as environmental, policy, technology, socioeconomic, culture, and location;
(ii) processes: related to land manager decisions and behaviours; and
(iii) manifestations of land-use and land-cover change: connected to intensification (e.g., high-density populated areas), and disintensification (e.g., land abandonment).

Many drivers influence land-use transitions, and they are the result of land supply and demand, affecting its patterns, structures, and functions. Some studies have contributed to describe the effects on landscape change [33], and its complex interaction processes [46]. There are plenty of driving forces that may be responsible for those transitions. Table 1 reviews some of these key drivers, from global to local scale.

Table 1. Global, national, and local driving forces.

Scale	Driving Force	Description	Source
Global	World prices	It can influence land-use change decisions.	[47]
	Climate change	It represents unpredictability—greater negative impacts.	[48]
	High energy prices	It increases food prices.	[49]
National	Urbanisation	It changes the food demand.	[50]
	Shortening market chains	It reflects a stricter price.	[51]
	Water scarcities	It promotes strategies to create irrigated agricultural land.	[52]
Local	Population pressure	It can reduce the agricultural land available for farming.	[53]
	Market access	It can improve output markets.	[54]

Worldwide, landscape has been experienced significant land-use changes. They have been encouraged by different drivers such as political reasons, cultural history, land reforms, and enhanced technological, as well as diverse institutional and economic drivers [33]. The population growth and the need for cropland, grassland, and forest have led to a high level of land-use and land-cover changes. At the same time, spatial patterns of urban development have registered significant changes over the last decades, especially from the fringes of large cities, which have registered high levels of land-use changes from natural and semi-natural areas into artificial land, mostly to residential and tourist settlements, industrial, and commercial surfaces.

Therefore, the understanding of different urban development processes is relevant. The study of sustainable urban growth in exurbanisation processes can encompass multiple disciplines [55] and may be a central key for land-use management to mitigate the disequilibrium between low- and high-density populated areas, by promoting the sustainable urban growth in low-density populated areas. Some of these disciplines may be those related to complexity science and spatial planning to define better policy priorities and endorse inclusive and equitable development [56,57].

3. Complex Spatial Models

In the interpretation of urban and population dynamics, different models and methods have been used in the scientific literature. Some of them, such as the classical geographic models have in common the study of interaction, diffusion, migration, and location, identifying the who, what, why, and where. They have been applied in urban economics and social physics, e.g. Von Thünen's model, Weber's model, Walter Christaller's central place formulation, Alonso's model, the gravity model of spatial interaction, Hagerstrand's model, and Tobler's law. The majority of them share the principles of complexity science, which are useful to describe how local interactions between individuals in a system can lead to emerging patterns over time [2].

In the 17th century, René Descartes argued that 'nothing comes out of nothing', and this quote describes very simply how complexity science can be understood. Nevertheless, there is not a single definition for complexity science and there is no consensus about it [58]. This is partially since complex system theory itself was only properly recognised in the 1990s [59]. However, it is agreed that complexity science corresponds to a system where a set of entities, processes, and agents interact over an extensive network with no central control [60]. Local interactions between agents and the environment can result in unexpected and unpredictable behaviour at the global level in a new bottom-up approach [61]. These local or global interactions may lead to positive and negative responses that can influence the state of the system [62].

Self-organisation, nonlinearity, and order and chaos were the fields that gave rise to complexity science. In self-organisation, the interactions inside the system lead to the spontaneous emergence of an intelligible spatial structure without exterior coordination, where there is no hierarchy of command and control, neither internal nor external agents that monitor the process [6]. In nonlinearity there is a continuous and discontinuous change, and, the cause–effect relation is disproportional [63]. Lastly, order and chaos is related to unpredictable behaviour in a system in which agents interact randomly with other agents, rather than being planned or controlled [9].

The complex systems evolution often comprises disconnected time-scales. The disconnection or transition is the consequence of an aggregation of techniques of changes, since collective behaviours and relations, and physical, economic, or social configurations cause irreversible changes in a system. Four stages of stability transition have been identified:

(i) pre-development: in which indicators change only slightly, in which does not exist a dynamic of equilibrium;
(ii) take-off and accelerated stage: in which indicators change with growing speed, and the system starts to break;
(iii) breakthrough or acceleration: in which the system changes structurally; and
(iv) stabilisation stage: in which the speed of social change declines and a new dynamic equilibrium is achieved.

These multi-stages provide a straightforward interpretation of what will occur throughout a transition process. The conceptual theory proposes a cyclic pattern, a stabilisation stage, and what could be the predevelopment stage for the next development stage.

Complex systems consider that connexions and interdependencies are challenging to describe, predict, and manage [64], and they are the result of collective behaviour. Complex systems are more than the sum of individual actions [58], and for a system to be called complex, its components have to be self-organised, and it has to be less dependent on environmental actions [65], exploring dynamic systems in a broad and multi-disciplinary context.

Complex systems studies are increasingly used in natural and social sciences and provide a powerful tool with which to capture evidence about the world [66]. More recently complexity science has been studied in policy and evaluation, more specifically in the understanding of collective decision-making [67]. This interconnection has been supported by modelling techniques, in which they have been used to solve complex problems, integrating empirical data, entities, and relations among objects. Models can reproduce experimentally-observed real systems (real world) and can be divided into space and time. In addition, they represent an abstraction of the world and they can be described into three different types:

(i) deterministic, in which the model is entirely defined by the parameter values and the initial conditions, displayed by deterministic rate equations. A deterministic model can be stretched to account for the spatial organisation and has been effectively used to analyse the reaction process [68];
(ii) stochastic, in which they have intrinsic randomness, and the set of parameter values and initial conditions will lead to an ensemble of different outputs; and

(iii) the hybrid model, which represents a combination of both deterministic and stochastic models. They are used in analysis, optimisation, synthesis, gaining, and in the comparison of alternative systems.

Complex model simulations can help to explain and predict geographic phenomena [69], and they have been used from a new perspective of spatial simulation modelling, to incorporate an accurate representation of geographic space [70–72]. They have been integrated an object-based and spatially-explicit approach linked to complex systems dynamics [73], allowing better understanding of the spatiotemporal phenomena by modelling human behaviour [74].

Complex spatial modelling represents an advance of geographic information science that has contributed to an efficient reflection on new space perceptions [75,76]. Predicting and assessing future land-use trajectories enables identification of their causes and consequences [77], involving a multidisciplinary evaluation [78], and integrating a broad range of biophysical, demographic, and socioeconomic drivers [79,80]. Currently, there is a variety of complex spatial models based on different empirical techniques, such as equation-based models, system models, evolutionary models, genetic algorithms, cellular automata (CA), artificial neural networks (ANN), and agent-based models (ABM). These last three, have been among the most used in modelling land-use and land-cover changes. CA is defined by cell space, timestep, cell states, cell neighbourhood, and transition rules [81]; ANN are based on a machine learning system and inspired by human brain neurons structure [82]; and ABM enable the reproduction of human actions such as cognition, communication, and learning [83].

These models have been used to simulate land-use dynamics, identifying driving forces for those changes [84], and capturing the behaviour of individuals, integrating simple rules but incorporating complex behaviours. Table 2 shows some examples that combine CA, ANN, and ABM in the study of land-use cover changes.

Table 2. Land-use models based on CA, ANN, and ABM.

Method	Model	Description	Source
Cellular automata	MOLAND	Provides a spatial planning tool used to evaluate, to monitor, and to model urban development at the regional level.	[85]
	SLEUTH	Designed with predefined rules. SLEUTH uses four types of urban transitions: spontaneous growth; new spreading-centre growth; edge growth; and road-influenced growth.	[86]
	RIKS	It is developed at two scales: macro and micro level.	[87]
Artificial neural network	GIS-ANN Web - SECOA	It allows stakeholders to measure land-use transitions according to different scenarios.	[82]
	Land Transformation Model	It projects spatial and temporal patterns of land-use changes and identifies its driving forces.	[88]
Agent-based models	PUMA	It simulates land-use changes based on a land conversion model and household model.	[89]
	ILUMASS	It was developed to run at microscopy level, simulating land-use changes, transportation, and environmental dynamics.	[90]
	RAMBLAS	It simulates the impacts of land-use changes, and transportation planning policies.	[91]

Combining different geographic models allows us to manipulate and create relationships between spatial data, and to integrate deterministic and stochastic predictive analysis to establish artificial relationships between different spatial data [92]. As a result, these models can create spatial knowledge that can subsequently be used as a support for spatial decision-making [93,94].

4. Land-Use Planning

Through the complex spatial models' outcomes, land-use planning can support better-planning practices [95]. It helps us to identify alternatives for land use and adopt the best land-use options, allocating land uses to meet the environmental, social, and economic needs of the population while preserving future resources [96]. It incorporates socioeconomic trends and physical and geographic elements. Land-use planning is a public policy that describes and regulates the use of land to support local development goals and creates legal and administrative instruments that support the plan to define land allocation, zoning, and density of construction. Land-use planning also comprises the anticipation of the need for changes as well as responses to that need, employing strategies to deal with territorial elements, e.g. transport, commercial, industrial, residential, and economic growth, and mitigating and adapting to climate change, as well as protecting people from natural disasters. These strategies must be selected taking into account their efficiency, guarantee equity, safeguard important requisites such as food security, employment, and recognise the current needs of the population, while still preserving resources for future generations [97].

The best principles for land-use planning are those that both decision-makers and stakeholders/ population can debate, identifying the highest consensus on the goals of a specific territory, as well as those that incorporate the largest development vision (larger scale) for the locality (local scale). At a larger scale, land-use planning, in many cases, establishes priorities by balancing the competing demands for land from sectors such as the economy, tourism, housing and public amenities, road network, industries, as well as wildlife preservation. At the local scale, land-use planning should capture local stakeholder knowledge and contributions, as well as local actions [98]. From the perspective of the mitigation of population distribution imbalance, in a region or country, spatial planning measures can be taken at larger and/ or local scale and should encourage sustainable urban development in low-density populated areas.

5. How to Support Planning Policies to Mitigate the Territorial Imbalance between Low- and High-Density Areas in a New Technological Era?

While new planning standards such as territorial cohesion or the reduction of inequality within and among countries (as promoted in the UN 2030 Agenda for Sustainable Development Goals) have been encouraged, the increasing socioeconomic distance between rural or small–medium sized cities and large cities has been one of the significant planning challenges [99]. It was found that the lack of effective spatial planning has resulted in uncoordinated strategies and has led to a territorial population imbalance in some regions of the world. Therefore, the study of exurbanisation processes may be useful to identify alternative spatial scenarios; propose and point out guidelines to mitigate urban growth pressure in large cities; and create incentives for people to live in rural areas or small–medium sized cities.

The principle of people's migration from large cities to low-density populated areas related to technological advances has already been discussed by several authors in the past. In the 1990s, Frances Cairncross published a book anticipating "The Death of Distance", in which Cairncross argued that with technological advances we will see a migration of people from urban to rural areas. However, more than 20 years have passed, and this transformation has not yet occurred. In 2012 Enrico Moretti, opposing the idea of Cairncross, argued in his book entitled "The New Geography of Jobs" that the death of distance is a myth. In 2018, this idea was corroborated by Joe Cortright in his article entitled "IoT: The Irrelevance of Thingies", in which Cortright defended that "people and social interaction, not technology, is the key to the future of cities". Partly, we think that the opinion of these both authors is valid (from the premise that large cities will continue to grow), however, we think that with the most recent technological advances, particularly related with the advances on the Internet (e.g. 5G), and with more powerful computers, that new settlements in low-density areas can emerge due to these new advances. In an article recently published by Michael Batty (May 2020), entitled "The Coronavirus Crisis: What Will the Post-Pandemic City Look Like?", Batty argues that the "low-density urban sprawl and new communities far from the central city" can be a new reality in the near future [15]. This subject is even more relevant when we are at the beginning of the third decade of the 21st century and are facing new global pressures, such as socioeconomic, climatic, and health challenges. In an era when the divide between high-density populated areas and low-density populated areas has been increasing, new approaches to study this phenomenon are needed. They can encompass new technological drivers such as good Internet access, which is directly connected with telecommuting and distance-learning education (behind the migration from large cities to rural or small-medium sized cities) by integrating it in the complex spatial models approaches, and thus promoting better land-use strategies. Therefore, a concept derived from exurbanisation is proposed. Based on the most recent technological era, where the notion of physical location is changing, the concept of 'cyber-exurbanisation' is proposed. It combines the terminology of 'cyber' or 'cyberspace'—i.e., a non-physical space where people can remotely access a network of information technology—and 'exurbanisation', which represents the migration of people from large urban areas to rural and/or small–medium sized cities. Based on this new opportunity, complex spatial models may play an important role by identifying in a region or country, outside large cities, how, why, when, and where people can live in the future.

Throughout human history, different stages in terms of innovation, technology, culture, and socioeconomic transformations have developed worldwide. The first stage recognised was the industrial revolution, when human labour started to be replaced by machines; the second stage was related to mass production using electric power; the third was associated with informatisation based on computers and the Internet; and the fourth has been linked to artificial intelligence, cyber-physical systems, and the Internet of Things [100]. Additionally, and more recently, some authors have mentioned sustainability as the new revolution that has emerged in the past few years [101]. Sustainability has been studied by the scientific community from different perspectives, such as pollution in cities [102], traffic jams [103], overcrowded cities [104], and food security [34]. In this new era of environmental concerns and technological advances, new lifestyles and new job opportunities have emerged. This era has created new opportunities—one of the most relevant opportunities for people working in a growing number of jobs is the possibility of deciding where they want to live. Therefore, different challenges, opportunities, strengths, and weaknesses are being faced in urban living.

From the socio-economic and technological perspective, there are plenty of drivers that may be responsible for migration movements from large cities to rural areas, or small–medium sized cities, such as housing prices, industry 4.0, telecommuting, distance-learning education, Internet, electric cars, aerial vehicles, and digital medicine, health, and therapeutics. They have all been recognised as drivers to interpret these future human settlements.

Currently, one of the most critical topics related to large cities worldwide is the supply/demand imbalance in the housing market. As a result, housing prices have soared [105]. In 2019, Hong Kong, San Francisco, New York City, Zurich, Paris, and London were ranked as the most expensive cities to buy or rent a home [106]. In some of these cities, middle-class families have lost the power to live inside their boundaries since their disposable income has not followed the same growing trend. This situation has been forcing many people to migrate out of these large cities over the past few years [107] and can contribute as one of the main push factors that encourage people to move from large cities to a 'cyberspace' located in a rural area and/or a small–medium sized city.

With the paradigm of industry 4.0, introduced in the early 2010s [108], new challenges are being faced worldwide. One of them is related to digital and technological employees that have been allowed to work and study remotely [109], and thus they are free to decide where to live [110]. A new technological generation of staff using the capability of the cyberspace has been developing in the past few years. Some technological advances in Internet connection, such as new fibre-optic technology [111] and 5G Internet [112], have increased Internet speed and coverage worldwide. Companies such as Google, Facebook, Airbus, Boeing, and SoftBank, have been working in projects targeted at spreading the Internet to the most remote populated areas worldwide employing satellites, drones, balloons, and airships. Consequently, these technological signs of progress have led us to believe that physical distances will be blurred in the near future, allowing people to access the Internet for personal or work purposes in the most remote areas in the world.

Equally as fast have been the recent developments in mobility, particularly in the market of electric cars to transport people, and in the market of aerial vehicles (e.g., drones) to transport goods. These advances have contributed and will further contribute to reducing environmental impacts by cutting CO_2 emissions; lower economic costs by decreasing maintenance and production costs [113]; and increase the mobility of people, goods, and products [114]. Additionally, some other drivers, which do not depend on a person's location, will contribute to reducing the isolation of areas outside large cities, such as digital medicine, health, and therapeutics (allowing practitioners to increase the early identification of diseases) [115]. Therefore, these mentioned drivers can directly or indirectly play a relevant role in the emergence of new inhabitants in rural and small–medium sized cities (out of large cities) in the near future, and they may later shape the new forms of human settlements.

Then, we argue that, apart from the widely used socioeconomic, political, and environmental explanatory variables in the complex spatial models' analysis, we need to integrate these new technological drivers in these analyses. This is even more evident when we are facing, particularly in recent years, increasingly improved technological development. This will allow the projection of a sustainable population growth in low-density areas and in that way, it will allow the demonstration of better alternatives for urban growth and thus better anticipation, interpretation, assessment, and mitigatation of the impacts of the spatial location of future human settlements.

This understanding may be helpful to some governments worldwide, in which they set out to mitigate the imbalanced population distribution in a region or a country; to strengthen territorial equity and territorial cohesion; promote decentralisation of state functions; and to promote a polycentric urban system by increasing the number of cities with supranational polarisation [116]. Thus, anticipation of a better sustainable urban growth in low-density areas can contribute to the creation of better land-use planning strategies; contribute to land-use sustainability [117], and the promotion of territorial cohesion in a country or region.

6. Conclusions

Planning strategies are focused on opportunities, organisational strengths, and framing processes. These strategies support decision-makers by enabling them to use skills that will lead to better decisions about future actions [118]. With the help of complex spatial models, it is possible to anticipate and understand future land-use dynamics, and to create land-use strategies accordingly [53,119]. In the past two decades, the majority of studies that deal with urban and population growth prediction, complex spatial models, and spatial planning, have analysed urbanisation and suburbanisation processes in large cities [68]. However, these analyses still lack the combination of these three dimensions for the study of exurbanisation processes in low-density populated areas.

Large cities are expected to keep on growing worldwide. However, a 'cyber-exurbanisation' process can contribute to the mitigation the population imbalance between large cities, with high-density populated areas, and rural areas and small–medium sized cities, with low-density populated areas. The future development and advance of some technological drivers and the desire of some people to live in a place with natural amenities and idealised lifestyles can promote new locations where people wish to live, creating new forms and new human settlements.

Urban population growth is the result of a complex process and represents the consequence of interactions in space and time between environmental and human dimensions [120]. Complex spatial models can provide an epistemological approach to enable us to better recognise it. Furthermore, it can help planners in the decision-making process to clarify unpredictable conditions, to identify, in time and space, plausible future images, and ensure a better quality of the living environment [121], identifying the valuation of different land-use options and socioeconomic settings. Thus, coupling complex spatial models, by creating spatial scenarios of future growth of human settlements, with land-use planning policies can better indicate alternatives for future population spatial allocation, and thus mitigate the population imbalance between low- and high-density populated areas.

This commentary can be valuable to create sustainable development strategies for understanding future land-use uncertainties. Moreover, it endeavours to examine directions for future scientific research, and we believe it will further help researchers and decision-makers to better interpret future human settlements based on the new era of technological and environmentally sustainable dimensions.

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References

1. Li, G.; Sun, S.; Fang, C. The varying driving forces of urban expansion in China: Insights from a spatial-temporal analysis. *Landsc. Urban Plan.* **2018**, *174*, 63–77. [CrossRef]
2. Holland, J.H. Genetic Algorithms—Computer programs that 'evolve' in ways that resemble natural selection can solve complex problems even their creators do not fully understand. *Sci. Am.* **1992**, *267*, 66–72. [CrossRef]
3. Portugali, J. *Complexity, Cognition and the City*; Springer: Berlin, Germany, 2011.
4. Batty, M. *Cities and Complexity: Understanding Cities with Cellular Automata, Agent-Based Models, and Fractals*; The MIT Press: Cambridge, MA, USA, 2005.
5. Mandelbrot, B. *The Fractal Geometry of Nature*; W. H. Freeman and Company: New York, NY, USA, 1982.
6. Heylighen, F. Complexity and Self-organization. In *Encyclopedia of Library and Information Sciences*; Bates, M., Maak, N., Eds.; CRC Press: Boca Raton, FL, USA, 2008; pp. 133–145.
7. Lorenz, E. Deterministic Nonperiodic Flow. *J. Atmos. Sci.* **1963**, *20*, 130–141. [CrossRef]
8. Heylighen, F. *Complexity: 5 Questions*; Automatic Press: Copenhagen, Denmark, 2007.
9. Lichtenstein, B.B.; Plowman, D.A. The leadership of emergence: A complex systems leadership theory of emergence at successive organizational levels. *Leadersh. Q.* **2009**, *20*, 617–630. [CrossRef]
10. Chettiparamb, A. Metaphors in Complexity Theory and Planning. *Plan. Theory* **2006**, *5*, 71–91. [CrossRef]
11. Ringland, G. *Scenario Planning: Planning for the Future*; John Wiley & Sons: Chichester, UK, 1998.
12. Iba, H. *Agent-Based Modelling and Simulation with Swarm*, 1st ed.; Chapman and Hall/CRC: Boca Raton, FL, USA, 2013.
13. Fuglsang, M.; Münier, B.; Hansen, H.S. Modelling land-use effects of future urbanization using cellular automata: An Eastern Danish case. *Environ. Model. Softw.* **2013**, *50*, 1–11. [CrossRef]
14. Clarke, K.C.; Hoppen, S.; Gaydos, L. A Self-Modifying Cellular Automaton Model of Historical Urbanization in the San Francisco Bay Area. *Environ. Plan. B Plan. Des.* **1997**, *24*, 247–261. [CrossRef]
15. Batty, M. The Coronavirus crisis: What will the post-pandemic city look like? *Environ. Plan. B Urban Anal. City Sci.* **2020**, *47*, 547–552. [CrossRef]
16. WB. World Bank Open Data. 2019. Available online: https://data.worldbank.org/ (accessed on 20 January 2019).
17. Chen, M.; Zhang, H.; Liu, W.; Zhang, W. The Global Pattern of Urbanization and Economic Growth: Evidence from the Last Three Decades. *PLoS ONE* **2014**, *9*, e103799. [CrossRef]
18. Van den Berg, L.; Drewett, L.H.K.L.; Rossi, A.; Vijverberg, C.H.T. *Urban. Europe: A Study of Growth and Decline*; Pergamon Press: Oxford, UK, 1982.
19. Turner, B.; Lambin, E.; Reenberg, A. The emergence of land change science for global environmental change and sustainability. *Proc. Natl. Acad. Sci. USA* **2007**, *104*, 20666–20671. [CrossRef]
20. Robson, J.P.; Berkes, F. Exploring some of the myths of land use change: Can rural to urban migration drive declines in biodiversity? *Glob. Environ. Change* **2011**, *21*, 844–854. [CrossRef]
21. Salvati, L.; Zambon, I.; Chelli, F.M.; Serra, P. Review: Do spatial patterns of urbanization and land consumption reflect different socioeconomic contexts in Europe? *Sci. Total Environ.* **2018**, *625*, 722–730. [CrossRef] [PubMed]
22. Marques da Costa, E. Cidades Médias e Ordenamento do Território: O caso da Beira Interior. Ph.D. Thesis, Universidade de Lisboa, Lisbon, Portugal, 2001.

23. Salvati, L.; Carlucci, M. Patterns of Sprawl: The Socioeconomic and Territorial Profile of Dispersed Urban Areas in Italy. *Reg. Stud.* **2016**, *50*, 1346–1359. [CrossRef]
24. Gennaio, M.-P.; Hersperger, A.M.; Bürgi, M. Containing urban sprawl—Evaluating effectiveness of urban growth boundaries set by the Swiss Land Use Plan. *Land Use Policy* **2009**, *26*, 224–232. [CrossRef]
25. Batty, M.; Xie, Y.; Sun, Z. The dynamics of urban sprawl. *Cent. Adv. Spat. Anal.* **1999**, *15*, 1–39.
26. Torrens, P.; Alberti, M. *Measuring Sprawl*; Centre for Advanced Spatial Analysis (UCL): London, UK, 2000.
27. EEA. *Urban sprawl in Europe—The ignored challenge*; EEA: Copenhagen, Denmark, 2006.
28. Oueslati, W.; Alvanides, S.; Garrod, G. Determinants of urban sprawl in European cities. *Urban Stud.* **2015**, *52*. [CrossRef]
29. Logan, J.R.; Crowder, K.D. Political Regimes and Suburban Growth, 1980–1990. *City Community* **2002**, *1*, 113–135. [CrossRef]
30. Bengston, D.N.; Youn, Y.C. Urban containment policies and the protection of natural areas: The case of Seoul's greenbelt. *Ecol. Soc.* **2006**, *11*, 3. [CrossRef]
31. Galster, G.; Hanson, R.; Ratcliffe, M.R.; Wolman, H.; Coleman, S.; Freihage, J. Wrestling Sprawl to the Ground: Defining and measuring an elusive concept. *Hous. Policy Debate* **2001**, *12*, 681–717. [CrossRef]
32. Jaeger, J.A.G.; Bertiller, R.; Schwick, C.; Kienast, F. Suitability criteria for measures of urban sprawl. *Ecol. Indic.* **2010**, *10*, 397–406. [CrossRef]
33. Van Vliet, J.; de Groot, H.L.F.; Rietveld, P.; Verburg, P.H. Manifestations and underlying drivers of agricultural land use change in Europe. *Landsc. Urban Plan.* **2015**, *133*, 24–36. [CrossRef]
34. Abrantes, P.; Fontes, I.; Gomes, E.; Rocha, J. Compliance of land cover changes with municipal land use planning: Evidence from the Lisbon metropolitan region (1990–2007). *Land Use Policy* **2016**, *51*, 120–134. [CrossRef]
35. Lambin, E.F.; Geist, H.J.; Lepers, E. Dynamics of Land-Use and Land-Cover Change in Tropical Regions. *Annu. Rev. Environ. Resour.* **2003**, *28*, 205–241. [CrossRef]
36. Gomes, E.; Banos, A.; Abrantes, P.; Rocha, J. Assessing the effect of spatial proximity on urban growth. *Sustainability* **2018**, *10*, 5. [CrossRef]
37. Jackson, R.J.; Kochtitzky, C. *Creating a Healthy Environment: The Impact of the Built Environment on Public Health*; Sprawl Watch Clearinghouse: Washington, DC, USA, 2003.
38. Nechyba, T.J.; Walsh, R.P. Urban Sprawl. *J. Econ. Perspect.* **2010**, *18*, 177–200. [CrossRef]
39. Owusu, G. Coping with Urban Sprawl: A Critical Discussion of the Urban Containment Strategy in a Developing Country City, Accra. *Planum J. Urban.* **2013**, *26*, 1–17.
40. Gomes, E.; Banos, A.; Abrantes, P.; Rocha, J.; Kristensen, S.B.P.; Busck, A. Agricultural land fragmentation analysis in a peri-urban context: From the past into the future. *Ecol. Indic.* **2019**, *97*, 380–388. [CrossRef]
41. Bhatta, B. *Analysis of Urban Growth and Sprawl from Remote Sensing Data*; Springer: Berlin/Heidelberg, Germany, 2010; pp. 17–37.
42. Arbury, J. *From Urban Sprawl to Compact City—An Analysis of Urban Growth Management in Auckland*; University of Auckland, Geography and Environmental Science: Auckland, New Zealand, 2005.
43. Nelson, A.C.; Dueker, K.J. The Exurbanization of America and Its Planning Policy Implications. *J. Plan. Educ. Res.* **1990**, *9*, 91–100. [CrossRef]
44. Spectorsky, A.C. *The Exurbanites*; Lippincott: Philadelphia, PA, USA, 1955.
45. Cadieux, K.V.; Hurley, P.T. Amenity migration, exurbia, and emerging rural landscapes: Global natural amenity as place and as process. *GeoJournal* **2011**, *76*, 297–302. [CrossRef]
46. Bürgi, M.; Hersperger, A.M.; Schneeberger, N. Driving forces of landscape change—Current and new directions. *Landsc. Ecol.* **2004**, *19*, 857–868. [CrossRef]
47. Golub, A.; Hertel, T.; Lee, H.-L.; Rose, S.; Sohngen, B. The opportunity cost of land use and global potential for greenhouse gas mitigation in agriculture and forestry. *Resour. Energy Econ.* **2009**, *31*. [CrossRef]
48. Pielke, R.A. Land Use and Climate Change. *Science* **2005**, *310*, 1625–1626. [CrossRef]
49. Steinbuks, J.; Hertel, T. Energy prices will play an important role in determining global land use in the twenty first century. *Environ. Res. Lett.* **2013**, *8*. [CrossRef]
50. Matuschke, I. Rapid Urbanization and Food Security: Using Food Density Maps to Identify Future Food Security Hotspots. In Proceedings of the International Association of Agricultural Economists Conference, Beijing, China, 16–22 August 2009.

51. Bren d'Amour, C.; Reitsma, F.; Baiocchi, G.; Barthel, S.; Güneralp, B.; Erb, K.-H.; Haberl, H.; Creutzig, F.; Seto, K.C. Future urban land expansion and implications for global croplands. *Proc. Natl. Acad. Sci. USA* **2017**, *114*, 8939–8944. [CrossRef] [PubMed]
52. De Espindola, G.M.; de Aguiar, A.P.D.; Pebesma, E.; Câmara, G.; Fonseca, L. Agricultural land use dynamics in the Brazilian Amazon based on remote sensing and census data. *Appl. Geogr.* **2012**, *32*, 240–252. [CrossRef]
53. Gomes, E.; Abrantes, P.; Banos, A.; Rocha, J.; Buxton, M. Farming under urban pressure: Farmers' land use and land cover change intentions. *Appl. Geogr.* **2019**, *102*, 58–70. [CrossRef]
54. Hettig, E.; Lay, J.; Sipangule, K. Drivers of Households' Land-Use Decisions: A Critical Review of Micro-Level Studies in Tropical Regions. *Land* **2016**, *5*, 32. [CrossRef]
55. Zscheischler, J.; Rogga, S.; Busse, M. The Adoption and Implementation of Transdisciplinary Research in the Field of Land-Use Science—A Comparative Case Study. *Sustainability* **2017**, *9*. [CrossRef]
56. Alexandratos, N.; Bruinsma, J. *World Agriculture Towards 2030/2050. The 2012 Revision*; Food and Agriculture Organization of the United Nations: Rome, Italy, 2012.
57. Batty, M.; Longley, P. The fractal simulation of urban structure. *Environ. Plan. A* **1986**, *18*, 1143–1179. [CrossRef]
58. Newman, M. Complex Systems: A Survey. *Phys. Rep.* **2009**, *79*, 10.
59. Waldrop, M. *The Emerging Science at the Edge of Order and Chaos*; Simon & Shuster: New York, NY, USA, 1992.
60. Heppenstall, A.; Malleson, N.; Crooks, A. Space, the Final Frontier: How Good are Agent-Based Models at Simulating Individuals and Space in Cities? *Systems* **2016**, *4*, 9. [CrossRef]
61. Massotte, P. Behavioural Analysis of a Complex System. *Int. J. Adv. Manuf. Technol.* **1996**, *12*, 66–76. [CrossRef]
62. Bennett, D.; McGinnis, D. Coupled and complex: Human-environment interaction in the Greater Yellowstone Ecosystem, USA. *Geoforum* **2008**, *39*, 833–845. [CrossRef]
63. Ladyman, J.; Lambert, J.; Wiesner, K. What is a complex system? *Eur. J. Philos. Sci.* **2011**, *3*, 33–67. [CrossRef]
64. Magee, C.; de Weck, O. Complex system classification. In Proceedings of the Fourteenth Annual International Symposium of the International Council on Systems Engineering, Toulouse, France, 20–24 June 2004; p. 18.
65. Cotsaftis, M. What Makes a System Complex?—An Approach to Self Organization and Emergence. In *From System Complexity to Emergent Properties*; Springer: Berlin/Heidelberg, Germany, 2009; Volume 44, pp. 49–99.
66. Lempert, R.J. A new decision sciences for complex systems. *Proc. Natl. Acad. Sci. USA* **2002**, *99* (Suppl. S3), 7309–7313. [CrossRef] [PubMed]
67. Silva, E.; de Roo, G. *A Planner's Encounter with Complexity*; Routledge: London, UK, 2010.
68. Musa, S.I.; Hashim, M.; Reba, M.N.M. A review of geospatial-based urban growth models and modelling initiatives. *Geocarto Int.* **2017**, *32*, 813–833. [CrossRef]
69. Worboys, M. Event-oriented approaches to geographic phenomena. *Int. J. Geogr. Inf. Sci.* **2005**, *19*, 1–28. [CrossRef]
70. Couclelis, H. Cellular Worlds: A Framework for Modeling Micro—Macro Dynamics. *Environ. Plan. A Econ. Space* **1985**, *17*, 585–596. [CrossRef]
71. Deadman, P.; Brown, R.D.; Gimblett, H.R. Modelling Rural Residential Settlement Patterns with Cellular Automata. *J. Environ. Manag.* **1993**, *37*, 147–160. [CrossRef]
72. White, R.; Engelen, G. High-resolution integrated modelling of the spatial dynamics of urban and regional systems. *Comput. Environ. Urban Syst.* **2000**, *24*, 383–400. [CrossRef]
73. Mekni, M.; Moulin, B.; Paris, S. Semantically-Enhanced Virtual Geographic Environments for Multi-Agent Geo-Simulation. In *Advanced Geo-Simulation Models*; Bentham Science: Sharjah, UAE, 2012; pp. 66–91.
74. Anderson, T.; Dragicevic, S. A Geosimulation Approach for Data Scarce Environments: Modeling Dynamics of Forest Insect Infestation across Different Landscapes. *ISPRS Int. J. Geo Inf.* **2016**, *5*, 9. [CrossRef]
75. Batty, M.; Heppenstall, A.; Crooks, A.; See, L.M. (Eds.) *Agent-Based Models of Geographical Systems*; Springer: Berlin, Germany, 2012; Volume 164, pp. 1–15.
76. Blaschke, T.; Merschdorf, H. Geographic information science as a multidisciplinary and multiparadigmatic field. *Cartogr. Geogr. Inf. Sci.* **2014**, *41*, 196–213. [CrossRef]
77. Verburg, P.H.; Schot, P.P.; Dijst, M.J.; Veldkamp, A. Land use change modelling: Current practice and research priorities. *GeoJournal* **2004**, *61*, 309–324. [CrossRef]

78. Agarwal, C.; Green, G.M.; Grove, J.M.; Evans, T.P.; Schweik, C.M. *A Review and Assessment of Land-Use Change Models: Dynamics of Space, Time, and Human Choice*; Department of Agriculture, Forest Service, Northeastern Research Station: Newton Square, PA, USA, 2002; p. 62.
79. Silva, E.; Wu, N. Surveying Models in Urban Land Studies. *J. Plan. Lit.* **2012**, *27*, 139–152. [CrossRef]
80. Houet, T.; Schaller, N.; Castets, M.; Gaucherel, C. Improving the simulation of fine-resolution landscape changes by coupling top-down and bottom-up land use and cover changes rules. *Int. J. Geogr. Inf. Sci.* **2014**, *28*, 1848–1876. [CrossRef]
81. Viana, C.M.; Rocha, J. Evaluating Dominant Land Use/Land Cover Changes and Predicting Future Scenario in a Rural Region Using a Memoryless Stochastic Method. *Sustainability* **2020**, *12*, 4332. [CrossRef]
82. Morgado, P.; Gomes, E.; Costa, N. Competing visions? Simulating alternative coastal futures using a GIS-ANN web application. *Ocean. Coast. Manag.* **2014**, *101*, 79–88. [CrossRef]
83. Boavida-Portugal, I.; Ferreira, C.C.; Rocha, J. Where to vacation? An agent-based approach to modelling tourist decision-making process. *Curr. Issues Tour.* **2017**, *20*, 1557–1574. [CrossRef]
84. Houet, T.; Verburg, P.H.; Loveland, T.R. Monitoring and modelling landscape dynamics. *Landsc. Ecol.* **2010**, *25*, 163–167. [CrossRef]
85. Shahumyan, H.; Williams, B.; Petrov, L.; Foley, W. Regional Development Scenario Evaluation through Land Use Modelling and Opportunity Mapping. *Land* **2014**, *3*, 1180–1213. [CrossRef]
86. Silva, E.A.; Clarke, K.C. Calibration of the SLEUTH urban growth model for Lisbon and Porto, Portugal. *Comput. Environ. Urban Syst.* **2002**, *26*, 525–552. [CrossRef]
87. Engelen, G. The theory of self-organization and modelling complex urban systems. *Eur. J. Oper. Res.* **1988**, *37*, 42–57.
88. Pijanowski, B.C.; Brown, D.G.; Shellito, B.A.; Manik, G.A. Using neural networks and GIS to forecast land use changes: A Land Transformation Model. *Comput. Environ. Urban Syst.* **2002**, *26*, 553–575. [CrossRef]
89. Ettema, D.; Jong, K.; Timmermans, H.; Bakema, A. PUMA: Multi-Agent Modelling of Urban Systems Modelling Land-Use Change. In *Modelling Land-Use Change*; Springer: Berlin, Germany, 2007; Volume 90, pp. 237–258.
90. Wagner, P.; Wegener, M. Urban Land Use, Transport and Environment Models. *disP Plan. Rev.* **2007**, *43*, 45–56. [CrossRef]
91. Veldhuisen, J.; Timmermans, H.; Kapoen, L. RAMBLAS: A regional planning model based on the microsimulation of daily activity travel patterns. *Environ. Plan. A* **2000**, *32*, 427–443. [CrossRef]
92. Macal, C.M. Everything you need to know about agent-based modelling and simulation. *J. Simul.* **2016**, *10*, 144–156. [CrossRef]
93. Gounaridis, D.; Chorianopoulos, I.; Symeonakis, E.; Koukoulas, S. A Random Forest-Cellular Automata modelling approach to explore future land use/cover change in Attica (Greece), under different socio-economic realities and scales. *Sci. Total Environ.* **2019**, *646*, 320–335. [CrossRef] [PubMed]
94. Tenedório, J.; Rocha, J. Introductory Chapter: Spatial Analysis, Modelling, and Planning. In *Spatial Analysis, Modelling and Planning*; IntechOpen: London, UK, 2018; pp. 1–13.
95. UN. *Guidelines for Land-Use Planning*; UN: New York, NY, USA, 1993.
96. Adams, V.M.; Pressey, R.L.; Álvarez-Romero, J.G. Using Optimal Land-Use Scenarios to Assess Trade-Offs between Conservation, Development, and Social Values. *PLoS ONE* **2016**, *11*, e0158350. [CrossRef]
97. Morgado, P. Modelação geográfica de indicadores de desenvolvimento sustentável. *Finisterra* **2012**, *37*. [CrossRef]
98. Kurz, T.; Baudains, C. Biodiversity in the Front Yard: An Investigation of Landscape Preference in a Domestic Urban Context. *Environ. Behav.* **2010**, *44*, 166–196. [CrossRef]
99. Bertrand, N.; Cremer-Schulte, D.; Perrin, M. Strategic spatial planning and territorial asymmetries. Grenoble and greater geneva: Two Alpine city regions put to the challenge of coherence. *J. Alp. Res.* **2015**, *103*. [CrossRef]
100. Philbeck, T.; Davis, N. The Fourth Industrial Revolution: Shaping a new era. *J. Int. Aff.* **2018**, *72*, 17–22.
101. Sakr, D. Sustainability and Innovation: The Next Global Industrial Revolution. *J. Clean. Prod.* **2017**, *142*, 3355–3356. [CrossRef]
102. García-Florentino, C.; Maguregui, M.; Ciantelli, C.; Sardella, A.; Bonazza, A.; Queralt, I.; Carrero, J.A.; Natali, C.; Morillas, H.; Arana, G.; et al. Deciphering past and present atmospheric metal pollution of urban

environments: The role of black crusts formed on historical constructions. *J. Clean. Prod.* **2020**, *43*, 118594. [CrossRef]
103. Brennand, C.A.R.L.; Filho, G.P.R.; Maia, G.; Cunha, F.; Guidoni, D.L.; Villas, L.A. Towards a Fog-Enabled Intelligent Transportation System to Reduce Traffic Jam. *Sensors* **2019**, *19*, 3916. [CrossRef]
104. Ho, H.-C.; Lin, S.-W.; Lee, H.-Y.; Huang, C.-C. Evaluation of a Multi-Objective Genetic Algorithm for Low Impact Development in an Overcrowded City. *Water* **2019**, *11*. [CrossRef]
105. Martínez-García, E.; Grossman, V. Explosive dynamics in house prices? An exploration of financial market spillovers in housing markets around the world. *J. Int. Money Finance* **2020**, *101*, 102103. [CrossRef]
106. Deutsche Bank. *Mapping the World's Prices 2019*; Deutsche Bank: London, UK, 2019.
107. Le Goix, R.; Giraud, T.; Cura, R.; Le Corre, T.; Migozzi, J. Who sells to whom in the suburbs? Home price inflation and the dynamics of sellers and buyers in the metropolitan region of Paris, 1996–2012. *PLoS ONE* **2019**, *14*, e0213169. [CrossRef]
108. Frank, A.G.; Dalenogare, L.S.; Ayala, N.F. Industry 4.0 technologies: Implementation patterns in manufacturing companies. *Int. J. Prod. Econ.* **2019**, *210*, 15–26. [CrossRef]
109. Freeman, L.; Urbaczewski, A. Critical Success Factors for Online Education: Longitudinal Results on Program Satisfaction. *Commun. Assoc. Inf. Syst.* **2019**, 630–645. [CrossRef]
110. Felstead, A.; Henseke, G. Assessing the growth of remote working and its consequences for effort, well-being and work-life balance. *New Technol. Work Employ.* **2017**, *32*, 195–212. [CrossRef]
111. Yue, Z.; Ren, H.; Wei, S.; Lin, J.; Gu, M. Angular-momentum nanometrology in an ultrathin plasmonic topological insulator film. *Nat. Commun.* **2018**, *9*, 4413. [CrossRef]
112. Zhang, L.; Liang, Y.-C.; Niyato, D. 6G Visions: Mobile ultra-broadband, super internet-of-things, and artificial intelligence. *China Commun.* **2019**, *16*, 1–14.
113. Deuten, S.; Gómez Vilchez, J.J.; Thiel, C. Analysis and testing of electric car incentive scenarios in the Netherlands and Norway. *Technol. Forecast. Soc. Change* **2020**, *151*, 119847. [CrossRef]
114. IEA. *Global EV Outlook 2019*; IEA: Paris, France, 2019.
115. Torous, J.; Hsin, H. Empowering the digital therapeutic relationship: Virtual clinics for digital health interventions. *npj Digit. Med.* **2018**, *1*, 16. [CrossRef]
116. Castanho, R.A.; Vulevic, A.; Naranjo Gómez, J.M.; Cabezas, J.; Fernández-Pozo, L.; Loures, L.; Kurowska-Pysz, J. Political commitment and transparency as a critical factor to achieve territorial cohesion and sustainable growth. European cross-border projects and strategies. *Reg. Sci. Policy Pract.* **2019**, *11*, 423–435. [CrossRef]
117. Sinsel, S.R.; Riemke, R.L.; Hoffmann, V.H. Challenges and solution technologies for the integration of variable renewable energy sources—A review. *Renew. Energy* **2020**, *145*, 2271–2285. [CrossRef]
118. Gomes, E.; Banos, A.; Abrantes, P.; Rocha, J.; Schläpfer, M. Future land use changes in a peri-urban context: Local stakeholder views. *Sci. Total Environ.* **2020**, *718*, 137381. [CrossRef]
119. Gomes, E.; Abrantes, P.; Banos, A.; Rocha, J. Modelling future land use scenarios based on farmers' intentions and a cellular automata approach. *Land Use Policy* **2019**, *85*, 142–154. [CrossRef]
120. Castree, N. The return of nature? *Cult. Geogr.* **2012**, *19*, 547–552. [CrossRef]
121. Herold, M.; Couclelis, H.; Clarke, K.C. The role of spatial metrics in the analysis and modeling of urban land use change. *Comput. Environ. Urban Syst.* **2005**, *29*, 369–399. [CrossRef]

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Rururban Partnerships: Urban Accessibility and Its Influence on the Stabilization of the Population in Rural Territories (Extremadura, Spain)

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Abstract: The process of population concentration in cities is a worldwide phenomenon—not yet finished—which has led to a widespread rural exodus and abandonment of rural areas. In Spain it occurred very abruptly from 1960, leaving numerous population centers abandoned in the northern half of the country. It is the so-called "empty Spain". This problem has recently transcended from the local to the European level and has become part of all political agendas such as "the fight against the demographic challenge", which the European Commission will finance in the next programming period 2021–2027. However, retaining the population in rural areas is a very complex problem that is difficult to solve. The aim of this article is to show that a polycentric system of towns, well distributed throughout the territory—as happens in Extremadura—has sufficient capacity to stabilize the population in the rural environment and is a viable and global alternative to the demographic challenge through the rururban partnerships and the integrated territorial investments. This article studies, as an empirical reality and demonstration effect, the autonomous community of Extremadura, an inland region bordering Portugal, in the southwest of the Iberian Peninsula, which has no abandoned nucleus and still maintains 50% of its population in rural areas, compared to a national average of less than 20%.

Keywords: accessibility; GIS; partnerships; population; rural territory; territorial planning

1. Introduction

The current process of urban concentration and rural depopulation is due to a territorial organization and a settlement that do not adjust anymore to the current socioeconomic characteristics. In this sense, it could be affirmed that the abandonment of rural areas, especially smaller towns, is a spontaneous adaptation to the thoughtful socioeconomic and technological changes that have occurred especially in recent decades, as well as a logical response from the population to the current demands for quality of life and social well-being. This has led the rural population to concentrate in urban centers and in some regional capitals. This was stated in the Europe 2000 document [1], which already indicated that "European society has therefore become largely an urban society" and that "the urban area becomes a magnet for growth in the region".

Since 1960, Spain has been facing a serious problem of widespread rural depopulation in the northern half of the country, where there are many totally abandoned population centers. As indicated in the Spanish urban agenda [2], "depopulation is fundamentally a territorial problem and one of lack of strategic vision and supra-local development".

Rural depopulation is not just a problem in Spain or in the Mediterranean, it is a burning issue in most EU countries, which is why all the European institutions are currently planning "the fight against the demographic challenge", basically oriented towards aging and rural depopulation. Hernández

Luque [3], in relation to the reform of the CAP for the period 2021–2027, expresses this concern for the future by stating that "the urgency of problems such as depopulation, aging—or limited access to basic services requires innovative responses and greater synergies".

Spain is institutionally addressing the challenge of rural depopulation, which is currently on the political agendas of all administrations. Thus, among the measures of territorial order proposed by the Senate to face the demographic challenge [4], it is indicated that it is necessary to adopt "measures that promote the concept of 'functional region', by fostering 'regional centrality'". Later, the National Commissioner for the Demographic Challenge [5] makes a clear reference to this issue by indicating that "... also the headwaters, the intermediate cities or the small provincial capitals are basic to achieve the dynamization of the spaces in demographic risk...".

References to cities and the major role they should play in stabilizing the rural population are increasingly frequent in all institutions. Cities have become the essence and fundamental axes of development, the nodes that structure the entire territory into a system of urban or functional areas, delimited according to the size and accessibility of each city.

This project seeks to demonstrate, that a polycentric system of cities, as the one of the case of study, Extremadura, is capable of decentralizing socioeconomic development, correcting territorial differences and stabilizing the rural population. This is indicated in the territorial agenda of the European Union 2020 [6] when it points out that "a polycentric and balanced territorial development of the European Union is a key element for achieving territorial cohesion". In opposition to the depopulation of the "emptied Spain", which mainly characterizes the northern half of the Spanish country, the population of Extremadura has been highly stabilized until the recent economic crisis, even in municipalities with less than 1000 inhabitants. Thus, Extremadura is one of the few autonomous communities in Spain that does not have any abandoned municipality. These characteristics could probably be extended to the southern half of Spain and to a large part of the rest of the Mediterranean countries of the EU.

The development of telecommunications and the competitiveness imposed by globalization have forced to the cities and their functional areas to organize themselves in networks and to become more complementary, generating synergies and much broader and more competitive economic spaces. The European spatial development perspective (ESDP, art. 183) [7] considers these urban networks as diversified development strategies, especially regarding the creation of networks of smaller towns in less densely settled and economically weaker regions or border areas (art. 75, 76 and 99), as the only opportunity to overcome development difficulties. It is about generating greater joint synergies for a more harmonious and balanced territorial development.

Copus [8], in relation to these networks and rural development, points to the option of rural–urban relationships more cooperative, sustainable and with ecological production and consumption chains within their own rural hinterlands.

Since the beginning of the last decade of the 20th century, the EU has implemented rural development programs, with the aim of diversifying activities and stabilizing the rural population. Although these programs have contributed to the diversification of rural incomes and the maintenance of the population, the he most optimal results have been achieved in territories where urban networks have promoted the diversification of activities and employment for their rural environment, as well as the provision of facilities and services. This is essential for the quality of life and well-being that today's society demands. Ultimately, integrated rururban development must be key to stabilizing the rural population.

Accordingly, the network of urban initiatives (RIU) [9], which prepared the work for the integrated sustainable urban development strategies (ISUDS), states that "in synthesis, sustainable urban development should be progressively channeled towards functional urban areas and polycentric urban systems and towards renewed forms of rural–urban cooperation". Subsequently, the Spanish urban agenda [2], "it pursues to connect the urban and rural environments" and "promote maximum interconnection between rural and urban areas", proposing a territorial model that takes into account, together with “metropolitan areas, new centralities and functional urban areas where new relationships are generated territorial and agglomeration economies and flows between various municipalities”.

This study proposes a topic that has been widely discussed since the 1990s and that has intensified in the last decade, both at the research level and at the political level: a polycentric urban system of small and medium-sized cities which provide employment and services to their rural areas of influence and, because of this, have contributed to the stability of the rural population. Therefore, it starts from a very consolidated approach and, in principle, it could seem evident and not original. However, in spite of that, it is still to be implemented and developed in EU policies and in most European countries. This is due, largely, to the lack of experiences of success and good practices of rururban development and therefore, to the distrust in the success of a possible financing. As Artmann et al. [10] indicate, “rural–urban partnerships are sometimes regarded as a concept with lacking content, because it is difficult to prove the effectiveness or rural–urban partnerships with hard facts”.

It is our intention to provide with this work, a case study, the autonomous community of Extremadura, an inland region on the border with Portugal in southwest Spain, which is a reference of good practices and rural experiences for both the EU Rural programs and the OECD [11,12] and with a territorial organization of small and medium-sized cities, well distributed over most of the territory, which provide facilities and services, but above all diversified activities, employment and multisectoral income not only to their inhabitants, but also to those in their rural environment and which have contributed to the stabilization of the population in their functional rural areas.

The ESPON Strategy [13] ensures that “making Europe open and polycentric is the most convenient territorial strategy supporting the competitiveness, social cohesion and sustainability goals. The efficiency and quality of the European territory lies in networking cities of all sizes, from local to global level [. . .]. The roadmap to make Europe smart, inclusive and sustainable, requires the European territory to become more open and polycentric”.

For this purpose, it would be desirable to develop integrated rurban policies and investments and to strengthen the main town of the county in peripheral areas. Although these are recommendations from the European institutions, there is no specific funding or instruments for their implementation. This is stated in the opinion of the European committee of the regions [14] on in “the improvement of the implementation of the territorial agenda of the European Union 2020” (2015/C 195/05), which points out the importance of relations between cities and their areas of influence and calls for a “policy approach” that promotes the creation of functional regions. In addition, the Directorate-General for regional and urban policy of EU in its “Opinion on integrated sustainable urban development for the period 2014–2020” [15]) expressed the possibility of having integrated management tools for this as the integrated territorial investments (ITI), community led local development (CLLD), etc.

For the moment, EU policies continue to consider rural development programs and urban development programs separately.

That is why we intend to continue insisting on the need to articulate and promote a polycentric system of cities with integrated territorial investments, with the certainty that the desired effects will be achieved, as has happened in Extremadura, even without any specific funding.

Throughout this study, first it reviewed the recommendations of the EU and the other European institutions with reference to this issue. Second, the methodology used is described, through the selection of the main small cities in Extremadura and the classification of its rural municipalities according to the distance to these small cities. In addition, third, the relationship between urban accessibility and the demographic dynamics of all population centers will be analyzed, with the idea that less accessibility corresponds to more regressive demographic dynamics and greater depopulation. Subsequently, proposals for spatial planning will be offered and conclusions will be drawn.

2. European Policy of Urban and Rural Integration

In this second section, a review is sought of EU policies in relation to polycentrism, partnerships and rurban integration, an approach that is increasingly explicit in the documentation emanating from the various national and European administrations.

The EU, with a certain delay and sectoral approaches, has been articulating policies and instruments to face, separately, the agrarian problems initially and the urban problems later. This was confirmed at the time by the General Director for regional policy, Dirk Ahner [16], when he said "However, the methods used under LEADER and URBAN were confined to rural and urban environments, but without any real interaction between them". Since then, despite the proliferation of institutional documents, very little progress has been made in urban functional integration policies. This is despite the fact that since the end of the 1990s, scientific and political recommendations for integration between the city and the countryside will follow, especially by the European Commission (EC) and the European Parliament. However, according to Copus [8] "It finds that the evidence of significant benefits for rural areas, from either 'growth pole' policies or more recent 'rural–urban cooperation' initiatives, is scant". Along with the European EDORA Project (European development opportunities for rural areas) [17], also the ROBUST project (Rural–Urban Europe) can be mentioned [18] or the ESPON strategy [13], with which policies in favor of integration between urban and rural areas have been studied and recommended. Furthermore, there are OECD studies [19], as well as others carried out by entities such as the Committee on Regional Development (REGI) of the European Parliament, the European committee of the regions (CoR) or Ministers responsible for spatial planning (CEMAT) in their successive informal meetings [6,14,20]. However, there is still no decisive European policy in this regard, possibly because evidence and experiences are lacking.

The agrarian measures were soon reflected in the common agricultural policy (CAP) in view of the problems of the sector. Nonetheless, already in the Single European Act [21] economic and social cohesion was proposed and the environment and rural development began to be discussed, albeit in a very vague manner, this materializing in a communication from the Commission to the Council and Parliament (1988) about "The future of the rural world" [22]. In 1991, the rural development programs (RDPs) were created through the LEADER Approach [23] and later, in 1996, the PRODER program [24] in the Spanish territory.

The "Agenda 2000: For a stronger and wider Union" [25], edited in 1999, modified the CAP and made a specific reference to rural development as "Second Pillar of the CAP". Although the common agricultural policy has been maintained even with modifications, it has tended to further enhance rural development and, since the late 1990s, to greater urban–rural integration, highlighting the essential role that the city should play in its rural environment in all organizations and forums.

As for urban policy, this is even more recent, starting specifically in the Europe 2000 Communication [1]. In this communication, it is pointed out that a more harmonious urban system is necessary, with the impulse of small and medium-sized cities, in order for them to carry out a role of intermediation and bridge between the metropolises and the most depopulated areas, in a clear reference to rural areas. For the first time, there is an indication regarding the integration between the city and the rural environment.

All the above are references that gradually crystallize, first with the Corfu European Council (1994) [26] and then, with the Europe 2000+ Communication [27], where the need for a "systematic strengthening of rural cities" and "the preservation of balance and equity between rural and urban areas" is mentioned. It is done with greater emphasis in the Cork Declaration (1996) [28], about Rural Europe—Perspectives for the Future, in which a determined bet is already made to "reinforce the role of small towns as integral parts of rural areas and key development factors". Given that this objective is stated in point 3, on Diversification, it seems that the city looms as support for diversification of economic and social activity for their rural hinterland, this being an aspect that will take shape at the end of the decade. In the 2nd European Conference on rural development of Salzburg (Austria, 2003) [29], the same theme will continue to be emphasized, indicating in the preamble of its Declaration that "convinced [. . .] a balanced relationship between the countryside and urban areas". However, they are not only mentioned in documents and actions referring to rural areas, but also in the European territorial planning policy, with the design of the ESDP (1999) [7]. In it, the necessary association between the city and the countryside and an endogenous, diversified and efficient development of rural spaces is specified. Furthermore, the ESDP has marked a clear trend towards integration between urban and rural areas, trying to "overcome the outdated dualism between city and countryside" (Art. 65:21) and later insisting that it should be "a re-evaluation of the relationship between city and countryside as a functional, spatial entity with diverse relationships and interdependencies" (Art. 92:25–26). The strategy even sentences that "the future of many rural areas is becoming increasingly related to the development of urban settlements in rural areas" and raises a "polycentric urban system where the small and medium-sized towns and their inter-dependencies form important hubs and links, especially for rural regions". Moreover, it indicates that "the towns in the countryside, therefore, require particular attention in the preparation of integrated rural development strategies" (Art. 93:26) sharing the responsibility for their mutual development. Hildebrand expressed himself in similar terms [30].

In the opinion of the European committee of the regions (CoR) about the European spatial development perspective (ESDP) [31], four areas of action are proposed. One of these areas deals with the intention of creates the partnership between urban and rural areas and the role of the second ones. Moreover, CoR establishes that "a polycentric urban system where the small and medium-sized towns and their inter-dependencies form important hubs and links, especially for rural regions" (C93) and emphasizing that "in rural problem regions only these towns are capable of offering infrastructure and services for economic activities in the region and easing access to the bigger labor markets".

The proposals for integration between the city and the countryside are becoming increasingly explicit and assiduous in all the documentation issued by the EU.

The socioeconomic development of rural territories necessarily involves the generation and diversification of employment and income unrelated to the agrarian sector and in relation to its neighboring cities. In this sense, the Agenda 2000 [25] and the 2nd European Conference on rural development of Salzburg [29] stipulate that it is necessary to "recognize that the development of rural areas can no longer be based on agriculture alone, and that diversification both within and beyond the agricultural sector is indispensable".

In 2004, in the proposal for a council regulation laying down general provisions on the European regional development fund, the European social fund and the cohesion Fund [32], it is stated that "in view of the importance of the urban dimension and the contribution of towns and cities, particularly medium-sized ones, to regional development, greater account should be taken ... ". Furthermore, it is specified that "the assistance shall, appropriately, support urban regeneration particularly as part of regional development and the renewal of rural areas, etc., through economic diversification" (Art. 3.3:25), taking a further step towards the economic endowment and financing of this urban–rural territorial policy, which at this time has not yet been achieved. It also insists on the "reinforcement of links between urban and rural areas" (Art. 9.4:12).

The reflections and recommendations that are established by European Commission in the Third report on economic and social cohesion: A new partnership for cohesion convergence competitiveness cooperation are deeper and more extensive [33]. Thus, in this report, the development of rural areas is directly linked to proximity to their cities "whereas a number of rural areas are suffering from inadequate economic links with neighboring small and medium-sized towns and their economies are often weakening as a result [...] while rural areas where there are no towns of any size are experiencing falling population and a decline in the availability of basic services". Moreover, this same report establishes three types of rural areas according to the extent of their integration into the rest of the economy and their links with large centers of activity:

(1) *Areas integrated into the global economy*, which are experiencing economic growth;
(2) Intermediate *rural areas* relatively far from urban centers, but with good transport links and reasonably well-developed infrastructure, which tend to have stable population and to be in the process of diversifying economically;
(3) *Isolated rural areas* that are sparsely populated and often situated in peripheral areas, far from urban centers and main transport networks. Their population is generally dependent on agriculture

and in decline, as well as they tend to have an aging population, poor infrastructure endowment, a low level of basic services, low income per head and a poorly qualified work force. Furthermore, these areas are not usually well integrated into the global economy, so there is a need to develop links with towns even if they are relatively far away.

In Leipzig (2007) [34], in The Territorial Agenda of EU, it is stated that "city regions are thereby surrounded by urban centers and rurally characterized areas and rural areas are surrounded by regional centers and small and medium-sized towns. This is what we call urban–rural partnership", which is a concept that the OECD later endorses and promotes [19], linking this whole approach with transport networks, mobility and accessibility, as well as with new forms of territorial governance between cities and their functional rural areas.

In response to the previous Leipzig Conference, the EU (2008–2009) launches the "Green Paper on Territorial Cohesion, the way ahead" [35], in which it points out that "small and medium-sized towns are more important than their size may suggest, providing infrastructure and services that are key to avoiding rural depopulation and urban drift". At the same time, it is emphasized that "regions and cities are the territorial platform where policies get connected and gain added value".

In the territorial agenda 2020 (Gödöllő, 2011) [6] it is pointed out that "we acknowledge the diverse links that urban and rural territories throughout Europe can have with each other, ranging from peri-urban to peripheral rural regions. Urban–rural interdependence should be recognized through integrated governance and planning based on broad partnership [...]. In rural areas, small and medium-sized towns play a crucial role; therefore, it is important to improve the accessibility of urban centers from related rural territories to ensure the necessary availability of job opportunities and services of general interest". Likewise, it is also recognized in this Agenda [6] that "rural, peripheral and sparsely populated territories may need to enhance their accessibility, foster entrepreneurship and build strong local capacities [...]. Special attention may need to be paid to underdeveloped peripheral rural and sparsely populated areas where disadvantaged social groups often suffer from segregation. Territories facing severe depopulation should have long-term solutions to maintain their economic activity by enhancing job creation, attractive living conditions and public services for inhabitants and businesses".

In the Informal Meeting of EU Ministers Responsible for Territorial Cohesion and Urban Matters Letonia with the Riga Declaration (2015) [36], it is stated that:

"2. Small and medium-sized urban areas (SMUAS) fulfil important economic and social functions being centers for jobs, public and private services, nodes of local transport, etc. 3. SMUAS are, therefore, essential to avoid rural depopulation and urban drift, promoting more balanced overall regional development. Yet they also contribute to development of metropolitan areas being connected in a polycentric network".

The opinion of the European committee of the regions [14] recognizes that "the effective functioning of small and medium-sized towns and the diversification of rural economies are essential steps towards fully implementing the territorial agenda" asserting that "they play an active role in ensuring well-being and prosperity to the inhabitants of surrounding rural areas because they are centers for employment, services, local transport hubs and guide growing transport demand. They therefore play a role in limiting depopulation of urban and rural areas".

In the CORK 2.0 Declaration "A better life in rural areas" (2016, 5) [37], the European Union recognizes that "EU support should strengthen rural–urban linkages and align the sustainable development of both rural and urban areas".

In the Pact of Amsterdam [38], the report urban agenda for the EU is drafted and indicates that "a growing number of urban challenges are of a local nature, but require a wider territorial solution (including urban–rural linkage) and cooperation within functional urban areas [...] urban authorities therefore need to cooperate within their functional areas and with their surrounding regions, connecting and reinforcing territorial and urban policies".

Finally, in the Opinion of the European committee of the regions (127th Plenary Session, 2018) [20] it is requested that “the integrated territorial investments (ITI) approach should be more fully exploited beyond urban areas, where it is most frequently used now, and implemented more widely in rural and functional areas”, although a multilevel governance framework is lacking.

In Spain, as in most European countries, these recommendations and agreements have not been taken into account, despite the fact that the competent Ministries have included it in different documents, as in the cited Spanish urban agenda [2], but with little result.

In the case of Extremadura (study area of this work), the role of the city in rural development is only mentioned in the Territorial Study of Extremadura II [39], where it is stipulated that “the balance and viability of rural areas is basically conditioned by the dynamism of medium-sized cities that must constitute an authentic interrelated urban framework that allows the integration of these rural areas with the neuralgic nodes of the urban system and with the main areas of activity and development of the autonomous community ”.

More specifically, the Government of Extremadura pronounces itself, through the Ministry of the Environment and Countryside, Agrarian Policies and Territory [40], that mentions the Coworking and Networking Rural–urban initiatives “with the purpose of advancing a territorial strategic vision on the consideration of rural–urban spaces as a single geographic space and applying solutions adapted to the needs of both on the same vision on them”.

All are proposals and initiatives that, however, have not had sufficient instruments or applicability for optimal development. In any case, practically from the beginning of the autonomic phase (early 1980s) the regional government of Extremadura undertook a process of decentralization of administrative, facilities, services and productive and social infrastructures towards the main cities. This has contributed to their empowerment as county seats, their development and that of their rural environments, relying on the improvement of road infrastructure and a balanced territorial distribution of cities. With this, it has been possible to stop the emigration bleeding and stabilize the rural population to a great extent [41].

Subsequently, in Law 11/2018, of 21 December, on “Territorial planning and sustainable urban planning of Extremadura” (BOE, 35, 9 February 2019) [42], it is indicated that “finding the balance between rural and urban has been the center of the policies for the regional government of Extremadura since its constitution”. Undoubtedly, an important effort has been made in the decentralization of facilities and services to the main cities, although there are still extensive peripheral areas, very isolated and inaccessible, without county seats in some cases and, in others, with poorly developed towns in backward environments with regressive demographic dynamics. In any case, as in the rest of Spain, a decided urban–rural comprehensive development policy is lacking, which has sought to articulate in the Territorial Strategy for the Demographic Challenge and Territorial Balance in Extremadura, already proposed in the CES Report [41].

3. Materials and Methods

As discussed in the introduction, cities are the axes of economic and social life, but increasingly rapid changes, especially technological ones, have caused disparate transformations in the urban system and rururban relations. Thus, Copus [8] study about “functional region failure” and new theoretical trends, some still incipient, which do not have the corresponding support, either practical or applied in European policies and programs. While in agreement with Copus [8], it must be borne in mind that in regions such as Extremadura and in other areas and countries of Southern Europe, traditionally agrarian and more backward, a traditional urban system still prevails with a set of small and medium-sized cities poorly hierarchized and disorganized in permanent competition and, therefore, quite isolated. However, these areas structure their respective territories or functional areas, although not the regional space as they are not organized through cooperation or complementary networks. In any case, they have formed a very stable, rigid and unalterable structure for decades, without the ability to adapt to the changes and transformations that are taking place on a global scale. As Pillet [43] states, the Spanish urban system, although it was reorganized, presents a poor hierarchization, is unbalanced and has serious difficulties for territorial structuring.

From this perspective, it is difficult for cities to radiate development to their rural areas, but they make them participants in their own development, as they need the labor reserve of this rural environment. Thus, the urban areas collaborate and cooperate with their respective functional areas with a diversified offer of employment unrelated to the agricultural sector and with the generation of a system of complementary multi sectoral incomes that allow a decent standard of living for the rural population. Consequently, rural population is also endowed with proximity facilities and services, stabilizing its population and promoting new rural dynamics.

In Extremadura, cities and their functional areas form a well distributed (although not organized) inherited polycentric system throughout most of the territory. This has allowed the stabilization of their population from 1980 or 1990 to 2012, at which time the crisis reached its greatest impact and reversed the previous trend.

In this and other Spanish regions, since the 80s of the last century, a set of interactions was generated between cities and their rural environments that are not normalized or organized, nor do they depend on specific policies or financing, so they are spontaneous and depend on personal decisions. As Berdegué and Meynard state [44], "functional territories are [...] social constructions, that is, spaces that emerge and acquire identity from the life and concrete activity of social actors over time".

This urban system articulates functional areas that are not very dynamic, but very open. In some cases, the rural population decided to migrate to the cities and, in other cases, it was integrated into urban development through increasing mobility, highly changing and inherent in modern-day society. As Velázquez and Estebaranz say [45], "it is possible to speak of a relocation of the rural population, since the most isolated rural areas are emptying out while a concentration of this population is taking place in those closest to the urban centers".

The general hypothesis of this study (see Figure 1) is based on the fact that the rural stability of Extremadura is mainly due to a territorial organization formed by a polycentric system of cities well distributed in most of the regional territory that provide facilities and services and, above all, diversified activities, employment and multi sectoral incomes not only to its inhabitants, but also to those of their rural environments, contributing to the stabilization of their rural functional areas. It is referred to in the graph as urban accessibility and demographic dynamism.

This more generic hypothesis contains two other more specific ones, according to its content: urban system and accessibility.

(a) The first hypothesis is based on the consideration that Extremadura has a system of cities well distributed throughout the territory, forming a polycentric urban system. To respond to this hypothesis, the main cities of the region have been selected, those with more than 10,000 inhabitants, which according to the criteria of the National statistics institute (INE) are the nuclei considered to be urban in Spain. However, in addition, resorting to the evolution of the population, they are the only nuclei that present a positive demographic trend throughout the 20th century until very recently. They are located in the most developed areas with population densities around the national averages. All the municipalities below this threshold, on the other hand, have a negative evolution.

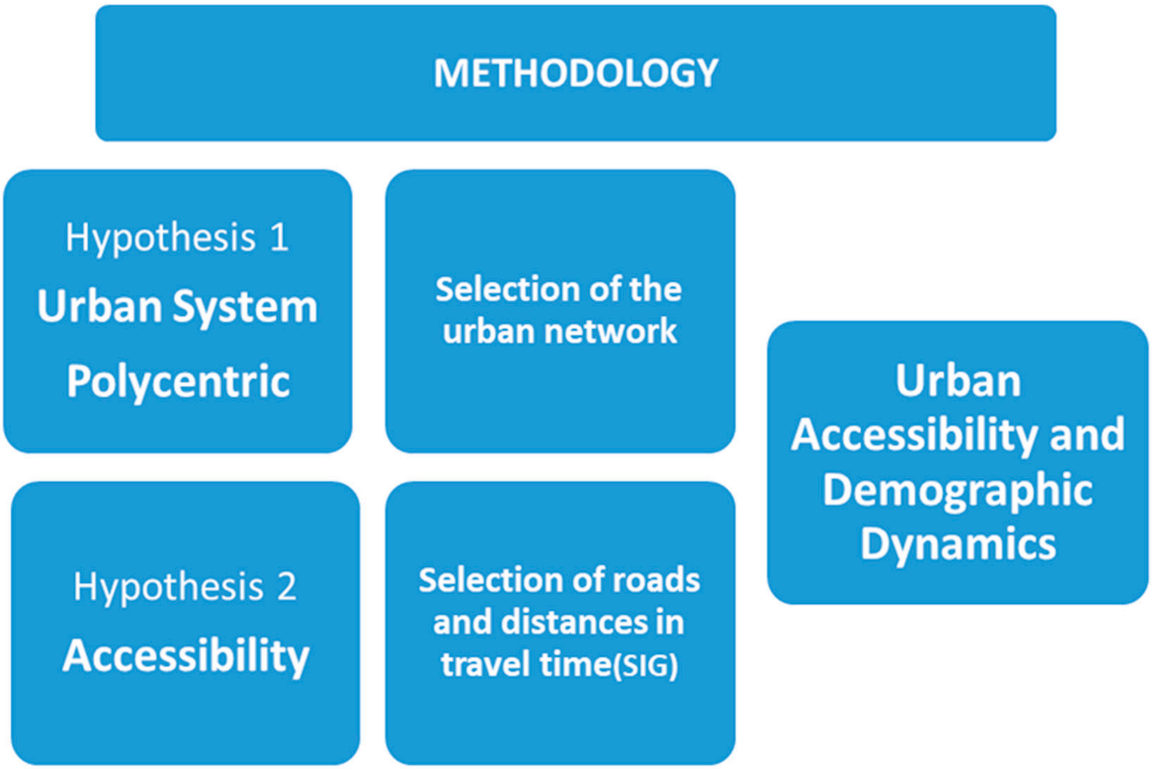

Figure 1. Methodology and hypothesis. Source: the authors.

Although population volume is often used to establish urban rank and hierarchy, since population size is an important variable, it cannot be an exclusive or definitive criterion, due to the diversity of the territorial structures of the Spanish population. As Precedo indicates [46] "a Galician settlement with a thousand inhabitants can achieve the same organizing function as an Andalusian town with more than 10,000 inhabitants". Other authors have resorted to market share, trade as the most characteristic activity, administrative services, public transport concessions, etc., and, in the Report on Large Cities in Spain (2001), the use of various criteria or variables together with that referring to the population is recommended.

In the case of Extremadura, Sánchez Zabala [47] applied a multivariate analysis and Arenal-Clave, in the System of Cities of Extremadura [48], initially classifies urban settlements according to their population, but also in relation to a synthetic index of functionality, which is determined by public and private services and wholesale commercial distribution. The results of these studies could have been used, but the time that has passed leads us to adopt the decision to consider the commercial areas together with the population variable, since they are a very distinctive urban indicator. Only cities with a definite urban rank are able to articulate the system of commercial areas that, in short, come to be functional areas.

For this, it has been decided to use the main cities in the region according to the Socioeconomic Atlas of Extremadura 2019 [49], from the Institute of Statistics of Extremadura. This document dedicates his fourth volume to the commercial areas in the region with enough territorial precision. They are 12 small cities than 10,000 inhabitants, and according to SNI (Statistic National Institute) criteria are considered as urban. Furthermore, they are the only municipalities that show a positive demographic trend throughout the 20th century until very recently. These are located in the most developed areas and with population densities around the national averages. Municipalities below this threshold, on the contrary, have a negative evolution. In Extremadura, there are only two cities that have little more than 10,000 inhabitants (Olivenza and Villafranca de los Barros) and that are not the head of commercial areas according to the Socioeconomic Atlas of Extremadura 2019 [49]. This is because Olivenza is located a few kilometers from the main city of Extremadura, Badajoz and other small cities as Villafranca de los Barros, Almendralejo and Zafra. Therefore, Olivenza is strangled and have not been able to develop its own commercial area. Moreover, so it has not been added as small cities of this analysis. In the opposite case, Trujillo appears which has less than 10,000 inhabitants, but has an extensive traditional commercial area due to its geographic location. Moreover, therefore, in this case, Trujillo has been added to this analysis as a small city.

(b) In the second specific hypothesis (Figure 1), which concerns accessibility, it is assumed that urban areas are articulated according to distance and the transport system and accessibility, with an influence that is degraded according to the time and resources invested in travel.

To test the hypothesis, that is, that the urban areas are articulated according to distance and the transport system, with an influence that is degrading according to time and the resources invested in travel, that is, depending on accessibility, the national road map (from the Ministry of transport, mobility and urban agenda) and the road map of the regional government have been used. It seems reasonable that this road network is that maintains the weight of current mobility and rururban interactions. With the twelve urban centers, the minimum travel times in minutes (impedance) have been obtained from each of the remaining 376 municipalities in the region to the closest city among the twelve ones selected following methodologies already used in previous work [50].

It was determined to calculate the time taken from the rural municipalities (less than 10,000 inhabitants) to the 12 small cities. For that, it was necessary to transform the polygonal layer of the municipalities, without taking into account those disseminated, to a dot layer that represent the centroids to calculate, later, their distance to the closest urban center (using the vertices generated). It is necessary to note that the study of accessibility is based on graph theory (these are a collection of nodes) [51,52]. The nodes correspond to the centroids of the population centers, which are connected by edges that are all communication paths. Thus, it is possible to know which node is attached to each edge to calculate the travel time between both nodes. Considering this, the minimum travel time of each population rural center to the nearest point of the urban ones are calculated in this paper. For this, it is necessary to know the hierarchy of the network and rely on impedance since it is a fundamental element in the study of accessibility [53]. The impedance is obtained in minutes and it is the minimum time for a vehicle (in this case, a car) from a population rural center to the nearest urban center. It is then obtained with network analyst tools from a GIS (closest facility). Subsequently, the IDW (inverse distance weight) method was used to capture the minimum travel time on a map, which allows interpolating cell values by combining a set of points to determine the inverse distance of these values [50,54,55].

Then, three ranges of municipalities have been established: those closest to the small cities (with a travel time of less than 15 min), those located between 15 and 30 min and the most remote and peripheral (with more than 30 min of displacement). Other studies and even the department for regional and urban regional and urban policy (DG REGIO), which is based on OECD studies, reach up to 60 min and Reig the alt. [56] reduces it for Spain to 45 min, since at the national level, if it is reduced further, most of the population would be in a situation of inaccessibility.

When descending to a regional scale, the territorial organization is very diverse, in such a way that in this region the influence of small cities or simple county seats is very small, sometimes barely exceeding 15 min, which is why we have estimated 30 min as the maximum limit for rururban interrelations. On the other hand, this region does not have the highway system that exists in other Spanish or European regions and, although it has an acceptable road system (average of 95 km/h), the 60 min journey time (even the 45 one) seems to us to be very excessive, especially for some health and education services. In any case, it will be possible to verify if the decision is correct or not when comparing the demographic variables between the ranges of municipalities and when ascertaining the volume of population within this radius.

Finally, in the discussion section, it is intended to insert a proposal to integrate most the regional population in the maximum environment of 30 min of travel.

4. Results

4.1. Urban Polycentrism in Rural Areas

The initial result has been the twelve cities that appear in Figure 2. This model basically coincides, although with small variations, with the results obtained by Sánchez Zabala [47] and its multivariate analysis and by Arenal-Clave [48], who used other criteria, as mentioned. This demonstrates the strength of the urban system, its territorial roots and its temporary stability. These are small and medium-sized cities in which the service sector prevails, highlighting commercial activity and transport, which fits into the schemes proposed by different authors for quite some time for other areas of Spain. Estébanez and Martín Lou [57] state that “commercial and service connections between centers are what determine a system of central places, especially in regions with a dominant agrarian economy”. Precedo [46] indicates that “there is a relationship between economic development and the tertiary level of cities [. . .] especially in small cities”.

Despite the elapsed time, according to previous references, the characterization of small cities in the region has remained practically unchanged. The main cities, coincide with the largest populations and with the most developed and extensive functional areas, are also a temporal constant. This network, which is identical in all the studies mentioned since 1990 despite applying different criteria and techniques, is formed by the two provincial capitals (Badajoz and Cáceres), which would occupy the highest rank (coincide with the range of population between 60,000 and 150,000 inhabitants); the autonomous capital (Mérida) and Plasencia, in a second rank (range from 40,000 to 60,000 inhabitants); and the rest, in a third rank: Coria and Navalmoral, which flank Plasencia, forming the northern axis; Trujillo, as a subarea of Cáceres; in the central axis of Las Vegas del Guadiana, Montijo, Don Benito and Villanueva de la Serena; and, further south, Almendralejo and Zafra (range from 10,000 to 40,000 inhabitants).

In the map, the two essential factors to explain the location of the small cities and their consequent development are represented; these are the topography and the system of the elementary main roads (national main roads only).

In this sense, it should be noted that all the small cities (except Cáceres and Trujillo) are located in the sedimentary basins, which are historically the most productive especially because of their irrigation in the middle of the last century. They are the irrigated areas in the north of the region (in the tributaries of the right bank of the Tagus River) and in the center (in the plains of the Guadiana River) that extend south through the sedimentary basin of Tierra de Barros. At the same time as they were irrigated, their productions were linked to agribusiness, achieving the highest levels of development and population density in the region, which led to a more progressive demographic dynamic and the stabilization of the rural population in their respective areas of influence.

In a traditionally agrarian region like Extremadura, the population has tended to be concentrated in the most productive agrarian areas. This is also verified by Arenal-Clave [48], which indicates that “the organization and arrangement of the constituent elements of the urban system are totally related to the spatial organization of the agrarian productive base”.

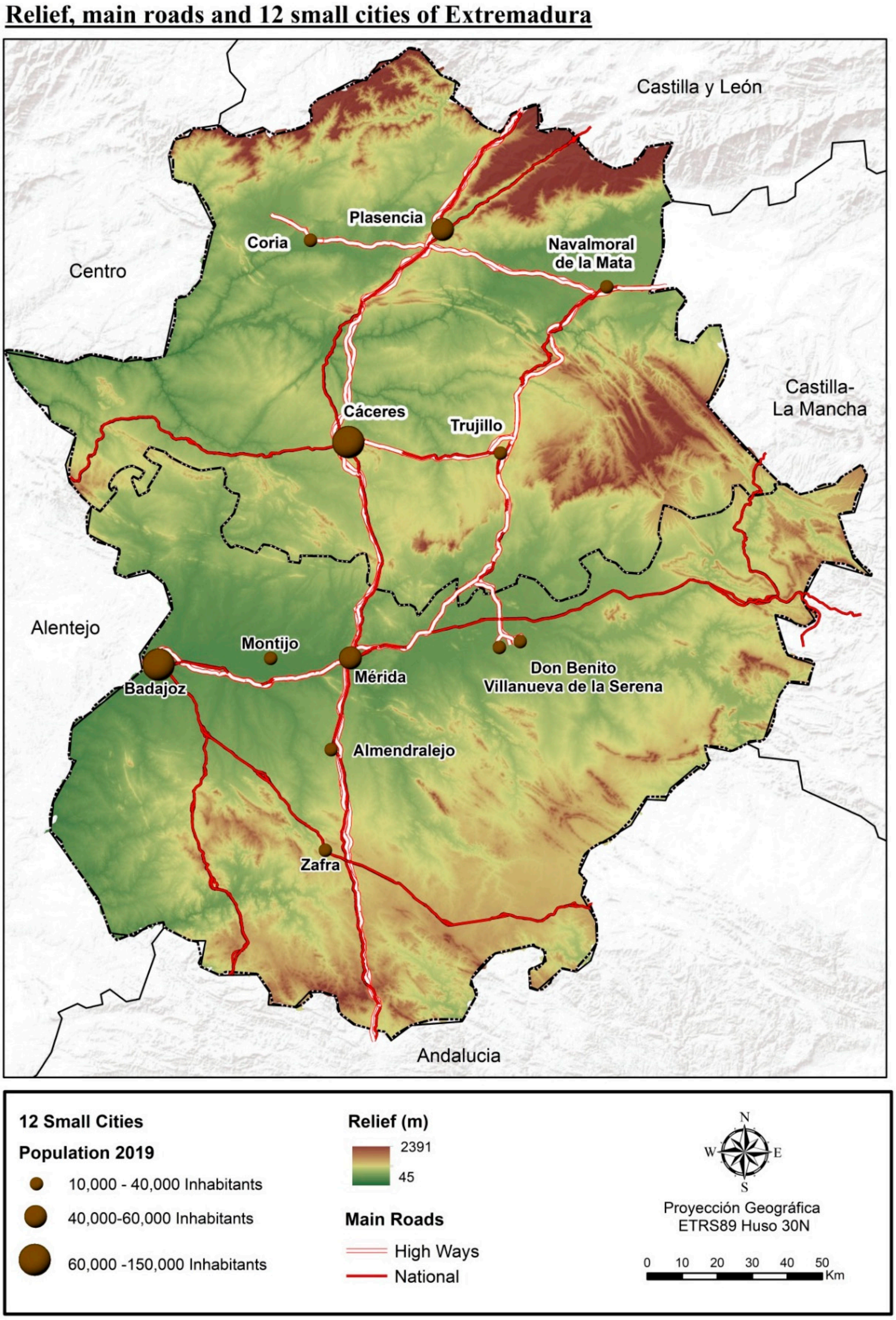

Figure 2. Relief, main roads and 12 small cities of Extremadura. Source: the authors, based on the National Geographic Institute (NGI) and Atlas of Extremadura 2019.

The second factor to explain this location is the transport system, especially the A-66 main road (Sevilla-Gijón), which crosses the region in a north–south direction and the A-5 main road (Madrid-Lisbon), with a northeast direction, due to its importance in communications, in the generation of activities and employment and in the structuring of the regional territory. All the small cities of the network in the region are located around the two mentioned main roads, except Coria and Don Benito-Villanueva de La Serena, although they are connected to them through two other regional main roads (EX-A1 and EX-A2). Thus, a polycentric urban system is generated, although with a very central extension in the region made up of two transversal axes along the two large sedimentary basins (Tagus River and Guadiana River—Tierra de Barros) and a north–south longitudinal axis that crosses them and communicates them. Along with these more developed areas, there are quite isolated and inaccessible peripheral areas, both due to the distance to the main cities and due to deficiencies in the transport system, with population densities of less than 10 inhabitants per km^2. These are the most backward rural areas with the lowest socioeconomic development and with the most regressive demographic behavior, which shows that, in fact, there is a clear correlation between the distance to the closest cities, urban accessibility and socioeconomic development, what is supported by the European Commission in the ESDP [7]. These are areas in which an agrarian economy persists with adverse factors such as those derived from the relief (mountainous areas of the Central System, to the north; Montes de Toledo, to the east; and Sierra Morena, to the south; or riparian areas because of the deep recess of the Tagus River and its entire dense subsidiary river network). In other cases, these are historical factors, as the case of the Spanish-Portuguese border (to the west), which has acted as an impassable and rigid barrier and repelled infrastructure and investment on both sides.

4.2. Urban Accessibility and Stabilization of the Rural Population

Urban influence is gradually degrading until it disappears with distance and travel times for reasons of efficiency and cost. The different areas of influence are spontaneously delimited and conform naturally depending on the urban range and accessibility of each small city. To verify it and as previously mentioned, three ranges were established, with all the municipalities in the region, delimited according to the travel time to the closest city among the twelve selected (less than 15 min, from 15 to 30 and more than 30). The objective is to obtain databases and detect to what extent small cities are influencing the stability of the population in rural areas, which is only possible through the diversification of activities, employment and income, and ultimately, through the decentralization of territorial development (Figure 3).

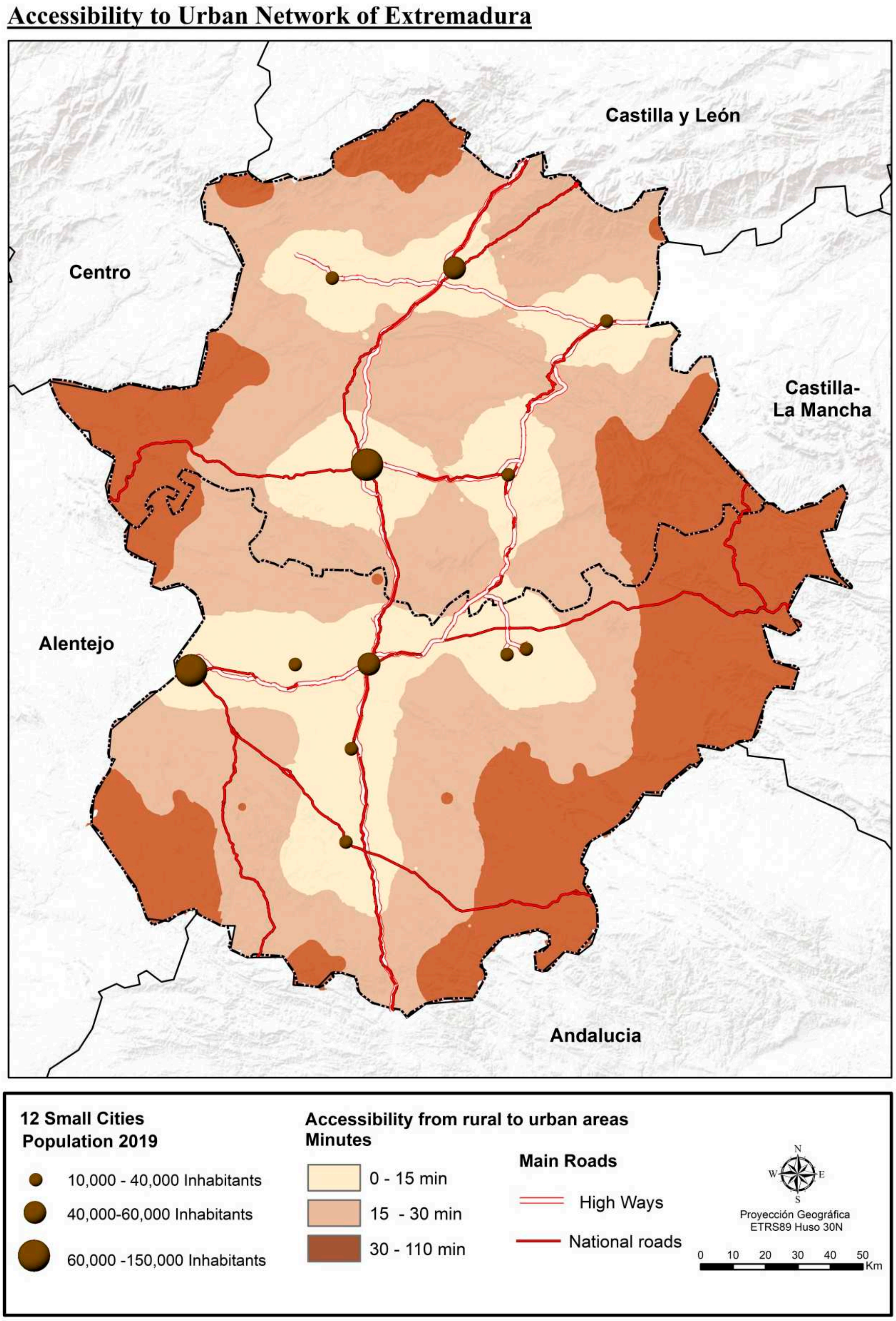

Figure 3. Accessibility to urban network of Extremadura. Source: the authors.

The population of the 12 cities with the highest urban rank does not reach 50%, so it can be deduced that the other half lives in nuclei with less than 10,000 inhabitants, being then Extremadura the Spanish region with the largest rural population in the country. Later, although it has been mentioned that these are small rural cities and there are no large urban concentrations, it must be considered that 66% of the Extremadura population lives less than 15 min of travel to one of these 12 small cities and 87% less than 30 min. Therefore, there is a less population that is distributed over a very peripheral fringe that is very isolated and inaccessible. In addition, other adverse factors for their development, almost exclusively agrarian, should be analyzed in these areas, such as the mountainous reliefs of the north, east and south of the region, in addition to the rigid and limiting border with Portugal to the west. These are the most depressed areas of Extremadura and with persistent emigration and regressive demographic dynamics, so they do not exceed 10 inhabitants/km^2.

Regarding the evolution of the population (Table 1), it is verified that the small cities have experienced a growth of 84.5% from 1950 to the present. The rural areas have registered losses directly proportional to the distance, in such a way that the municipalities located in the perimeter of the 15-min journey to the small cities show a decrease of close to 28%. While, in the range up to 30 min, the losses already exceed 50% of its population (double that in the municipalities closest to the small cities).

Finally, in the most remote municipalities (with travel times greater than 30 min), the losses exceed 60%. Therefore, the existing correlation between urban accessibility and population evolution is evident, or, in other words, the influence of small cities in stabilizing the population or slowing down the processes of rural depopulation.

Table 1. Evolution of the population (1950 = 100).

	Small Cities	<15′	15–30′	>30′
1950	100.0	100.0	100.0	100.0
1960	116.2	102.9	97.0	93.1
1970	125.4	83.8	71.3	69.2
1975	127.6	77.5	64.8	59.9
1981	141.1	72.3	59.3	54.2
1986	155.2	74.5	58.5	53.6
1991	159.0	72.0	54.4	48.4
1996	157.8	75.9	55.9	48.7
2001	163.7	75.6	54.1	46.5
2006	174.7	75.6	52.4	44.2
2011	184.9	76.6	51.8	42.9
2016	186.7	75.2	49.9	40.9
2019	184.5	72.3	47.4	38.7

Source: the authors based on the National Statistics Institute (2020).

Without a doubt, the size of the municipalities is also another factor of depopulation, due to the limitations of the smaller towns, since they do not have the most essential facilities and services or even more employment than that generated in the agricultural sector with permanent and declining labor surpluses, especially in smallholder areas. However, in Extremadura, even municipalities with less than a thousand inhabitants have remained stabilized between 1990 and 2010, although it has had a slight regressive trend due to the effect of quite negative natural growth.

In this case, the distance variable is more defining than the one referring to the size of the population centers, since the small municipalities of irrigated land and those closest to the small cities, which have an acceptable dynamism, contrast those found in the peripheral and mountainous areas and that are at serious risk of depopulation. As Copus [8] indicates, a "complex mix of socioeconomic processes, some sensitive to spatial proximity, others 'liberated' by transport and IT improvements, now driven by 'organized proximity" is developing.

As seen in Figure 4 and Table 2, the degradation of the values with distance remains constant throughout the period studied. This is proof that the city system, already consolidated in the middle of the last century, was already exerting its influence, although much more limited to the closest and most accessible municipalities.

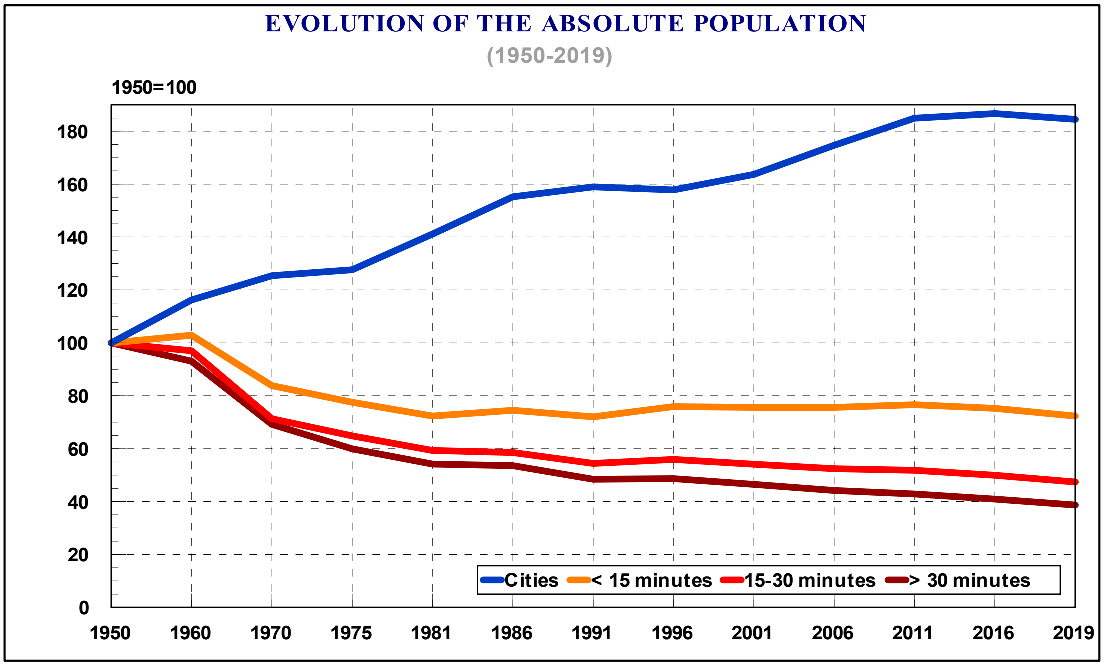

Figure 4. Evolution of the absolute population. Source: the authors, based on National Statistics Institute (2020).

First, the intense losses in all rural areas between 1960 and 1981 can be seen, a period in which the municipalities of the two most peripheral fringes lost more than 40% of their population due to the rural exodus. These losses began to diminish in 1981 in all rural areas, but largely after 1991, especially in areas closer to small cities. However, the stability described is considered "regressive" due to the effects of increasingly negative natural growth and not so much due to emigration, as will be seen below.

The rural municipalities with greater accessibility to the cities separated from the rest very early, in 1960, since their proximity allowed their population to move to the cities through public transport. The towns on the other two most distant fringes presented a superimposed trend until 1970, from which time the road network, public transport and the availability of own vehicles were improved. In short, the accessibility to the small cities was improved and the population of the municipalities a little further away (with movements between 15 and 30 min) began to move to the cities, distancing themselves from the more distant towns and stabilizing their population. There are no great differences between the municipalities of the two most peripheral fringes, but there is a decoupling that was increasing imperceptibly, but constantly.

It is necessary to take into account the strong degradation of values after 15 min of travel, since cities are small with a limited urban range and have a limited influence beyond the distance from which a significant gap between some municipalities and others is appreciated. In addition, it is necessary to point out the intense differences between the demographic behavior in the small cities and that already observed in the rural municipalities closest to them. This is a consequence not so much of current factors, but of emigration from the fifties to the eighties of the century past, whose negative effects reach to the present and are still projected into the future.

Regarding the distribution of the regional population of the four ranges of municipalities (the small cities and their three areas of influence) (Table 2), it should be noted that, in 1950, only 20% of the population lived in the small cities, which would reach up to 40% considering the municipalities within 15 min compared to 26% of the population that was distributed in the most peripheral areas.

Table 2. Proportion of the population according to the accessibility of the municipalities.

	Small Cities	<15 min	15–30 min	>30 min	Total Population
1950	20.4	18.9	34.7	25.9	100
1960	23.5	19.3	33.3	23.9	1000
1970	30.5	18.8	29.4	21.3	100
1975	33.1	18.6	28.5	19.7	100
1981	37.4	17.7	26.7	18.2	100
1986	39.6	17.6	25.4	17.4	100
1991	41.9	17.6	24.4	16.2	100
1996	41.0	18.3	24.7	16.1	100
2001	42.6	18.2	23.9	15.3	100
2006	44.8	18.0	22.8	14.4	100
2011	46.4	17.8	22.1	13.7	100
2016	47.5	17.7	21.6	13.2	100
2019	48.4	17.6	21.1	12.9	100

Source: the authors based on the National Statistics Institute (2020).

Currently, almost 50% of the population lives in the small cities and only 13% live in the most inaccessible areas, whose proportion of the population has been cut in half. For their part, the municipalities within 15 min have kept their population very stable, with a loss of only one percentage point, despite the emigration they have suffered. Something similar occurs with the towns located on the border from 15 to 30 min, which register moderate losses, although they already reach seven percentage points.

Thus, the evolution of the absolute population is nothing more than a synthesis of the vital events that demographic dynamics gathers, so that the variables of Gross Birth Rate, Gross Mortality Rate, Vegetative Growth Rate and Migratory Balance Rate also maintain a degradation proportional to distance and accessibility, as can be seen in the following table. As Oliveira states [58], "there is positive growth spillovers from urban to rural regions in terms of population. These effects are decreasing with distance".

The degradation based on accessibility is especially evident in the natural growth variable, as reflected in Table 3 and Figure 5. Natural growth is a synthesis variable in which only the small cities still have a slightly positive balance close to zero increase. Thus, the differences between the rest of the municipalities are very sharp and constant and with a very negative trend throughout the entire period. Currently, the values range from −3.9 per thousand (municipalities closest to the small cities) to −9.5 per thousand (for the most remote municipalities).

Table 3. Urban accessibility and demographic dynamics.

	Gross Birth Rate				Gross Mortality Rate			
	Small Cities	**<15 min**	**15–30 min**	**<30 min**	**Small Cities**	**<15 min**	**15–30 min**	**<30 min**
1986–1990	13.5	13.2	12	11	7.3	9.8	11.2	12.3
1991–1995	12.2	11.6	10	9.1	7.5	9.7	11.3	13
1996–2000	10.8	9.7	8.5	7.8	8	10	11.2	12.6
2001–2005	10.9	8.9	7.7	6.9	8.1	10.1	11.4	13
2006–2010	11.6	8.6	7.2	6.6	7.6	10.2	11.3	13.4
2011–2015	10.1	7.9	6.7	6	7.8	10.5	12.2	13.9
2016–2019	8.9	7.5	6.3	6	7.9	11.4	13	15.1
	Vegetative Growth Rate				**Migratory Balance Rate**			
	Small Cities	**<15 min**	**15–30 min**	**<30 min**	**Small Cities**	**<15 min**	**15–30 min**	**<30 min**
1986–1990	6.2	3.3	0.9	−1.3	−1.3	−10.2	−15.3	−19
1991–1995	4.7	1.8	−1.3	−3.9	−6.2	8.6	6.7	5.2
1996–2000	2.8	−0.3	−2.7	−4.8	4.6	−0.3	−4.1	−4.6
2001–2005	2.8	−1.2	−3.7	−6.1	10.2	0.3	−2	−4
2006–2010	4	−1.6	−4.1	−6.8	7.4	4.1	1.8	0.7
2011–2015	2.3	−2.6	−5.4	−8	−0.3	−1.1	−1.8	−1.6
2016–2019	1	−3.9	−6.7	−9.1	−4.9	−7	−7.2	−9.5

Source: the authors based on the National Statistics Institute (2020).

The most distant municipalities started the 1980s with negative values. Then, in the early 1990s, towns with 15 to 30 min of travel had negative natural growth. Later, towards the end of the century, the municipalities closest to the small cities were the ones that reached the negative balances. Thus, there was a slight slowdown in the decreasing trend around the 2006–2010 period due to slight immigration, which was much more noticeable in the case of the small cities. In the last two five-year periods, the drop has been very intense, even in the small cities, since they have also registered negative migratory balances, as will be seen below.

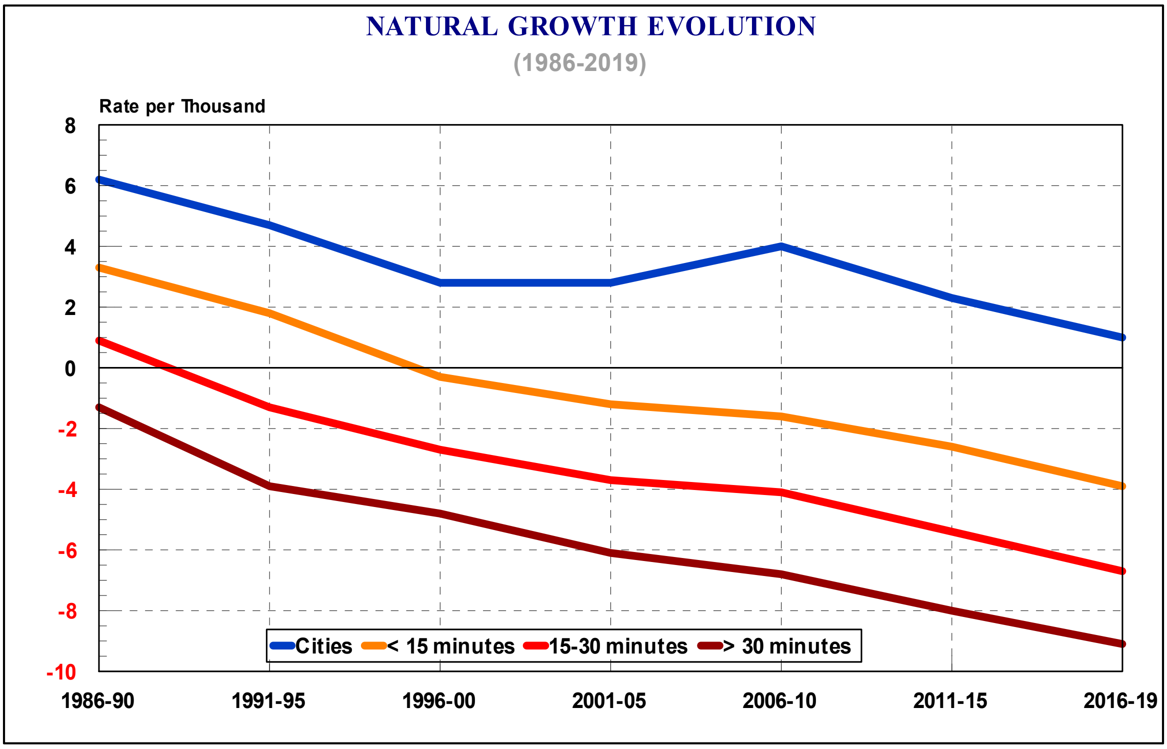

Figure 5. Evolution of the natural growth rate. Source: the authors, based on National Statistics Institute (2020).

The variable of migration balances (Figure 6) is more complex in all cases, due to its more unstable and changing nature, although a series of behavior guidelines can be specified.

Throughout the series, five-year periods with a predominance of emigration and others of immigration alternate, but most of the time, maintaining degradation in one sense or another depending on the accessibility to the small cities. In any case, it should be borne in mind that this variable owes its complexity to a greater dependence on external and, above all, economic factors.

The series begins in the second half of the eighties with negative values in all cases. This period coincides with the entry of Spain into the EU on 1 January 1986. At this time, significant resources from the ERDF Funds entered into infrastructure and were accompanied by Spanish government policies in construction and housing to deal with the Unemployment pockets that the late industrial reconversion was generating after the unstable period of transition from dictatorship to democracy. Simultaneously, works were undertaken for the Universal Expo in Seville and for the Olympics in Barcelona (1992), so in that five-year period, a significant offer of construction employment emerged, causing massive emigration from rural areas, but even from cities as well.

The following five-year period (1991–1995) was characterized by a generalized economic recession and by the stoppage of activity in the construction sector. For this reason, a large part of the previous emigrants returned to their rural hometowns, so that in this period, important immigration movements predominated, although not to the same extent as in the previous period. In the small cities, emigration remained and with more intensity because of the lack of housing and the departure of a certain young population towards the closest towns.

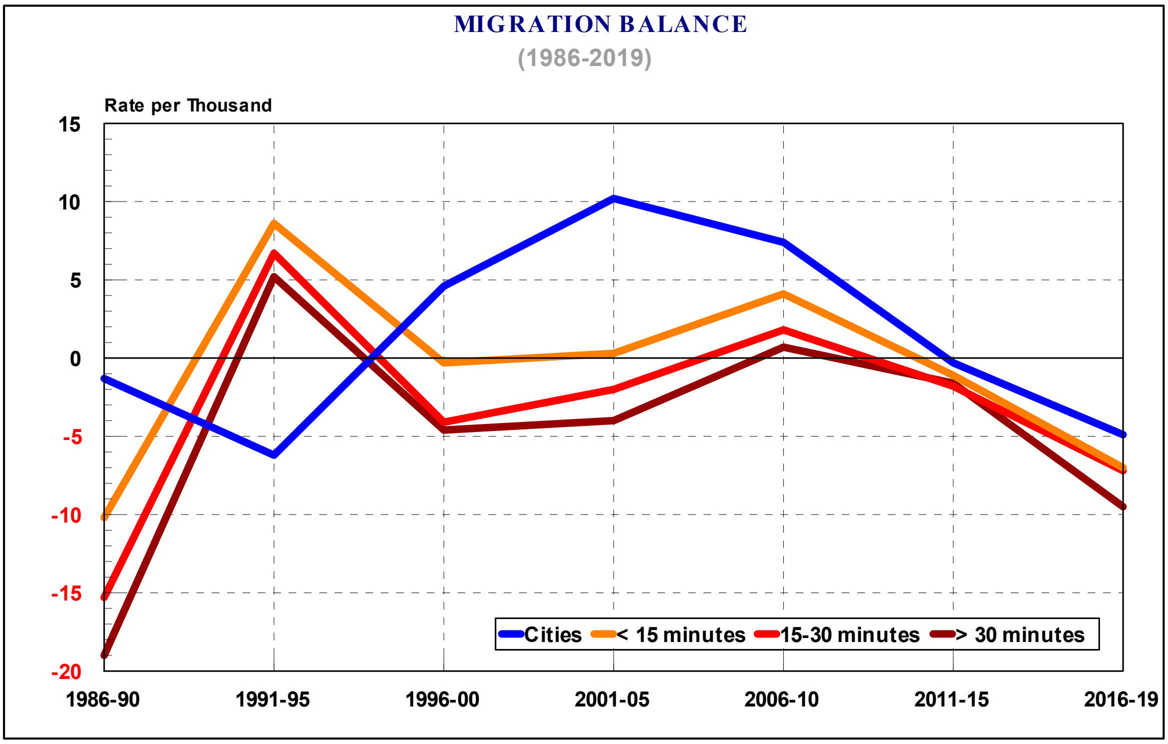

Figure 6. Evolution of the migration balance rate. Source: the authors, based on National Statistics Institute (2020).

1996–2010 was a long period of economic development and a strong attraction for foreign immigration, which was concentrated in the cities and which finally reached all rural areas, to a greater or lesser extent, in the five-year period 2006–2010.

In the current decade, there has been a general emigration to all population centers due to the consequences of the economic crisis that has caused the return of a large part of foreign immigrants to their countries of origin. If there have been slightly negative data in the first half of the decade, in the second they have reached important values. Job losses in cities have also been important for their respective areas of influence. For this reason, emigration has intensified until reaching the second maximum of the entire period. Throughout the series, the degradation of the values according to distance and accessibility has maintained, with the only exception of the small cities during the five-year period 1991–1995.

The small cities have been able to limit the losses due to emigration only in the closest towns. However, they have not been able to mitigate the losses due to negative natural growth, since it is due to long-range structural factors, such as aging and high mortality, on one hand, and the drop in fertility and birth rate, on the other. The effects of emigration are very noticeable also in other five variables, with which the population structure could be synthesized: the average age, the active population, the young population, the senile population and, above all, thedependency index (Table 4).

Table 4. Relationship between urban accessibility and demographic dynamics.

Minutes/Rates	Small Cities	<15′	15–30′	>30′
Total number of municipalities	12.0	93.0	176.0	101.0
Population 2019 (%)	48.8	17.6	21.1	12.9
Average age	41.1	46.3	49.1	50.2
Active population (%)	67.8	63.7	61.0	60.3
Young population (%)	15.5	11.1	9.6	9.5
Senile population (%)	16.7	25.2	29.5	31.1
Dependency Index (%)	49.8	60.5	67.7	71.1

Source: the authors based on the National Statistics Institute (2020).

The average age of the population ranges from 41 years in the small cities to 50 years in municipalities located more than 30 min away. This is due to the continuous decrease in birth rates and the youth population group, which is 15.5% in the small cities, while in towns that are more distant it is already below 10%. This is mainly a consequence of low fertility rates and the lack of women of childbearing age due to the persistent effects of emigration. The senile population, on the other hand, is higher than the young population group in all cases, even in the small cities, where it reaches almost 17%. This senile population almost doubles in the most remote municipalities. Consequently, the labor force is progressively decreasing from 70% to 60%.

The dependency index, which ranges between values of 50% and more than 70%, indicates that there are more than 70 passive people for every 100 active people in the most remote towns because of the extremely high aging that they suffer. It is evident, therefore, that the demographic dynamics are very regressive, with little capacity for regeneration, especially in the smaller municipalities and far from the small cities.

5. Discussion and Conclusions

According to the data presented, the influence of the small cities on the development of their functional areas (almost exclusively rural) to which they offer facilities and services and, above all, diversification of activities, employment and income, is very evident, favoring the stability of the rural population. Extremadura, with a polycentric system of well-distributed small and medium cities in most of the regional territory, has managed to maintain half of its population in rural areas, with the highest percentage of all the autonomous communities in Spain. In addition, a certain stability of the rural population has been fostered in the region, although this is a "regressive" stability with a slightly negative trend since 1980. This is mainly due to a negative natural growth that is already beginning to affect even cities due to the progressive and intense aging and the drastic drop in fertility and birth rates. These characteristics are very widespread (higher in rural areas) due to the effects of emigration from 1950 to 1980, which dragged between 40% and 60% of the population from rural areas.

It is also very clear that urban influence in rural areas is degrading with distance, consequently with urban accessibility, which depends on the range and size of each city, as well as on infrastructure and the transport system.

The polycentric urban system in Extremadura is made up of a group of twelve small cities whose influence in their rural areas does not exceed, sometimes, the first border of the 15-min journey and gradually degrades until it loses almost all influence beyond 30 min. It should be borne in mind that these are small cities with little labor supply except for the cities that form the basic structure and with a greater urban range, in which case their influence does extend even beyond 30 min. In any case, within the maximum radius of 30 min of travel 87% of the total regional population settles. Cities have undoubtedly slowed down the process of rural depopulation, but they have not been able to stop the structural effects of emigration in previous decades or the drop in fertility rates. Furthermore, there is no doubt that Extremadura, a border inland region with the highest percentage of rural population in Spain, maintains a demographic dynamism superior to other regions with the same characteristics, especially with respect to the northern half regions of the Spanish country that have numerous abandoned rural centers and a very regressive demographic dynamism. These are the so-called "empty Spain" and are very depopulated. This depopulation is the result of a settlement of widely scattered small municipalities and without cities or county seats capable of retaining the population in rural areas. In fact, as Reig et al. state [56], "58% of rural municipalities can be classified as accessible, since the travel time of their inhabitants to access the services offered by cities is less than 45 min. 70% of the population of rural municipalities live in them". It could be considered that it is a large volume of population, but it is not comparable to that registered in Extremadura and less than 30 min (87%).

In any case, there are extensive peripheral areas in Extremadura that are very distant from the small cities and very inaccessible. These have a very regressive socioeconomic (basically agrarian) and demographic development, in such a way that most of their municipalities do not even reach 10 inhabitants per km^2. Thus, as EU indicates in The Territorial Agenda 2020 [6], "in rural areas small and medium-sized towns play a crucial role; therefore it is important to improve the accessibility of urban centers from related rural territories to ensure the necessary availability of job opportunities and services of general interest".

The proposal made in this article involves integrating rural areas into regional dynamics, for which it would be necessary to decentralize development through territorial planning. This, without a doubt, must be based on the impulse of the traditional county seats, which have gradually lost their traditional functionality in the context of economic backwardness and emigration. In the 1990s, the regional government of Extremadura carried out the second administrative decentralization towards the main cities, but some small cities and county seats (mainly on the periphery) were relegated, so a third decentralization would must be carried out towards these towns, as well as its corresponding functional areas.

According to CES [41], for peripheral rural municipalities, geographic characteristics and territorial planning are key, since the low accessibility or the absence of more populated nearby municipalities are the phenomena that hinder their integration into a dynamic of rural development.

In Figure 7, it can be seen how in the easternmost strip (the most extensive and continuous) three small cities (traditionally county seats) have been incorporated, however, they currently have lost most of their previous functionality. From north to south, they are Herrera del Duque (in the county of La Siberia), Castuera (in La Serena) and Azuaga, in La Campiña.

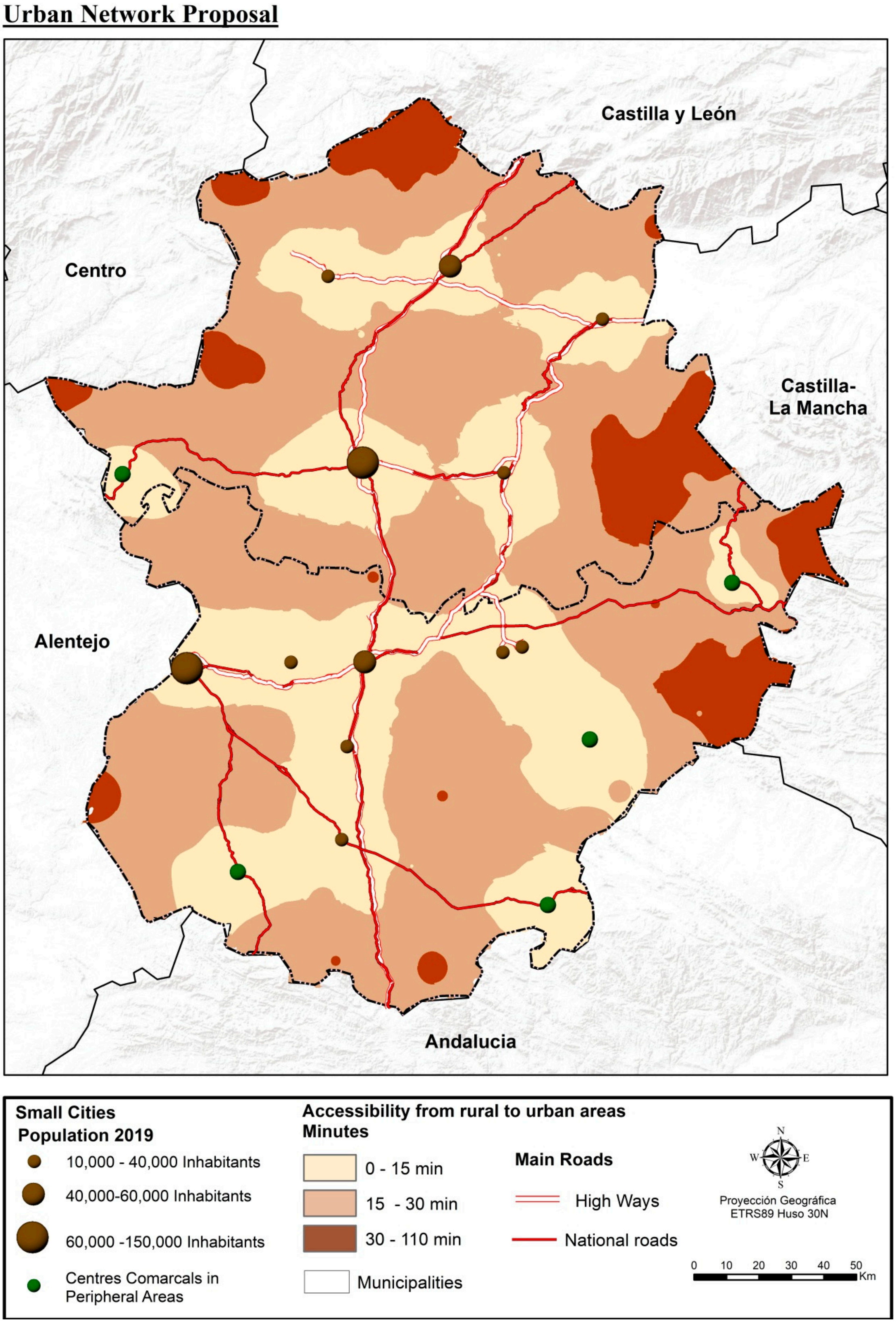

Figure 7. Urban network proposal of Extremadura. Source: the authors.

In the other western fringe, bordering Portugal, two other small cities have been included with a range that could be considered third order. These are Valencia de Alcántara in the central zone and Jerez de los Caballeros in the south, being more distant from the border, but with the possibility of extending its influence to it. These two municipalities are also traditional county seats that have managed to maintain two commercial subareas, especially Valencia de Alcántara because it is located more than an hour from the nearest city (Cáceres).

Of the five cities mentioned, four already have railway routes, although very obsolete and with little capacity (Jerez de los Caballeros, Valencia de Alcántara, Castuera and Llerena, near Azuaga), that should be improved. Furthermore, some highways are also pending to be built: Zafra-Jerez de los Caballeros-Huelva, Badajoz-Zafra-Llerena-Azuaga-Córdoba and Badajoz-Valencia, perhaps by Castuera or Herrera del Duque. These main roads would make these areas permeable, provide them with greater accessibility and incorporate them into national and international circuits, promoting investment and decentralization of development. If these five cities, located in the most peripheral areas, were promoted, the population that could be less than 30 min from any of those 17 cities that appear on the previous map would rise to 98% of the regional total. Only 2% of the population would be outside this 30-min perimeter.

There would be four small areas, almost enclaves that do not have county seats, so it would be necessary to articulate specific development projects to achieve the stability of a minimum population in these more backward, aged and isolated areas. In this case, there are small mountain regions, Sierra de Gata and Las Hurdes in the *Central System*, Villuercas and southern Siberia in *Montes de Toledo*, as well as Alcántara in the northern border area and in the *Riberos del Tajo*, also with steep slopes by the nesting of the river system. Some of these four regions, due to their centuries-old socioeconomic backwardness, have already been the subject of different specific development plans throughout the 20th century, especially in the second half, but have not been able to restraint their inertia.

These more peripheral areas, which are socioeconomically backward and have a very regressive demographic dynamic, show that urban accessibility and the integration of rurban partnerships are essential for the stability of the rural population and its demographic dynamism. All the specific socioeconomic plans for these areas have previously failed. Not even the EU's own rural development programs have the same opportunities, nor are their achievements as noticeable in these peripheral areas of Extremadura or in the northern half of Spain

Any strategy to meet the demographic challenge must consider a territorial planning that will ultimately allow the decentralization of development and the overcoming of existing imbalances. Small centers of population and those more distant from cities only have the capacity to generate employment in an agricultural sector in decline and with permanent labor surpluses and cannot provide acceptable facilities and services. Only a polycentric system of cities can contribute to the generation of employment and income outside the agricultural sector, as well as to the provision of quality services, not only for their inhabitants, but also for those in their rural environments.

Now that the new rural development programs for the next EU programming period (2021–27) are beginning to be planned, these options—not yet taken into account—of rurban partnerships and integrated territorial investments, which can guarantee the success of European investments in the face of the demographic challenge and rural depopulation, as is evident in this region and without any funding, should be considered.

As a final conclusion, the results confirm the initial hypotheses, in the sense that "the future of rural areas is increasingly dependent on the development of cities. Balanced urban systems—and in their case polycentric ones—are of greater interest in Europe because of their better capacity to organize innovative systems in the development, dissemination and support of local economies. Cooperation between the city and its environment is key to restructuring the territory and generating responsible change [. . .]", according to Ortega [59]. Moreover, the other hand, these results have demonstrated the functioning of the rurban partnerships and their functionality in the face of the demographic challenge, which can be easily extrapolated to other environments.

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References

1. *Comunicación de la Comisión al Consejo y al Parlamento Europeo: 'Europa 2000': Perspectivas del Desarrollo del Territorio de la Comunidad Comisión de las Comunidades Europeas*; Comisión Europea: Brussels, Belgium, 1990.
2. *Agenda Urbana Española 2019*; Ministerio de Fomento: Madrid, Spain, 2019.
3. Hernández Luque, J.M. La Reforma de la Política Agraria Común para el período 2021–2027. *Rev. Desarro. Rural (CEIPREX y ADERCO)* **2019**, *XXIV*, NO. 43.
4. Ponencia de estudio para la adopción de medidas en relación con la despoblación rural en España, constituida en el seno de la Comisión de Entidades Locales. In *Boletín Oficial de las Cortes Generales (BOCG)*; Senado: Spain, 2015.
5. Comisionado Nacional para el Reto Demográfico. *La Estrategia Nacional frente al Reto Demográfico*; Ministerio de Política Territorial y Función Pública: Madrid, Spain, 2019.
6. *Agenda Territorial de la Unión Europea 2020: Hacia una Europa Integradora, Inteligente y Sostenible de Regiones Diversas*; Reunión ministerial informal de los ministros responsables de ordenación del territorio y desarrollo territorial; European Union: Gódollo, Hungary, 2011.
7. Comisión Europea. *Estrategia Territorial Europea. Hacia un Desarrollo Equilibrado*; Oficina de Publicaciones Oficiales de las Comunidades Europeas: Luxembourg, 1999.
8. Copus, A. *New Relationships between Rural and Urban Areas in EU Countries*; OECD: Paris, France, 2015. [CrossRef]
9. Grupo de Trabajo sobre Estrategias Integradas en Actuaciones de Desarrollo Urbano Sostenible(RIU). In *Orientaciones Para la Definición de Estrategias de Desarrollo Urbano Sostenible Integrado en el Período 2014–2020*; Ministerio de Fomento: Madrid, Spain, 2015.
10. Artmann, J.; Huttenloher, C.; Kawka, R.; Scholze, J. *Partnership for Sustainable Rural-Urban Development: Existing Evidences*; Publications Office of the EU: Brussels, Belgium, 2013.
11. OCDE. *Placed-Based Policies for Rural Development*; Extremadura. Spain (case study); OECD Head Quarters: Paris, France, 2004.
12. Regidor, J.G. Junta de Extremadura. In *Desarrollo Rural de Base Territorial: Extremadura (España)*; Consejería de Desarrollo Rural; Ministerio de Agricultura, Pesca y Alimentación (MAPA): Madrid, Spain, 2006; p. 283.
13. *The ESPON 2006 Programme, Programme on the Spatial Development of an Enlarging European Union*; European Union: Luxembourg, 2003.
14. *La mejora de la aplicación de la Agenda Territorial de la Unión Europea 2020*; Diario Oficial de la Unión Europea (2015/C 195/05): Brussels, Belgium, 2015.
15. Opinion of the European Committee of the Regions. In *The Improvement of the Implementation of the Territorial Agenda of the European Union 2020*; European Union: Brussels, Belgium, 2015.
16. Ahner, D. *Urban-Rural Seminar*; European Union: Brussels, Belgium, 2009.
17. *The ESPON 2013 Programme EDORA (European Opportunities for Rural Areas)*; European Union: Luxembourg, 2011.
18. *Robust:Rural-Urban Europe: European Research Project*; European Union. Available online: https://rural-urban.eu/ (accessed on 15 April 2020).
19. Rural-Urban Partnerships. *An Integrated Approach to Economic Development, OECD Rural Policy Reviews*; OECD: Paris, France, 2003.
20. Comité Europeo de las Regiones. *Las Inversiones Territoriales Integradas (ITI): Un Desafío para la Política de Cohesión de la UE Después de 2020*; Diario Oficial de la Unión Europea (2018/C 176/10): Brussels, Belgium, 2018.
21. *Acta Única Europea.*; Comunidad Económica Europea: Luxemburgo; La Haya, The Netherlands, 1986.

22. The Future of the Rural World. In *Communication from the Commission to the European Parliament and the Council – COM(88)*; European Commission: Luxembourg, 1988.
23. *The Community Initiative for Rural Development: LEADER, Information Memo, 25 July 1990*; European Commission: Brussels, Belgium, 1990.
24. *Programa Nacional Proder I.*; Ministerio de Agricultura Pesca y Alimentación: Madrid, Spain, 1996.
25. *Agenda 2000 for a Stronger and Wider Union*; Commuication of European Union: Brussels, Belgium, 1997.
26. Consejo de Corfú. In *Conclusiones de la Presidencia*; Consejo de Europa: Brussels, Belgium, 1994.
27. *Europa 2000 +. Cooperación para la Ordenación del Territorio Europeo*; Comisión Europea: Luxembourg, 1995.
28. Especial Conferencia de Cork "Un Medio Rural Vivo. *Leader Magazine*, 1996; 13.
29. *2ª Conferencia Europea Sobre Desarrollo Rural: Plantar las Semillas del Mundo Rural del Mañana Las Perspectivas de la Política Rural en una Europa Ampliada*; Comisión Europea: Brussels, Belgium, 2003.
30. Hildebrand, A. *Política de Ordenación del Territorio*; Universidad de Sevilla: Sevilla, Spain, 1996.
31. Dictamen del Comité de las Regiones sobre la. In *Perspectiva Europea de Ordenación del Territorio Diario Oficial*; Comité de las Regiones Europeas: Brussels, Belgium, 1999; n° C 093 de 06/04/1999.
32. *Dictamen del Comité Económico y Social Europeo sobre la «Propuesta de Reglamento del Consejo por el que se Establecen Disposiciones Generales Sobre el Fondo Europeo de Desarrollo Regional, el Fondo Social Europeo y el Fondo de Cohesión*; Diario Oficial de la Unión Europea: Brussels, Belgium, 2005; (COM(2004) 492 final—2004/0163 (AVC).
33. *Tercer Informe Sobre la Cohesión Económica y Social:Una Nueva Asociación para la Cohesión, Convergencia, Competitividad, Cooperación*; Oficina de Publicaciones Oficiales de las Comunidades Europeas: Luxembourg, 2004.
34. Carta de Leipzig. *Territorial Agenda of the European Union, Towards a More Competitive and Sustainable Europe of Diverse Regions*; Comisión Europea: Leipzig, Germany, 2007.
35. *El Libro Verde Sobre la Cohesión Territorial: El Camino a Seguir*; Oficina de publicaciones oficiales de las Comunidades Europeas: Luxembourg, 2008.
36. *Declaración de Riga: Declaración de los Ministros en Relación con el Programa Urbano de la UE*; Ministros de la UE responsables de la Cohesión Territorial y Asuntos Urbanos: Riga, Letonia, 2015.
37. Declaración de Cork 2. *0 "Una Vida Mejor en el Medio Rural"*; Oficina de Publicaciones de la Unión Europea: Luxembourg, 2016.
38. *Informal Meeting of EU Minister Responsible for Urban Matters in Amsterdam Urban Agenda for the European Union*; European Union: Amsterdam, The Netherlands, 2016.
39. Estudio Territorial de Extremadura II. Dirección General de Urbanismo, Agricultra y Ordenación del Territorio. Available online: https://www.aragon.es (accessed on 20 July 2020).
40. Plan Estratégico de apoyo al Medio Rural. Available online: http://www.juntaex.es/filescms/con03/uploaded_files/SectoresTematicos/DesarrolloRural/DiversificacionYDesarrolloRural/PlanEstrategicoDeApoyoAlMedioRuralEnExtremadura.pdf (accessed on 20 July 2020).
41. *Reto Demográfico y Equilibrio Territorial en Extremadura*; Consejo Económico y Social de Extremadura y Junta de Extremadura: Mérida, Spain, 2019.
42. Comunidad Autónoma de Extremadura. Ley 11/2018, de 21 de diciembre, de "Ordenación Territorial y Urbanística Sostenible de Extremadura". In *BOE, n° 35, de 9 de Febrero de 2019*; Boletín Oficial del Estado: Madrid, Spain, 2019.
43. Pillet Capdepón, F. La planificación urbanística y estratégica y su relación con la valoración catastral en España. *Boletín De La AGE* **2010**, *54*, 323–333.
44. Berdegué, J.A.; Meynard, M.F. *Las Ciudades en el Desarrollo Territorial Rural*; RIMISP-Centro Latinoamericano para el Desarrollo Rural: Santiago, Chile, 2012.
45. Velázquez, J.M.; Estebaranz, A. *Introduction of Sustainable Urban Mobility Plans (SUMP) –Implantación de los Planes de Movilidad Urbana Sostenible*; Federación Española de Municipios y Provincias (FEMP) and ISOIN S. L.: Madrid, Spain, 2011.
46. Precedo, A. *La Red Urbana*; Editorial Síntesis: Madrid, Spain, 1988.
47. Sánchez Zabala, R. Jerarquía y red urbana en Extremadura: Aplicación de la técnica del Análisis Factorial. *Norba. Rev. De Geogr.* **1989**, 8–9.
48. Arenal-Clave, A.T. *El Sistema de Ciudades de Extremadura*; Dirección General de Urbanismo, Consejería de Vivienda, Urbanismo y Transporte; Junta de Extremadura: Mérida, Spain, 2001.

49. *Atlas Socieconómico de Extremadura*; Instituto de Estadística de Extremadura; Junta de Extremadura: Mérida, Spain, 2019.
50. Nieto Masot, A.; Cárdenas Alonso, G.; Engelmo Moriche, Á. Spatial Analysis of the Rural-Urban Structure of the Spanish Municipalities. *ISPRS Int. J. Geo-Inf.* **2020**, *9*, 213. [CrossRef]
51. Cardozo, O.D.; Gómez, E.L.; Parras, M.A. Teoría de grafos y sistemas de información geográfica aplicados al transporte público de pasajeros en Resistencia (Argentina). *Rev. Transp. Y Territ.* **2009**, 89–111.
52. Menédez, A. Una breve introducción a la teoría de grafos. *Suma* **1998**, *28*, 11–26.
53. Gómez Delgado, M.; Bosque Sendra, J.B. Cálculo de rutas óptimas para el transporte de residuos tóxicos y peligrosos. *Geofocus. Rev. Int. De Cienc. Y Tecnol. De La Inf. Geográfica* **2001**, 49–75.
54. Nieto Masot, A.; Engelmo-Moriche, Á.; Cárdenas-Alonso, G. La distribución territorial de recursos sanitarios y socio-sanitarios públicos para población mayor en Extremadura. *Rev. De Estud. Andal.* **2019**, *37*, 141–160.
55. Nieto Masot, A.; Cárdenas Alonso, G. Research on the accessibility to health and educational services in the rural areas in Extremadura. *Eur. Ctry.* **2015**, *7*, 57–67. [CrossRef]
56. Reig, E.; Gisbert, F.J.; Cantarino, I. Construcción de una tipología rural/urbana para los municipios españoles. *Investig. Reg.* **2016**, *35*, 151–173.
57. Estebanez Alvarez, J.y.; Martin Lou, A. Determinación cuantitativa de la centralidad de los asentamientos. *Geogr. Cons. Super. De Investig. Científicas* **1973**, *4*, 313–331.
58. Oliveira Martins, J. Assessing and Governing Rural-Urban Interactions. In *Sustainable Urban Rural Partnership European Conference*; Regional Development Policy Division; GOV OECD: Metz, France, 2012.
59. Ortega Delgado, M. *La ciudad y los sistemas urbanos desde una visión territorial. Urban. Revista del Departamento de Urbanística y Ordenación del Territorio de la Escuela Técnica Superior de Arquitectur*; Universidad Politécnica de Madrid: Madrid, Spain, 2003; No. 8.

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Article

Smart Villages: Where Can They Happen?

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Abstract: The European Union is actively promoting the idea of "smart villages". The increased uptake of new technology and in particular, the use of the internet, is seen as a vital part of strategies to combat rural decline. It is evident that those areas most poorly connected to the internet are those confronted by the greatest decline. The analysis in this paper is based on Poland, which at the time of EU accession had many deeply disadvantaged rural areas. Using fine-grained socio-economic data, an association can be found between weak internet access and rural decline in Poland. The preliminary conclusions about the utility of the smart village concept as a revitalisation tool for rural Poland point to theoretical and methodological dilemmas. Barriers to the concept's implementation are also observed, although there is a chance they may be overcome with the continued spread of information and communication technologies in rural areas.

Keywords: smart villages; EU instruments; rural decline; rural areas; information and communication technologies

1. Introduction

In the past decade European countries have been undergoing a transformation towards an information society, and the changes taking place depend on global technological development. Rural residents are also a part of this process. Adjusting to the changes is not so much an opportunity as a necessity, as more and more types of activity are performed in the virtual world. This allows distances to be "reduced" and goods and services, especially public ones, to become more accessible. In this context, information and communication technologies are treated as a chance to overcome development difficulties [1–5]. However, their usefulness depends on the availability and quality of the internet. Its absence or poor accessibility deprives a given area of opportunities for smart development [6–9].

A new concept for rural development proposed by the European Commission is called "smart villages". It is primarily aimed at villages that are declining due to remoteness and depopulation [10–12]. The first and most often repeated definition of smart villages comes from the document on the EU's actions for this idea [13]. According to its authors, smart villages are those (local communities) that use digital technologies and innovations in their daily life, thus improving its quality, improving the standard of public services and ensuring better use of local resources. The document by the European Network for Rural Development (ENRD) underlines that a smart environment is created by people, and their main objective should be to find practical solutions to the main problems they face. It can be said that the EU promotes support for the development of areas in decline by using digital technologies and innovations. By engaging in a discussion on the concepts that have only just been formulated, the question can be asked whether these areas have the capacity for smart technology-based development. The authors assume that smart villages "begin" with an analysis of the use of digital technologies to create a space in which it is easier for local leaders to take account of the needs and capabilities of the inhabitants. Adopting such an approach makes it possible to consider the elements necessary for this process. The authors believe that the sine qua non is access to the internet.

The accessibility of the internet is spatially differentiated. The question is about its scale and nature. So where does the smart-village concept stand a chance? The decline in rural areas is characterised by the lowest level of socio-economic development, the following hypothesis will be tested: the lower the level of rural development, the lower the internet accessibility. This makes it more difficult to implement the smart-village concept. The implementation of such a defined objective will take place in three stages: (1) tracing changes in the rural population in Poland in relation to the level of socio-economic development; (2) identification areas of internet infrastructure deficiency and verification that they overlap spatially with areas of the lowest development level; (3) determining what smart villages are or are meant to be, what they should be like in the future, and what resources rural areas need to support activities fostering such initiatives in the EU's future financial framework.

The beginnings of the smart village concept date to the middle of the last decade, when a vision of smart rural areas was presented by T. van Gevelt and J. Holmes [14] on the basis of activities already pursued in this area in Africa and Asia. Due to substantial developmental and structural differences between rural areas in those regions of the world and rural areas in Europe, the concept is understood a little differently in the EU, also in view of its objectives and the instruments used in its implementation. An important document giving direction to smart village initiatives in Europe appears to be the above-mentioned the *EU Action for Smart Villages* [13], planning specific actions aimed at putting the idea into practice. What has become the driving force of the discussion on smart villages, however, is the vision of "a better life in rural areas" outlined in the 2016 Cork 2.0 Declaration [15], in which one of the challenges for EU policies for the development of rural areas was described as follows: "to overcome the digital divide and develop the potential offered by connectivity and digitisation of rural areas" (p. 3). The Rural People's Declaration of Candás Asturias [16] from late 2019 underlines the necessity to support smart initiatives as part of EU policies. The development of "smart rural villages and towns" is also recommended by the Organisation for Economic Cooperation and Development (OECD) in its rural policy-making principles [17] (p. 7). The great role of digital technologies is also highlighted by F. Bogovic and T. Szanyi, who view the concept's development and practical application as a chance to ensure an easier and better life for rural residents, adding that it is necessary to respond to the problems created by the ageing of society and a shortage of services [10]. Another underlined aspect of smart villages is the idea's territorial sensitivity, enabling any projects to be adjusted to local circumstances. The virtue of the concept's possible broad application is at the same time a drawback whenever we try to say what a smart village really is (or can be) (see Sections 3.3 and 4). The authors of the present paper see this issue as a general challenge, not just for the institutions that plan the development but also for the scientific community, its task being to deliver knowledge that best describes reality.

2. Materials and Methods

2.1. Study Area

The analysis was carried out for rural areas in Poland, which show great territorial differences in the socioeconomic development level. This is the effect of historical (19th and 20th centuries) circumstances related to Poland being partitioned among three powers (Russia, Prussia and Austria) as well as socialist state policies for rural areas that were pursued until the fall of communism in Central and Eastern Europe in 1989 [18]. Efforts to make up for infrastructural backwardness in rural Poland did not really take off until the country joined the EU in 2004. The social and economic structure of rural areas is still heavily influenced by the economic power of regional cities, which drains the demographic potential from areas far from urban centres. The scale of these differences is well illustrated by the results of research conducted in Poland as part of the Rural Development Monitoring (MROW) project [19,20] (Figure 1). In order to see the true scale of these differences, it is advisable to consider the lowest level of spatial aggregation, i.e., the local structure. In Poland this requirement is met when data are considered for the *gmina*/commune (local administrative unit) level, based on the current administrative division (in this case from 2019), taking into account rural communes and the rural segments of urban-rural communes (2175 local administrative units—LAUs). By "rural areas" in Poland we mean areas lying outside the administrative boundaries of towns/cities [21].

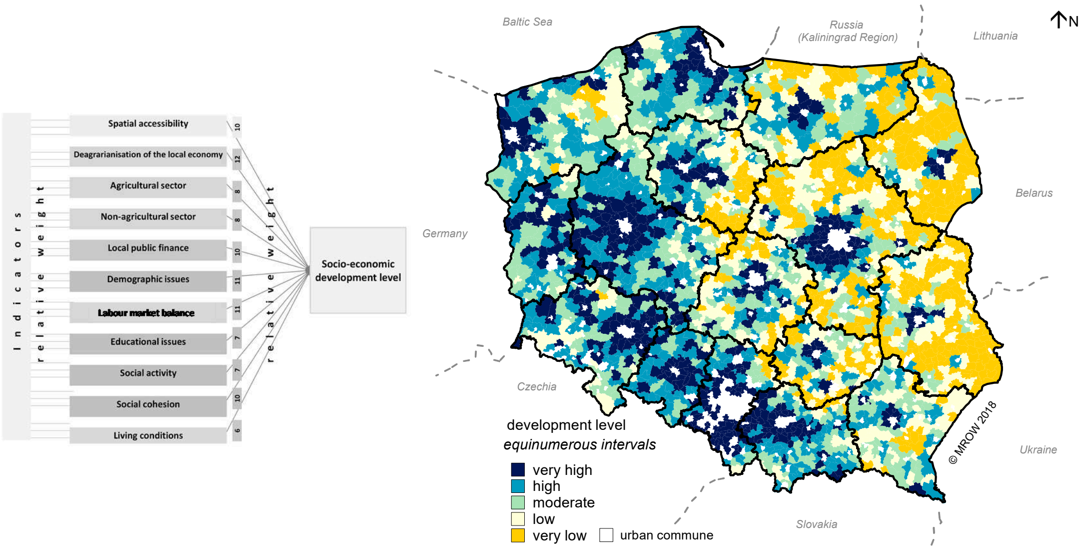

Figure 1. Synthetic measure of socioeconomic development level in rural areas in Poland[1]. Source: [20] (p. 16; 219).

2.2. Data Collection

The authors took advantage of public statistical databases available in the Local Data Bank of Statistics Poland (BDL GUS); in the field of "population": total commune population (2005–2018); in the field of "communications": land-line telephone subscribers (1995–2018). In addition, they used periodical publications of Statistics Poland (GUS)—statistical yearbooks and information society surveys to obtain data on the number of households with an internet connection (2005–2018). Since the amount of published statistics on information and communication technologies is limited (and available only at the voivodeship/province level), the authors also used data on internet accessibility in rural areas made available by the Office of Electronic Communications (UKE) for the Rural Development Monitoring (MROW) project. Results of MROW research project on the socioeconomic development were used as well. These data are not accessible through open repositories, hence the results of research conducted at the local level on their basis can be considered of great interest for territorial development.

In the study, quantitative methods have been used:

- Thematic (choropleth) maps to show the spatial differentiation of the phenomena;

[1] Socioeconomic development is understood as "the process of transforming rural areas into an inhabitant-friendly environment, i.e., one which allows them to fulfil their needs and aspirations, particularly with regard to labour conditions and obtaining satisfactory income; access to public services and broadly defined cultural goods; a sense of participation in the life of the local community; a sense of agency in the ongoing transformation; etc." [19] (p. 13). According to the MROW study, "to obtain one evaluation that would characterise an object from many standard features, all standardised variables for each object should be summed. The evaluation of a variable that characterises an i-th object is called a 'synthetic variable'. A synthetic variable obtained from following Formula (2) assumes values within the range 0–1: $W_i = \frac{1}{n} \sum_{j=1}^{m} m_i \alpha'_{ijn}$ where a'ij is the normalised value of the j-th feature in the i-th object (after the destimulant is changed to stimulant), n is number of objects, and mi is the weight factor of an i feature" [22].

- Spearman's rank correlation coefficient to identify the interdependence of the ordinal data;
- Time-series analysis to observe and interpret trends;
- Contingency tables to summarize the interrelatedness between variables.

2.3. Content Analysis

The authors of the present paper have carried out a broad analysis of scientific studies on the smart-village concept and broader rural development issues (in the context of demographic processes) as well as other publications: documents, declarations, reports, notes (see Sections 3 and 4). This desk research suggests that the main group of sources are documents drawn up in connection with the planned smart-village concept (including by the European Network for Rural Development and the European Commission). The authors also used the participant-observation method, taking part in the 9th and 11th meetings of the ENRD Thematic Group on Smart Villages; study visits were undertaken in two Finnish localities vying for smart-village status; at the 4th European Rural Parliament in Candás (Spain)—taking part actively in workshops on the smart-village approach—and within the framework of the group developing the Common Agricultural Policy Strategic Plan for 2021–2027 (smart villages section). The authors were also responsible for holding Poland's first *My SMART Village* competition to choose villages undertaking smart initiatives.[2]

3. Results

3.1. Rural Decline: Where is the Problem?

Demographic processes (internal migration above all) which shape the demographic and social/occupational structure of the rural population today are key factors determining the socioeconomic development of a given area. With the exception of suburban areas, in most European countries including Poland rural areas are becoming depopulated (the rural net migration rate is below zero), and the low birth rate (often close to zero) is unable to compensate for the population decline [23]. This relationship between the components of actual population growth is leading to the rural depopulation and consequently to the rural ageing. The existing demographic structure affects the functioning of entire local communities in aspects such as education, the labour market, healthcare and other public services. It is this last aspect that is currently at the focus of the discussion on adapting services to the needs of an ageing society. In Poland this problem is most often limited territorially to the central-eastern regions, in which rural residents are the oldest in Poland on average. Among the demographically oldest 100 rural and rural-urban communes, more than half are located in the east of the country, in Podlaskie province, and one-third are in Lubelskie province. The median share of people beyond retirement age in the overall commune population in this group is 24%, seven percentage points more than in Poland as a whole. These are relatively mono-functional agricultural areas with a permanent outflow of people. The depopulation process had already been diagnosed there in the 1980s [24]. Figure 2 confirms that the suburban areas of regional centres are relatively young, indicating a steady outflow of young residents from peripheral communes. The demographically youngest rural communities are found in western Poland, in Pomorskie province in particular. Such a perceptible territorial diversity of the population's age structure is—similarly to the diverse level of development—a consequence of two main factors: historical circumstances (post-World War II resettlement) and the polarisation of regional development (an outflow of residents from peripheral areas to the suburban zones of big cities) [25]. Spearman's rank correlation coefficient of these two

2 The organiser was the Institute of Rural and Agricultural Development of the Polish Academy of Sciences, call for applications 3/2019 of the Polish Rural Network (KSOW). The project involved a competition for descriptions of smart-village initiatives, which contributed to disseminating and promoting the concept among rural residents, identifying a wide range of social and digital innovations emerging in rural areas, and presenting them in a knowledge bank.

spatial trends is rho = −0.600, i.e., the most underdeveloped areas are usually demographically old (cf. Figures 1 and 2).

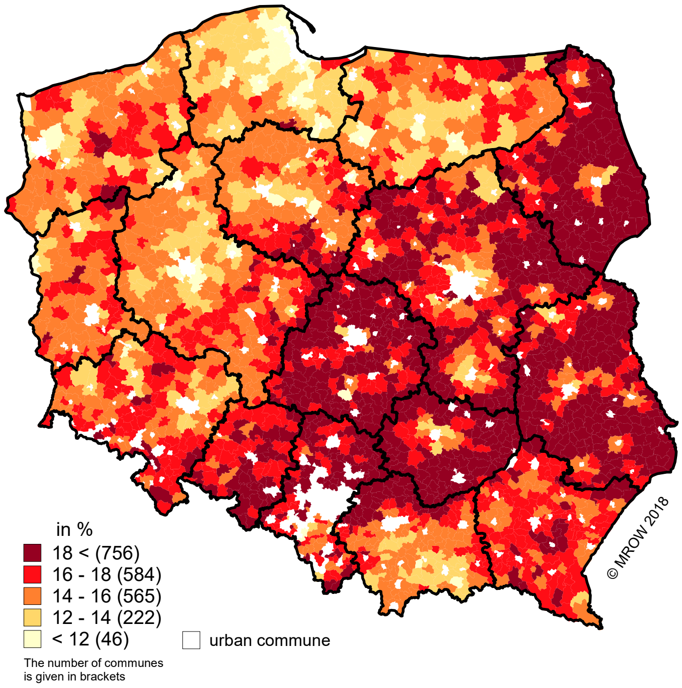

Figure 2. Proportion of rural residents at retirement age in the total commune population. Source: [20] (p. 116).

Poland's regular Rural Development Monitoring (MROW) survey confirms that migration is a "silent moderator" of social and economic changes in rural areas [20] (p. 258). These changes can also be the result of a certain inertia of development in a given area, and at the same time a cause of further changes—both positive (in areas with immigration) and negative (in areas undergoing depopulation) (Figure 3). The emigration of rural residents drives the vicious cycle of collapse (underdevelopment), which can be described by cause-and-effect relations strengthened by negative population trends in many rural areas (more: [26–29]). Awareness of this process is even more important, as population changes are strongly interdependent with the level of rural development. Spearman's rank correlation coefficient is rho = 0.700 (cf. Figures 1 and 3).

Population changes recorded since Poland's accession to the EU deepen the tendencies observed for the beginning of the country's urbanisation process, which accelerated in the 1950s [30]. Areas where the population is increasing cover about one-third of rural and urban-rural communes in Poland and these are mainly suburban zones around large regional centres. Nearly 90% of communes located within the boundaries of functional urban areas (FUAs)[3] in provincial capitals show the highest population growth. These are areas of long-term immigration.

Increasing the number of inhabitants of rural areas takes place not only within the range of influence of provincial capitals but also around cities of subregional importance. However, it is a tendency determined by historical factors and more often characterises the cities of western rather than eastern Poland. In regional terms, the greatest increase in the rural population is observed in the communes from the Pomorskie, Podkarpackie and Wielkopolskie provinces. These regions are

3 "A functional urban area consists of a city and its commuting zone. Functional urban areas therefore consist of a densely inhabited city and a less densely populated commuting zone whose labour market is highly integrated with the city" [31].

inhabited by indigenous people, with traditions of circular migration, relatively culturally (ethnically) homogeneous, with a strong sense of what is known as land attachment [32].

The communes with the deepest, permanent depopulation are located on the "eastern wall" (Podlaskie and Lubelskie provinces). The others are scattered along the provinces' borders of central Poland. The deep depopulation also enters the areas of what are known as the Western and Northern Lands, incorporated into Poland after World War II. The region underwent a profound economic transformation in the 1990s, which, however, did not stop the emigration. After Poland joined the EU, it was mainly emigration to Germany and Great Britain [33]. This problem concerns Opolskie province in particular.

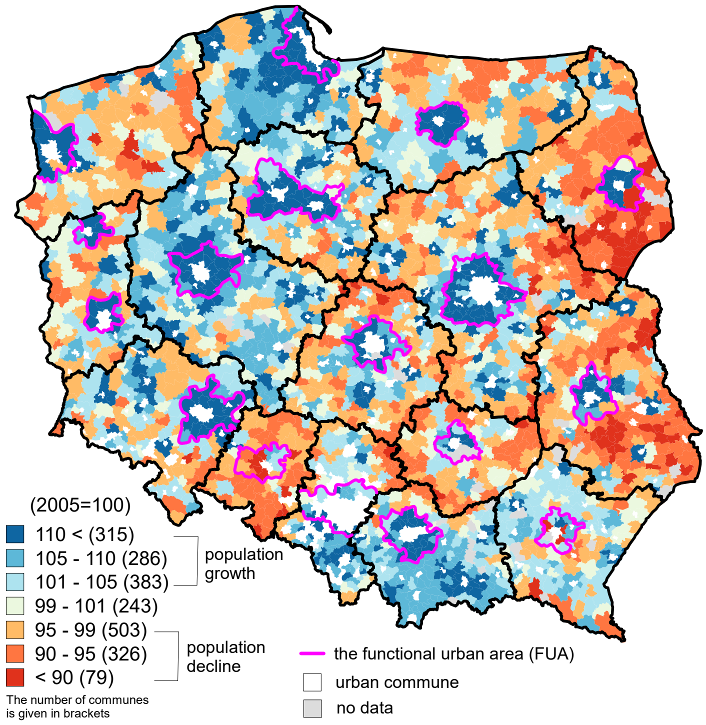

Figure 3. Rural population change in 2005–2018. Source: own work based on the Local Data Bank of Statistics Poland (BDL GUS) data and [34] (p. 196–197).

The falling number of residents ("tax base") as a result of emigration reduces local-government budgets, leading to difficulties in providing day-to-day public services (e.g., in transport or culture). It also causes local authorities to hesitate to undertake infrastructure projects improving residents' lives and increasing a locality's attractiveness to prospective investors. Given the low number of potential users, this translates into high maintenance costs for such projects. A lack of economic stimuli then leads to relative mono-functionality of the local economy's structure, based on farming. A poorly developed labour market increases emigration, but such emigration is selective: those leaving are young people, women more often than men [35–37]. This in turn negatively affects the structure of the remaining population, now dominated by people at retirement age. The population density decreases, the distances between homesteads grow, which further exacerbates problems in providing services and necessary infrastructure. This system of inter-related events leads to loss of rural vitality, the consequence being rural decline [28].

The process of depopulation, although in a sense inevitable, encourages the scientific community and all the rural stakeholders to seek solutions that would limit the negative effects of emigration and its socioeconomic consequences. This has led to increasingly frequent questions about instruments that could be used to intervene at the present time as well as enabling the prevention of future problems caused by existing demographic trends (see: [38]).

3.2. Development of Information and Communication Technologies in Rural Areas

The measurable benefits of using state-of-the-art forms of telecommunications, which by their nature help overcome many inconveniences of the rural living, were already noticed in the 1980s and 1990s [39]. The purpose of new means of communication was to reduce the distance to public services, e.g., health care, educational, cultural or recreational services. Using technical innovations such as—at the time–telephones, faxes and non-portable computers was meant to contribute to halting rural outmigration and to revitalise rural areas experiencing infrastructural backwardness. The instrument promoted at the time was the telecottage—a local telecommunications centre equipped with the latest telecommunications tools, made available to residents and entrepreneurs to meet informational, cultural and the work-related needs [40].

The first telecottage was set up in the mid-1980s in Sweden. It was intended as a response to the growing 'brain drain' process. A joint initiative of the Swedish government, the local authorities and scientists, it revived the local community cut off from the outside world, enabling residents to acquire new skills (transit to an information society), launch collaborations and stimulate enterprises [41].

In the following years the Swedish idea was adapted elsewhere, initially in the Nordic countries and later also in the west of Europe and in Hungary. In the mid-1990s Poland also saw a similar initiative, involving a telecommunications centre in Kujawsko-Pomorskie province, but the idea was never put into practice [40]. It seems that 30 years ago it was a concept which in Poland's case was ahead of its time, especially in terms of infrastructure requirements. It was not until the late 1990s that rural areas were speedily supplied with land-line telephones, but then other technologies (computers, mobile phones, the internet) rapidly supplanted this form of communication [42]. The evolution of telecommunications in rural Poland is shown in Figure 4.

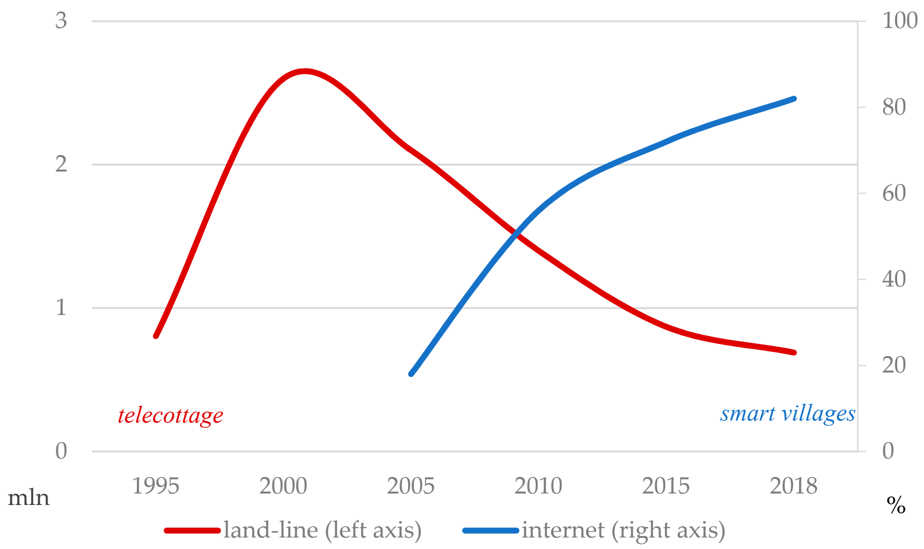

Figure 4. Rural land-line telephone subscribers and rural households with internet access. Source: own work based on BDL GUS data and [43,44] (p. 437, p. 327).

According to GUS data, in 2018 84.2% of Polish households had internet access, most of them via a broadband link [44] (p. 327). The difference between urban and rural areas was a mere 3.3 percentage points, although in 2005 access in cities had been twice as high (36% compared to 19% in rural areas) [43] (p. 437). Public statistics on spatial differentiation in internet access is only available at the provincial level, without a division into cities/towns and rural areas. These data show that the situation was the worst in provinces of central and eastern Poland, i.e., the part of the country with the highest percentage of less-developed communes (cf. Figure 1.).

A little more information is provided by data from the Office of Electronic Communications (UKE) aggregated to the local level (Figure 5). It shows that the most basic measures—internet accessibility—have large inter- and intra-regional differences. The technically most developed base is found in the western regions, some areas around big cities, and isolated areas in the rest of the country. On the other hand, the least developed internet infrastructure measured in this way is found in south-eastern and central Poland and, with a few exceptions, in the east of the country.

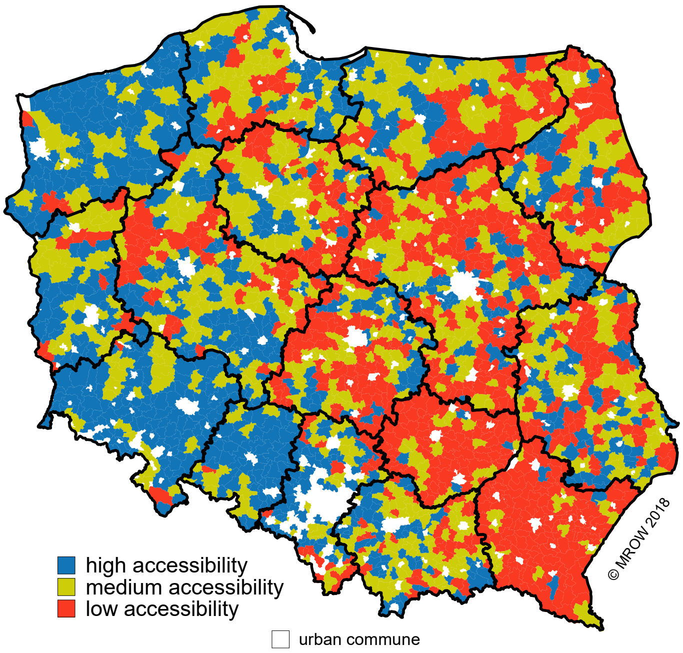

Figure 5. Internet accessibility rate in rural areas[4]. Source: own work based on UKE data.

The interdependence of the accessibility of internet infrastructure and the level of socio-economic development has been confirmed statistically. Spearman's rank correlation coefficient is rho = 0.300 and is statistically significant (cf. Figures 1 and 5). It is not a strong interdependence; however, it should be remembered that it is calculated for the full set of communes (N = 2175). It is therefore justified to conclude that with the increase in the level of development, the provision of ICT infrastructure in rural areas also increases. The verification of this relation in five development levels (as in Figure 1) has shown that only one in five communes with a low or very low level of development have a high level of internet accessibility. However, one in two of the communes in the category with high and very high levels of development also have the highest level of internet accessibility (Figure 6).

Insufficient internet access is a problem that rural communities often try to solve when dealing with local authorities. The basis for such a conclusion is provided by the Communes Survey,[5] carried out as a part of the Rural Development Monitoring (MROW). The topic of internet access is discussed with village leaders in two out of three gatherings and meetings. However, as calculated by the authors the weaker the access to the internet the more often is this issue discussed: in 70% of cases in the low-access class and 58% in the high-access class. This shows that the financial needs of the villages are still in many cases focused on "hard" projects. The allocation of funds for digitisation of rural areas under the Digital Poland 2014–2020 Operational Programme (co-funded by the EU) is a reflection of this and, at the same time, an opportunity to overcome the infrastructural barrier. By February 2020, contracts for tasks of about €3bn had been signed [45]. The programme implementation plan assumes that about 37% of the total allocation will directly cover rural areas [46] (p. 53).

4 The internet accessibility rate is measured as the ratio of the number of network terminations enabling internet services to be provided in a given area to the number of housing units in that area.
5 The questionnaire form was filled in by the commune office. The response rate was 95% (N = 2064).

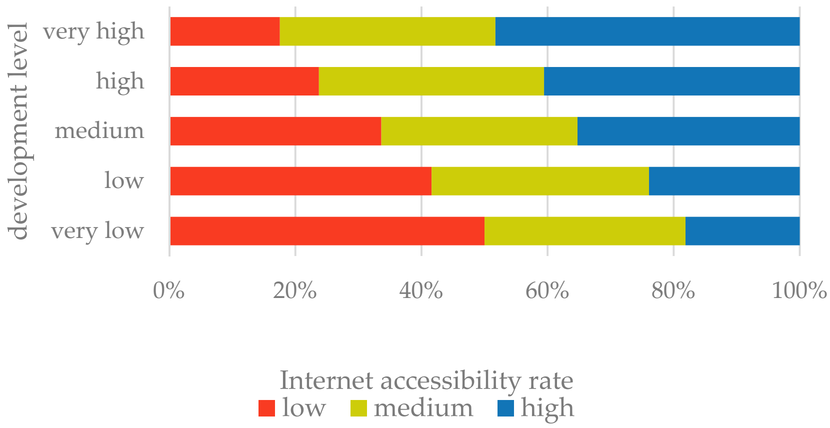

Figure 6. Internet accessibility rate structure according to socio-economic development level. Source: own work.

3.3. Smart Village, Meaning What?

Insofar as the telecottage idea emerged too soon for the technical (and awareness-related) possibilities of rural Poland, the currently discussed concept of smart villages appears to fit in well with current circumstances. The recommendations on the smart village idea recently developed in a collaboration between the Polish Rural Network (KSOW), the Ministry of Agriculture and Rural Development, rural residents and researchers suggests some answers to the earlier question of what a smart village is (can be). These recommendations state that for the successful implementation of the concept, we need to [47]:

1. **Build on experience**, on the basis of existing forms of collaboration, often long-term and successful, for example related to rural revival or the LEADER approach. The concept should not be allowed to become bureaucratised.
2. **Start from one village, but build partnership**. Smart-village projects have to respond to the needs of local communities, even if they are in small localities. Advisory support in finding funds should be obtained from units specialising in consulting.
3. **Account for the digital backwardness of rural areas.** Although smart villages, unlike smart cities, are not based solely on new technologies, rural residents' basic access to a (fast and stable) internet network is crucial for local development. Appropriate competences are also important.
4. **Appreciate people's activity**. The smart-village approach should not be planned without the involvement of local leaders, local government, NGOs and other stakeholders. Existing resources should be utilised, such as active village heads and other local leaders.
5. **Reward active attitudes**. To promote the smart-village concept, it is worth showing rural communities the potential benefits of its implementation, for example with the help of identified, existing examples of smart solutions.
6. **Make sure the smart-village concept helps small farms**. Agriculture is a large area for developing the smart-village concept, as it uses advanced new technologies more and more often. Together with stimulating cooperation among farmers, this creates chances for the development of this segment of the economy, also in places where farming is fragmented and seemingly in decline.
7. **Involve the consulting sector in supporting smart ideas of local communities**. New technologies should be used to develop consulting services, which should ultimately become innovation brokers.

The fact that smart villages are not a fully developed or researched concept is reflected in the small number of scientific studies on the issue. The great majority of such publications are overviews, due to the fact that work still continues on determining what smart villages are (or will be), what they should be like in the future, and what instruments would be used for their implementation in the EU's future financial framework [48]. The concept is often criticised for its lack of scientific foundations, although some authors have sought to place it within some kind of theoretical framework [49–53]. B. Slee remarks that "the evolution of support for community level development generally and what are termed smart villages has happened almost without reference to theory" [51] (p. 645). He situates the smart-village concept in regional development theories (centre-peripheries), Florida's creative classes, or Putnam's social capital theory. A. Davies considers the ties between smart technologies, political strategies and the vitality of the rural population in the context of the Internet of Things (IoT) [53]. A different approach is offered by M. Zwolińska-Ligaj, D. Guzal-Dec and M. Adamowicz, who have tried to operationalise the smart-village concept. However, they also conclude that such an approach "creates many problems in the way research reflects new factors of development" [54] (p. 271), and point to the weakness of data from public statistics related to innovation and technological changes on the local level.

The authors also wish to contribute to these deliberations, offering their own theoretical analysis. We would like to suggest considering an analogy between the smart-village concept and the concept of sustainable development. The analogy has also been recognised by other researchers (more: [50,55,56]). Both these approaches seek a compromise between environmental, economic and social goals, consisting in a game of limitations in utilising all forms of capital. It involves improving residents' quality of life (the social order) while necessarily optimising current economic benefits for households as well as local government and businesses (the economic order) and ensuring continual nature and landscape protection (the environmental order). It seems that some years ago sustainable development was—and today smart villages can be—a concept invoked in legal regulations, political documents and development strategies at different management levels (e.g., Poland's National Regional Development Strategy 2030, adopted in 2019). This could be a "daughter concept" seeking harmony among three components: the natural environment, the economy and society, highlighting the social factor in the name of social justice, access to services, standard of living, life surroundings and wellbeing. It is already a concept based on overcoming territorial barriers (reducing distances) experienced by rural residents when accessing public services, in order to create a responsible and desirable living environment.

4. Discussion

Some researchers believe that the smart-village concept draws upon the equivalent concept of smart cities [49,57–63]. However, the problems faced by urban and rural areas seem to be completely different, therefore the solutions proposed during implementation of these two approaches are also different. The authors of one study on smart villages conclude that one of the biggest challenges is how to overcome the emigration from rural areas to conurbations, and ask a fundamental question: "what smart services, provided by whom, how and at what cost could be provided to ease the situation?" [63] (p. 3). In this context, it seems equally important to ask not only about the scope but also the means of providing such services.

In the context of areas struggling with problems caused by negative demographic trends, we can speak of smart solutions in three aspects: public services, public management, and economic activity in a broad sense (Table 1).

The first group includes services provided mainly in traditional forms by local government. The steadily diminishing population, decreasing population density and increasing percentage of the elderly will reduce the financial capacity to continue these services. On the other hand, demand for some specific services, e.g., related to healthcare or elderly care, will grow. L. Philip and F. Williams [64] noted this in their study, mentioning such solutions as digitally supported communication platforms or assisted living technologies. This forces us to think about how to meet these needs, and new technologies are one of the tools proposed in development policies being drafted for the coming years [65,66]. Apart from solutions for basic social services, the idea of smart villages also envisages using innovative solutions in transport and power supply.

Table 1. Examples of smart actions in rural areas.

Smart Solution Group	Public Services:	Public Management:	Enterprise:
Areas of intervention	power supply (e.g., RES)	e-administration	precision agriculture
	safety and security (e.g., visual monitoring)	waste management (e.g., container fill-level sensors)	online trade (e.g., in local products)
	distance learning	town-and-country planning (e.g., digitisation)	rural tourism (based on smart solutions)
	transport (e.g., telebuses)	environmental monitoring (e.g., air quality sensors)	sharing (e.g., of specialist equipment)
	e-care		
	e-health		

Source: own work based on [67] and materials from meetings of the European Network for Rural Development (ENRD) Thematic Group on Smart Villages [68].

The second group of smart solutions is intended for the public administration. The solutions that seem especially important from the point of view of the rural areas being considered here are those designed to rationalise the performance of some of its tasks, e.g., in waste management. Equally important, although requiring greater involvement and skills from residents, are e-administration tools, which research has shown are still inadequately developed in Poland, partly due to barriers of awareness in society [69,70].

One important objective of smart villages is not just to uphold the vitality of depopulating areas but to revitalise them as well. The solutions proposed here are related to farming itself as well as to other economic sectors not linked to agriculture. Enterprise in a broad sense is the least identified and, it seems, most difficult area of implementation. It depends on many aspects that are of a highly individual nature (impossible to standardise), such as businesses' financial resources, competences as well as residents' needs.

For the smart-village concept to function it requires the harmonisation of several elements: initiatives and collaboration aimed at proposing new solutions, necessary infrastructure related to information and communication technology, institutions activating and coordinating the work, and finally, the provision of services which would respond to the needs of local communities on the one hand, while enabling local authorities to alleviate the effects of emigration on the other (e.g., by reducing the cost of providing services). Implementations of the concept carried out so far, however, show that the above elements will not become reality without appropriate competence, skills and changes in rural residents' perception of new technologies (awareness of the need for them)—this applies both to the recipients of smart solutions and to the people and maybe even institutions that will provide those solutions.

These requirements appear in the plans to support smart villages in the future Common Agricultural Policy (CAP), among others in Finland [71] and Poland [72]. In both countries support is planned in two ways:

1. At the national and regional level, where projects in basic infrastructure (e.g., broadband), development of e-services for different economic sectors (e.g., tourism, agriculture, public health) will be financed. In addition, the environmental component of such projects will be mandatory—thus, national authorities also see an analogy between smart villages and sustainable development.
2. At the level of local communities, ideas and strategies of individual villages, their clusters or local action groups (LAGs) are to be supported. The scope of support will depend on the bottom-up smart-village concept" proposed (especially highlighted in Poland).

The link between these levels of support can be provided by what are called innovation brokers, selected from LAGs and national rural network structures. Thus the initial government proposals take into account, to a certain extent, the elements of smart villages: both the basic ones (such the ICT infrastructure), but also those related to the expertise and activity of the rural residents, above all their leaders (Figure 7).

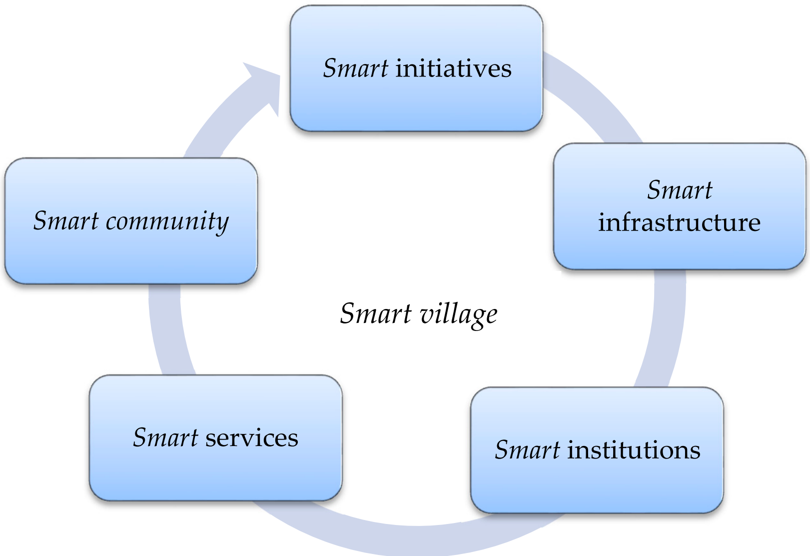

Figure 7. Main elements of smart village 'space'. Source: own work based on [73] (p. 441).

GUS data from 2019 [74] indicate that, of the people who do not use the internet on a daily basis, as much as 68% see no such need and over half justify it with their lack of skills. This is hard to imagine, however, when we see how common smartphones or notebooks have become as elements of the daily lives of the Polish and, more broadly, the European population, offering online access to all kinds of resources. Excessive costs of ensuring internet accessibility are indicated by a fifth of those polled, while some 14% cite overcoming an aversion to the internet as a barrier (p. 2). The results of the Social Diagnosis from 2015 enable us to conclude that rural residents' competence in using the latest devices is increasing, including among the elderly [75]. There are also other studies indicating that this group uses new technologies increasingly often and has a more positive attitude towards them [76,77]. The need to digitise rural areas has been recognised in research carried out in other countries, to mention the United States, Germany, Italy and Slovenia [60,78]. At the same time, access to fast internet networks is just one link in the entire chain of a process that also includes issues of adapting to the new technologies and matching smart solutions to the needs of local communities. It needs remembering, however, that in practice the implementation of the concept in question could take a dozen (or a few dozen) years, which means that the potential beneficiaries will be people who already function very well in a world based on new technologies.

5. Conclusions

The attention of rural stakeholders is turning to the concept of smart villages, an idea that raises great hopes for improving rural residents' standard of living. Successful development based on the concept of the smart village is conditional on relatively good access to the village internet. Without it, there is no access to digital technologies and further to smart initiatives based on digital solutions. Research has shown that only one in five communes with a low or very low level of development have high internet access. At the same time, more than half of the rural areas facing decline have a low level of accessibility to the internet infrastructure (which may also sometimes mean a lack of it). The authors confirmed the hypothesis that with the decrease in the level of development the provision of ICT infrastructure in rural areas also decreases. Although research on smart villages is not yet advanced, it would seem that given the possibility of such solutions being co-financed from European funds, the main barrier to implementing the idea are a lack of skills and confidence in new technologies among people who do not use them on a daily basis. As data on rural residents' access to and use of computers, the internet or smartphones suggest, however, innovative solutions are increasingly being used by people who will become beneficiaries of smart initiatives in the coming years. It is worth underlining that the competence of entities responsible for local development will be equally important for smart villages to be a success.

In view of the above, we posit that the smart-village concept should not be limited to the conditions created by developing technologies, but should be more open, i.e., receptive to social innovations. By these we mean not only introducing unique solutions but also implementing already existing ones, albeit in a new social context—an ageing society or rural decline. The solutions in question are intended to respond to the needs of a specific local community as well as to lead to lasting, positive changes in a given social group. This can involve innovative products, smart services or processes enabling different solutions to be found for typical social problems in local communities, in line with the motto "a better life in rural areas" [15] (p. 1).

We see a certain analogy between the smart-village concept and the sustainable-development concept. In both these concepts, attention is drawn to maintaining a balance between the economy, society and the natural environment. This should improve the quality of life of residents but take account of current economic benefits of different groups as well as the environment they live in. In this context, it is worth mentioning U. von der Leyen's declaration on measures aimed at adjusting to the digital age: "I want Europe to strive for more by grasping the opportunities from the digital age within safe and ethical boundaries" [79] (p. 13).

The issue outlined here leads to one more observation: that the smart-village concept is not completely new. Similar ideas to take advantage of new technologies have appeared before, and the current technological progress allows us to conceive that today's initiatives have a greater chance of success. However, it is worth referring to earlier experiences in order to adapt the present intervention in the best possible way to both the needs and the capacity of local communities and their institutional environment. Especially since work on the new framework of European funds for 2021–2027 is about to reach the crucial phase when decisions will be taken on how much funding will go to smart villages.

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This article was written just before the coronavirus pandemic. During the pandemic, the authors have added this paragraph, also at the suggestion of reviewers. The whole world of science is observing this new situation and trying to draw conclusions from the current facts. We have started thinking differently about the future. We have undoubtedly entered a world of permanent changes. Will the "corona crisis" deepen the processes of depopulation of peripheral zones and at the same time increase the concentration of population in suburban areas? Will we take advantage of the possibilities offered by virtual communication, remote working, on-line consumption and telemedicine, and will there be a renaissance of villages remote from urban civilisation? What is happening is a "process" and as we observe it we will acquire arguments to determine possible scenarios. Today, however, we can already see that the emergence of this crisis has shown both certain weaknesses and benefits in the implementation of this concept. The undoubted benefits include, among others, the rapid acquisition of competences by people of different ages, development of on-line services, and above all—in the hinterland—"taming the internet".

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References

1. Bryden, J.M.; Dawe, S.P. Development Strategies for Remote Rural Regions: What Do We Know So Far? 1998. Available online: https://www.academia.edu/17486574/Development_strategies_for_remote_rural_regions_what_do_we_know_so_far (accessed on 3 May 2020).
2. Chapman, R.; Slaymaker, T. *ICTs and Rural Development: Review of the Literature, Current Interventions and Opportunities for Action*; ODI: London, UK, 2002; Working Paper 192.
3. Ramírez, R. Appreciating the contribution of broadband ICT with rural and remote communities: Stepping stones toward an alternative paradigm. *Inform. Soc.* **2007**, *23*, 85–94. [CrossRef]
4. Nayak, S.K.; Thorat, S.B.; Kalyankar, N.V. Reaching the unreached. A role of ICT in sustainable rural development. *Int. J. Comput. Sci. Inf. Secur.* **2010**, *7*, 220–224.
5. Salemink, K.; Strijker, D.; Bosworth, G. Rural development in the digital age: A systematic literature review on unequal ICT availability, adoption, and use in rural areas. *J. Rur Stud.* **2017**, *54*, 360–371. [CrossRef]
6. James, J. *Information Technology and Development: A New Paradigm for Delivering the Internet to Rural Areas in Developing Countries*; Routledge: Abingdon, UK, 2004.
7. Warren, M. The digital vicious cycle: Links between social disadvantage and digital exclusion in rural areas. *Telecommun. Policy* **2007**, *31*, 374–388. [CrossRef]
8. Janc, K.; Czapiewski, K.Ł. The internet as a development factor of rural areas and agriculture—Theory vs. Practice. *Studia Reg.* **2013**, *36*, 89–105.
9. Naldi, L.; Nilsson, P.; Westlund, H.; Wixe, S. What is smart rural development? *J. Rural Stud.* **2015**, *40*, 90–101. [CrossRef]
10. ENRD. Smart Villages: Revitalising Rural Services. *EU Rural Rev.* **2018**, 26. Available online: https://enrd.ec.europa.eu/sites/enrd/files/enrd_publications/publi-enrd-rr-26-2018-en.pdf (accessed on 14 February 2020).
11. ENRD. Smart Villages: Revitalising Rural Services. 2018. Available online: https://www.youtube.com/watch?v=ckB71hb0kx0 (accessed on 3 May 2020).
12. ENRD. How to Support Smart Villages Strategies Which Effectively Empower Rural Communities? Orientations for Policy-Makers and Implementers. 2019. Available online: https://enrd.ec.europa.eu/sites/enrd/files/enrd_publications/smart-villages_orientations_sv-strategies.pdf (accessed on 3 May 2020).
13. EC. EU Action for Smart Villages. 2017. Available online: https://enrd.ec.europa.eu/news-events/news/eu-action-smart-villages_en (accessed on 13 February 2020).
14. van Gevelt, T.; Holmes, J. A Vision for Smart Villages. 2015. Available online: https://e4sv.org/wp-content/uploads/2015/08/05-Brief.pdf (accessed on 13 February 2020).
15. Cork 2.0 Declaration. 2016. Available online: https://ec.europa.eu/agriculture/sites/agriculture/files/events/2016/rural-development/cork-declaration-2-0_en.pdf (accessed on 13 February 2020).
16. Rural People's Declaration of Candás Asturias. 2019. Available online: https://www.arc2020.eu/wp-content/uploads/2019/11/declaration.pdf (accessed on 4 March 2020).
17. OECD. Principles on Urban Policy and on Rural Policy. 2019. Available online: https://www.oecd.org/regional/ministerial/documents/urban-rural-Principles.pdf (accessed on 13 February 2020).
18. Davies, N. Volume II: 1795 to the Present. In *God's Playground. A History of Poland*; Oxford University Press: New York, NY, USA, 2005.
19. Rosner, A.; Stanny, M. *Socio-Economic Development of Rural Areas in Poland*; EFRWP, IRWiR PAN: Warsaw, Poland, 2017.
20. Stanny, M.; Rosner, A.; Komorowski, Ł. *Monitoring Rozwoju Obszarów Wiejskich. Etap III. Struktury Społeczno-Gospodarcze, Ich Przestrzenne Zróżnicowanie i Dynamika (Rural Development Monitoring. Stage III. Socioeconomic Structures, Their Spatial Diversity and Dynamics)*; EFRWP, IRWiR PAN: Warsaw, Poland, 2018. [CrossRef]

21. GUS. Rural Areas in Poland—National Agricultural Census 2010. 2013. Available online: https://stat.gov.pl/en/topics/agriculture-forestry/national-agricultural-census-2010/rural-areas-in-poland-national-agricultural-census-2010,1,1.html (accessed on 3 March 2020).
22. Stanny, M.; Rosner, A.; Komorowski, Ł. The Relationship between the Level of development and the socio economic structure of Rural Areas. Poland: At the junction of Eastern and Western Europe. *IRWiR PAN*. under review.
23. ESPON. Shrinking rural regions in Europe. Towards Smart and Innovative Approaches to Regional Development Challenges in Depopulating Rural Regions. 2017. Available online: https://www.espon.eu/sites/default/files/attachments/ESPON%20Policy%20Brief%20on%20Shrinking%20Rural%20Regions.pdf (accessed on 4 March 2020).
24. Stasiak, A. Problems of Depopulation of Rural Areas in Poland after 1950. In *The Processes of Depopulation of Rural Areas in Central and Eastern Europe*; Stasiak, A., Mirowski, W., Eds.; IGiPZ PAN: Warsaw, Poland, 1990; Conference Papers 8; pp. 13–37.
25. Frenkel, I.; Rosner, A.; Stanny, M. Kształtowanie się populacji ludności wiejskiej (Rural population development). In *Ciągłość i zmiana. Sto lat Rozwoju Polskiej Wsi (Continuity and Change: A Hundred Years of the Development of Polish Rural Areas)*; Halamska, M., Stanny, M., Wilkin, J., Eds.; IRWiR PAN: Warsaw, Poland, 2019; Volume 1, pp. 77–117.
26. Flaga, M.; Wesołowska, M. Demographic and social degradation in the Lubelskie Voivodeship as a peripheral area of East Poland. *Bull. Geogr. Socio-Econ. Ser.* **2018**, *41*, 7–27. [CrossRef]
27. Halamska, M. Wspierać czy zalesiać? Dylematy rozwoju wiejskich obszarów problemowych (Supporting or Afforesting? Dilemmas in the Development of Rural Problem Areas in Poland). *Wieś I Rol.* **2018**, *180*, 69–91. [CrossRef]
28. Li, Y.; Westlund, H.; Liu, Y. Why some rural areas decline while some others not: An overview of rural evolution in the world. *J. Rural Stud.* **2019**, *68*, 135–143. [CrossRef]
29. OF. Błędne Koło Niedorozwoju (The Vicious Circle of Underdevelopment). 2019. Available online: https://www.obserwatorfinansowy.pl/tematyka/makroekonomia/bledne-kolo-niedorozwoju (accessed on 4 March 2020).
30. Czarnecki, A. Urbanizacja Kraju I Jej Etapy (Urbanization of the Country and Its Stages). In *Ciągłość i zmiana. Sto Lat Rozwoju Polskiej Wsi (Continuity and Change: A Hundred Years of the Development of Polish Rural Areas)*; Halamska, M., Stanny, M., Wilkin, J., Eds.; IRWiR PAN: Warsaw, Poland, 2019; Volume 1, pp. 51–76.
31. OECD. Glossary: Functional Urban Area. Available online: https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Functional_urban_area (accessed on 3 May 2020).
32. Rosner, A. *Zmiany Rozkładu Przestrzennego Zaludnienia Obszarów Wiejskich. Wiejskie Obszary Zmniejszające Zaludnienie I Koncentrujące Ludność Wiejską (Changes in the Spatial Distribution of Rural Population. Rural Areas Reducing and Concentrating Rural Population)*; IRWiR PAN: Warsaw, Poland, 2012.
33. Grabowska-Lusińska, I. Migrations from Poland after 1 May 2004 with Special Focus on British Isles. *Space Popul. Soc.* **2008**, 247–260. [CrossRef]
34. Śleszyński, P. Delimitacja miejskich obszarów funkcjonalnych stolic województw (Delimitation of the Functional Urban. Areas around Poland's voivodship capital cities). *Przegląd Geograficzny* **2013**, *85*, 173–197. [CrossRef]
35. Ravenstein, E.G. *The Birthplaces of the People and the Laws of Migration*; Trübner & Co., Ludgate Hill, E.C.: London, UK, 1876.
36. Stanny, M. Dynamika zmian demograficznych ludności wiejskiej i jej zasobów pracy (Demography of Rural Areas in Poland). *Polityka Społeczna* **2012**, *7*, 1–9.
37. Rosner, A. Współczesne procesy zmian zaludnienia obszarów wiejskich w Polsce (Contemporary Processes of Population Changes of Rural Areas in Poland). In *Obszary Wiejskie. Wiejska Przestrzeń I Ludność, Aktywność Społeczna I Przedsiębiorczość (Rural Areas—Countryside Expanse and Population, Social Activity and Enterpreneurship)*; Heffner, K., Klemens, B., Eds.; KPZK PAN: Warsaw, Poland, 2016; Volume 167, pp. 232–249.
38. Paniagua, A. Smart Villages in Depopulated Areas. In *Smart Village Technology. Concepts and Developments*; Patnaik, S., Sen, S., Mahmoud, M.S., Eds.; Springer: Cham, Switzerland, 2020; Volume 17, pp. 399–409. [CrossRef]
39. Gomez, R.; Hunt, P. *Telecentre Evaluation: A Global Perspective. Report of an International Meeting on Telecentre Evaluation*; Gómez, R., Hunt, P., Eds.; IDRC: Ottawa, ON, Canada, 1999.

40. Kaleta, A. Telechata jako instrument zrównoważonego rozwoju obszarów wiejskich (Telecottage as a tool of the rural areas sustainable development). *Annales Universitatis Mariae Curiae-Skłodowska Sectio I Philosophia-Sociologia* **2011**, *36*, 85–92. [CrossRef]
41. Lundin, R. Communications Technology. In *Think Tank on Research into Rural Education, Proceedings of the Conference Held by the RERDC, Townsville, Australia, 10–14 June 1990*; McShane, W., Ed.; James Cook University: Townsville, Australia, 1990; pp. 90–99.
42. Komorowski, Ł.; Stanny, M. (R)ewolucja wyposażenia wsi w wodę, prąd i telefon ((R)evolution in bringing water, electricity and telephones to rural areas). In *Ciągłość i Zmiana. Sto Lat Rozwoju Polskiej Wsi (Continuity and Change. Hundred Years of the Development of Polish Rural Areas)*; Halamska, M., Stanny, M., Wilkin, J., Eds.; IRWiR PAN: Warsaw, Poland, 2019; Volume 2, pp. 761–801.
43. GUS. Statistical Yearbook of the Republic of Poland. 2017. Available online: https://stat.gov.pl/en/topics/statistical-yearbooks/statistical-yearbooks/statistical-yearbook-of-the-republic-of-poland-2017,2,17.html (accessed on 10 February 2020).
44. GUS. Statistical Yearbook of the Republic of Poland. 2019. Available online: https://stat.gov.pl/en/topics/statistical-yearbooks/statistical-yearbooks/statistical-yearbook-of-the-republic-of-poland-2019,2,21.html (accessed on 10 February 2020).
45. POPC. Lista Projektów (List of Projects). Available online: https://www.polskacyfrowa.gov.pl/strony/o-programie/projekty/lista-beneficjentow/ (accessed on 3 May 2020).
46. MFiPR. Wpływ Polityki Spójności na Rozwój Obszarów Wiejskich (The Impact of Cohesion Policy on Rural Development). 2019. Available online: https://www.ewaluacja.gov.pl/strony/badania-i-analizy/wyniki-badan-ewaluacyjnych/badania-ewaluacyjne/wplyw-polityki-spojnosci-na-rozwoj-obszarow-wiejskich/ (accessed on 15 April 2020).
47. KSOW. Rekomendacje KSOW Wobec Smart Villages (KSOW Recommendations for Smart Villages). 2019. Available online: http://ksow.pl/news/entry/15022-rekomendacje-ksow-wobec-smart-villages.html (accessed on 16 February 2020).
48. Komorowski, Ł. Laboratorium Smart Villages: Wizyta w Fińskich Smart Wsiach (Smart Village Laboratory: A Visit to Finnish Smart Villages). 2019. Available online: http://ksow.pl/news/entry/15075-laboratorium-smart-villages-wizyta-w-finskich.html (accessed on 16 February 2020).
49. Guzal-Dec, D. Inteligentny Rozwój Wsi—Koncepcja Smart Villages: Założenia, Możliwości I Ograniczenia Implementacyjne (Intelligent Development of the Countryside—the Concept of Smart Villages: Assumptions, Possibilities and Implementation Limitations). *Econ. Reg. Stud.* **2018**, *3*, 32–49. [CrossRef]
50. Pérez-delHoyo, R.; Mora, H. Toward a New Sustainable Development Model for Smart Villages. In *Smart Villages in the EU and Beyond*; Visvizi, A., Lytras, M.D., Mudri, G., Eds.; Emerald Publishing Limited: Bingley, UK, 2019; pp. 49–62. [CrossRef]
51. Slee, B. Delivering on the concept of smart villages—in search of an enabling theory. *Eur. Countrys.* **2019**, *11*, 634–650. [CrossRef]
52. Wolski, O.; Wójcik, M. Smart Villages Revisited: Conceptual Background and New Challenges at the Local Level. In *Smart Villages in the EU and Beyond*; Visvizi, A., Lytras, M.D., Mudri, G., Eds.; Emerald Publishing Limited: Bingley, UK, 2019; pp. 29–48. [CrossRef]
53. Davies, A. IOT, Smart Technologies, Smart Policing: The Impact for Rural Communities. In *Smart Village Technology. Concepts and Developments*; Patnaik, S., Sen, S., Mahmoud, M.S., Eds.; Springer: Cham, Switzerland, 2020; Volume 17, pp. 25–37. [CrossRef]
54. Zwolińska-Ligaj, M.; Guzal-Dec, D.; Adamowicz, M. Koncepcja inteligentnego rozwoju lokalnych jednostek terytorialnych na obszarach wiejskich regionu peryferyjnego na przykładzie województwa lubelskiego (The Concept of Smart Development of Local Territorial Units in Peripheral Rural Areas: The Case of Lublin Voivodeship). *Wieś I Rol.* **2018**, *179*, 247–280. [CrossRef]
55. Vaishar, A.; Šťastná, M. Smart village and sustainability. Southern Moravia case study. *Eur. Countrys.* **2019**, *11*, 651–660. [CrossRef]
56. Bonenberg, W.; Qi, L.; Zhou, M.; Wei, X. Smart Village as a Model of Sustainable Development. Case Study of Wielkopolska Region in Poland. In *Advances in Human Factors in Architecture, Sustainable Urban Planning and Infrastructure*; Charytonowicz, J., Falcão, C., Eds.; Springer: Cham, Switzerland, 2020; pp. 234–242. [CrossRef]

57. Kidyba, M.; Makowski, Ł. *Smart City. Innowacyjne Rozwiązania w Administracji Publicznej a Zarządzanie Inteligentnym Miastem (Smart City: Innovative Solutions in Public Administration vs. Smart city Management)*; Wydawnictwo WSB: Poznań, Poland, 2017.
58. Fajrillah, F.; Mohamad, Z.; Novarika, W. Smart city vs smart village. *J. Mantik Penusa* **2018**, *22*, 1–6.
59. Visvizi, A.; Lytras, M.D. Rescaling and refocusing smart cities research: From mega cities to smart villages. *J. Sci. Tech. Pol. Manag.* **2018**, *9*, 134–145. [CrossRef]
60. Zavratnik, V.; Kos, A.; Duh, E.S. Smart villages: Comprehensive review of initiatives and practices. *Sustainability* **2018**, *10*, 2559. [CrossRef]
61. Malek, J.A.; Adawiyah, R. Smart city (SC)—smart village (SV) and the 'Rurban' concept from a malaysia-indonesia perspective. *Afr. J. Hosp. Tour. Leis.* **2019**, *8*, 1–7.
62. Park, C.; Cha, J. A Trend on smart village and implementation of smart village platform. *Inter. J. Adv. Smart Converg.* **2019**, *8*, 177–183. [CrossRef]
63. Visvizi, A.; Lytras, M.D. It's not a fad: Smart cities and smart villages research in European and global contexts. *Sustainability* **2018**, *10*, 2727. [CrossRef]
64. Philip, L.; Williams, F. Healthy ageing in smart villages? Observations from the field. *Eur. Countrys.* **2019**, *11*, 616–633. [CrossRef]
65. OECD. Rural 3.0. A Framework for Rural Development. 2018. Available online: https://www.oecd.org/cfe/regional-policy/Rural-3.0-Policy-Note.pdf (accessed on 1 February 2020).
66. MFiPR. Krajowa Strategia Rozwoju Regionalnego 2030. Rozwój Społecznie Wrażliwy I Terytorialnie Zrównoważony (National Regional Development Strategy 2030: Socially Sensitive and Territorially Sustainable Development). 2019. Available online: https://www.gov.pl/web/fundusze-regiony/krajowa-strategia-rozwoju-regionalnego (accessed on 14 February 2020).
67. Bled Declaration. 2018. Available online: http://pametne-vasi.info/wp-content/uploads/2018/04/Bled-declaration-for-a-Smarter-Future-of-the-Rural-Areas-in-EU.pdf (accessed on 14 February 2020).
68. ENRD Thematic Group "Smart Villages". Available online: https://enrd.ec.europa.eu/enrd-thematic-work/smart-and-competitive-rural-areas/smart-villages_en (accessed on 1 February 2020).
69. Jedlińska, R.; Rogowska, B. Rozwój e-administracji w polsce (The development of e-administration in Poland). *Ekon. Probl. Usług* **2016**, *123*, 137–147. [CrossRef]
70. Śledziewska, K.; Zięba, D. *E-Administracja w Polsce na tle Unii Europejskiej. Jak z Niej (nie) Korzystamy (E-Administration in Poland Compared to the European Union: How We Are (Not) Using It)*; Digital Economy Lab UW: Warsaw, Poland, 2016.
71. Maaseutu. Smart Villages in Finland, Plans for the Future. 2019. Available online: https://enrd.ec.europa.eu/sites/enrd/files/tg9_smart-villages_future-interventions_selkainaho.pdf (accessed on 3 May 2020).
72. MARD. The Existing Rural Development Measures and Idea for Future Framework for Supporting Smart Villages in Poland. 2020. Available online: https://enrd.ec.europa.eu/sites/enrd/files/5_tg11_smart-villages_sv-interventions_gierulska_0.pdf (accessed on 3 May 2020).
73. Haider, M.F.; Siddique, A.R.; Alam, S. An approach to implement frees space optical (FSO) technology for smart village energy autonomous systems. *Far East. J. Electron. Commun.* **2018**, *18*, 439–456. [CrossRef]
74. GUS. Społeczeństwo Informacyjne w Polsce w 2019 r. (The Information Society in Poland in 2019). 2019. Available online: https://stat.gov.pl/obszary-tematyczne/nauka-i-technika-spoleczenstwo-informacyjne/spoleczenstwo-informacyjne/spoleczenstwo-informacyjne-w-polsce-w-2019-roku,2,9.html (accessed on 14 February 2020).
75. Batorski, D. Technologies and Media in Households and Lives of Poles. In *Social Diagnosis 2015, The Objective and Subjective Quality of Life In Poland*; Czapiński, J., Panek, T., Eds.; Contemporary Economics: Warsaw, Poland, 2015; Volume 9/4, pp. 367–389. [CrossRef]
76. Zalega, T. Korzystanie z Internetu i Wirtualizacja Konsumpcji Wśród Polskich Seniorów: Wyniki Badań Bezpośrednich (The use of the Internet and the Virtualisation of Consumption among Polish Seniors: The Results of Primary Research). In *Organizacja Społeczna w Strukturach Sieci: Doświadczenia i Perspektywy Rozwoju w Europie Środkowej i Wschodniej (Social Organisation in Network Structures: Experiences and Development Prospects in Central and Eastern Europe)*; Betlej, A., Partycki, S., Parzyszek, M.J., Eds.; Wydawnictwo KUL: Lublin, Poland, 2016; pp. 138–153.

77. Kolkowska, E.; Soja, E.; Soja, P. Implementation of ICT for Active and Healthy Ageing: Comparing Value-Based Objectives Between Polish and Swedish Seniors. In *Information Systems: Research, Development, Applications, Education*; Wrycza, S., Maślankowski, J., Eds.; Springer: Cham, Switzerland, 2018; Volume 333, pp. 161–173. [CrossRef]
78. Meyn, M. Digitalization and Its Impact on Life in Rural Areas: Exploring the Two Sides of the Atlantic: USA and Germany. In *Smart Village Technology. Concepts and Developments*; Patnaik, S., Sen, S., Mahmoud, M.S., Eds.; Springer: Cham, Switzerland, 2020; Volume 17, pp. 99–116. [CrossRef]
79. Ursula von der Leyen A Union that Strives for More. My Agenda for Europe. Available online: https://ec.europa.eu/commission/sites/beta-political/files/political-guidelines-next-commission_en.pdf (accessed on 5 March 2020).

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Farmers' Intentions to Lease Forestland: Evidence from Rural China

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Abstract: In the last decade, despite considerable research developed for the forestland leasing market, little has been published in terms of econometric results on determinants of intentions and behaviors of Chinese farmers. With respect to leasing forestland, this study uses a Bayesian logit model to examine the factors that influence farmers' intentions, using household data collected in one county in 2017. The results show that farmers' past experience of leasing forestlands have significant impacts on their leasing intentions. Once farmers participated in leasing in or leasing out forestland in the last five years, it was shown that they will have stronger intentions of doing so in the future. Farmers will neither lease in or out forestland if the leasing profits are less than the profits originated from forestland management. As such, household head age, household population, proportion of income from nonfarm sources to total income, and security of rights to forestland use are significant factors in influencing farmers' decisions on leasing in forestland. On the other hand, household head age and educational level, proportion of income from nonfarm sources to total income, and importance of forestland in terms of inheritance are significant factors in influencing farmers' decisions on leasing it out. Results imply that institutional and market factors, which have impacts on transaction costs, are important for farmers in making decisions on forestland leases. Policy implications to reduce institutional intervention are discussed.

Keywords: land lease market; decision making; forest market factors; rural land rights; China

1. Introduction

Since the early 1980s, a series of economic reforms have been launched in China, as well as a number of market-driven mechanisms that have been implemented to improve resource allocation efficiency and productivity—partly designed to promote the development of the land rental market [1–6]. Market-based mechanisms are thought to be able to play an important role in improving the use of input factors and the economies of scale for land management [7–9]. Due to constitutional provisions of land property rights, rural land is collectively owned and managed. In the process of de-collectivization of rural land, collective ownership is not allowed to be changed and use rights of rural land is contracted to the member of the collective, i.e., the farmer, for a period ranging from 30 to 70 years [10]. The rural land market in China is substantially a land lease market with limited usage rights circulated within the market. In this market, leasing in forestland is equivalent as buying forestland usage rights and leasing out is equal to selling it outright. Farmers' intentions of leasing land therefore play a dominant role on the development of the market—forming the basis for this study.

While forestland accounts for more than two thirds of the rural landscapes in southern China, forestland lease markets have received little research attention compared to the considerable amount of attention farmland markets garner [9,11]. This is probably due in part to the fact that reforms in farmland tenure occurred before forestland tenure. The farmland tenure reform was initiated in 1978 by creating a Household Contract Responsibility System and granting usage rights of farmland to farm households [4]. Following farmland tenure reform, the initial collective forestland tenure reform in 1981 aimed to distribute forestland to individual households and fix three issues pertaining to collective forest tenure, that being: (1) clarification of rights to the forest (i.e., for family plots), (2) delimitation of boundaries of private plots (i.e., responsibility hills), and (3) establishing a forest responsibility system (i.e., collective management system) [10,12–14]. However, the reform was terminated by the central government in 1987 since it was widely believed that large scaled deforestation was taking place as a result [13]. Therefore, before a new round of collective forest tenure reforms would be undertaken in China in 2003 [15], most collective forestlands were collectively managed until 1987. This caused inefficiency to the forest management system resulting in collective forests having a lack of professionals and an inequity of farmers benefitting from the harvest.

These new reforms are regarded as a de-collectivization step [12], aimed at promoting efficiency and equity of the whole collective forest management system. Rural households are granted forestland usage rights through clarification and confirmation of property rights of forests and forestland. It is widely held that farmers have the motivation to enhance forest investment and management when they are convinced greater incentives and security exist in terms of its use in relation to forestland rights. Together with favorable policies, it has been observed that reducing production costs and enhancing profitability of forest production are aftereffects [13,15]. The reforms are still ongoing, with a goal to make forest management more profitable for farmers by eliminating any existing institutional barriers, such as the difficulty for farmers to obtain a loan by mortgaging the usage right of forestland and ownership of stumpages.

More recently, a few studies were undertaken to investigate China's forestland lease market with specific focuses on fundamental issues of development of the forest market (e.g., Kong and Du [16], Nie [17], and Xie et al. [11]. Kong and Du [16] examined whether farmers had the right to participate in the forestland lease market, particularly the right to lease out forestland use rights. They found that transferability of farmers' land was secured by current land tenure system and farmers were free to decide whether to participate in the market or not. Nie [17] found that current market mechanisms lacked efficiency. That is, there were high transaction costs for seeking lease information and contracting agreements. The market prices for leasing forestland were not transparent and farmers had inadequate knowledge about their forestland value, therefore, suffering in terms of economic loss when leasing out forestland at a low price. Xie et al. [11] examined profitability of farmer leasing out forestlands in the market compared to timber benefit by way of self-management. The study showed that, due to the limitation of China's logging quota system, farmers were unable to harvest all mature stands, hence, their timber benefits were lower than the land rent.

The incidence of leased forestland transactions seems much higher than that of farmland [18]. This is explained by several econometric studies at the farm household level. Xu et al. [9] examined forestland transactions, their scope and motivation, and the characteristics of households participating in the market for forestland in eight villages of Lin'An and Anji counties located in Zhejiang Province. Using household survey data collected from 2009, they found that households in Anji were more likely to lease out land and less likely to lease in than households in Lin'An. The age of the household head, social status of the household head (i.e., whether they were a village leader or not), population size, and number of laborers in the household did not seem to have much explanatory power in farmers' decisions to lease in or lease out forestland. The educational level of household heads was not statistically significant for leasing in behaviors but was slightly significant for leasing out. If there were any household member hired by a business or the government, the household would be more likely to lease out forestland. The most apparent and significant factors for a household's likelihood to participate in land leases were household income and ratio of non-agricultural income. It also was apparent the number of parcels of land households owned affected their decisions. The satisfaction with the transaction price was statistically significant in the lease in and lease out model.

Xu et al. [19] reviewed recent econometric studies about factors affecting farmers' decisions to lease land with a focus on research characteristics, including: analytical framework, regression techniques, data features, and findings. Their synthesis of existing literature indicates that a similar analytical framework is employed by different researchers. It confirms four categories of lease determinants: demographic characteristics, policy variables, forestland conditions, and economic variables. These determinants have been widely discussed in terms of farmers' decision making related to forest management [20]. Demographic characteristics are most frequently used by researchers and can be observed in all cited research, while regression coefficients of demographic characteristics and relating variables are not statistically significant. Policy variables consist of farmers' evaluation of the reform, logging quota system, and regulation of the forestland market. Economic variables include forest management costs and revenue. In addition, all research isolates, to some degree, farmers' leasing in and leasing out behaviors by employing two separate models. Similar research findings of factors affecting farmers' participation in forestland transactions have been examined by Hong et al. [21]. Zhang et al. [22] highlighted the effect of off-farm employment on forestland transfers in China using a simultaneous-equation Tobit model estimation verified that off-farm employment is endogenous to farmer' decision to lease their forestland.

On a global-scale, forestland markets signal a large body of literature from countries that exhibit a sound market economy. In parallel, there are increasing studies from other countries experiencing this transition, i.e., from a centralized market to an open market economy, that also indicate this trend [23–25]. Driving forces of forestland markets, such as forestland prices, physical characteristics of the forestland, and buyer perception and intentions, are major research focuses conducted in the countries with sound market economies [26–31]. Comparatively, studies in countries that are going through a transformative state, indicate the emergence of forestland markets and overlook impacts from institutional reform and related remodeling efforts. Though forestland markets are still underdeveloped, forest plantation farm households have started to rent in forestland from familiar local farmers with government support via cost-sharing in Vietnam [32]. As such, governmental support has promoted development of forestland markets in Uganda [33] and Ethiopia [34,35]; however, land speculation is active in both countries and requires further procurement controls. In Romania, large areas of forestland have shifted from public to private ownership [36], promoting forestland market competition [37,38]. Along with the furthering of market-oriented economic development, forestland markets in these countries will need to embrace significant reforms that better understand the varying actors and perceptive roles that support local livelihoods—via subsistence, commercial, and ecological contributions [25].

The objective of this study is to bridge an understanding on farmer' past lease experience and future lease intentions, and then provide references for a predictive element for the development of the future of the forestland lease market. Individuals' past experience has been recognized as a significant influence on their behavior in several studies, e.g., investigating leisure choice [39] and recycling behaviors [40,41]. Past experience has also been regarded as the best predictor of conservation behavior [42]; however, there are limited studies specific to the forestland lease market. As such, farmers performing as dominant actors, in leasing forestland usage rights, focalized on their leasing intentions formulates the practicality and significance of this study. The incorporation of this research with existing studies (i.e., investigating development of the forestland market based on studies of farmers' lease behaviors [19,21,22]) presents a more complete approach in predictive development of the forestland lease market in China. A conceptual model and econometric approach are presented in Section 2. Data collection and descriptive statistics are provided in Section 3. At length, empirical results are illustrated in Section 4, followed by a discussion and conclusion in Section 5.

2. Model Design

The derived conceptual model investigates farmers' intentions of leasing forestland. The conceptual model consists of key factors that affect intention and factor in aspects of decision making and economic viability. Specific empirical specifications, in terms of corresponding variable selection, are integrated and estimated in the model for robustness.

2.1. Conceptual Model

We applied a profit-maximization function by utilizing an approach presented by Johansson and Lofgren [43]. The intended examination of leasing forestland, by representative households as well as identifying factors that affect farmers' decisions on leasing, is a core focus of the model. Our interest is focalized on farmers' land leasing decisions in which the conceptual model considers decision-based variables, that being: lease in only, lease out only, both lease in and lease out, and neither lease in or lease out. As such, in reference to a number of studies [15,44] and fieldwork observations, farmers in developing countries also tend to pay little or no attention to the amenity value of forests, hence, we isolated the physical value of the forest and timber yield of forestland in our model. In comparison to other models (i.e., specifically investigating forestland markets in China [22]), our model differs, respectively, in the decomposition of timber profit into terms of revenue and cost. The conceptual model, as representative of households, is assumed to maximize the profit from timber production, as formulated via Equation (1).

$$\begin{aligned} \max\pi &= \pi(\mathrm{A_0, A_b, A_s; Z,\ L, I}) \\ &= \mathrm{R(A_0, A_b, A_s; Z,\ L, I) - C_t(A_0, A_b, A_s; Z, L, I) - C_b(A_b; Z, L, I)} + \pi_\mathrm{s}(\mathrm{A_s; Z, L, I}) \end{aligned} \tag{1}$$

where: $\mathrm{R}(\ )$ is a revenue function of timber production; $\mathrm{C_t}(\ )$ is a function to measure cost in planting, managing, and harvesting forest; $\mathrm{C_b}(\ )$ is a cost function for leasing in forestland; and $\pi_\mathrm{s}(\ )$ is a profit function for leasing out forestland. Moreover, $\mathrm{A_0}$ is a vector of the characteristics of forestland area currently held by one household, $\mathrm{A_b}$ is a vector of the characteristics of forestland leased in, and $\mathrm{A_s}$ is a vector of the characteristics of forestland leased out. In terms of decision-based variables, if a farmer is grouped in lease in only, $\mathrm{A_b}$ is kept and $\mathrm{A_s}$ is removed. If a farmer is grouped in lease out only, $\mathrm{A_b}$ is removed and $\mathrm{A_s}$ is kept. If a farmer is grouped in both lease in and lease out, both $\mathrm{A_b}$ and $\mathrm{A_s}$ are kept. If a farmer is grouped in neither lease in or lease out, both $\mathrm{A_b}$ and $\mathrm{A_s}$ are removed. Z is a vector of the characteristics of a household, including household head (i.e., denoted as HHC) and household (i.e., denoted as HC). L is a vector of the characteristics of past leasing experiences of the household. I is a vector of the characteristics of perceived institutional impacts from the household in terms of the collective forest tenure reform.

Let $\mathrm{A_b^*}$ and $\mathrm{A_s^*}$ denote the optimal decision to lease in and lease out forestland behaviors, respectively. If the farmers are grouped in lease in only, the profit function can be written as $\pi\left(\mathrm{A_0, A_b^*; Z}\right)$, and satisfies the following notation in terms of Equations (2)–(4).

$$\pi\left(\mathrm{A_0, A_b^*; Z,\ L, I}\right) \geq \pi(\mathrm{A_0; Z,\ L, I}) \tag{2}$$

$$\pi\left(\mathrm{A_0, A_b^*; Z,\ L, I}\right) \geq \pi(\mathrm{A_0, A_s^*; Z,\ L, I}) \tag{3}$$

$$\pi\left(\mathrm{A_0, A_b^*; Z,\ L, I}\right) \geq \pi\left(\mathrm{A_0, A_b^*, A_s^*; Z,\ L, I}\right) \tag{4}$$

where: $\pi(\mathrm{A_0; Z, L, I})$ is the profit function for keeping the current management scale, $\pi(\mathrm{A_0, A_s^*; Z, L, I})$ is the profit function for only leasing out forestland, and $\pi\left(\mathrm{A_0, A_b^*, A_s^*; Z, L, I}\right)$ is the profit function for both leasing in and leasing out forestland.

Equation (2) suggests that the farmers' decisions to lease in forestland depends on the following attributes: whether it is currently held, characteristics of the household, timber production costs, cost of leasing in, past leasing experiences, and perceived institutional impact. Equation (3) can be used to provide additional interpretation for leasing in forestland, compared to Equation (2), i.e., the decision to lease in depends on the profit margin of leasing out. Equation (4) can be interpreted similarly to

Equation (2) and Equation (3) with further integrated interpretation from both of these equations. Furthermore, the probability of the decisions grouped in as lease in only is written using Equation (5).

$$P\big(\pi = \pi\big(A_0, A_b^*; Z,\ L, I\big)\big) = g(A_0; Z,\ L, I) \tag{5}$$

where: g( ) is a probability function which denotes that the probability to be grouped in the lease in only function which has been originally held forestland and characteristics of the household head and household having impacts on cost of timber production and forestland lease in and profit from forestland lease out.

These factors are employed to indicate how the heterogeneity of farmers' characteristics vary in terms of revenue, cost, and profit in timber production as well as farmers' participation in the forestland market. We enumerate the farmers' decisions on land rental using the following number classes: 1 = lease in only, 2 = lease out only, 3 = both lease in and lease out, and 4 = neither lease in or lease out. The number classes are used to differentiate the four groups without any implication that one group would be superior or inferior to another. Hence, the four groups are depicted using Equation (6).

$$P(y = i) = g(A_0, HHC, HC, L, I) \tag{6}$$

where: y denotes the group of the farmer, and i is valued 1, 2, 3, or 4.

2.2. Empirical Model Specification

We specified our empirical model specifications upon the conceptual model of framing and existing literature to measure the factors that affect farmers' intentions of leasing forestland (Table 1).

Table 1. Variables selections and assumed impacts.

Factor	Variable	Assumed impact	References
Heterogeneity of forestland	Forestland area (*area*)	Ambiguous impact	[22,45–47]
	Forestland as inherited (*inherited*)	Negative impact both on leasing in and leasing out	[22,47]
Characteristics of the household head	Age of the head (*age*)	Ambiguous impact	[11,18,19,45–48]
	Educational level of the head (*education*)	Ambiguous impact	[18,46,47]
Characteristics of household	Number of laborers in a family (*labor*)	Positive impact on leasing in and negative impact on leasing out	[45–47]
	Nonfarm income (*nonfarm*)	Ambiguous impact on leasing in and positive impact on leasing out	[45,47,49]
Institutional factor	Security of forestland usage rights (*security*)	Positive impact	[13,44,50]
Past experiences of leasing forestlands	Whether leased in (*wea_in*)	Positive impact	[40–42]
	Whether leased out (*wea_out*)	Positive impact	[40–42]
	Difficulty in leasing in (*easy_in*)	Positive impact	[45]
	Difficulty in leasing out (*easy_out*)	Positive impact	[45]
	Whether leased in profitable (*profit_in*)	Positive impact	[22]
	Whether leased out profitable (profit_*out*)	Positive impact	[22]

We used two variables to denote heterogeneity of forestlands based on the reviewed literature. The first variable is forestland area (i.e., denoted as area) was used to describe the forestland held and managed by each household. We assumed that forestland area has an ambiguous impact on farmers' intentions to lease forestland—as such—existing studies reveal competing results from the impacts of forestland area [22,45–47]. The second variable is whether farmers treat forestland as inherited (i.e., denoted as inherited). Once farmers treated forestland as inherited, they usually become less active in forest management [20]. Similarly, these farmers have appeared to be inactive in the leasing of forestland—per se [47]. We, therefore, assume farmers' treatment of forestland as inherited as a negative impact both on their intention of leasing in and leasing out the land.

We employed two variables to denote the characteristics for the household head (i.e., HHC). First, we assume that the impact of the age of the household head (i.e., denoted as age) on leasing in and leasing out of forestland is ambiguous. The age of the household head had been found to have a negative impact both on leasing in [45] and leasing out of forestland [47,48]; however, some studies contested that age had no influence on forestland lease in [16] or lease out behavior [11,19,46]. Second, we assume the educational level of the household head is ambiguous (i.e., denoted as education) due to the majority of previous studies that concluded the effect as not significant [29,31,46] with a few studies showing a positive effect [18].

Household characteristics variables (i.e., HC) include the number of laborers in a family unit (i.e., denoted as labor) and income from nonfarm work (i.e., denoted as nonfarm). The more labor force a household had, the more likely the household would lease in forestland [45,46] and the less likely they were to lease it out [47]. Farmers can get nonfarm income not only by working for others (i.e., a wage income), but also from doing additional business dealings. Nonfarm income is measured by aggregating wage income and business income. A higher nonfarm income implies that the return on aggregate labor and capital input in nonfarm activities as well as opportunity costs of working in forestry is high. We assumed that nonfarm income has a positive impact on leasing out forestland [30,32]; however, the impact of nonfarm income on leasing in forestland was ambiguous since contradicting results exist from previous studies [45,47,49].

Only one institutional variable was used by incorporating security of forestland usage rights (i.e., denoted as security). Previous studies show that insecurity of land property rights resulted in a lack of incentive for farmers to intensify forest investment and expand forest management scale [13,44,50]. Though it can be noted that there are policy incentives for forestland leasing in other areas of China, for example in Zhejiang Province [45], we did not find any such policies in our study area.

Regarding impact of past experience of leasing forestlands, we employed three variables as indicators. The first variable is whether farmers leased in (i.e., denoted as wea_in) or leased out forestlands (i.e., denoted as wea_out) in the past five years. Intuitively, farmers who have experiences in leasing forestlands might have a better understanding on how to lease forestland, which could cause variability in intentions between farmers with experience versus not. In order to capture a more detailed impact from past experience, we employed a second variable of whether farmers had difficulty in leasing in (i.e., denoted as easy_in) or leasing out (i.e., denoted as easy_out) forest land in the past five years. We assumed that farmers with such difficulty might have less intention of leasing forestland in the future. It has been proved, however, that once transaction costs of leasing forestlands are lowered, the leasing effect becomes more active [45]. A third variable was assigned to whether forestland lease in or lease out profitable existed (i.e., denoted as profit_in and profit_out), respectively. The third variable assumed to have a similar impact as the second variable on farmers' leasing intention. The timber price was used as a proxy variable to measure farmers' profit of lease from forestland. When timber prices rose, lease in became more active. Conversely, once timber price lower, lease out became more active—according to Zhang et al. [22].

Noticeably, very few farmers both leased in and leased out forestlands in our observation. Therefore, we specified our focus on farmers' intention of either leasing in or leasing out by utilizing the following two equations (i.e., Equations (7) and (8)) to formulate our reduced empirical models.

$$P(y = 1) = f\begin{pmatrix} area, inherited, \ age, \ education, \ labor, nonfarm, \\ security, wea\_in, easy\_in, profit\_in \end{pmatrix} \quad (7)$$

$$P(y = 2) = f\begin{pmatrix} area, inherited, \ age, \ education, \ labor, nonfarm, \\ security, wea\_out, easy\_out, profit\_out \end{pmatrix} \quad (8)$$

Equation (7) is a lease in model where y is equal to 1 and Equation (8) is a lease out model where y is equal to 2.

2.3. Model Estimation

The specified models were estimated by adopting Bayesian logit regression models in which farmers' responded intention of leasing in or leasing out forestlands were the dependent variables. In the models, farmers who had answered "Yes" indicating that they have intentions of leasing in or leasing out forestland was coded as one. Merged responses of "No" and "I don't know" were placed into a single category and coded as zero by following Sanchez and Morchio's [51] and Groothuis and Whitehead's [52] analyses. Bayesian methods can randomly sample and estimate individual-specific parameters [53] as well as consider model uncertainty by taking into account various combination of models to minimize the subjective judgment [54]. Bayesian analyses provide a robust estimation approach by using not only the data but also existing know-how about model parameters. They also allow one to introduce stochastic conditions in the posterior distribution of parameters to address estimation challenges in the empirical model (e.g., excessive multi-collinearity among explanatory variables as described by Hair et al. [55], Western and Jackman [56], and Willis and Perlack [57]).

According to the Bayesian theorem [58], the posterior density of the parameters of the independent variable is proportional to the likelihood of reported knowledge given model parameters (i.e., β), and knowledge of the prior probability distribution. The prior distribution of β_j (j = 1, 2, 3, ... , m) where m is the number of independent variables was assumed to be normally distributed with $\beta_j \sim N(\mu_i, \sigma_j^2)$ in respect to Congdon's [59] work. In this study, μ_i was set to 0 and σ to 10,000. The random-walk Metropolis-Hastings sampling method, a default setting in the Bayesian calculation provided by Software Stata 15, was used to estimate the posterior distribution [60–62]. Metropolis-Hastings sampling is a general algorithm that releases the assumption in Gibbs sampling that proposed distributions are the posterior conditionals. Random-walk is the most commonly used Metropolis-Hastings algorithm when simulating candidate samples from a Gaussian proposal distribution that randomly perturbs the current state of the chain [63–65]. The coefficients of the explanatory variables were calculated by 10,000 iterations of the sampling based on the Monte Carlo errors with a burn-in of an initial 1,000 iterations [66].

3. Methodology

We define the study area where we conducted data collection at the farm household level. A description of the general characteristics of our data are also noted.

3.1. Study Area

We conducted data collection in Ningdu County of Jiangxi Province. Jiangxi was one of the four provinces to host pilot projects for the reforms implemented during the collective forest property rights restructuring in 2004 [15]. In consequence, Jiangxi was considered an ideal study area for the research especially since its implementation of collective forest tenure reform and subsequent emergence as a forestland market [11,15,67]. As one of the key forestry counties, Ningdu is ranked fourth in terms of acreage of forestland province-wide. The total forestland is estimated at around 300,000 hectares.

The forest coverage is high at 71.3%, which is 10% higher than the provincial average. Collective forestlands are 280,000 hectares, accounting for 93% of total forestlands while the rest are state-owned. The total standing forest stock is 9.7 million cubic meters. On average, each farmer owns 0.5 hectares of forestlands (i.e., more than 10 times 0.05 hectares of crop land from the county level). Forestlands are crucial resources to local households. As a result of the reform, more than 90% of collective forestlands usage rights and ownership were transferred to farm households. This process was regarded as de-collectivization of collective forestland, generating more secure and beneficial rights to use it at the farmer-level [12,13].

Forestland lease market emerged along with increasing transfer of usage rights of forestland from collective to individual farm households in Ningdu. This provided us with ample local-based evidence to form a sound understanding of development for the ongoing forestland market. The Ningdu Forestry Administration Bureau set up an agency providing services as policy consultation, forestland demand or supply information distribution, auction, bidding, and assistance of the contract signing. This universal practice facilitated development of the lease forestland market throughout Jiangxi Province [11]. The agency started to collect data of forestland leasing based on the transfers of contracts signed in-house from 2006. The data presents leased forestland with an area per case larger than 10 hectares (Figure 1). The data provided the general dynamics of the lease forestland market from 2006 to 2016—note that inadequate information of single cases of leased forestland with a scale of smaller than 10 hectares was not available.

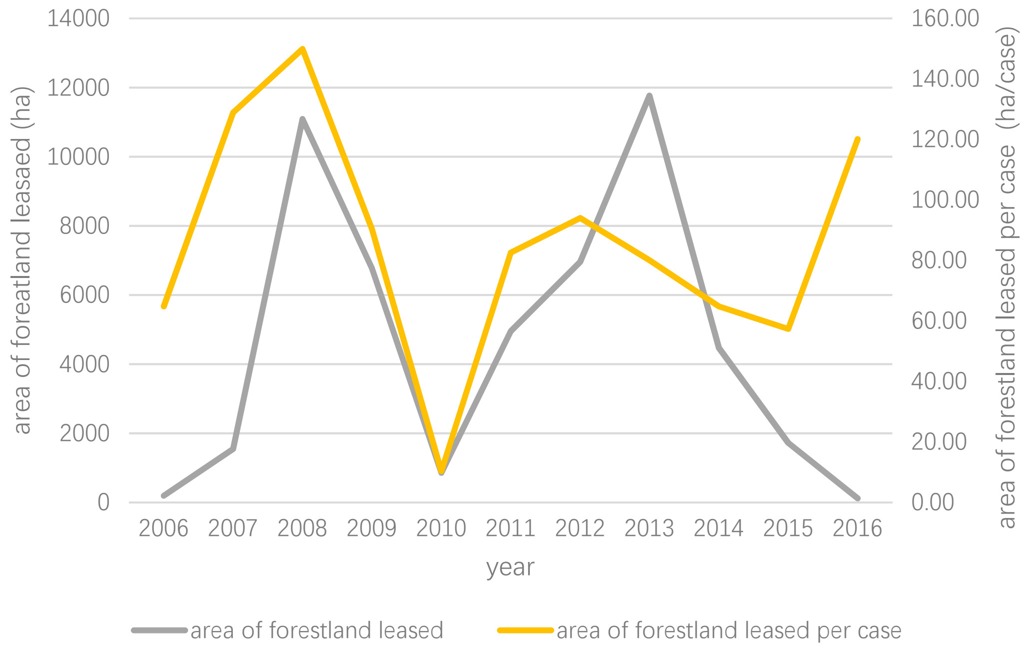

Figure 1. Dynamics of leased forestland with areas per case larger than 10 hectares.

As noted in Figure 1, the lease forestland market fluctuated sharply during the period from 2006 to 2016. In isolation, from 2006 to 2008, the leased forestland continued to be more active and reached a summit of 11,091 hectares in 2008, while from 2008 to 2010, the leased forestland kept decreasing and reached a low of 857 hectares in 2010. Noticeably, China State Council announced that the collective forest tenure reform was to be implemented nationwide in 2008—at the same time the lease forestland price reached a summit in Ningdu County. From 2010 to 2013, the lease forestland market experienced recovery and rapid development and reached 11,766 hectares in 2013. We believe that the announcement released by the China State Forestry Administration that all necessary transfer of collective forestland from the collective to the individual farm households were to be completed in 2012 had a positive impact on the development of the lease forestland market. During this period, China State Forestry endorsed a document encouraging forestland lease and scale management of forests. From 2013 to 2016, the forestland lease continued to decrease and reached a new low of 120.1 hectares in 2016. At this point, China State Council conducted a nationwide inspection on the finished transfer of usage rights of forestlands which aimed to resolve existing conflicts [68].

The fluctuation of leased forestland in our study area implied that the previous forestland leasing will have an impact on the current situation as well as significant impact on the future market. All leased forestland recorded by the agency were rented out by local farmers with similar statistics pointing to most of them being rented in as well. This initially implied that farmers' past experience with leasing forestland should have an impact on their future decision making.

3.2. Data Collection

A stratified sampling method was applied to selected interviewed households. Following the administrative system within the county, we selected seven townships from a total of 24 (i.e., one lower level than that of a county). These townships were distributed evenly regarding their geographic location. We randomly selected three villages from each township for a total of 21 sample villages. Next, we randomly selected 20 farm households from each village totaling 420 interviewed household representatives. Noting that a larger sample might provide more accurate results; however, due to financial and time constraints this hampered our time in the field and field-oriented resources.

The interviews were conducted in the selected villages at the end of 2017 when most household heads had returned from outside work places to have the Spring Festival with their families. A two-person group was organized and appointed to conduct the investigation county-wide. All investigators were able to communicate in local dialects and were trained to efficiently ask questions and fill in the questionnaire in 10 minutes. This protocol greatly reduced communication problems caused by the fact that dialects are popular in the study area where most of the population are Hakka people. The questionnaire used in the interviews were collected as primary data—characterized by household head, general situation of the household, forest plot characteristics, and past experience of leasing forestland. From the 420 planned interviews we only concluded 408 households in our sampling—discarding 12 interviews due to incompleteness.

3.3. Data Description

Descriptive statistics of the data are presented in Table 2. The intentions given by the farmers on whether they would lease forestland are stated in the Section 4.1. Farmers' intention and past experience of leasing in and leasing out of forestland. Descriptive findings will ensure a complete picture of the past experience and future intention. The data indicates that the average forestland held by one household was 1.83 hectares, a figure that closely resembled the Chinese national average. Moreover, 56% of the households did not indicate that usage rights of the forestland were unchanged—due to previously implemented reforms. In addition, only 14% of the households indicated that they would leave forestland as an expected inheritance for the next generation.

The majority of the household heads were aged between 40 and 60 years old with an average age of 49 years old. As far as the attainment of education was concerned, 206 household heads, i.e., 50.49%, completed high school. There were 150 household heads that completed middle school accounting for 36.76%, 32 households or 7.84% were headed by people who had schooling at the elementary level, and 19 household heads who had university degrees, accounting for 4.66% of the sampled households. In terms of the number of people being employed, the range was from zero to six. Among the households, 216 households had two people working in the household, which accounted for 52.94% of the total. Another 67 (i.e., 16.42%) households had three people working, 55 (i.e., 13.48%) households had four people working, and 42 (i.e., 10.29%) households had one person working. The number of households that had nobody working was 13, accounting for 3.19%. There were five households having more than four people working, accounting for 1.23% of the total. The households differed from one another in terms of nonfarm income relative to the total income. On average, 41.9% of the total income comes from nonfarm sources. In fact, 127 households reported that they had no income from nonfarm work, while 27 households reported that all of their incomes were from nonfarm work.

Table 2. Descriptive statistics of the data.

Variable	Definition	Mean	SD †
	Dependent variables		
will_in	farmers' intention of leasing in forestland (1 = *yes*, 0 = otherwise)	0.32	0.47
will_out	farmers' intention of leasing out forestland (1 = *yes*, 0 = otherwise)	0.21	0.41
	Independent variables		
area	forestland area (ha)	1.83	5.05
inherited	whether forestland was inherited (1 = yes, 0 = otherwise)	0.14	0.35
age	age of household head (years)	49.69	11.76
education	education level of household head (1 = primary school or below, 2 = middle school, 3 = high school, 4 = university or above)	2.51	0.72
labor	number of people working in the family (people)	2.39	1.11
nonfarm	proportion of income from nonfarm sources of total income (%)	41.94	37.30
security	forestland usage rights (1 = yes, 0 = otherwise)	0.44	0.49
wea_in	leased in forestland in the past five years (1 = yes, 0 = otherwise)	0.12	0.32
easy_in	easy to lease in forestland (1 = yes, 0 = otherwise)	0.14	0.35
profit_in	not profitable to lease in forestland (1 = yes, 0 = otherwise)	0.25	0.43
wea_out	leased out forestland in the past five years (1 = yes, 0 = otherwise)	0.07	0.25
easy_out	easy to lease out forestland (1 = yes, 0 = otherwise)	0.17	0.38
profit_out	not profitable to lease out forestland (1 = yes, 0 = otherwise)	0.18	0.39

† standard deviation.

4. Results

The results of the farmers' intentions and past experience of leasing in and leasing out forestland is elucidated. An additional detailed examination of the Bayesian logit model, pinpointing the main factors affecting farmers' intention of leasing out forestland, in terms of the assigned variables, are shown.

4.1. Farmers' Intention and Past Experience of Leasing in and Leasing out of Forestland

Results indicate that those farmers that intended to lease in forestland accounted for 32% of the total sample; however, those farmers that intended to lease out forestland were 11% fewer (Table 2). Regarding past experiences of leasing in or leasing out forestland, the results indicated slightly more than 10% of farmers who had experience with leasing in versus only 7% of those leasing out. Comparatively, 14% of farmers' positive responses in terms of ease of leasing in forestlands versus 12% of them for leasing out forestlands. In addition, there are about a quarter of the farmers who did not perceive that lease in of forestlands as profitable, and 18% of them that did not respond to leasing out as profitable.

We grouped all farmers into two categories according to their differing perspectives of experiences of leasing in forestlands. We found the group with experience of leasing in forestland had a significantly higher intention of leasing in forestlands than the other group (i.e., t-test value of −5.78). We also found that the group with responses of not being profitable in terms of leasing out had fewer intentions of leasing in forestlands than the other group (i.e., t-test value of 6.29). In addition, we found significantly different impacts of ease to leasing in forestlands on intention of leasing in between two groups with different responses in term of ease of lease in (i.e., t-test value of −5.92).

When we categorized farmers into two groups according to whether they had experiences of leasing out forestlands, we found the group with this type of experience had significantly higher intentions of leasing out forestlands than the other group (i.e., t-test value of −2.65). We also found different intention of leasing out forestlands between the group responding to it not being profitability to lease out versus the other group (i.e., t-test value of 5.88). However, we did not find significantly different impacts of ease in leasing out forestlands on intention of leasing out between two groups with different responses in terms of ease in leasing out (i.e., t-test value of −1.35).

4.2. Factors affecting Farmers' Intention of Leasing in Forestland

As illustrated in Table 3, the results of the Bayesian logit model identify the effects of demographic characteristics, characteristics of forestland, and past experiences of leasing in forestland of the respondents on their intention of leasing it in. We tested for correlation between all explanatory variables and found that none of the correlative coefficients exceeded 0.50. Furthermore, all of the variance inflation factors (VIF) were less than two, indicating that our data did not suffer from multi-collinearity issues based on commonly used cut-off values [55,69]. The estimated Monte Carlo errors were all less than 5% of the standard deviation, indicating that random-walk Metropolis-Hastings sampling was appropriate [70].

Table 3. Results of factors affecting farmers' intention of leasing forestlands.

	Model 1		Model 2		Model 3		Model 4	
	Mean	**SD †**	**Mean**	**SD †**	**Mean**	**SD †**	**Mean**	**SD †**
area	−0.003	0.002	−0.002	0.001	−0.002	0.002	−0.003	0.002
inherited	−0.059	0.327	−0.253	0.332	−0.676	0.411	−0.391	0.265
age	−0.479 ***	0.009	−0.045 ***	0.009	−0.045 ***	0.011	−0.045 ***	0.010
education	−0.188	0136	−0.189	0.162	−0.147	0.197	−0.232	0.152
labor	0.196 **	0.081	0.229 **	0.088	0.227 ***	0.081	0.216 ***	0.073
nonfarm	−1.471 ***	0.0262	−1.449 ***	0.294	−1.589 ***	0.354	−1.575 ***	0.361
security	0.829 ***	0.174	0.669 ***	0.229	0.950 ***	0.234	0.625 **	0.247
wea_in	1.732 ***	0.365					1.589 ***	0.382
esay_in			1.304 ***	0.316			1.351 ***	0.302
pro_in					−3.165 ***	0.387	−3.153 ***	0.279
Constant	*1.259 ****	*0.423*	*1.055*	*0.739*	*0.882*	*0.875*	*0.966*	*0.637*
Model features								
Log likeli.		−280.5		−280.8		−285.7		−282.6
Accept. Rate ‡		21.65		19.89		19.42		20.39
Mean VIF		1.13		1.14		1.15		1.17

† standard deviation; ‡ percentage; * significant at P < 0.10; ** significant at P < 0.05; *** significant at P < 0.01.

In order to check robustness of impacts of farmers' past experiences of leasing in forestland, Table 2 reports on four models and employed each of three indicators of past experiences in the first three and all three indicators in the fourth. The impacts of the indicators of past experiences and other variables are consistent in all four models—which convinced us of its robustness. We conducted the following analysis based on the fourth model. The regression results showed that seven factors have statistically significant impacts on farmers' intentions of leasing in forestland. These factors are the household head age (i.e., age), number of people working in a family (i.e., labor), security of forestland usage rights (i.e., security), lease in of forestland in the past five years (i.e., wea_in), ease of leasing in forestland (i.e., easy_in), and not profitable to lease in forestland (i.e., profit_in).

The coefficient for the age variable is negative and significant at 1%; thus, the intention to lease in forestland decreases as the age of the household head increases. The education level of the household head (i.e., education) also had a negative effect on lease in of forestland, but the effect was not significant. The effect of the number of people working in the household (i.e., labor) is positive and insignificant. The coefficient of the nonfarm variable is negative and significant at 1%. This implied that those households with larger nonfarm income are less likely to lease in forestland.

Regarding impact of characteristics of forestlands on farmers' intention of leasing in forestland, we found that only the coefficient of the security variable is positive and significant at 5%. Those households holding the view that forestland usage rights were secure had a higher probability to lease in forestland. This may have resulted from the fact that farmers are afraid that their right to lease forestland cannot be well protected if usage rights are not secured. The other two variables, including area and inherited, did not have significant impacts on farmers' intention of leasing in forestland. However, both of these impacts were negative.

In terms of the impact of farmers' past experiences of leasing in forestland, both coefficients of the *wea_in* and *easy_in* variables were positive and significant at 1% whereas the *profit_in* variable was negative and significant at 1%. The results suggested that those households that once participated in leasing in of forestland were perceived to more easily lease in forestland or had a higher intention of doing it in the future. This is in line with the fundamental economic theory that low transaction cost will always facilitate a transaction. This also implied that farmers' past experiences play a significant role and impact on their intention to lease in in the future.

4.3. Factors Affecting Farmers' Intention of Leasing Out Forestland

We presented the results of the Bayesian logit model by identifying the effects of demographic characteristics, characteristics of forestland, and past experiences of leasing out forestland from the respondents' intention to leasing out their land (Table 4). We also reported four models as a check on the robustness of the impacts of farmers' past experiences to leasing in forestland. The consistency of the impacts of farmers' past experiences on famers' intention to lease out forestland convinced us that the results are robustly conclusive. We also made use of results from the fourth model for further inquiry. The regression results showed that seven factors have statistically significant impacts on farmers' intentions to lease in forestland. These factors are the household head age (i.e., age), educational level of household head (i.e., education), number of people working in the family (i.e., labor), security of forestland usage rights (i.e., security), leasing out of forestland in past five years (i.e., wea_out), and not profitable to lease forestland (i.e., profit_out).

Table 4. Results of factors affecting farmers' intention of leasing out forestlands.

	Model 1		Model 2		Model 3		Model 4	
	Mean	**SD** †	**Mean**	**SD** †	**Mean**	**SD** †	**Mean**	**SD** †
area	0.002	0.002	0.001	0.002	0.002	0.002	0.002	0.002
inherited	−3.258 ***	0.742	−2.644 ***	0.345	−1.758 *	1.005	−1.711 ***	0.419
age	−0.022 ***	−0.008	−0.015 *	0.009	−0.026 **	0.011	−0.026 ***	0.008
education	−0.691 ***	0.175	−0.658 ***	0.131	−0.695 ***	0.157	−0.614 ***	0.179
labor	−0.048	0.086	−0.066	0.079	−0.049	0.092	-0.051	0.087
nonfarm	1.579 ***	0.354	1.679 ***	0.331	1.082 *	0.588	1.717 ***	0.381
security	−0.097	0.251	-0.120	0.219	−0.266	0.239	−0.234	0.267
wea_out	0.837 **	0.421					0.864 *	0.444
easy_out			0.468	0.288			0.237	0.275
pro_out					−3.852 ***	0.402	−3.703 ***	0.547
Constant					*2.306* ***	*0.692*	*1.181* ***	*0.236*
Model features								
Log likeli.		−246.8		−248.4		−240.2		−245.6
Accept. rate ‡		27.42		15.01		17.36		22.64
Mean VIF		1.12		1.11		1.15		1.16

† standard deviation; ‡ percentage; * significant at $P < 0.10$; ** significant at $P < 0.05$; *** significant at $P < 0.01$.

The coefficient for the age variable is negative and significant at 1%. This points to the correlative finding that an intention to lease out forestland decreases as the household head's age increases. The education level of the household head (i.e., education) also has a negative and significant effect on the leasing out of forestland. This implied that once the household head had a higher educational level, they had a smaller intention to lease out their land. The effect of the number of people working in the household (i.e., labor) was negative with an insignificant correlation. The coefficient of the nonfarm variable was positive and significant at 1%. This implied that those households with larger nonfarm income were more likely to lease out their forestland.

Regarding impact of characteristics of forestlands on farmers' intention of leasing in forestland, we found that only the coefficient of the inherited variable was negative and significant at 5%.

Those households treating forestland as inherited have a lower probability to lease out their forestland. This result is in line with our expectations. Two variables, i.e., area and security, did not have a significant impact on farmers' intention of leasing out forestland—however both had positive impacts.

In terms of the impact of farmers' past experiences of leasing in forestland, the coefficient of the wea_out variable was positive and significant at 10%, the coefficient of the easy_out variable was positive and insignificant, and the coefficient of the *profit_out* variable was positive and significant at 1%. These results suggest that those households that participated in leasing out forestland were more likely to do it again. Once farmers did not believe leasing out of forestland was profitable, they have less intention to lease out at all. This also implied that farmers' past experiences played a significant impact on their intention of lease in—in the greater scope of the study.

In terms of the robustness of the results, a Bayesian approach was used as an alternative method to the classical approaches, e.g., logit model and probit model, to avoid biased estimators and misspecifications (i.e., left out variables, errors in variables, and heteroskedastic errors common in traditional models) [71–73]. Zellner and Rossi [74], the first to use a Bayesian analysis for qualitative choice in econometrics, point out that the Bayesian approach exhibits operational capability and provides an avenue for proper analysis of differing scaled samples. A review of recent studies also reveals that Bayesian approaches have been adopted to overcome non-robustness when attached with traditional models (i.e., Caglayan-Akay and Sedefoglu [75] and Cai et al. [70]). As such, low autocorrelation is more efficient in a Markov Chain Monte Carlo simulation procedure designed to fit Bayesian models. The procedures within our study, hence, reported on the existence of autocorrelation automatically and took into consideration any avoidance of it. Moreover, we ignored the spatial factors at the township and village level since they were not found to be significant or have spatial heterogeneity in terms of forestland lease. It should be noted that every approach has a certain level of embedded weakness which may generate non-robustness—something we have attempted to limit and veer away from as best as possible. Finally, poor statistical background may have also curbed our contribution to modify the existing approach, leaving us with causation factors for the affected farmers' intention to lease in or lease out farmland.

5. Discussion and Conclusions

In this study, we examined how farmers' past experiences in leasing forestlands affect their future intention to lease it again. The results indicate that farmers do not have strong intentions both of leasing in and leasing out of forestland. Compared to farmers' low participation in leasing in and leasing out in the past five years, strong intentions imply that the forestland market might be on the brink of rapid development. At present, the leasing market of forestlands has become less active for both participation in leasing in and leasing out of forestland—as noted by Xu et al. [19] in Anji County of Zhejiang Province, which is more than two times larger than our study in Ningdu. Notably, Anji has a much stronger market-orientated economy than Ningdu which may play an important role in its brisker development.

Furthermore, it should be noted that farmers' intentions of leasing in forestlands are stronger than their intentions of leasing out forestlands. Similarly, we found farmers' participation in leasing in of forestlands much more active than their participation in leasing it out. However, there is a reversal when compared to farmers' past participation in the forestland market in Zhejiang [19] (i.e., where farmers' participation in leasing out forestland is nearly three times that of their participation in leasing in forestland). If forestlands are only leased in and leased out between local farmers, an unbalanced bias would be a part of our datasets. However, we noted that other actors outside of local farmers participated in the leasing of forestlands. For example, some forestlands are leased out by some forest firms at the village level. The gap between intentions to lease in and lease out of the forestlands also needs to be closely observed in terms of supply by other actors rather than just local farmers.

Regarding impact of demographic factors of household heads, the results impacted household head age in that intention to lease in forestland is consistent with research findings from Xu and Li [45]. The insignificant effect of educational levels of household heads indicates research finding at par with Wang et al. [48] and Chen et al. [46]. Regarding impacts of demographic factors of the household head in terms of leasing out forestland, negative and significant results of age are consistent with Wang et al. [48] and Ran and Lv [47], while negative and significant results of educational level are consistent with Xu et al. [19].

The significant and positive results regarding farmers' leasing in of forestlands correlate Xu and Li's [45] and Chen et al.'s [46] research, however, the insignificant and negative results regarding framers leasing out forestlands are not consistent—in terms of significance and negative effects—with Ran and Lv [47]. A possible reason for this discrepancy is that farmers' leasing in practices—to expand their scale of forest management—do not corelated with the total labor workforce but, instead, do not need less labor (i.e., at the moment). Another important variable, denoting demographic characteristics of a household, the nonfarm factor has significant effects on intention of leasing in and leasing out of forestland—however this result is somewhat antipodal to finding by Ran and Lv [47]. Finally, it should be noted that the nonfarm factor has been proven to be endogenous with farmers' leasing behaviors [22]. In this study, farmers' nonfarm work outweighs their intention to lease forestland which convinces us not to ignore the endogeneity effects of this impact.

Among three variables related to forestland held by farmers, our results indicate that security is the only variable having significant impact on farmers' intention to lease in forestland, and inherited is the only variable having significant impact on farmers' intention to lease out forestland. These results identify security as consistent with research finding from Zhang and Pearse [50], Zhang and Owiredu [44], and Xie et al. [13]. We have learned, from our field survey, that some farmers do not have a strong sense of security in terms of usage rights of their forestland to lease in. For example, they cannot obtain harvest permission if they do not get assistance of the original holders proving their legal use and rights to the forestland. The result of the impact of inherited land and the intention to lease it showed that once farmers have an intention to pass on their forestland (i.e., to next generation), they are less active in the forestland market. A similar result is observed by Amacher et al. [20] in which farmers were less likely to be active in forest management as well. In addition, the insignificant impact of forestland held by farmers and their intention of leasing in and leasing out implies that farmers do not treat forestlands solely as a physical asset and that entails a certain amount of know-how in the practice for it to be successful.

Our results about farmers' past experiences of leasing forestland are consistent with existing research findings [19,22]. Farmers' past experiences of participating in lease in and lease out forestland will reduce transaction costs and increase profit for the future leasing agreements. Among these are three different variables that clearly indicate farmers' past experiences, i.e., wea_in and wea_out concern farmers' past behavior of leasing in and leasing out of forestlands, and easy_in, easy_out, pro_in, and pro_out concern farmers' perceptions of past experiences. Their perceptions are either formed by their personal experiences or formed in terms of observation of and communications with their relatives, neighbors, and friends. The correlations between lease behavior, their response to ease, and their response for profitability are smaller than 0.25, i.e., it implies that our employment of these three types of indicators are well captured by farmers' past experiences from three independent perspectives. Clearly, profitability from a previous lease plays a significant role and hardens future decisions and intentions rather than easing and encouraging open participation. This behavioral response pertains to market mechanisms that also provides evidence and support for the employment of the profit-maximization function [43,76–80].

Since farmers are major holders of forestland usage rights in rural of China, their intention of leasing in and leasing out of forestland determine development of the forestland market [13,15,19,67]. We do not compare wellbeing of those farmers having past experiences or with other farmers, in addition, we cannot confirm if there is a need to increase farmers' intention of leasing in or leasing out of forestlands for a rapid development of the area. However, we believe it to be necessary that consideration of what factors affect or restrict farmers' intention (i.e., of leasing in or leasing out) be carefully observed for sounder advancement. Our results indicate household bearing smaller transaction costs and embracing larger profits will be more active in the forestland market. In order to ensure stable development of the forestland market, a policy is needed to reduce transaction costs and promote related profits for farmers who lease in or lease out such land. A more important policy would consider removing restrictions on forestland management and their benefits. Regarding households with elderly heads that have an intention to treat forestland as inherited, a less active forestland market should be expected, forcing policy makers to best coordinate and management these conditions—making countermeasures a priority.

This study explored the causable relationship between farmers' past experiences and future intentions of lease in and lease out of forestland. There is no doubt that this explored causable relationships that show theoretic reference for further future study. However, we note our study was conducted based on survey data from one county which, respectively, is a narrow representation of results. Another limitation is our lack of comparative research of forestland markets between China and other countries in terms of a farmer's perspective. We also note that our indicators, used to measure farmers' past experience, carried limited information reflecting heterogeneity of that experience. We also should state that we differentiate between "forestland market" and "cropland market", and specifically did not incorporate "cropland market" into our study scope. Further study could investigate more details of farmers' past experiences including: area of forestland leased in or leased out and the setting up of a temporal-spatial model (i.e., used to synthesis and compare research finding at different time periods and regions for increased reliability). At length, a follow-up study to this one is suggested to test how many intentions of leasing can be turned into reality.

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References

1. Kung, J.K.S. Shouying Liu Farmers' preferences regarding ownership and land tenure in post-Mao China: Unexpected evidence from eight counties. *China J.* **1997**, *38*, 33–63. [CrossRef]
2. Zhang, Y.; Uusivuori, J.; Kuuluvainen, J. Impacts of economic reforms on rural forestry in China. *For. Policy Econ.* **2000**, *1*, 27–40. [CrossRef]
3. Kung, J.K.S. Off-farm labor markets and the emergence of land rental markets in rural China. *J. Comp. Econ.* **2002**, *30*, 395–414. [CrossRef]
4. Ho, P. *Institutions in Transition: Land Ownership, Property Rights and Social Conflict in China*; Routledge: New York, NY, USA, 2005; ISBN 9780199280698.
5. Krusekopf, C.C. Diversity in land-tenure arrangements under the household responsibility system in China. *China Econ. Rev.* **2002**, *13*, 297–312. [CrossRef]
6. Brandt, L.; Rozelle, S.; Turner, M.A. Local Government Behavior and Property Rights Formation in Rural China. *J. Inst. Theor. Econ.* **2004**, *160*, 627–662. [CrossRef]
7. Li, J.; Yao, Y. Egalitarian land distribution and labor migration in rural China. *Land Reform Land Settl. Coop.* **2002**, *1*, 80–91.
8. Kung, J.K.S. Equal entitlement versus tenure security under a regime of collective property rights: Peasants' preference for institutions in post-reform chinese agriculture. *J. Comp. Econ.* **1995**, *21*, 82–111. [CrossRef]

9. Xu, X.; Zhang, Y.; Li, L.; Yang, S. Markets for forestland use rights: A case study in Southern China. *Land Use Policy* **2013**, *30*, 560–569. [CrossRef]
10. Zhou, Y.; Shi, X.; Ji, D.; Ma, X.; Chand, S. Property rights integrity, tenure security and forestland rental market participation: Evidence from Jiangxi Province, China. *Nat. Resour. Forum* **2019**, *43*, 95–110. [CrossRef]
11. Xie, Y.; Wen, Y. Empirical Study on the Influence Factors of Farmers' Forestland and Stumpages Transfer. *J. Beijing For. Univ.* **2009**, *8*, 48–54. (In Chinese)
12. Yin, R.; Yao, S.; Huo, X. China's forest tenure reform and institutional change in the new century: What has been implemented and what remains to be pursued? *Land Use Policy* **2013**, *30*, 825–833. [CrossRef]
13. Xie, Y.; Gong, P.; Han, X.; Wen, Y. The effect of collective forestland tenure reform in China: Does land parcelization reduce forest management intensity? *J. For. Econ.* **2014**, *20*, 126–140. [CrossRef]
14. Liu, C.; Wang, S.; Liu, H.; Zhu, W. Why did the 1980s' reform of collective forestland tenure in southern China fail? *For. Policy Econ.* **2017**, *83*, 131–141. [CrossRef]
15. Xie, Y.; Wen, Y.; Zhang, Y.; Li, X. Impact of property rights reform on household forest management investment: An empirical study of southern China. *For. Policy Econ.* **2013**, *34*, 73–78. [CrossRef]
16. Kong, F.; Du, L. Research on Regulating the Circulation of Collective Forest Property Rights. *Issues For. Econ.* **2008**, *5*, 377–384.
17. Nie, Y. Forestry-property-rights-circulation efficiency and constraints analysis. *Ecol. Econ.* **2009**, *6*, 90–94.
18. Kong, F.; Liao, W. An analysis of farmer households' woodland transferring behavior based on their differential income structure—Taking Jiangxi province as example. *China Rural Econ.* **2011**, *8*, 89–97.
19. Xu, L.; Xie, Y.; Wei, W.; Zhou, Y. Meta-analysis of econometric studies on farmer's willingness and behaviors of collective forestland transfer in China. *World For. Res.* **2015**, *3*, 91–96.
20. Amacher, G.S.; Conway, M.C.; Sullivan, J. Econometric analyses of nonindustrial forest landowners: Is there anything left to study? *J. For. Econ.* **2003**, *9*, 137–164.
21. Hong, Y.Z.; Chang, H.H.; Dai, Y.W. Is deregulation of forest land use rights transactions associated with economic well-being and labor allocation of farm households? Empirical evidence in China. *Land Use Policy* **2018**, *75*, 694–701. [CrossRef]
22. Zhang, H.; Kuuluvainen, J.; Yang, H.; Xie, Y.; Liu, C. The Effect of Off-Farm Employment on Forestland Transfers in China: A Simultaneous-Equation Tobit Model Estimation. *Sustainability* **2017**, *9*, 1645. [CrossRef]
23. Weiss, G.; Lawrence, A.; Hujala, T.; Lidestav, G.; Nichiforel, L.; Nybakk, E.; Quiroga, S.; Sarvašová, Z.; Suarez, C.; Živojinović, I. Forest ownership changes in Europe: State of knowledge and conceptual foundations. *For. Policy Econ.* **2019**, *99*, 9–20. [CrossRef]
24. Umaerus, P.; Högvall Nordin, M.; Lidestav, G. Do female forest owners think and act "greener"? *For. Policy Econ.* **2019**, *99*, 52–58. [CrossRef]
25. Rasmussen, L.V.; Watkins, C.; Agrawal, A. Forest contributions to livelihoods in changing agriculture-forest landscapes. *For. Policy Econ.* **2017**, *84*, 1–8. [CrossRef]
26. Kilgore, M.A.; MacKay, D.G. Trends in Minnesota's Forestland Real Estate Market: Potential Implications for Forestland Uses. *North. J. Appl. For.* **2007**, *24*, 37–42. [CrossRef]
27. Snyder, S.A.; Kilgore, M.A.; Hudson, R.; Donnay, J. Influence of purchaser perceptions and intentions on price for forest land parcels: A hedonic pricing approach. *J. For. Econ.* **2008**, *14*, 47–72. [CrossRef]
28. Ekvall, H.; Bostedt, G.; Jonsson, M. Least-cost allocation of measures to increase the amount of coarse woody debris in forest estates. *J. For. Econ.* **2013**, *19*, 267–285. [CrossRef]
29. Raunikar, R.; Buongiorno, J. Ecological integrity as an economic variable: An application to forested landscapes in the southern United States. *J. For. Econ.* **2008**, *14*, 29–45. [CrossRef]
30. Liira, J.; Lõhmus, K.; Tuisk, E. Old manor parks as potential habitats for forest flora in agricultural landscapes of Estonia. *Biol. Conserv.* **2012**, *146*, 144–154. [CrossRef]
31. Grüebler, M.U.; Schuler, H.; Horch, P.; Spaar, R. The effectiveness of conservation measures to enhance nest survival in a meadow bird suffering from anthropogenic nest loss. *Biol. Conserv.* **2012**, *146*, 197–203. [CrossRef]
32. Cuong, T.; Chinh, T.T.Q.; Zhang, Y.; Xie, Y. Economic Performance of Forest Plantations in Vietnam: Eucalyptus, Acacia mangium, and Manglietia conifera. *Forests* **2020**, *11*, 284. [CrossRef]
33. L'Roe, J.; Naughton-Treves, L. Forest edges in western Uganda: From refuge for the poor to zone of investment. *For. Policy Econ.* **2017**, *84*, 102–111. [CrossRef]

34. Gemeda, B.S.; Abebe, B.G.; Paczoski, A.; Xie, Y.; Cirella, G.T. What Motivates Speculators to Speculate? *Entropy* **2019**, *22*, 59. [CrossRef]
35. Byg, A.; Novo, P.; Dinato, M.; Moges, A.; Tefera, T.; Balana, B.; Woldeamanuel, T.; Black, H. Trees, soils, and warthogs – Distribution of services and disservices from reforestation areas in southern Ethiopia. *For. Policy Econ.* **2017**, *84*, 112–119. [CrossRef]
36. Knorn, J.; Kuemmerle, T.; Radeloff, V.C.; Szabo, A.; Mindrescu, M.; Keeton, W.S.; Abrudan, I.; Griffiths, P.; Gancz, V.; Hostert, P. Forest restitution and protected area effectiveness in post-socialist Romania. *Biol. Conserv.* **2012**, *146*, 204–212. [CrossRef]
37. Popa, B.; Niță, M.D.; Hălălișan, A.F. Intentions to engage in forest law enforcement in Romania: An application of the theory of planned behavior. *For. Policy Econ.* **2019**, *100*, 33–43. [CrossRef]
38. Scriban, R.E.; Nichiforel, L.; Bouriaud, L.G.; Barnoaiea, I.; Cosofret, V.C.; Barbu, C.O. Governance of the forest restitution process in Romania: An application of the DPSIR model. *For. Policy Econ.* **2019**, *99*, 59–67. [CrossRef]
39. Ajzen, I.; Driver, B.L. Application of the Theory of Planned Behavior to Leisure Choice. *J. Leis. Res.* **1992**, *24*, 207–224. [CrossRef]
40. Davis, G.; Phillips, P.S.; Read, A.D.; Iida, Y. Demonstrating the need for the development of internal research capacity: Understanding recycling participation using the Theory of Planned Behaviour in West Oxfordshire, UK. *Resour. Conserv. Recycl.* **2006**, *46*, 115–127. [CrossRef]
41. Miliute-Plepiene, J.; Hage, O.; Plepys, A.; Reipas, A. What motivates households recycling behaviour in recycling schemes of different maturity? Lessons from Lithuania and Sweden. *Resour. Conserv. Recycl.* **2016**, *113*, 40–52. [CrossRef]
42. Macey, S.M.; Brown, M.A. Residential Energy Conservation. *Environ. Behav.* **1983**, *15*, 123–141. [CrossRef]
43. Johansson, P.O.; Löfgren, K.G. *The Economics of Forestry and Natural Resources*; Basil Blackwell Ltd.: Oxford, UK, 1985; ISBN 0631141626.
44. Zhang, D.; Aboagye Owiredu, E. Land tenure, market, and the establishment of forest plantations in Ghana. *For. Policy Econ.* **2007**, *9*, 602–610. [CrossRef]
45. Xu, X.; Li, C. Behavior and influencing factors of household's forestland in flowed: Analysis on 12 villages in Zhejiang province. *Cap. Mark.* **2013**, *6*, 121–126.
46. Chen, K.; Zhou, R.; Wang, C.; Wang, J. Research on factors influencing on peasant households' willingness of forestland transfer after collective forest tenure reform. *Issues For. Econ.* **2009**, *6*, 493–498.
47. Ran, L.; Lv, J. Peasant household forest land circulation behavior choice after collective ownership of forests system reform. *Issues For. Econ.* **2011**, *2*, 121–126.
48. Wang, C.; He, X.; Xu, X.; Wang, S. Scale efficiency of forestland and forestland transfer among farm household: An empirical study in Zhejiang province. *Rural Technol. Econ.* **2010**, 58–65.
49. Tian, S.; Zhai, Y. Empirical analysis factors affecting behavior of farmers' forestland circulation—Based on Liaoning province. *Issues For. Econ.* **2011**, *2*, 127–130.
50. Zhang, D.; Pearse, P.H. The influence of the form of tenure on reforestation in British Columbia. *For. Ecol. Manag.* **1997**, *98*, 239–250. [CrossRef]
51. Sanchez, M.E.; Morchio, G. Probing "Don't Know" Answers: Effects on Survey Estimates and Variable Relationships. *Public Opin. Q.* **1992**, *56*, 454–474. [CrossRef]
52. Groothuis, P.A.; Whitehead, J.C. Does don't know mean no? Analysis of "don't know" responses in dichotomous choice contingent valuation questions. *Appl. Econ.* **2002**, *34*, 1935–1940. [CrossRef]
53. Allenby, G.M.; Arora, N.; Ginter, J.L. Incorporating Prior Knowledge into the Analysis of Conjoint Studies. *J. Mark. Res.* **1995**, *32*, 152. [CrossRef]
54. Asanović, Ž. Early warning models for systematic banking crises in Montenegro. *Econ. Bus. Rev.* **2013**, *15*, 135–149.
55. Hair, J.F.; Black, W.C.; Babin, B.J.; Anderson, R.E. *Multivariat Data Analysis: Exploratory Data Analysis in Business and Economics*; Pearson: Upper Saddle River, NJ, USA, 2014; ISBN 9781292021904.
56. Western, B.; Jackman, S. Bayesian Inference for Comparative Research. *Am. Polit. Sci. Rev.* **1994**, *88*, 412–423. [CrossRef]
57. Willis, C.E.; Perlack, R.D. Multicollinearity: Effects, Symptoms, and Remedies. *J. Northeast. Agric. Econ. Counc.* **1978**, *7*, 55–61. [CrossRef]

58. Bayes, T. An essay toward solving a problem in the doctrine of chance. *Philos. Trans. R. Soc. London* **1763**, *53*, 370–418. [CrossRef]
59. Congdon, P. *Bayesian Statistical Modelling*, 2nd ed.; John Wiley & Sons: Chichester, UK, 2006; ISBN 9780470018750.
60. Metropolis, N.; Ulam, S. The Monte Carlo Method. *J. Am. Stat. Assoc.* **1949**, *44*, 335–341. [CrossRef]
61. Hastings, W.K. Monte Carlo Sampling Methods Using Markov Chains and Their Applications. *Biometrika* **1970**, *57*, 97. [CrossRef]
62. Chib, S.; Greenberg, E. Understanding the metropolis-hastings algorithm. *Am. Stat.* **1995**, *49*, 327–335.
63. Lynch, S.M. *Introduction to Applied Bayesian Statistics and Estimation for Social Scientists*; Springer: New York, NY, USA, 2007; ISBN 978-0387712642.
64. Cemgil, T. Lecture Slides on Monte Carlo Methods. Available online: https://www.cmpe.boun.edu.tr/~{}cemgil/Courses/cmpe548/mc-lecture01.pdf (accessed on 12 December 2019).
65. Yildirim, I. Bayesian Inference: Metropolis-Hasting Sampling. Available online: http://www.mit.edu/~{}ilkery/papers/MetropolisHastingsSampling.pdf (accessed on 6 September 2019).
66. Gelman, A.; Carlin, J.B.B.; Stern, H.S.S.; Rubin, D.B.B. *Bayesian Data Analysis*, 3rd ed.; CRC Press: London, UK, 2014; ISBN 9781439840955.
67. Xie, Y.; Wen, Y.; Gong, P. Rationality analysis of household transfer benefits in collective forest tenure right system reform: Take Suichuan County of Jiangxi Province as example. *For. Sci.* **2009**, *45*, 130–140.
68. Wei, W.; Xie, Y. Analysis on current situation and causable factors for collective forest tenure conflicts at farm household level. *For. Econ.* **2016**, *6*, 34–38.
69. Billionnet, A. Designing an optimal connected nature reserve. *Appl. Math. Model.* **2012**, *36*, 2213–2223. [CrossRef]
70. Cai, Z.; Xie, Y.; Aguilar, F.X. Eco-label credibility and retailer effects on green product purchasing intentions. *For. Policy Econ.* **2017**, *80*, 200–208. [CrossRef]
71. Greene, W.H. *Econometric Analysis*; Prentice Hall: Upper Saddle River, NJ, USA, 2012; ISBN 9780131395381.
72. Wilde, J. A simple representation of the Bera-Jarque-Lee test for probit models. *Econ. Lett.* **2008**, *101*, 119–121. [CrossRef]
73. Yatchew, A.; Griliches, Z. Specification Error in Probit Models. *Rev. Econ. Stat.* **1985**, *67*, 134. [CrossRef]
74. Zellner, A.; Rossi, P.E. Bayesian analysis of dichotomous quantal response models. *J. Econom.* **1984**, *25*, 365–393. [CrossRef]
75. Çağlayan-Akay, E.; Sedefoğlu, G. What does Bayesian probit regression tell us about Turkish female-and male-headed households poverty? *J. Int. Stud.* **2017**, *10*, 46–62. [CrossRef]
76. Davis, L. How to generate good profit maximization problems. *J. Econ. Educ.* **2014**, *45*, 183–190. [CrossRef]
77. Crossan, K.; Lange, T. Business as Usual? Ambitions of Profit Maximization and the Theory of the Firm. *J. Interdiscip. Econ.* **2006**, *17*, 313–326. [CrossRef]
78. Nentjes, A.; Schöpp, W. Discretionary profit in subsidised housing markets. *Urban Stud.* **2000**, *37*, 181–194. [CrossRef]
79. Mert, M. What does a firm maximize? A simple explanation with regard to economic growth. *Int. J. Eng. Bus. Manag.* **2018**, *10*, 184797901881529. [CrossRef]
80. Anderson, W.L.; Ross, R.L. The methodology of profit maximization: An Austrian alternative. *Q. J. Austrian Econ.* **2005**, *8*, 31–44. [CrossRef]

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Fishing Tourism as an Opportunity for Sustainable Rural Development—The Case of Galicia, Spain

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Abstract: The functional diversification of coastal fishing communities has been a central objective of the Common Fisheries Policy (CFP) since the early stages of its implementation. A large part of the initiatives financed throughout Europe have been linked to the creation of synergies between the fishing sector and tourism. This paper analyses the opportunities for the development of fishing tourism at the regional level, considering the investments of European and regional funds on the development of fishing tourism in Galicia. Special attention is given to the incorporation of the territorial perspective and Community-Led Local Development (CLLD) for the sustainable development of fishing areas. The results show limitations of this form of tourism in terms of employment and income, especially those developed by fishermen, despite the significant support of the regional government for this activity. This situation allows a critical reflection on the opportunity to convert fishermen into tourist guides, based on the need to diversify the economy and income of fishing communities.

Keywords: fishing tourism; European fishing funds; Galicia (Spain); sustainable rural development

1. Introduction

Local development is a generalised paradigm in order to initiate processes of socioeconomic progress in peripheral areas, in an attempt to respond to productive restructuring and economic crises, as stated by [1–5]. The EU rural development programmes began to be drawn up in the last decade of the twentieth century with the aim of promoting a change from a model based on agricultural development to one oriented towards the diversification of the rural economy. Since 2007, rural development has been a fully developed policy, funded by the European Agricultural Fund for Rural Development (EAFRD), and created to respond to the socio-economic and environmental challenges of rural areas and their agricultural model. Since Agenda 2000, it has been called the “second pillar” of the Common Agricultural Policy (CAP), as an approach for sustainable development in rural areas, complementing the great reform of 1992. With the European Union LEADER initiative, the issue of rural development was included within the European Regional Policy framework to promote the application of the new structural and territorial measures of the CAP [6,7].

Diversification, innovation and cooperation were the general objectives of LEADER between 1991 and 2006 [8], and were added to the new national and regional programmes, PRODER in Spain and AGADER in Galicia, inspired by its approach and methodology [9–11]. In order to include local actors in the design of sustainable, multisectoral and inclusive development strategies, all these rural programmes were based on a bottom-up approach, in which the tourism sector was considered a fundamental aspect for the economic diversification of the territories. In this way, LEADER—and also PRODER and AGADER—allocated a large part of their funds to projects related to tourism development in rural areas [12–18].

The objectives of local development and economic diversification, as part of the European rural development, were transferred from the early years of the twenty first century to the Common Fisheries Policy (CFP) [19], based on lessons learned from the LEADER experience. Additionally, the territorial objectives were included in the sectoral policy, and the Community-led Local Development (CLLD) was adopted, an approach that took the communities into account in the design and management of strategic development plans [20]. In this way, a decentralised management of European funds was adopted in coastal areas dependent on fishing. This has been the case of Fisheries Local Action Groups (FLAGs) financed with funds specifically allocated for the sustainable development of fishing areas from the European Fisheries Fund (EFF) (2007–2013) and the European Maritime and Fisheries Fund (EMFF) (2014–2020) [21–25].

Considering sustainable tourism as a factor of local development, and creator of synergies with the rest of the economic sectors, has allowed its inclusion in the EFF and EMFF as an element favouring economic diversification in fishing areas, generating new sources of income for the fishermen and their families. In this way, the Fisheries Areas Network (FARNET)—a network supported by the European Commission to implement CLLD—has designed a guide, "Fisheries and Tourism: Creating benefits for the community", to promote the dissemination of fishing tourism activities in European fishing areas, with the aim of developing a more sustainable tourism that values the local community and contributes to its growth [26,27].

The proliferation of fishing tourism activities in Galicia is closely linked to the subsidies from the European Fisheries Fund, aimed at the economic diversification of coastal communities, and to the regional policy itself, which incorporates marine tourism and fishing tourism into the regional fisheries law, as an activity aimed at the enhancement and dissemination of marine cultural heritage (Law 11/2008 on fisheries in Galicia). In this context, the present study focuses on marine and fishing tourism in Galicia, Spain, and the difficulties in becoming a central element in the economic diversification in coastal areas. To reach this objective, four research questions are formulated: (1) what have been the investments in fishing tourism; (2) what importance has been given to fishing tourism in the development strategies of fishing areas; (3) what role has fishing tourism played in the economic diversification of coastal areas so far; (4) what is the interest of this tourism modality for the small-scale fishing sector itself. From a theoretical point of view, this contribution aims to advance the analysis of the contribution of European funds to sustainable development in fishing areas. A critical perspective is adopted since the authors consider an overvaluation of fishing tourism as a dynamizing factor for the economies in areas dependent on fishing in Galicia.

The focus of this study was on Galicia, a region situated in the NW of Spain, and one of the European regions with the greatest socio-economic dependence on fishing and aquaculture [28,29]. As of 2020, Galicia has a population of 2,700,269 inhabitants, that is concentrated on the Atlantic coast, the most demographically and economically dynamic area of the region. The regional government has had broad powers since the 1980s, transferred by the Spanish state, as a result of the development of the State of Autonomies. Among the exclusive powers that Galicia has are the organisation and management of fishing and tourism, which has had important implications in the development of fishing tourism, since Galicia has its own fishing and tourism laws, and the government has the capacity to apply for and manage European funds. These funds have facilitated the early creation of FLAGs in Galicia, and the development of numerous activities related to fishing tourism. Finally, the aim of this investigation is present a critical discussion of Galician experiences in marine and fishing tourism, and highlight the need to get a coordinated regional strategy, defined on the basis of a bottom-up process, where the participation of the fisheries sector is guaranteed.

2. Literature Review

2.1. Fishing Sector and Tourism

The strong link between small-scale fishing and tourism has become a global trend mainly caused by the decrease in income generated by fishing, and the search for economic diversification alternatives by the fishermen, who resort to fishing tourism activities [30–32]. Thus, the relationships between small-scale fishing and tourist activities as a source of complementary income for the populations of coastal communities have been increasingly frequent. Multiple synergies have been identified between professional fishing, recreational fishing and tourism, providing mutual benefits, and demonstrating their complementary nature in the management policies of coastal resources [33]. Although there is plentiful literature on sport fishing and its role as a stimulus for the economy and regional development in Europe, Spain and Galicia [34,35] are good examples, as well as in other territorial areas [36], there are few studies on fishing tourism, a relatively recent tourism modality that integrates a great variety of activities—some of them poorly regulated—and for which there are hardly any statistics that allow comparative studies at different scales.

There is a broad and imprecise conception of the term fishing Tourism, an umbrella that includes a large number of marine and land activities [37]. Fishing tourism can be conceptualised as a culture-based tourism: the culture-motivated, -inspired, and -attracted tourism [38] cited by [39] (p. 90), [31] (p. 145). It is also necessary to consider that the tourism industry in rural areas is based on nature and nature-based activities, such as fishing [39] (p. 89), and thus fishing tourism has its roots in rural tourism, sharing some similarities [40,41]. For some authors, Fishing Tourism includes a series of activities among which recreational or sport fishing stand out, but also different tourism industries such as accommodation, restaurants, retail, and services for tourists [36]. In relation to its definition, Kauppila and Karjalainen [39], following Hänninen and Tonder [42], consider that recreational fishing includes fishing tourism, distinguish between *tourism fishing and fishing tourism.* For tourism fishing, fishing is only one of several reasons to choose a destination. In the case of fishing tourism, fishing is the main motivation for tourists [39] (p. 89). Other authors, however, restrict fishing tourism to a recreational activity in which fishermen take tourists aboard fishing vessels to go fishing [30] (p. 85). Chung-Ling Cheng and Ya-Chiao Chang, in their study focused on the development of fishing tourism in Taiwan, recall previous experiences in Ecuador [43], Mexico [44], South Korea [45], and also Italy [46] and Scotland [47], where tourists accompany fishermen, and even fish, dive or sight whales from traditional fishing boats, or stay in fishermen' houses in some cases [30] (p. 84). These studies reflect the tensions between small-scale fishing and sport fishing, and focus on the role that fishermen play as providers of tourism services, and the competition with professional tourism agencies.

Finally, the meaning of fishing tourism used in this study refers to those activities carried out by fishing professionals, complementing their professional activity: activities carried out on board professional fishing and aquaculture boats, guided tours, accommodation in sea professionals' houses, or gastronomic activities. We use the definition of fishing tourism as included in the different rules that regulate the activity in Spain, at a national and regional level, and in studies focused on the evolution of the activity in Spain [32,40,41,48–55]. This type of tourism includes the activities carried out by groups of sea professionals, with the aim of diversifying and complementing the main fishing and shellfish activity (Preamble to Galician Fishing Law 11/2008) The development of this type of tourism in Europe has its origins in Italy [53], where it was included in legislation as of 1982, with modifications in 1999, 2001 and 2004. In this sense, the following concepts were defined in Italy at the beginning of the 1980s: (i) fishing tourism referred to non-crew members boarding fishing boats for the purpose of recreational and tourist activities; (ii) and ittitourism, which includes activities carried out by fishermen who offer their houses or facilities to tourists and visitors, through hotel and restaurant services, and recreational and cultural activities. The Italian regulations also provide for the development, by fishermen, of complementary activities such as the processing, conservation and marketing of fishery products. The Lega Pesca National Association of Fishing Cooperatives estimated that 800 fishing vessels had been authorised to conduct fishing tourism in Italy in 2003 [56]. Its early development in Italy helped promote the activity in the south of Europe in later years.

This tourism typology is characterised by a varied functionality: economic, social, cultural and environmental. Fishing tourism allows sea professionals to diversify and complement their income, generate new employment opportunities, reduce pressure on fishing resources, and raise awareness among professionals and tourists about the need to preserve the coastal environment [48]. As studied by Nicolosi et al. [57] in the Southern Tyrrhenian Coastline, the development of fisheries-related tourism activities such as "pesca-turismo" and "itti-turismo" can play an important role in the diversification of local economies, generating additional income for fishermen, and contributing to the promotion of local products through direct sales, restaurants and events related to fishing activities. There are also the synergies between fishing and tourism, which favour the patrimonial activation of the fishermen' knowledge and traditional practices [58], and which intensify the use of the cultural heritage of fishing as a resource for the community [31,59] (p. 155–160), helping to promote the maritime heritage—both tangible and intangible—and to value the crafts of the sea [60]. The work of N.T. Rubio-Cisneros et al. on the development of fishing and tourism on Holbox Island (Mexico) [61], states that the conservation of resources, as well as facing the management of the accelerated development of tourism, benefits from the incorporation of the traditional knowledge of fishermen.

2.2. Fishing Tourism in Spain and Galicia

The decrease of primary sector activities in the economy of rural areas in Spain has been accompanied by the presence of industrial and tertiary activities in these areas, and a growing interest in tourism [49,62]. Ivars [62], citing Vera and Marchena [63], highlights the commitment of many regions—not specialised in tourism—in the development of rural-natural tourism as a tool to favour regional economic diversification.

According to Santos [64], the development of tourism since the 1990s in Galicia is related to the increase in the number of accommodation establishments on the regional coast, and the promotion of inland tourism linked to the crisis in the rural world, the search for economic diversification, and the interest in other types of tourism, different from sun and beach destinations. Much of the accommodation offer of this inland tourism is located near the sea. This author points out that tourism, and inland tourism in particular, were favoured by the political decentralisation in Spain—which allowed Galicia to design its own tourism policy starting in the 1980s, thanks to the European programmes for rural development, and the Galician administration initiatives. Santos and Trillo-Santamaría [65] link the development of tourism activities in Galicia with the construction of a regional image based on its rural character compared to the rest of Spain, and with rural tourism as one of the priorities of the regional tourism policy.

The introduction of the Common Fisheries Policy (CFP) in Europe, and of a series of adjustment measures to reduce fishing capacity, especially in some countries such as Spain, has had a series of negative effects on communities dependent on fishing. Successive funds dependent on the CFP have been allocated towards a series of measures with the aim of avoiding or mitigating these socioeconomic impacts on coastal communities [19,48,66]. Additionally, the economic diversification of these territories has been promoted, which has favoured the investment of numerous European funds in tourism projects [49,67], following the previous experience of the Leader Programme in rural areas [25]. Additionally, small-scale fishing has been immersed for decades in a process of crisis and loss of economic profitability, both in Europe and Spain in general [32,68], and in Galicia in particular [50,69,70], which has contributed to transforming the perception of fishing as a way of life, opening up to the development of new economic diversification activities [60].

It is in this context that fishing tourism has evolved in Spain and in Galicia, favoured by the strong synergies created between the tourism and fishing sectors since the last decades of the twentieth century, and by the opportunities that this activity offers, in terms of employment and income, to coastal communities [32,37,40,41,48–54,71–73]. In any case, although many fishing tourism projects have been started in Galicia [40,74], their evolution and continuity has been uneven, due to the difficulties they face, among which are the lack of tourism training for fishermen [41], and the lack of continued institutional support and specific regulations that regulate the activity [53] (p. 175).

3. Materials and Methods

This work incorporates the results of a literature review on tourism and local development, with particular attention to fishing tourism and its contribution to economic diversification and multi-functionality in coastal areas. Google Scholar and Science Direct have been used as Internet search engines using the key words Fishing Tourism, Marine Tourism, Pesca-turismo, Ittiturismo. Work focused on recreational and sport fishing, where fishermen did not play an active role as activity hosts, have been rejected for analysis. Emphasis is placed on European Funds in support of the Common Fisheries Policy, and the application of the bottom-up approach to this policy since 2007, with the objective of sustainable development of coastal and fishing areas.

Firstly, a detailed study of the technical documentation of the CFP framework, Financial Instrument for Fisheries Guidance (FIFG), European Fisheries Fund (EFF), European Maritime and Fisheries Fund (EMFF), and Fisheries Local Action Groups (FLAGs), was performed through the analysis of regulations, and strategic and operational programmes. The information published by the Spanish Government related to fisheries and aquaculture diversification [51] have also been taken into account, as well as data from the Spanish Network of Fisheries Groups (REGP), which provides data on investment and employment for each of the actions financed, at regional and local level.

In a second phase, the planning phase conducted by the Fisheries Local Action Groups (FLAGs) in the coastal areas of Galicia has been analysed. These groups are partnerships between fisheries actors and other local private and public stakeholders. Together, they design and implement a local development strategy (LDS) to address their area's needs be they economic, social and/or environmental. Based on their strategy, the FLAGs select and provide funding to local projects that contribute to local development in their areas [75]. This research has considered the LDS approved by FLAGs in Galicia (7 in 2007–2013 period and 8 in 2014–2020 period), in order to analyse the importance given to tourism as an engine for diversification, and specifically to fishing tourism.

In a third phase, focused on the case study, the investments of public funds made to companies and institutions between 1995 and 2018 were analysed using official data published by the Directorate General for Fisheries Management from the Spanish government, which show the nominal data for beneficiaries of EU funding through the FIFG and the EFF, which is successively updated (the latest updated version from 11/7/2018 is available on https://www.mapa.gob.es/es/pesca/temas/fondos-europeos/iniciativa-comunitaria-de-transparencia/default.aspx). This data is complemented with data published by the networks of European fishing groups (https://webgate.ec.europa.eu/fpfis/cms/farnet2/node_en), national (<https://regp.pesca.mapama.es/) and Galician (https://galp.xunta.gal/en). The joint analysis of the strategies and the projects financed allows us to see, in the implementation phase of the funds, the level of development achieved in the objectives defined in the strategy.

Finally, the methodological work was completed with the study of the position of the regional government in relation to the development of fishing tourism in Galicia, analysing the economic, political and technical support for this form of tourism.

4. Results

4.1. Normative Framework

In relation to the concept of fishing tourism, as indicated in previous sections, there is a lack of accurate terminology. In most cases it is used in a broad sense, to designate all kinds of leisure activities related to the fishing sector, in a maritime or coastal environment, carried out by professionals of the sea or by tourist agents. In the case of Galicia, it is used as a synonym for Marine Tourism, as included in the regional tourism legislation, and in the tourism information materials published by the Galician administration [76]. Even so, from a regulatory point of view, the activity is well defined in national and regional fishing laws, and is restricted exclusively to activities carried out by professionals in the fishing sector, as a complement or as an alternative to the main fishing or aquaculture activity. Fishing tourism encompasses various activities, the main one "*pesca-turismo*", is a modality that specifically refers to the activities carried out on board professional fishing and aquaculture vessels, which in Spain are registered in a specific census by law. Due to the type of activity, and the working conditions on board, it is the small-scale fishing vessels that are directly related to this activity, as they develop their work in inland or coastal waters, leaving and returning to port on the same day.

Since the beginning of the twenty first century, in Spain and Galicia, fishing tourism has been included in the fishing laws with the aim of promoting the economic diversification of the fishing and aquaculture sector. This is the case of law 3/2001 in Spain—which incorporate fishing tourism, "*pesca-turismo*" and aquaculture tourism—among the measures to be promoted by the Spanish government, and Law 33/2014, which reinforces the role of fishing tourism, defining its typologies and establishing the conditions to develop the activity. In Galicia, Law 11/2008 on Fishing, devotes a specific chapter to marine tourism, linked to the European Fishery Fund (EFF), where the activities that can be included in this type of tourism are detailed, and these are the "*pesca-turismo*" in fishing boats, guided tours, accommodation in sea professionals' houses, and activities aimed at promoting and enhancing the consumption of gastronomic products related to fishing, shellfish farming and aquaculture. Additionally, the Plans and Strategies for tourism in Galicia in the last decade regard marine tourism among the priority tourism products in Galicia, as is the case with the Galicia Comprehensive Plan for Tourism [77], and the 2020 Galicia Tourism Strategy [78]. It is worth noting the attempt by the Galician government to publish a regulation for the development of ittitourism between 2009 and 2010, but has never materialised.

In Spanish and Galician laws, these activities receive a specific mention as elements of diversification and complementarity in addition to the main fishing and shellfish activities, which allow the revitalisation of coastal and rural areas, and the promotion and appreciation of cultural fishing heritage. The latest measure has been the approval in April 2019, of a state regulation that establishes the conditions for the development of the fishing tourism activity carried out on board fishing and aquaculture vessels (Royal Decree 239/2019), with the objective of guaranteeing regulatory security and allowing the broad development of the activity in the Spanish coastal context. The rule bans tourists from fishing activities. It is still too early to assess the impact of the regulation on the development of the activity, although part of the sector considers that it introduces great administrative and bureaucratic complexity, in addition to increasing the economic investment needed to start the activity.

4.2. State and Regional Governments Support

As mentioned above, the legislative and regulatory initiatives on fishing tourism have been included in the framework of strategic plans and programmes developed by the Spanish and Galician governments, guiding diversification in fishing areas. These plans and strategies are financially supported by CFP's financial instruments. This is the case of the FIFG between 1994 and 2006, which favoured diversification in the early stages of fishing tourism. Additionally, later, the EFF (2007–2013) and the EMFF (2014–2020) funds, establishing among their objectives the support towards the diversification, or the economic and social restructuring, of the areas that face socio-economic difficulties due to the evolution of the fishing sector (EFF, Article 43), and promoting the diversification of the fishermen' income through the development of complementary activities, such as investments onboard vessels, sport fishing tourism, restaurants, environmental services related to fishing and educational activities on fishing (EMFF, article 30).

In this context, the Spanish Ministry with powers in the area of fishing drew up the White Paper on Fishing in 2000, where special mention is made to fishing tourism and where the progress of the main research projects focused on this subject is included [79]. Similarly, in the 2013–2020 Fisheries and Aquaculture Diversification Strategic Plan (DIVERPES Plan), the Ministry set out fishing tourism, and its varieties, among the most important diversification alternatives for coastal areas dependent on fishing [80]. In supporting fishing tourism, there have been collaboration agreements between the administration and the universities that, for example, have made it possible to draw up a diagnosis on fishing tourism in Spain [50].

As a result, many research projects, mostly funded by European funds (Table 1), have produced fishing tourism analyses, evaluations and pilot projects in Spain and its regions [37,40,41,48]. We highlight three projects due to their importance: (1) the Sagital Project "Adaptation Services for the Management of Fishing Tourism Initiatives in Coastal Areas", developed within the framework of the EQUAL II Initiative of the European Social Fund (ESF) in the period 2005–2007, coordinated by the Polytechnic University of Madrid, which concludes that there is an interest by fishermen towards fishing tourism as a means of recognition of their role as managers of the sea, and an increasingly favourable approach by the administration and associations of the sector [49]. Additionally, two projects led by the Technological Centre of the Sea Foundation (CETMAR)—foundation with the involvement of the Spanish and Galician governments, Galician universities and members of the fishing sector; (2) the "Seaside Reorientation Activities" (SEREA) project, funded by the ESF between 2006 and 2008, which highlights that marine professionals who participate in fishing tourism actions must undergo a training process to communicate their experience to tourists and promote the need to value the environment and the activities carried out at sea [55]; (3) the Project "Seamen and Women, Project for diversification in the sectors of fisheries, shellfish gathering and aquaculture" (SEAWO-MEN), funded by Interreg IIIC between 2004 and 2007, where meeting points between members of the regional administration and the fishing sector were organised to advance the development of fishing tourism. In parallel, and with regional funds, the Galician government has also supported the development of research activities through agreements with Galician universities. This is the case of the project "Study on fishing tourism. Examples of good practices developed in Spain", funded in 2006 by the Galician government tourism department.

Table 1. Projects related to fishing tourism in Spain and Galicia.

Acronym	Years	Funds	Participating Countries
PRESPO	2009–2011	Interreg Atlantic Area	FR, PT, ES
SEREA	2006–2008	FSE	FR, IT, ES
SAGITAL	2005–2007	Equal II, FSE	
SEAWO-MEN	2004–2006	Interreg IIIC	ES, IR, NO
MARIMED	2004–2005	Interreg IIIB	IT, FR, ES
MEDAS21	2002–2004	Equal I, FSE	ES
SOUTH-ATLANTIC	2002–2004	Equal I, FSE	ES

Source: Own work.

4.3. *Fishing Tourism Experiences in Galicia*

Fishing tourism activities in Galicia began around 2004, following the example of Italy, and gradually spreading among Galician coastal communities, in most cases supported by guilds (fishermen' associations), non-profit public-sector corporations, which act as consultation and collaboration bodies of the regional government for fisheries issues [81]. This is the case of the guild of Lira, a small village of less than 100 inhabitants in western Galicia, the first to launch the Fishing and Marine Tourism Workshop, with the aim of enlivening the social environment of this fishing community and to make the work of fishermen known to society as a whole [82]. In 2007, a fishing marine reserve was created in this same village, aimed at promoting sustainable fishing and favouring strong synergies between tourism and environmental awareness programmes in the marine environment, resulting in the first experiences of fishing tourism. In the early 2000s, fishing tourism activities were launched in other Galician ports, including those initiated by shellfish women's associations to promote and highlight the fishing and shellfish culture [52]. This is the case of the

Guimatur cultural association, created in 2004, which organised guided tours through the shellfish banks, aimed at both visitors and schoolchildren, advocating the fishing culture and the traditional values of work at sea [83]. There are other relevant examples in which several fishermen' guilds have grouped together to develop marine tourism initiatives, such as Pescanatur, an association created in 2006, bringing together three guilds in the province of Pontevedra, to offer tourism packages focused on food tours to taste local fish and shellfish, tours with shellfish women through their places of work, or pesca-turismo experiences [52].

In this way, projects and initiatives related to fishing tourism, which would have a greater role as of 2006 with the approval of the EFF, emerged in Galicia. The development of Axis 4 of the EFF (2007–2013), specifically focused in the sustainable development of fisheries areas, with the aim of supporting economic diversification, played a fundamental role in the dissemination of fishing tourism in Galicia [53], as stated in the preamble of the Galician Fishing Law. Thus, in 2008 the creation of Fisheries Local Action Groups (FLAGs) began with the selection of 7 groups and 7 fisheries areas, and later expanded to 8 [24]. FLAGs design LDS that guide European and regional investment in order to strengthen the economy of fishing communities through economic diversification, increasing the income of marine professionals and protecting employment. Fishing tourism has been the object of special attention in the local development strategies designed and approved by the FLAGs (Tables 2 and 3), which have funded numerous fishing tourism projects and created cooperation networks between the different FLAGs at regional level. Among them was the creation of the Marine Tourism Product Club, Mar Galaica, launched in 2012 with EFF funds, which generated the interest of all the FLAGs, and had the support of the fishing and tourism departments of the Galician government [76]. Mar Galaica was created with the aim of building a platform for the dissemination of activities related to the fishing leisure offer and its cultural heritage [24,40]. In the current programming period (2014–2020), economic diversification activities continue to be funded in coastal communities, and there is a commitment to fishing tourism projects, gastronomy and restaurants, and fishing environmental services and educational activities (Supplementary material, Tables S1 and S2).

Table 2. Fishing tourism (FT) in local development strategy (LDS) by Fisheries Local Action Groups (FLAGs) (2007–2013).

FLAG	Importance of FT in LDS 2007–2013	FT is A Line of Action in the LDS	Public Expenditure Budget for FT EUR	Total Public Expenditure Budget LDS EUR
1 Vigo—A Guarda	Not mentioned	No	0	3,711,630.01
2 Pontevedra	Very low	No	0	3,711,630.00
3 Arousa	Very high	Yes	528,807.50	3,711,630.00
4 Costa Sostible	Very high	Yes	813,396.83	8,133,333.33
5 Costa da Morte	Medium	Yes	798,199.90	7,423,259.00
6 Southern Artabro + 7 Northern Artabro	Mean	Yes (includes marine tourism, coastal tourism, and sport fishing)	69,567	3,711,630.00
8 Mariña-Ortegal	High	Yes	657,934.63	3,711,630.00

Source: LDS.

The local development strategies (LDS) designed by the FLAGs in Galicia in the period 2007–2013 granted tourism a relevant role in achieving the objective of economic diversification. But there is a big difference amongst the 7 FLAGs in regard to the importance they give to fishing tourism. In some cases, this type of tourism does not appear in the strategies, or it is barely acknowledged, as in the Ría de Vigo-Aguarda (1) and Pontevedra (2) FLAGs, on the southern coast of Galicia. In the opposite case, the Costa da Morte (5) and Costa Sostible (4) FLAGs allocate a significant part of their investment forecast to actions related to marine tourism and "*pesca-turismo*". As an example, we will focus on the Costa Sostible FLAG (4), which in its LDS includes actions towards both the creation of a product and the improvement of its commercialisation. Among them are the creation of new types of hotels

"hotels marineros" and restaurants "tascas marineras", the recovery of fishing houses with traditional typologies, or the creation of a Marine Product Plan. The analysis of the LDS shows that they apply a broad concept of fishing tourism, which includes all those activities carried out on the coast, related to fishing and marine cultural heritage, but not carried out exclusively by sea professionals. As a result, a significant part of the European funds used to finance fishing tourism have not benefited fishermen, although they have benefited broad sectors of coastal communities.

Table 3. Fishing tourism (FT) in local development strategy (LDS) by FLAGs (2014–2020).

FLAG	Importance of FT in LDS 2007–2013	FT is a Line of Action in the LDS	Public Expenditure Budget for FT EUR	Total Public Expenditure Budget LDS EUR
1 Vigo—A Guarda	High	Yes	451,472.40	5,016,360.03
2 Pontevedra	Medium	Yes	294,000	5,714,908.00
3 Arousa	Very high	Yes	442,604.76	7,451,258.55
4 Costa Sostible	High	Yes	176,941.33	7,077,653.16
5 Costa da Morte	Medium	No	0	7,304,701.37
6 Southern Artabro	Very high	Yes	360,000.00	4,000,000.00
7 Northern Artabro	Very high	Yes	571,324.12	6,143,270.06
8 Mariña-Ortegal	High	Yes	677,199.85	7,619,688.84

Source: LDS.

The LDS approved by the FLAGs for the 2014–2020 period was created thanks to the experience in the implementation of fishing tourism projects and initiatives in the previous programming period. In some cases, such as the Northern Artabro FLAG (7), a specific working group on Fishing Tourism was created for the development of the new LDS [84]. In general, all the Galician LDS acknowledge the importance of fishing tourism for the economic diversification, and continue to apply it in its broadest sense, including within fishing tourism activities that enhance maritime cultural heritage, the transformation of seafood products, riverside carpentry, guide tours, retail and hospitality, and also "*pesca-turismo*" [85]. As a result of the experience from previous projects, some of the strategies have identified challenges and threats that must be taken into account for the future development of the activity, such as the complexity of the administrative processes, or the excess of fishing tourism promotion and marketing when the sector is not yet able to implement these activities [86] (p. 19). Additionally, there is the need to create synergies with nautical tourism [87], and take advantage of the existing synergies between fishing tourism and wine tourism [88].

After analysing the projects approved by the Galician FLAGs, with the support of EFF and EMFF funds, only a few have been promoted or have had professionals from the fishing sector as beneficiaries of the funds. According to information from the Spanish Network of Fishing Groups, of the 341 projects funded by the EMFF in the eight Galician FLAGs, 112 include fishing tourism among their lines of action. It should be noted that of these 112 fishing tourism projects, 40% correspond to initiatives to increase or improve the accommodation and catering offer in fishing communities. Fishing tourism projects that entail greater complexity for their implementation and that require public-private governance agreements in these communities, are fewer. This is the case of projects related to the promotion of marine cultural heritage—tangible and intangible—and environmental awareness, which only account for 16% of the total (Supplementary material, Table S2). We highlight among them the "Mar das Illas" project started in 2017 as a cooperation action between 3 FLAGs, Vigo-A Guarda (1), Pontevedra (2) and Arousa (3), with the aim of training professionals in the fishing sector with an interest in developing fishing tourism and pesca-turismo within the National Park of Galician Atlantic Islands (Parque Nacional Marítimo Terrestre das Illas Atlánticas de Galicia). This project was funded with EUR 58,400 from the EMFF for the years 2017 and 2018. It has currently been extended, and in August 2020 several pilot projects for pesca-tourism and fishing tourism have been developed.

Finally, it should be noted that the support by the regional government towards fishing tourism in recent years has not only been financial, but it has also had a markedly political nature, as seen in public demonstrations of interest by the main heads of the Administration, both in the form of statements in the press, visits to ports, and participation in the activities organised by the guilds, as reported by the regional and national press.

5. Discussion

The effort led by the Spanish State to promote the regulation and promotion of fishing tourism activities has allowed the development of laws and regulations (Supplementary material, Table S3), numerous research projects and pilot projects, which on a regional scale, have addressed the design of tools and training actions to give support to those interested in starting this type of activity [49]. Fishing tourism has an important relationship with fishing innovation [48], and in coastal communities, social innovations are in many cases related to new tourism products linked to maritime heritage and the presence of women in fishing and shellfish activities [24]. Some studies show that fishermen' organisations that implement fishing tourism projects also tend to conduct innovative projects related to sustainable fishing or technological innovation [55]. Despite the interesting results of a large part of these projects and their experiences in relation to the implementation of pilot fishing tourism projects, no work has yet been carried out to standardise the results in order to design a fishing tourism development strategy at state level.

The proliferation of fishing tourism activities in Galicia has been, as in the rest of Spain, closely linked to funds from the European Fisheries Fund—aimed at the economic diversification of coastal communities—and to the regional policy, which incorporates marine tourism in regional fishing regulations. For the regional government, marine tourism includes the activities carried out by groups of sea professionals, with the aim of diversifying and complementing the main activity of fishing and shellfish (Preamble of Law 11/2008 of fishing of Galicia). Even so, this activity in Galicia still has ample room for development. It is necessary to study in depth the challenges of this type of tourism and take into account the following factors:

- A. In relation to fishermen: Fishermen interested in fishing tourism must have the experience, skills and capital necessary to meet the regulatory obligations and financial demands for the development of the activity [89]. The community of fishing professionals, in most cases, has difficulties in adapting their working hours to tourism activities or to accommodate tourists on fishing boats. The development of the *pesca-turismo* activity poses multiple challenges, since the vessels do not offer the comfortable conditions that tourists expect (in terms of sanitary equipment, resting areas or space available on board). Nor do fishermen have adequate training to make their activity known to visitors in a didactic, structured and motivating way.
- B. In relation to the normative framework: In addition, in the case of *pesca-turismo*, tourists onboard the vessels are not allowed to fish (Article 74, Law 33/2014), so their activity is limited to the mere contemplation of nature, which may contradict their expectations, since many of the promotional campaigns for *pesca-turismo* products are more related to adventure tourism. This is the case of the company Pesca Turismo (www.pescaturismospain.com) which uses slogans such as "Embárcate con Pescaturismo Spain y pon rumbo a la aventura" ("Embark with Pescaturismo Spain and start the adventure").
- C. In relation to the institutional and sector related associations support: The fishermen' guilds, leaders of many of the pioneering experiences of fishing tourism in Galicia, do not show strong support for fishing tourism, especially in the case of pesca-turismo, due to the regulatory complexity of the activity and their lack of knowledge of the tourism sector. In addition, development of fishing tourism in Galicia requires a strategic plan, designed on the basis of a participatory process and with a bottom-up approach. A strategy developed by the fishermen' guilds, the associations representing the professionals of the sea (ship owners, shellfish women, small-scale fishing, mussel producers) with the support of the FLAGs, the advice of the academia, and coordinated with the regional government and the bodies representing professionals in the tourism sector (Galician Tourism Cluster) is needed. A roadmap should be drawn up to

acknowledge the interest in fishing tourism by the different sectors of the sea following a decade of experiences, which have identified potentialities, shown the interest of the coastal communities, and made them aware of the problems to be faced. There have been projects, such as SAGITAL, mentioned above, that have developed pilot projects and participatory processes focused on fishing tourism opportunities. This small-scale experience should be taken into account when defining a regional-scale strategy [49]. Additionally, it is necessary to coordinate the support for the development of fishing tourism. This is due to the fact that the existence of economic stimuli that public funds have caused this promotion has not been in accordance with the existing offer, thereby generating unrealistic expectations [86].

6. Conclusions

There is unanimity in considering fishing tourism as a tourism modality with great potential, due to the benefits it can bring to communities in which small-scale fishing plays a significant role in the economy. Benefits related to the revitalisation of the fishing sector, and also to the promotion of fishing cultural heritage, so fishermen can continue to exploit their knowledge and professional skills, and maintain the social networks linked to fishing [89].

Its development is still limited and irregular in Spain, and it does not constitute a relevant contribution of supplementary income for the majority of fishing professionals in the communities where it takes place [48,52]. Among the main difficulties identified for the implementation of fishing tourism are the lack of experience and previous training of fishermen in tourism activities, the irregular distribution and lack of monitoring of the implemented initiatives, and the existing legal uncertainty [54]. Until very recently, the Spanish legal system did not allow the use of professional fishing vessels for activities other than extractive activities and, therefore, prevented the embarkation of people other than the vessel's crew [49] (p. 1640). In this way, the development of the *pesca-turismo* modality has been restricted, and subject to the search for formulas that would allow it to circumvent this regulatory restriction. Authors like Nicolosi et al. [57], point out other factors, such as how the potential of *pesca turismo* and *ittiturismo* in the Southern Tyrrhenian Coastline is underestimated by the fishing sector due to its lower profitability in relation to fishing, and because the advanced age of fishermen reduces their interest in innovation and access to new forms of communication.

Fishing tourism has generally included elements of environmental education and awareness, and therefore has contributed to transforming the attitudes and values of the parties involved, in local communities and the fishing sector, and of course, visitors. This is evident from the perspective of the sustainability of the fishing sector, in relation to the environmental awareness of the parties involved and the recognition of trades linked to the sea, as well as the sustainability of the coastal tourism model, by complementing the sun and beach offer with new tourism products related to fishing [53] (p. 177).

One of the fundamental objectives of the Common Fisheries Policy is the reduction of fishing captures in Europe, which has had serious consequences for communities dependent on fishing. The policies of economic diversification have pushed many fishermen to consider the possibility of combining their trade with other activities, such as tourism, for which in most cases they have barely received any training. Turning sea professionals into hosts of their own vessels, and part-time tour guides, is a complex task that requires a debate on the opportunity to undertake this path, the means, the pace and the expected objectives. This process, if carried out, must be directed and coordinated by the fishing organisations, which must reflect on how to reconcile tourism and professional fishing so that professionals in the sector are interested in these activities, favouring the promotion of traditional trades and knowledge, and the fishing cultural heritage in general.

Supplementary Materials: The following are available online at http://www.mdpi.com/2073-445X/9/11/437/s1, Table S1: EMFF Projects in Galicia (2014–2020), Table S2: EMFF Projects with line of action in Fishing Tourism. Galicia (2014–2020), Table S3: Current laws and regulations that have introduced definitions and considerations on fishing or marine tourism and fishing tourism in Spain.

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References

1. Arocena, J. *El Desarrollo Local, un Desafío Contemporáneo*; Taurus-Universidad Católica: Montevideo, Uruguay, 2002; p. 245.
2. Boisier, S. Desarrollo (local): ¿de qué estamos hablando? In *La Visión Territorial y Sostenible del Desarrollo Local: Una Perspectiva Multidisciplinar*; Noguera, J., Ed.; Publicacions de la Universitat de València: Valencia, Spain, 2016; Volume 1, pp. 23–46.
3. Klein, J.-L. Ivniciativa local y desarrollo: Respuesta social a la globalización neoliberal. *Eure* **2005**, *31*, 25–39. [CrossRef]
4. Márquez, J.A. Sobre la necesidad de profundizar en los principios del desarrollo local. Experiencias en el suroeste peninsular. *Polígonos* **1998**, *8*, 87–98.
5. Vázquez, A. Desarrollo endógeno. Teorías y políticas de desarrollo territorial. *Investig. Reg.* **2007**, *11*, 183–211.
6. Ray, C. The EU Leader Programme: Rural Development Laboratory. *Soc. Ruralis* **2000**, *40*, 163–171. [CrossRef]
7. Nemes, G. *The Politics of Rural Development in Europe (Vol. 5)*; Institute of Economics Hungarian Academy of Sciences: Budapest, Hungary, 2005; Available online: http://econ.core.hu/doc/dp/dp/mtdp0505.pdf (accessed on 6 October 2020).
8. Dax, T.; Strahl, W.; Kirwan, J.; Maye, D. The Leader Programme 2007–2013: Enabling or Disabling Social Innovation and Neo-Endogenous Development? Insights from Austria and Ireland. *Eur. Urban Reg. Stud.* **2016**, *23*, 56–68. [CrossRef]
9. Esparcia, J. The LEADER program and the rise of rural development in Spain. *Sociol. Ruralis* **2000**, *40*, 200–207. [CrossRef]
10. Esparcia, J.; Serrano, J. From development to power relations and territorial governance: Increasing the leadership role of LEADER Local Action Groups in Spain. *J. Rural Study* **2015**, *45*, 28–41. [CrossRef]
11. Plaza Gutiérrez, J.I. Desarrollo y diversificación en las zonas rurales de España: El programa proder. *B Asoc. Geogr. Esp.* **2005**, *39*, 399–422.
12. Esparcia, J. LEADER II y PRODER en el desarrollo rural en España. In *Estrategias Territoriales de Desarrollo Rural*; Frutos Mejías, L.M., Ruiz Budría, E., Eds.; Diputación de Zaragoza: Zaragoza, Spain, 2006; pp. 65–90.
13. MARM. *LEADER en España (1991–2011). una Contribución Activa al Desarrollo Rural*; Ministerio de Medio Ambiente y Medio Rural y Marino: Madrid, Spain, 2011; Available online: https://www.uv.es/~{}javier/index_archivos/Esparcia%20-%20LEADER%20en%20Espa%C3%B1a%201991-2011%20-%202011.pdf (accessed on 6 June 2020).
14. Maroto, J.C.; Pinos, A.; Cejudo, E.; Navarro, F.A. La apuesta por el turismo rural dentro del Eje Leader. El análisis de los proyectos turísticos en Andalucía 2007–13. In Proceedings of the International Conference on Regional Science, Sevilla, Spain, 15–17 November 2017; Universidad Pablo de Olavide: Sevilla, Spain, 2017. Available online: http://reunionesdeestudiosregionales.org/media/uploads/2017/10/08/MarotoPinosCejudoNavarro.pdf (accessed on 12 June 2020).
15. McAreavey, R.; McDonagh, J. Sustainable Rural Tourism: Lessons for Rural Development. *Sociol. Ruralis* **2011**, *51*, 175–194. [CrossRef]
16. Pérez, F.M.M.; López, I.E. La contribución del turismo a la diversificación de actividades en un espacio rural periférico: Análisis del impacto de la Iniciativa LEADER en Galicia. *Rev. Esp. Estud. Agrosoc. Pesq.* **2005**, *206*, 111–136.
17. Tirado, B.J.G.; Hernández, M.H. Promoting Tourism through the EU LEADER Programme: Understanding Local Action Group Governance. *Eur. Plan. Study* **2018**, *27*, 1–19. [CrossRef]
18. Tirado Ballesteros, J.G.; Hernández, M.H. Assessing the Impact of EU Rural Development Programs on Tourism. *Tour. Plan. Dev.* **2017**, *14*, 149–166. [CrossRef]

19. Symes, D.; Phillipson, J. Whatever became of social objectives in fisheries policy? *Fish. Res.* **2009**, *95*, 1–5. [CrossRef]
20. European Commission. Guidance on Community-Led Local Development in European Structural and Investment Funds. 2014, p. 61. Available online: https://ec.europa.eu/regional_policy/en/information/publications/guidelines/2014/guidance-on-community-led-local-development-in-european-structural-and-investment-funds (accessed on 15 June 2020).
21. Budzich-Tabor, U. Area-based local development—A new opportunity for European fisheries areas. In *Social Issues in Sustainable Fisheries Management*; Urquhart, J., Acott, T.G., Symes, D., Zhao, M., Eds.; MARE Publication Series; Springer: Dordrecht, The Netherlands, 2014; pp. 183–197. [CrossRef]
22. Capgemini Consulting. *Study on the Implementation of Axis 4 of the European Fisheries Fund*; DG MARE: Brussels, Belgium, 2014; Available online: https://ec.europa.eu/fisheries/sites/fisheries/files/axis-4-final-report_en.pdf (accessed on 12 August 2020).
23. Phillipson, J.; Symes, D. Finding a Middle Way to Develop Europe's Fisheries Dependent Areas: The Role of Fisheries Local Action Groups. *Sociol. Ruralis* **2015**, *55*, 343–359. [CrossRef]
24. Piñeiro-Antelo, M.A.; Felicidades, J.; Lois, R. Fisheries Policy for Sustainable Development: Coastal Models and Limitations Derived from Participation and Power Organisation in Atlantic FLAGs in Spain and Portugal. *Sociol. Ruralis* **2019**, *59*, 44–65. [CrossRef]
25. Van de Walle, G.; Gomes da Silva, S.; O'Hara, E.; Soto, P. Achieving Sustainable Development of Local Fishing Interests: The Case of Pays d'Auray FLAG. *Sociol. Ruralis* **2015**, *55*, 360–377. [CrossRef]
26. FARNET. *Fisheries and Tourism: Creating Benefits for the Community*; European Commission: Brussels, Belgium, 2014; Available online: https://webgate.ec.europa.eu/fpfis/cms/farnet2/library/guide/farnet-guides-1-10_en (accessed on 13 June 2020).
27. Miret-Pastor, L.; Svels k Freeman, R. Towards territorial development in fisheries areas: A typology of projects funded by Fisheries Local Action Groups. *Mar. Policy* **2020**, *119*, 104111. [CrossRef]
28. Surís-Regueiro, J.C.; Santiago, J.L. Characterization of fisheries dependence in Galicia (Spain). *Mar. Policy* **2014**, *47*, 99–109. [CrossRef]
29. Sobrino Heredia, J.M.; Oanta, G.A. The legal impact of the common fisheries policy on the Galician fisheries sector. *Ocean. Coast. Manag.* **2019**, *167*, 87–99. [CrossRef]
30. Chen, C.; Chang, Y. A transition beyond traditional fisheries: Taiwan's experience with developing fishing tourism. *Mar. Policy* **2017**, *79*, 84–91. [CrossRef]
31. Rogelja, N.; Janko-Spreizer, A. *Fish on the Move, Fising between Discourses and Borders in the Northern Adriatic*; Springer, MARE Publication: New York, NY, USA, 2017.
32. Herrera-Racionero, P.; Miret-Pastor, L.; Lizcano, E. Viajar con la tradición: Los pescadores artesanales ante la pesca-turismo en la Comunidad Valenciana (España). *Cuad. Tur.* **2018**, *41*. [CrossRef]
33. Voyer, M.; Barclay, K.; McIlgorm, A.; Mazur, N. Connections or conflict? A social and economic analysis of the interconnections between the professional fishing industry, recreational fishing and marine tourism in coastal communities in NSW, Australia. *Mar. Policy.* **2017**, *76*, 114–121. [CrossRef]
34. Gordoa, A.; Dedeu, A.L.; Boada, J. Recreational fishing in Spain: First national estimates of fisher population size, fishing activity and fisher social profile. *Fish. Res.* **2019**, *211*, 1–12. [CrossRef]
35. Pita, P.; Villasante, S. The building of a management system for marine recreational fisheries in Galicia (NW Spain). *Ocean Coast Manag.* **2019**, *169*, 191–200.
36. Butler, E.C.; Amber-Robyn, C.; Saayman, A.; Potts, W.M. Can Fishing Tourism Contribute to Conservation and Sustainability via Ecotourism? A Case Study of the Fishery for Giant African Threadfin Polydactylus quadrifilis on the Kwanza Estuary, Angola. *Sustainibility* **2020**, *12*, 4221. [CrossRef]
37. Moreno Muñoz, D. Aportación a los conceptos de turismo marinero/pesquero y pesca-turismo. *Cuad. Tur.* **2018**, *42*, 385–396. [CrossRef]
38. Bywater, C. The marker for cultural tourism in Europe. *Travel Tour. Anal.* **1993**, *6*, 30–46.
39. Kauppila, P.; Karjalainen, T.P. A process model to assess the regional economic impacts of fishing tourism: A case study in northern Finland. *Fish. Res.* **2012**, 88–97. [CrossRef]
40. Pardellas, X.X.; Padín, C. La nueva demanda combinada de turismo litoral y turismo pesquero: Motivaciones y efectos. *Cuad. Tur.* **2013**, *32*, 243–258.
41. Pardellas, X.X. O turismo pesqueiro. Motivacións da demanda e efectos. *Aunios* **2016**, *19*, 32–34.

42. Hänninen, J.; Tonder, M. Matkailukalastuksen kehittäminen Saimaan Pihlajavedellä. Kala-ja Riistaraportteja. Available online: https://core.ac.uk/download/pdf/52287509.pdf (accessed on 7 November 2020).
43. Schuhbauer, A.; Koch, V. Assessment of recreational fishery in the Galapagos marine reserve: Failures and opportunities. *Ocean. Coast. Manag.* **2013**, *144*, 103–110. [CrossRef]
44. Rodríguez-Dowdell, N.; Enriquez-Andrade, R.; Cardenas-Torres, N. Property rightsbased management: Whale shark tourism in Bahia de Los Angeles, Mexico. *Fish. Res.* **2007**, *84*, 119–127.
45. Cheong, S.M. Privatizing tendencies: Fishing communities and tourism in Korea. *Mar. Policy* **2003**, *27*, 23–29. [CrossRef]
46. Cillari, T.T.; Falautano, M.; Castriota, L.; Marino, V.; Vivona, P.; Andaloro, F. The use of bottom longline on soft bottoms: An opportunity of development for fishing tourism along a coastal area of the Strait of Sicily (Mediterranean Sea). *Ocean. Coast. Manag.* **2012**, *55*, 20–26. [CrossRef]
47. Woods-Ballard, A.J.; Parsons, E.C.M.; Hughes, A.J.; Velander, K.A.; Ladle, R.J.; Warburton, C.A. The sustainability of whale-watching in Scotland. *J. Sustain. Tour.* **2003**, *11*, 40–55. [CrossRef]
48. Miret Pastor, L.; Muñoz Zamora, C.; Herrera Racionero, P.; Martínez Novo, R. Análisis regional del turismo pesquero en España. *Rev. Anál. Tur.* **2015**, *20*, 23–28.
49. Molina García, A.; González Pintado, J.F.; García Aranda, C. El Turismo Pesquero como Instrumento de Apoyo al Desarrollo Sostenible en Zonas Litorales: La Experiencia del Proyecto Sagital. Available online: http://oa.upm.es/8159/1/INVE_MEM_2010_81564.pdf (accessed on 15 June 2020).
50. Molina García, A. Diagnóstico Estratégico de la Actividad de Pesca-Turismo en España. Available online: https://www.mapa.gob.es/es/pesca/temas/diversificacion/Diagnostico%20Pesca-turismo%20en%20Espa%C3%B1a%20(UPM)_tcm30-286139.pdf (accessed on 15 June 2020).
51. Molina García, A.; García Aranda, C. Análisis Económico de la Diversificación Pesquera y Acuícola. 2015. Available online: https://www.mapa.gob.es/es/pesca/temas/diversificacion/analisiseconomicodeladiversifiacionpesquerayacuicola_tcm30-290383.pdf (accessed on 15 June 2020).
52. Padín, C.; Aboy, S. Nuevos productos turísticos: La apuesta por el turismo marinero en Galicia. *Tékhne Rev. Estud. Politéc.* **2010**, *14*, 55–83.
53. Padín, C.; Lima, C.; Pardellas, X.X. A market analysis for improving fishing tourism management in Galicia (Spain). *Ocean. Coast. Manag.* **2016**, 172–178. [CrossRef]
54. Pardellas, X.X.; Padín, C.P.; Aboy, S. Turismo pesquero: Experiencias en Europa y España. *Papel. Econ. Esp.* **2011**, *128*, 221–227.
55. SEREA. *La Pesca de Bajura: Situación en 2007 y Perspectivas Para una Orientación Sostenible*; CETMAR: Vigo, Spain, 2010; Available online: http://www.ceida.org/sites/default/files/adxuntos-publicaciones/libroserea.pdf (accessed on 12 May 2020).
56. Lariccia, M. Pescaturismo en Italia. Available online: https://docplayer.es/41553609-Pescaturismo-en-italia-michele-lariccia.html (accessed on 2 August 2020).
57. Nicolosi, A.; Sapone, N.; Cortese, L.; Marcianò, C. Fisheries-related Tourism in Southern Tyrrhenian Coastline. *Proc. Soc. Behav. Sci.* **2016**, *223*, 416–421.
58. Santana-Talavera, A.; Fernández, J.L.P. Pesca y turismo: Conflictos, sinergias y usos múltiples en Canarias. *Rev. PH* **2003**, 86. [CrossRef]
59. Brookfield, K.; Gray, T.; Hatchard, J. The concept of fisheries-dependent communities. A comparative analysis of four UK case studies: Shetland, Peterhead, North Shields and Lowestoft. *Fish. Res.* **2005**, *72*, 55–69.
60. Jiménez de Madariaga, C.; García del Hoyo, J.J. Enhancing of the cultural fishing heritage and the development of tourism: A case study in Isla Cristina (Spain). *Ocean. Coast. Manag.* **2019**, *168*, 1–11.
61. Rubio-Cisneros, N.T.; Moreno-Báez, M.; Glover, J.; Rissolo, D.; Sáenz-Arroyo, A.; Götz, C.; Salas, S.; Andrews, A.; Marín, G.; Morales-Ojeda, S.; et al. Poor fisheries data, many fishers, and increasing tourism development: Interdisciplinary views on past and current small-scale fisheries exploitation on Holbox Island. *Mar. Policy* **2019**, *100*, 8–20. [CrossRef]
62. Ivars Baidal, J.A. Turismo y espacios rurales: Conceptos, Filosofías y realidades. *Investig. Geogr.* **2000**, *20*, 59–88.
63. Vera, J.F.; Marchena, M. Efectos del turismo en las estructuras regionales periféricas: Una aproximación analítica. *Millars Espai Hist.* **1998**, *21*, 109–144.

64. Santos Solla, X.M. Los turismos de interior en Galicia. Balance y perspectivas. *Polígonos. Rev. Geogr.* **2012**, *23*, 213–234.
65. Santos Solla, X.M.; Trillo-Santamaría, J.M. Tourism and nation in Galicia (Spain). *Tour. Manag. Perspect.* **2017**, *22*, 98–108. [CrossRef]
66. Symes, D.; Phillipson, J.; Salmi, P. Europe´s Coastal Fisheries: Instability and the Impacts of Fisheries Policy. *Sociol. Ruralis* **2015**, *55*, 245–257. [CrossRef]
67. FARNET. *Diversification of Fisheries Areas, Guide 5*; European Commission: Brussels, Belgium, 2011; Available online: http://thekey.farnet.eu/library/guides/FARNET_Guide_05_EN_Diversification-of-fisheries-areas.pdf (accessed on 13 June 2020).
68. Pascual-Fernández, J.J.; Pita, C.; Bavinck, M. (Eds.) *Small-Scale Fisheries in Europe: Status, Resilience and Governance*; MARE Publications Series: New York, NY, USA, 2020; p. 23. [CrossRef]
69. García Allut, A.; Freire, J. *Procesos de Producción Pesquera e Incertidumbre: La Comercialización de los Productos Pesqueros en la Pesca Artesanal de Galicia, Andar o Mar: II Xornadas Internacionais de Cultura Tradicional*; Asociación Canle de Lira: Carnota, Spain, 2002; pp. 151–178. Available online: http://hdl.handle.net/2183/108 (accessed on 6 June 2020).
70. Villasante, S. *Sostenibilidad de las Pesquerías Artesanales de Galicia*; Instituto Universitario de Estudios Marítimos: A Coruña, Spain, 2010.
71. Andrade, M.J. El desarrollo pensado desde una cofradía de pescadores: Capital social y despliegue de potencialidades locales de Lira (A Coruña). Análisis cualitativo de la significación del proyecto Mardelira. In *Castilla-La Mancha: 25 Años de Autonomía*; Pérez Redondo, R.J., Martín Cabello, A., Eds.; ACMS: Toledo, Spain, 2007; pp. 429–441.
72. Miret-Pastor, L.; Molina-García, A.; García-Aranda, C.; Herrera-Racionero, P. The connection between recreational fishing and the traditional fishing sector in the emerging area of marine tourism: Challenges and opportunities for diversification with the European Fisheries Fund (EFF). *ICES J. Mar. Sci.* **2019**, fsz150. [CrossRef]
73. Pardellas, X.X. *Turismo Gastronómico: Recursos e Itinerarios*; Universidade de Vigo: Vigo, Spain, 2009.
74. Patiño Romarís, C.A. El turismo marinero: Un producto diferenciador y emergente de la oferta turística del litoral gallego. In *Actas del X Congreso Internacional de Turismo Rural y Desarrollo Sostenible (CITURDES)*; Santos, X.M., Taboada, P., López, L., Eds.; Universidad de Santiago de Compostela: Santiago de Compostela, Spain, 2016; pp. 401–410.
75. Felicidades, J.; Piñeiro, M.A. Competitividad, Sostenibilidad y Diversificación en la Fachada Atlántica de la Península Ibérica: La Gestión Local del Fondo Europeo de Pesca (2007–2013). *Rev. Estudios Andal.* **2017**, *34*, 350–379. [CrossRef]
76. Turgalicia. Marine Tourism. 2012. Available online: https://www.turismo.gal/folletos-e-publicacions?langId=en_US (accessed on 24 August 2020).
77. de Galicia, X. Plan. Integral de Turismo de Galicia. 2016. Available online: https://www.turismo.gal/canle-profesional/plans-e-proxectos/plan-integral-de-turismo-2016?langId=es_ES (accessed on 24 August 2020).
78. Xunta de Galicia. Estrategia de Turismo de Galicia 2020. 2017. Available online: https://www.turismo.gal/docs/mdaw/mjk2/~{}edisp/turga296028.pdf?langId=es_ES (accessed on 24 August 2020).
79. MAPA. Libro Blanco de la Pesca. 2010. Available online: https://www.mapa.gob.es/es/pesca/publicaciones/libro_blanco_tcm30-77136.pdf (accessed on 4 June 2020).
80. MAPA. Plan. Estratégico DIVERPES: Plan. de Diversificación Pesquera y Acuícola. 2013. Available online: https://www.mapa.gob.es/es/pesca/temas/diversificacion/planestrategicodiverpes2013-2020_tcm30-78145.pdf (accessed on 4 June 2020).
81. García-Lorenzo, I.; Varela-Lafuente, M.M.; Garza-Gil, D. Adaptative processes in small-scale traditional fishermen's organisations. The case of Cofradías in Galicia (NW Spain). *Mar. Policy* **2019**, *99*, 382–390. [CrossRef]
82. García Allut, A. Proyecto de Escuela Taller de Pesca y Turismo-Rural Pesquero Lira-Carnota-A Coruña. *Boletín Inst. Andaluz Patrimonio Histórico* **2003**, *11*, 106–107.
83. Cacabelos, M.J. Turismo mariñeiro, un valor engadido ó marisqueo. *IV Foro dos Recursos Mariños e da Acuicultura Galega*. Rey-Méndez, M., Lodeiros, C., Fernández Casal, J., Guerra, A., Eds.; 2002, pp. 41–52. Available online: http://foroacui.com/wp-content/uploads/2018/09/iv_foro_recursos_marinos.pdf (accessed on 10 September 2020).

84. FLAG Northern Artabro. Estratexia de Desenvolvemento Local Participativo. n. d. Available online: https://galp.xunta.gal/es (accessed on 2 March 2020).
85. FLAG Southern Artabro. Estratexia de Desenvolvemento Local Participativo. n. d. Available online: https://galp.xunta.gal/es (accessed on 2 March 2020).
86. FLAG Pontevedra. Estratexia de Desenvolvemento Local Participativo. n. d. Available online: https://galp.xunta.gal/es (accessed on 2 March 2020).
87. FLAG Ría de Vigo-A Guarda. Estratexia de Desenvolvemento Local Participativo. n. d. Available online: https://galp.xunta.gal/es (accessed on 2 March 2020).
88. FLAG Arousa. Estratexia de Desenvolvemento Local Participativo. n. d. Available online: https://galp.xunta.gal/es (accessed on 2 March 2020).
89. Morgan, R.; Lesueur, M.; Henichart, L.-M. Fisheries diversification: A case study of French and English fishers in the Channel. In *Social Issues in Sustainable Fisheries Management*; Urquhart, J., Acott, T.G., Symes, D., Zhao, M., Eds.; MARE Publication Series: New York, NY, USA, 2014; pp. 165–182. [CrossRef]

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Hunting Tourism as a Possible Development Tool in Protected Areas of Extremadura, Spain

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Abstract: The constant declaration of new protected natural spaces that has taken place on a world scale in recent decades has caused changes in rural areas, where these spaces are often host to traditional activities that have acted over time as the area's main sources of wealth. Among these activities, hunting has been one of the most affected. For this reason, the following study analyzes the incidence of one of the economic sectors linked to *venatoria*, hunting tourism, in two protected areas with an established hunting tradition: Sierra de San Pedro and Monfragüe. In order to achieve this objective, a questionnaire was drawn up and subsequently completed by a large proportion of the tourist accommodation establishments located in these areas. The results were obtained by means of statistical techniques and yielded very interesting information. This included information about the strong presence of hunting tourism in both regions, the differences in the presence of hunters according to the type of tourist accommodation, and the interest of hunters in taking part in activities other than hunting.

Keywords: hunting tourism; natural protected area; sustainable development

1. Introduction

The protection of natural areas has a long history and is universal in nature [1], although a distinction should be made between the aims pursued in terms of the protection of territory before and after the declaration of the first national park in the United States in 1872. For example, in the Middle Ages in Europe, the first protected spaces appeared for reasons linked to hunting or timber interests [2], giving rise over time to exclusive hunting reserves where only kings and noblemen could hunt. However, after U.S. President Grant created the first national park in the United States (Yellowstone), a kind of protected space arose that was characterized by a public nature and a recreational purpose: " … a public park or pleasuring ground for the benefit and enjoyment of the people". The declaration stressed that the preservation of Yellowstone's natural state would be a priority: " … such regulations shall provide for the preservation, from injury or spoliation, of all timber, mineral deposits, natural curiosities, or wonders within said park, and their retention in their natural condition."

Therefore, starting with the year 1872, there was constant growth in terms of the number of protected spaces around the world. According to Tolón and Lastra, this increase can be divided into three stages of varying intensity [3].

The first of these stages included the period between 1872 and 1975, which was characterized by incipient development in the regulatory framework of protected areas and the creation of the first national and international bodies specializing in environmental protection. Likewise, the holding in

1962 of the first "World Congress on National Parks" in Seattle considerably encouraged the declaration of new spaces, since it was after that year that 80% of the protected areas of the world were created [4].

The second stage was between the years 1975 and 1992, during which policies on environmental conservation were intensified. At the same time, regulations became more numerous. In this period, the number of protected areas and their surface area increased considerably all over the world, although the differences between countries were significant.

The third stage began after the holding of the "Río de Janeiro Summit" in 1992, since after this date, a new ideological trend emerged regarding conservation, namely, one associating conservation with the principle of sustainability and the three pillars on which sustainability is based: social, ecological, and environmental sustainability.

These stages led us to the current situation: in 2018, protected territory accounted for 14.87% of the surface area of the world [5], with this percentage being much higher in some areas or countries. Examples include the European Union, with 18% [6]; Spain, with 27% [7]; and Extremadura (the territory in which this study was set), where the protected surface area exceeds 30%.

This growth in protected surface areas has had multiple and varied consequences and has given rise to a new context in which very different interests are interrelated, especially in terms of the regulations that affect both public and private land. These regulations have established "rules of the game" that describe the way in which the relationship between man and a protected territory must be sustained. As a consequence of this, on occasion there has been tension related to the restrictions imposed by regulations insofar as the use of certain natural resources is concerned. These restrictions can affect traditional activities such as hunting, which has generated a heated debate as to whether this activity should be allowed or restricted in the aforementioned spaces, given that in many cases the locations of protected areas and traditional hunting areas coincide. Likewise, although no pattern can be valid for all protected areas from a socioeconomic point of view, at least in Extremadura a considerable number of these areas are situated in spaces that currently have deficits in economic development (a lower level of income, higher unemployment, little economic diversification) and lack a suitable sociodemographic balance (the loss of population, regressive population pyramids, and aging). The European Union has implemented many development programs to alleviate this situation in rural areas, with measures such as the LEADER or FEADER programs, which seek to promote economic diversification and encourage the development of certain sectors, such as tourism. Thanks to the implementation of these initiatives, Extremadura currently has a wide infrastructure network linked to this sector, among which the existence of a large offering of accommodations stands out (on 31 December 2019, the number was 1778) [8]. Although all of this has led to an increase in the tourism sector, it is experiencing some problems linked to seasonality and the mismatch between the growth in supply and demand [9]. In this sense, hunting tourism is a possible tool for avoiding the seasonality of other forms of tourism in these territories, as it can be developed during periods of falling demand [10]. However, on many occasions, growth in protected areas has led to limitations on the practice of certain traditional activities, with hunting being one of the most affected due to various factors. All of this has happened despite the fact that it has been acknowledged that in many natural spaces (e.g., in Europe), a high level of conservation has been attained thanks to interests related to hunting [11]. In this sense, Extremadura represents a clear example of a location where protected areas and traditional hunting areas coincide, among which are the two territorial laboratories we studied: Sierra de San Pedro and Monfragüe [12]. In these areas, recreational hunting is practiced: this activity takes many varied forms [13], and hunting tourism is a derivation of it.

As a consequence of this, and given the new circumstances of many of the territories that are now protected, there are different points of view as to the role that hunting should play, taking into account that there are two conflicting approaches due to the fact that hunting is an activity that consumes wild resources [14,15]:

- The first approach affirms that hunting is compatible with nature conservation and can therefore be practiced in protected spaces for three reasons: its traditional character; its contribution to the conservation of habitats and fauna, provided that it is carried out under suitable management; and the generation of income, which has an effect on the local economy [10,12,16–22]. These arguments make hunting a sustainable activity conceived as the exploitation of hunting species and their habitats in a way and at a pace that does not lead to a long-term decline in biological diversity and satisfies the needs and aspirations of present and future generations [23]. At the same time, this focus is related to the theory that if wild resources are used under conditions of suitable handling this becomes a valid tool for maintaining biological diversity [24]. However, it is as well to specify that it is absolutely necessary to carry out suitable management and planning to avoid possible negative effects [25]. At the same time it is important for there to be regulations adapted to each territory so as not to trigger problems in environmental conservation [22,26], as regarding hunting one should not generalize and there are no formulae which cater to all territories and species. In this sense some authors consider that a surfeit of restrictions may lead to an increase in illegal hunting, the loss of numerous economic opportunities, and may even affect the conservation of spaces [22,26] by endangering habitats and biodiversity itself [27,28].

- The second approach stresses that hunting is not compatible with conservation and should therefore not be practiced in the protected spaces as this puts biodiversity at risk and has other kinds of impacts [29–31]. This approach is based on the negative effects of hunting which are a result not only of the death of animals but also of the consequences associated with its practice, as is maintained by various groups who argue that considerable harm is done to all kinds of species. At the same time, they understand that the income from visitors who are not hunters to natural protected spaces could replace that provided by hunters, which refutes one of the arguments generally put forward by defenders of hunting.

In relation to the above two positions, it must be said that this debate should be enriched with an intermediate position which defends that hunting is compatible with activities such as nature observation tourism, as both activities are not mutually exclusive, which means that the two together may considerably improve the economic benefits [32].

Apart from the aforementioned positions, in the present context there are two currents which oppose hunting owing to ethical and moral considerations. On the one hand we have a current represented by the animalist ideology which is against the death of animals on granting them the same rights as human beings, which implies respecting their lives on an equal footing. On the other hand, there is an opposing current against recreational hunting on the grounds that it is not ethical to kill animals for pleasure. This latter current was given a considerable boost by the death of the lion Cecil as this event triggered a much more profound debate on a world scale and encouraged the setting in motion of more restrictive policies on recreational hunting [26].

In synthesis, Extremadura is a clear example of the juxtaposition of natural protected spaces on hunting grounds—a direct consequence of the fact that the protected area amounts to 30.6% [33] in a territory of which 87% is considered to be hunting areas [34]. Moreover, as has already been mentioned, many protected areas in which hunting is exploited in a secular manner show a lack of social and economic balance as occurs in most rural areas of Extremadura [35]. Given this scenario, and taking into account that hunting and hunting tourism are activities which generate economic benefits to varying degrees (as reflected by various studies carried out at very different scales [17,34,36–41]), this study aimed to empirically corroborate the relationship between hunting and the demand for tourist services—to be precise, for accommodations located in two protected areas of great hunting tradition in Extremadura: Sierra de San Pedro and Monfragüe. In this way we intend to confirm whether companies of this kind in the municipalities located in both spaces benefit from hunting, as is habitually argued.

In order to achieve this objective this research was divided into the following sections:

- First, a closer look is taken at the phenomenon of hunting tourism by means of a revision of the literature.

- Secondly, the study area is described together with the materials and methods used in this research.
- Subsequently the results obtained are analyzed with the help of a survey which allowed the assessment of the presence of hunting tourists in the tourist accommodations located in the study area.
- Fourthly, a discussion is opened on the potential of sustainable hunting as an activity which may contribute to the generation of economic resources in rural areas.
- Finally, a series of conclusions are drawn from the results obtained.

2. Hunting and the Demand for Tourist Services

Tourism is a sector which, after an intense evolutionary process, has attained enormous importance on a global scale in recent decades. In Spain the relevance of this activity can be appreciated in current statistics, in which the number of foreign tourists in 2017 increased by 8.0% compared with the previous year. This trend continued during 2018 albeit with a slight reduction in growth (1.1%); the total figure exceeded 82 million foreigners [42]. These data express a continuous increase in demand from this type of tourist. Moreover, in order to get to know the situation of tourism in Spain it is necessary to take into account the movements of Spanish residents as they account for a large proportion of the travelling carried out within the country. To go deeper into this matter, the figures on the movements of residents within Spanish frontiers exceed 177 million journeys for 2018, which makes clear the considerable economic and social relevance of the tourist sector in Spain [43].

These movements are a response to varied motivations which may fall within types of tourism that can be classed as general (rural tourism, sun and beach, and urban tourism) or specific (sports, nature, cultural, etc.) [44]. Hunting tourism, which has become a strong line of research as can be seen from any repository of scientific studies, is one of the specific types which some authors classify with other more general types such as sports tourism, nature tourism [45], or rural tourism [21]. This is a consequence of hunters' interest in shooting various specimens which are distributed irregularly all over the world, thus giving rise to a considerable number of international and national journeys. As a result of this, the hunters require tourist services of various kinds (accommodation, guides, means of transport, restaurants) during their journeys, owing to which hunting has been considered as a tool which helps to develop or at least maintain the rural world. The demand for tourist services is reflected in all the economic studies that have been carried out on hunting. In the case of Extremadura, we can mention the study carried out by the Hunting Federation of Extremadura (2018) [34], which gives an estimate of the economic importance of hunting as far as accommodations and restaurants are concerned.

In contrast to other specific types of tourism, the history of hunting tourism is one of contrasts which led Rengifo (2008) [46] to distinguish three stages:

He situates the first stage in the 19th century which saw the first international travels with the aim of hunting in Africa and Asia [14]. During this period hunters were attracted by the possibilities of having an adventure and obtaining trophies of exotic species with the support of the progress in transport systems, colonization, and the dissemination of the natural treasures of little-known destinations.

The second stage covers most of the 20th century, during which the recreational nature of hunting became general. Little by little, hunting destinations became consolidated and their range became wider in the context of the growing improvement of means of transport and the increasing number of companies who provided services to meet this demand. Spain was one of the destinations chosen by hunters and is considered by some authors to be the "game preserve of Europe" [47]. This scenario led to the appearance and development of the hunting tourism industry in our country, with the advent of the first hunting tour operators. At the same time, the Spanish Public Administration began to promote this sector by means of campaigns and encouraged the carrying out of some quantitative analyses to measure the impact of the arrival of these tourists [48].

Finally, in the 21st century the sector has become more and more established worldwide, especially in its variant of hunting for trophies. At the same time voices have been heard advocating the restriction or prohibition of this kind of hunting. Given this situation, various international bodies have stressed the need for trophy hunting to be practiced in a sustainable manner, in which case they consider it to be beneficial to local populations and conservation; a series of documents have been published along these lines [49,50].

3. Materials and Methods

3.1. Case Study

The landscape, climate, and relief characteristics [51,52] which define Extremadura make this territory an ideal place for the practice of hunting. The surface area currently occupied by hunting grounds amounts to 87% of the region, although the abundance of game in them is very irregular. In accordance with current regulations, the number of hunting species comes to 7 in the case of big game and 23 for small game. The hunting types of greatest interest to hunters from outside the region include wild boar and deer hunting and red-legged partridge beating, which are both highly developed in Extremadura [53].

In view of the undoubted advantages of the region for hunting, it is not surprising that Extremadura is chosen by a large number of hunting tourists and is therefore one of the main hunting destinations in Spain [36,47]. Likewise, its advantages for hunting are accompanied by a low level of transformation of the natural environment as a result of its low population density (25 inhabitants/km^2), property structure, low level of industrialization, and peripheral nature. These are some of the reasons why about one-third of its surface area is protected by one of the systems included in regional, national, and international regulations.

Two of the protected natural spaces of highest environmental value in Extremadura are Sierra de San Pedro and Monfragüe (Figure 1). These are territories in which on the one hand environmental protection and on the other hunting tradition coincide, as is expounded below:

- Sierra de San Pedro. This is a protected territory under the system of Areas of Regional Interest (*Zonas de Interés Regional*, ZIRs) which covers a surface area of 115,032 ha. It is also part of the Natura 2000 Network by means of Special Protection Areas (SPAs) and Special Areas of Conservation (SACs). In accordance with Law 9/2006 on the conservation of nature and natural spaces in Extremadura, the declaration of a ZIR reflects the "presence of natural systems or elements with a representativeness, singularity, rarity, fragility, or interest which suggests they should be declared natural protected spaces". The surface area of this space is 115,032 ha, distributed in 11 municipalities of little demographic importance with the exception of Cáceres (95,000 inhabitants).
- Monfragüe. Monfragüe is protected by different systems which cover a different surface area: The National Park (18,000 ha in which hunting is forbidden by law), Special Protection Areas (SPAs), Special Areas of Conservation (SACs), and the Biosphere Reserve (116,000 ha). In this study we have taken as a reference the 14 eminently rural municipalities which form part of the area of socioeconomic influence of the natural park of 195,500.73 ha [54] in accordance with that specified by Law 1/2007 on the declaration of the National Park of Monfragüe.

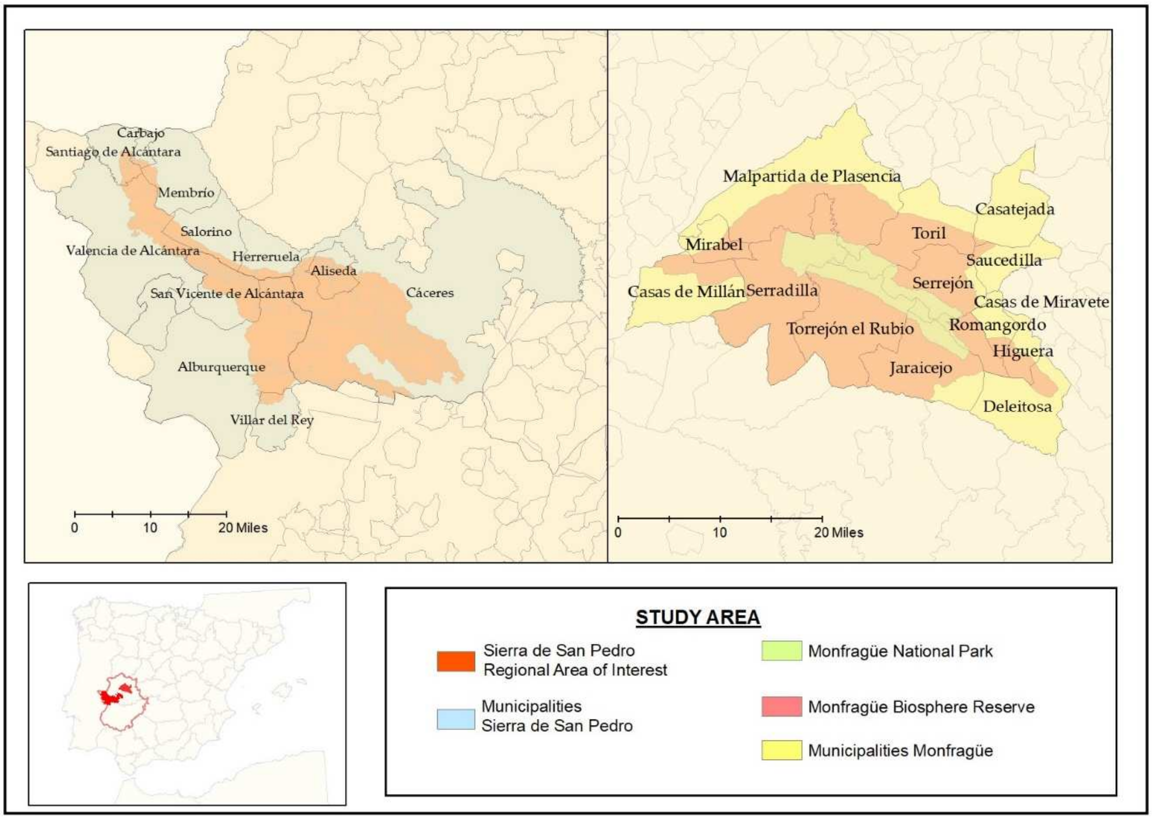


Figure 1. Study area.

Although there are certain territorial disparities between these two protected areas, both constitute a common nexus of great importance for the purposes of this study: their different hunting techniques, their environmental values, and also their demographic and socioeconomic imbalances.

In order to assess the importance of hunting in both spaces we have consulted the information of the General Hunting Plan (2015) [55] for Extremadura which divides the region into 23 districts. The information in this plan has allowed us to carry out an analysis of the hunting districts of Sierra de San Pedro–Tajo Internacional and Monfragüe–Sierras Periféricas, which coincide territorially to a certain extent with the protected spaces proposed in this research (Figure 2). In the latter case it should be pointed out that the municipalities making up the Area of Socioeconomic Influence of Monfragüe are distributed in three different hunting districts according to the system included in the General Hunting Plan, owing to which in this analysis we have taken as a point of reference that best fitting the study area. The choice of these hunting districts is fully justified in Table 1, in which it can be seen that the majority of the municipalities restricted to them are in turn part of the study area. In this sense, the data show the surface area that each municipality contributes to each hunting region such that in the case of the municipalities in the study area of this work they account for just over 85% of the surface area recognized as the region of Sierra de San Pedro; in the area of Monfragüe–Sierras Periféricas this surface area exceeds 94%. Thus, the rest of the municipalities that the General Hunting Plan integrates within both hunting regions and which do not appear in the area of study of this research barely represent 14.5% of the surface area of Sierra de San Pedro area and 5.38% in the case of Monfragüe.

Table 1. Surface area.

District	Municipalities	Surface Area of District (ha)	Surface Area of District (%)	Surface Area Contributed by the Municipalities to the District (%)
Sierra de San Pedro–Tajo Internacional	Aliseda	9611.65	3.58	85.50
	Alburquerque	30,167.08	11.26	
	Cáceres	85,481.37	31.90	
	Carbajo	2799.44	1.04	
	Herreruela	11,394.05	4.25	
	Membrío	20,817.27	7.77	
	Salorino	15,797.87	5.90	
	San Vicente de Alcántara	9218.40	3.44	
	Santiago de Alcántara	9583.69	3.58	
	Valencia de Alcántara	30,294.90	11.31	
	Villar del Rey	3863.49	1.44	
	Remaining municipalities	38,907.23	14.50	14.50
Monfragüe–Dehesas Periféricas	Mirabel	4935.25	4.23	94.62
	Casas de Millán	15,263.75	13.10	
	Deleitosa	52.45	0.04	
	Higuera	24.66	0.02	
	Jaraicejo	15,997.49	13.73	
	Malpartida de Plasencia	25,832.07	22.17	
	Romangordo	804.63	0.69	
	Serradilla	22,290.80	19.13	
	Serrejón	12,422.06	10.66	
	Toril	12,637.21	10.85	
	Remaining municipalities	6252.06	5.38	5.38

Source: General Hunting Plan [55].

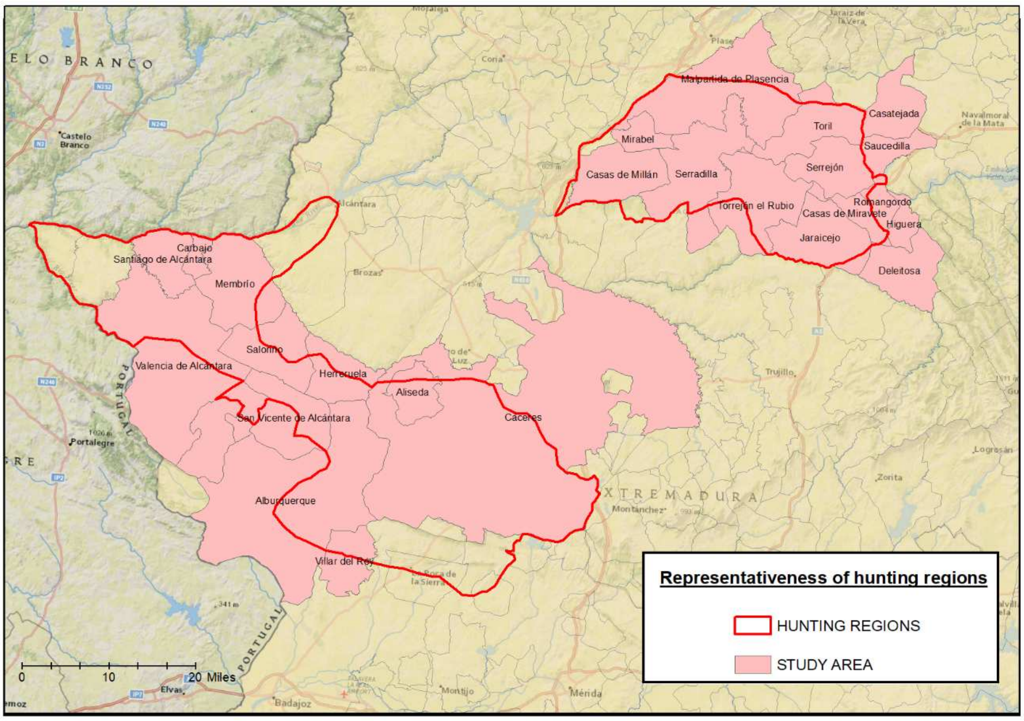


Figure 2. Representativeness of hunting regions.

The data included in Table 2 prove without a doubt the importance of hunting in both areas, despite the fact that certain superficial differences exist. The hunting district of Sierra de San Pedro has a larger surface area devoted to hunting of over 304,000 ha, while in Monfragüe the figure is less than 98,000 ha. This situation is mainly due to two factors which are present in the latter territory:

- This hunting district does not include the totality of the municipalities found in the study area. For this reason it is necessary to add the hunting grounds of the three municipalities which the General Hunting Plan locates in districts other than that taken as a point of reference for this analysis (Casatejada, Saucedilla, and Torrejón el Rubio).
- The presence of Monfragüe National Park, the normative framework which forbids hunting in the 18,396 ha which are restricted to it, except for scientific or environmental reasons [56].

Table 2. Hunting grounds.

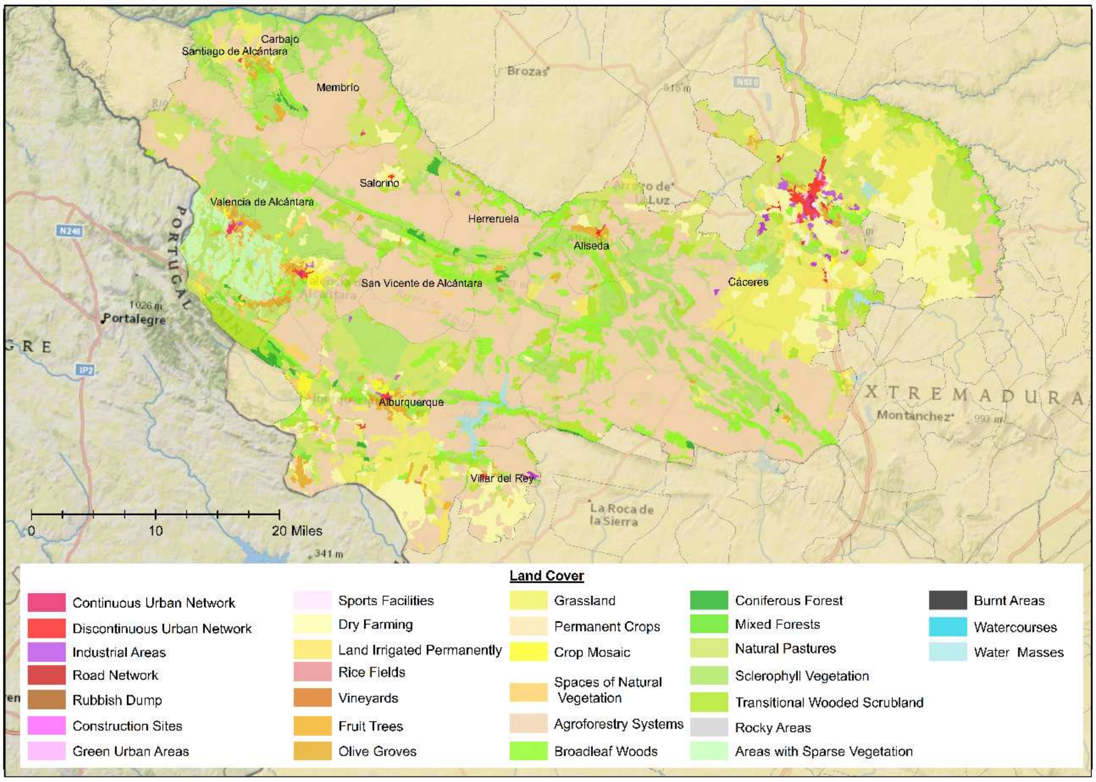
District	Type of Hunting Grounds	Number of Hunting Grounds	Surface Area (ha)	Surface Area (%)
Sierra de San Pedro–Tajo Internacional	Social	35	81,753	26.89
	Small Game	92	52,294	17.20
	Big Game	166	170,026	55.92
Monfragüe–Sierras Periféricas	Social	12	26,978	27.58
	Small Game	14	9837	10.06
	Big Game	68	61,002	62.36

Source: General Hunting Plan [55].

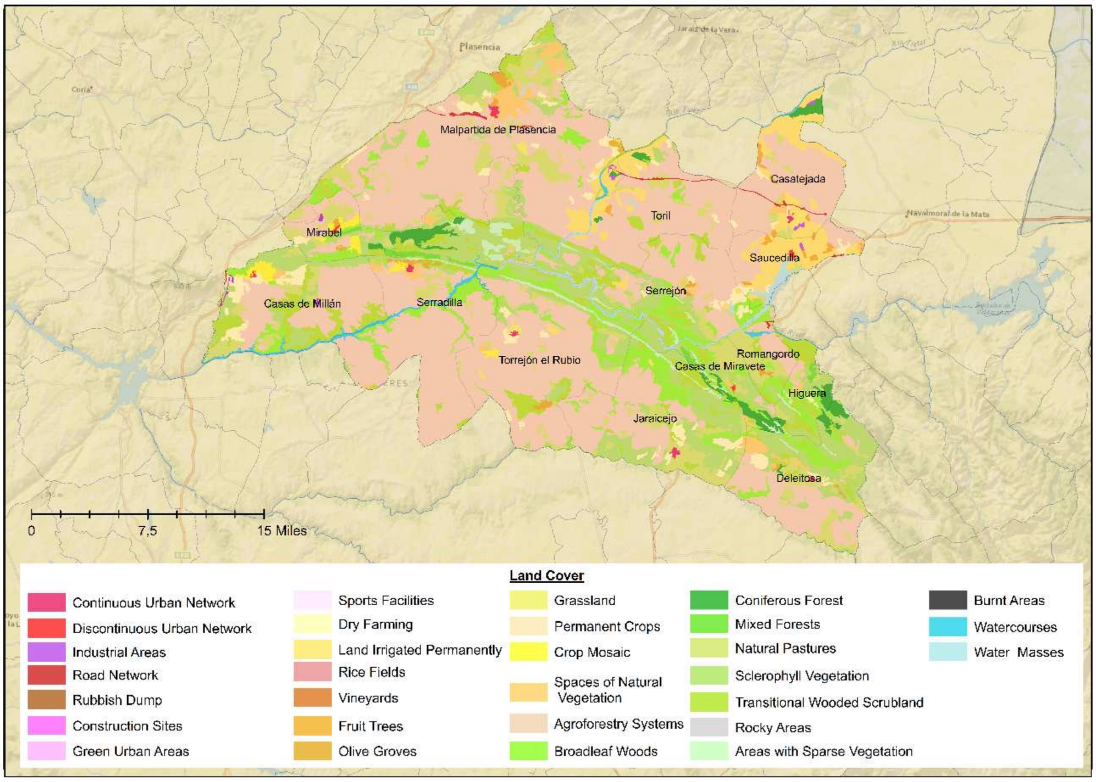
Despite these differences, both districts have a large surface area devoted to hunting and also a considerable number of game preserves which correspond to different categories responding to the existence of two models of hunting exploitation in Extremadura: social and economic hunting. In this sense, big game and small game preserves that are privately enclosed are dedicated to the economic exploitation of the hunting resource, whereas the so-called social preserves try to guarantee access to the hunting activity under conditions of social equality for all hunters in Extremadura. This type of hunting reserve is managed by groups of hunters under the name of Local Hunting Societies, which have managed to play a very important role in hunting in Extremadura [57].

Among these categories, the high figure of preserves devoted to big game hunting stands out, as it exceeds 50% in both territories. These percentages are not directly correlated with the situation in Extremadura, where the surface area devoted to big game hunting falls to 27% [55].

The statistics on the surface area devoted to the exploitation of big game hunting in these territories serve to confirm the potential of the study area as a hunting destination, as it is precisely this type of hunting which is particularly attractive to hunting tourists [46]. The strong presence of this kind of preserve is due largely to the forestry vocation of both areas (Figure 3a,b). This aspect and the occurrence of various crops shape a habitat that is particularly suitable for the development of big game species [58].



(**a**)



(**b**)

Figure 3. Land use in (**a**) Sierra de San Pedro and (**b**) Monfragüe.

Figure 3 shows a decrease of 570 inhabitants in the period from 2000 to 2018. In spite of this, it should be pointed out that several localities within this area (Malpartida de Plasencia, Mirabel, Romangordo and Saucedilla) showed positive population growth. This situation does not transfer to Sierra de San Pedro, where the rate of growth showed an increase of more than 10,000 inhabitants, although in contrast to what happened in Monfragüe, only the city of Cáceres showed positive growth (Table 3). The lack of employment opportunities is one of the main reasons for this demographic decline, which is the direct reason why young people tend to move to the large urban centers in search of work. This situation is evident in the district of Sierra de San Pedro where it can be observed that the size of the municipality influences the dynamic of population increase or decrease.

Table 3. Population changes.

Areas Name	Municipality	Population in 2000	Population in 2018	Percentage of Population that Contributes to the Area (2018)	Balance of Population Growth (2000–2018)	Population Growth Rates
Sierra de San Pedro	Alburquerque	5645	5340	4.6	−305	−5.4
	Aliseda	2265	1850	1.7	−415	−18.3
	Cáceres	82,235	96,068	82.3	13,833	16.8
	Carbajo	280	208	0.2	−74	−25.7
	Herreruela	470	342	0.3	−128	−27.2
	Membrío	873	634	0.5	−239	−27.3
	Salorino	796	581	0.5	−215	−27.0
	Santiago de Alcántara	751	522	0.4	−231	−30.5
	San Vicente de Alcántara	5908	5475	4.7	−433	−14.9
	Valencia de Alcántara	6240	5439	4.7	−801	−12.8
	Villar del Rey	181	136	0.1	−45	−24.9
	Total	**105,644**	**116,595**	**100.0**	**10,951**	**10.4**
Monfragüe	Casas de Millán	809	585	4.8	−224	−27.7
	Casas de Miravete	182	140	1.1	−42	−23.0
	Casatejada	1319	1381	11.0	62	−4.7
	Deleitosa	898	728	5.8	−170	−18.9
	Higuera	111	102	0.8	−9	−8.1
	Jaraicejo	724	489	3.9	−235	−32.4
	Malpartida de Plasencia	4119	4602	36.7	483	11.7
	Mirabel	812	653	5.2	159	19.6
	Romangordo	185	259	2.1	74	40.0
	Saucedilla	614	858	6.8	244	39.7
	Serradilla	1919	1568	12.5	−351	−18.3
	Serrejón	496	420	3.4	−76	−15.3
	Toril	198	164	1.3	−34	−17.2
	Torrejón el Rubio	704	571	4.6	−133	−18.9
	Total	**13,090**	**12,520**	**100**	**−570**	**−4.4**

Source: National Institute of Statistics [59].

Unemployment is another of the serious problems affecting the rural world under study. According to the sources consulted, these municipalities are in a worrying situation where their unemployment rates are higher than the national and regional averages (Table 4). These data show that the unemployment registered in Monfragüe affects over 20% of the population in most settlements and even exceeds 30% in the municipalities of Higuera and Saucedilla. However, this scenario is not reproduced in the same way in Sierra de San Pedro, the registered unemployment rate of which is below 20% in 7 of the 11 municipalities of the territory. These figures augur an uncertain future for both areas; the development of activities to encourage economic diversification may help to mitigate this scenario, and these activities include hunting.

Table 4. Registered unemployed rates by municipality.

District	Municipality	Registered Unemployed (%)
Monfragüe	Malpartida de Plasencia	20.00
	Toril	21.25
	Serradilla	24.45
	Mirabel	22.03
	Casatejada	22.00
	Casas de Miravete	21.74
	Saucedilla	34.15
	Deleitosa	14.67
	Torrejón el Rubio	22.78
	Casas de Millán	22.81
	Jaraicejo	22.24
	Romangordo	14.54
	Higuera	15.08
	Serrejón	30.46
Sierra de San Pedro	Cáceres	19.05
	Aliseda	18.74
	Herreruela	14.67
	Salorino	18.71
	Membrío	18.56
	Carbajo	15.01
	Santiago de Alcántara	14.95
	Valencia de Alcántara	21.23
	San Vicente de Alcántara	21.04
	Alburquerque	22.65
	Villar del Rey	22.49
Extremadura		19.64
España		13.92

Source: datos.macro.com [60].

3.2. Materials and Methods

Taking into account the extensive surface area devoted to hunting, together with the worrying sociodemographic situation of the municipalities of these territories, we aimed to corroborate empirically whether there is a relationship between hunting and the demand for the tourist services of the accommodations located in these territories. If this is the case, hunting would be contributing to the generation of wealth and employment.

In order to attain this objective we used data from primary sources of information (surveys) and also consulted secondary sources. The alphanumeric data come from the results obtained after the distribution of a survey among all tourist accommodation establishments located in the two territories under study, irrespective of their type: hotel, non-hotel, and rural. In order to do so, in the first instance a list of accommodations was drawn up from the official information provided by the competent authority, in this case the Regional Government of Extremadura. It is however necessary to point out that in the case of the city of Cáceres only those tourist accommodation establishments corresponding to the hotel type as described in current legislation [61] were selected after detecting that they were the only ones in which hunters were interested owing to their accessibility and other characteristics. In this sense it must be taken into account that Cáceres is a heritage tourist destination in which there is accommodation designed to work with these market segments owing to their location and other characteristics. The surveys were answered by the managers of the establishments, except in the case of larger hotels when they were answered by reception personnel. In both cases, we consider that the informants are the appropriate ones due to their responsibility and because they have direct information from the establishments, which are essential requirements to respond with solvency to the survey. In order to complement the data obtained from this survey and obtain further evidence, we resorted whenever possible to a comparison with the data from a survey carried out on the travelers who visited the various tourist offices located in the whole of Extremadura in 2017. Given the slant of this study, however, only the surveys in which hunting was mentioned as a major motivation for visiting Extremadura (82 cases) were studied (82 cases). As far as the use of secondary sources of information is concerned, the following were consulted: data of the municipal census of inhabitants from the National Union of Statistics, registered unemployment figures drawn up by Expansión (https://datosmacro.expansion.com/), and the National Topographical Database at a scale of 1:100,000 available at the National Geographical Institute (http://centrodedescargas.cnig.es/CentroDescargas/index.jsp).

The survey featured in this study consisted of five questions, which are described in the table below (Table 5). The number of questions is reduced in order to stick to our objectives, which were to evaluate in an approximate way the relationship between hunting and the demand for tourist services in the selected territories of Sierra de San Pedro and Monfragüe. These questions allowed us to obtain interesting information on various key aspects: the use of the tourist accommodations in the area by hunters, the existence of any patterns when choosing a specific type of establishment present in the area, the carrying out of activities to complement hunting, and the duration and seasonality of hunters at their destination.

Table 5. Survey questions.

Questions
1. Do you receive hunters in your lodging?
2. What percentage of the demand is made up of hunters?
3. Does this type of tourist show interest in the development of activities other than hunting?
4. How many nights do hunters usually stay overnight?
5. When do these overnight stays occur?

The technical data sheet (Table 6) shows the statistical reliability of the results obtained after the dissemination of the survey included in this research. In this manner, in Sierra de San Pedro 63 completed forms were obtained from the total of 78 tourist lodgings, which means that the sample error in the most unfavorable case is 5.4% and in the most favorable 3.3%. The situation is similar in Monfragüe, where 37 of the 44 tourist lodgings currently operating in that area answered the questionnaire. For this reason, the sample error in the worst-case scenario is 6.5% and at best 3.9%.

Table 6. Technical data sheet.

Variables	Sierra de San Pedro	Monfragüe
Total	78 tourist lodgings	44 tourist lodgings
Sample size	63 completed surveys	37 completed surveys
Sampling	Random sample of the tourist lodgings located in the municipalities that make up the Area of Regional Interest of Sierra de San Pedro	Random sample of the tourist lodgings located in the municipalities that make up the Area of Socioeconomic influence of the Monfragüe National Park
Truthfulness level	95%	95%
Type of survey	Online questionnaire sent via email and filled in via the silver-digital from Google Drive	Online questionnaire sent via email and filled in via the silver-digital from Google Drive
Sampling error ($p = q = 0.50$; $p = q = 0.90$)	5.4%; 3.3%	6.5%; 3.9%
Date of completion	From 29 January to 10 April 2019	From 1 May to 31 July 2019

The data obtained in these questionnaires were processed by means of univariant and bivariant descriptive statistical techniques—to be precise, the distribution of frequencies and crosstabs.

This allowed us to determine the presence of hunting tourists in the study area together with a wealth of relevant information (the duration of overnight stays, preference for a type of tourist accommodation, etc.). As a complement, Geographical Information Systems were used for the production of maps, which made it possible to determine the geographical distribution of some of the variables studied.

4. Results

The data given in Table 7 reveal the presence of hunters in the tourist accommodations located in the two protected spaces under study, although it should be pointed out that the incidence in Sierra de San Pedro was higher. In this area 88.9% of the tourist lodgings declared that they received hunting tourists in 2018, while in Monfragüe this figure was 70.3%. This confirms that hunters contribute to the economic sustainability of the accommodation of these territories. The percentage differences between the two areas may be explained by the fact that, in Monfragüe (the emblematic space for the protected species of Extremadura), almost one-third of the accommodation establishments have no interest in receiving hunters.

Table 7. Accommodation establishments that receive hunters.

Accommodation Establishments that Receive Hunters	Sierra de San Pedro (%)	Monfragüe (%)
Receive hunters	88.9	70.3
Do not receive hunters	11.1	21.6
Do not admit hunters	0.0	8.1

Despite the presence of hunters in most of the accommodation establishments surveyed, one cannot speak of a significant dependence of this market segment in either of the two territories. According to the data shown in Table 8, in 62.5% of the establishments located in Sierra de San Pedro the impact of hunting tourists represented less than 5% of the total number of tourists received in 2018, while this percentage was 46.2% in Monfragüe. However, in Sierra de San Pedro rather more than 30% of lodgings considered that the demand from hunters represented over 16% of the total, while in Monfragüe it accounted for 19%. The differences between both areas can be found in the size of the surface area devoted to hunting in Sierra de San Pedro—a territory which exceeds 300,000 ha. Likewise, to interpret the data correctly at least one observation must be made: the impact of the demand for accommodation from hunters is limited to the hunting season, which coincides with the autumn and winter months (essentially from October to February), owing to which the impact of the demand during these months is much higher. In this sense hunting tourism cannot compete with other forms of tourism which may be practiced throughout the year.

Table 8. Incidence of hunting tourists.

Hunting Tourists	Sierra de San Pedro (%)	Monfragüe (%)
Very low (less than 5%)	62.5	46.2
Low (between 6% and 15%)	3.6	34.6
Average (between 16% and 30%)	21.4	11.5
High (between 31% and 40%)	3.6	7.7
Very high (more than 40%)	8.9	0.0

With the aim of determining whether there is a correlation between the type of tourist accommodation and the preferences of hunters, the following crosstab was drawn up in which clear contrasts can be appreciated. In order to do so, the different categories of hotel accommodations (hostels, guest houses, 1 to 3 star hotels, and 4 and 5 star hotels), non-hotel accommodation (tourist apartments and albergues), and rural accommodation (casas rurales and rural hotels) were distinguished. These contrasts were analyzed independently in the two territories studied:

- Sierra de San Pedro. This space is characterized by having a large number of hotels (from 1 to 3 stars and 4 and 5 stars). This is due to the presence in its territory of Cáceres, a city of undeniable tourist attractions that has been declared a World Heritage City by the UNESCO [62]. The results of the survey indicate that 18.2% of the hostels, 7.1% of the hotels from 1 to 3 stars, and 10.5% of the *casas rurales* of Sierra de San Pedro considered that the presence of hunters was very high. Likewise, for 7.1% of the hostels and 5.1% of the *casas rurales* in Sierra de San Pedro it was high. However, the number of lodgings in which the presence of hunters in Sierra de San Pedro (tourist apartments, hostels, 1 to 3 star hotels, 4 to 5 star hotels, and *casas rurales*) was classed as average was much more significant. Finally, there were very high percentages of accommodation establishments in which the presence of hunters was low or very low.
- Monfragüe. In the territory of Monfragüe the offer of places in hotels (from 1 to 3 stars and 4 and 5 stars) is considerable, although their percentage is appreciably lower than in Sierra de San Pedro. Likewise the importance in Monfragüe of rural lodgings must be emphasized, especially in the case of *casas rurales*, a type of accommodation which is better suited to the characteristics of small natural spaces and municipalities. As for the preferences of hunters in Monfragüe, they are attracted by hotels with 1 to 3, stars as 100% of those polled declared the presence of hunters to be high (Table 9).

Table 9. Incidence of the hunter by type of accommodation.

Region	Category	Very Low (%)	Low (%)	Average (%)	High (%)	Very High (%)	Total Number of Places	Percentage of Places with Respect to the Total of the Sample (%)
Sierra de San Pedro	Tourist apartment	0.0	0.0	100.0	0.0	0.0	12	0.2
	Albergue	100.0	0.0	0.0	0.0	0.0	28	0.6
	Hostel	45.5	9.1	27.3	0.0	18.2	314	6.4
	Guest house	100.0	0.0	0.0	0.0	0.0	56	1.2
	Hotel between 1 and 3 stars	71.4	0.0	14.3	7.1	7.1	2289	46.9
	Hotel between 4 and 5 stars	57.1	0.0	42.9	0.0	0.0	1910	39.1
	Casa rural	63.2	5.3	15.8	5.3	10.5	255	5.2
	Rural hotel	100.0	0.0	0.0	0.0	0.0	20	0.4
Monfragüe	Tourist apartment	25.0	75.0	0.0	0.0	0.0	37	4.7
	Hostel	0.0	33.4	66.6	0.0	0.0	93	11.9
	Guest house	0.0	100.0	0.0	0.0	0.0	18	2.3
	Hotel between 1 and 3 stars	0.0	0.0	0.0	100.0	0.0	144	18.4
	Hotel between 4 and 5 stars	0.0	100.0	0.0	0.0	0.0	120	15.5
	Casa rural	69.2	15.4	7.7	0.0	0.0	351	44.9
	Rural hotel	100.0	0.0	0.0	0.0	0.0	18	2.3

In view of the data it can therefore be appreciated that hunters tend to choose hotels. This tendency was also observed in the results obtained from the survey carried out by the Extremadura Tourist Observatory in which hunters' preference for hotel-type accommodation can be seen. The explanation for this can be found in the observations of various owners of the accommodation establishments polled, who mentioned that hunting tourists require restaurant services which are only provided by hotel-type accommodation. Likewise it should be said that road accessibility has considerably improved in recent years, which makes it easier for a hunter to travel to a municipality with the desired accommodations within a limited period of time.

To go deeper into this matter, in the survey carried out by the Tourist Offices it was found that hunters are willing to choose the municipality of their overnight stay in accordance with the presence of this kind of accommodation. As a consequence, the selection of the municipality in which hunters spend the night may depend on this circumstance.

Those in charge of tourist accommodations located in the study area corroborate the interest of the hunting tourist in carrying out activities other than hunting, among which stand out those related to other forms of tourism as diverse as those involving nature, culture, and the rural milieu (Table 10). Nevertheless, the declared interest of this kind of tourist in protected natural spaces is noteworthy, to the extent that in both territories the visits to these spaces represent a preferred practice for hunters. In the answers given in the survey of this study there is once again a certain parallelism with the results deriving from the survey of the Tourist Observatory, in which the strong interest of the hunting tourist in protected natural spaces stands out, particularly in Monfragüe National Park. This is not surprising given hunters' interest in natural spaces and their inclination to contribute to the conservation of ecosystems by means of various initiatives [12,57–63]. Along the same lines, their interest in local gastronomy can also be mentioned; this is of greater importance in the Monfragüe area (31.6%). Practices related to cultural and rural tourism and birdwatching appear less frequently. Note that birdwatching only occurs in the Monfragüe area because of the great richness of the National Park.

Table 10. Hunting tourism activities.

Activity Type	Sierra de San Pedro (%)	Monfragüe (%)
Gastronomy	19.4	31.6
Birdwatching	0.0	15.8
Visits to protected natural areas	36.1	36.8
Cultural tourism	19.4	26.3
Rural tourism	17.7	26.3

The hunting season conditions the travel of hunters, as the most recent closed-season regulations published in Extremadura [64] generally establish hunting periods as weekends and long weekends between the months of October and February, to which Thursday must be added for some specific forms of hunting. This rule has two exceptions, although there is no doubt that they have a much lower impact. This situation therefore conditions the duration of the stays of hunting tourists and the concentration of their travels essentially on weekends (82.5% in Sierra de San Pedro; 92.0% in Monfragüe) (Table 11). The establishments polled ratified the short duration of the stays, declaring that they tend to vary between one and two nights, with few stays lasting longer (1.6%, Sierra de San Pedro; 8.0%, Monfragüe).

Table 11. Hunting tourists' overnight stays.

Overnight Stays	Sierra de San Pedro (%)	Monfragüe (%)
One night	22.2	52.0
Two nights	63.5	40.0
More than two nights	1.6	8.0

5. Discussion and Evaluation of Results

Hunting and by extension hunting tourism is an activity which has been carried out without interruption in numerous protected natural spaces in Spain [65] and in other countries, playing an important role in the economy of the rural milieu and also in the conservation of the environment [22,66–68]. However, for various reasons there is heated debate as to whether it is convenient to allow hunting in spaces which are environmentally representative. The central idea is currently to restrict some traditional forms of exploitation such as hunting, which in certain places such as national parks is forbidden, at least in the case of Spain. Monfragüe National Park is an example of this, owing to which the population of ungulates has grown continuously to exert strong pressure on the ecosystem, contributing to the degradation of the area's vegetation. Given the pressure on the environment, the Park Management approved certain culls [69]. This confirms the role that hunting may play in the conservation of these spaces in which certain species have no natural predators, which means that an increase in their populations may lead to the deterioration of the landscape.

This situation occurs despite the fact that sustainable hunting can provide social, economic, and environmental benefits, as mentioned in various studies. It is however necessary to be prudent as to the decisions made because no formula can be suitable for all protected spaces or for all species. Owing to this, a planning and management policy appropriate for each case must be drawn up. In this sense it is being insisted upon that, given the lack of alternatives, the prohibition of hunting may have an undesired effect in terms of the loss of biodiversity, especially on private land.

The results of this study prove that hunters make moderate use of the accommodation establishments located in Sierra de San Pedro and also in those in part of the Area of Socioeconomic Influence of the Monfragüe National Park, which contributes to the generation of economic benefits. Both spaces have serious problems of employment, loss of population, and ageing, owing to which the sustainable exploitation of the endogenous resources, which include hunting, may encourage the maintenance of rural life. Nevertheless, it should be stressed that more studies using specific areas as a territorial basis need to be carried out with the objective of assessing the role of hunting as a tool for development and the generation of knowledge which serves as an instrument for management and planning. As was seen in the survey, hunters choose a certain type of accommodation based on the different services it may provide. There is no doubt that this knowledge may provide a competitive advantage with the view to a specific territory capturing a larger number of hunting tourists.

Finally, in view of the lack of data on the characterization of the demand of the hunting sector in Extremadura and its impact on accommodation, it must be pointed out that this work is innovative in that it allows progress to be made in the knowledge of an issue that has a direct impact on hunting territories of great environmental value, where there are serious social and economic problems. Therefore, this knowledge has an undoubted applied character for managers of tourist accommodations located in the study area, as well as for the public administration, with a view to designing strategies to attract hunting tourists in sustainable terms. Nevertheless, and taking into account that we are facing a work that represents a first approximation on this subject, it is necessary to open new lines of research that answer specific questions:

- Is hunting tourism compatible with other forms of nature tourism in protected areas?
- What weight does hunting tourism have in comparison with nature tourism in these areas?
- What is the perception of hunting tourism by the inhabitants of the territories in economic terms?
- How can the expenditure of hunters in hunting areas be increased?

6. Conclusions

The results of this study show that the municipalities within the Area of Regional Interest of Sierra de San Pedro and the area of socioeconomic influence of the Monfragüe National Park are located in territories with a long hunting tradition. As a result, both areas currently have a large number of hunting grounds, to which must be added the presence of a network of accommodation establishments of different types and categories in accordance with the information obtained from the secondary sources consulted. At the same time it was found that both territories are experiencing serious sociodemographic and economic difficulties in common with other rural areas of Extremadura: loss of population, ageing, and high employment rates.

Given these circumstances, the objective of this research was to verify the hypothesis of whether there is a relationship between hunting and the demand for tourist services, to be precise for the accommodation located in the municipalities making up the two territories.

In order to achieve this objective it was necessary to draw up a list of the accommodation establishments located in these municipalities and to request collaboration in the form of answering a survey. The collaboration obtained was very high, thanks to which it was possible to draw the conclusions given below:

- The presence of hunters was confirmed in most of the accommodation establishments located in the study area, amounting to almost 90% in Sierra de San Pedro and over 70% in Monfragüe.
- Despite the aforementioned percentages which prove the presence of a large number of hunters, it cannot be said that there is a significant dependence on this market segment in either of the two territories, barring exceptions. However, if these data are restricted to the general hunting period, October to February, the results are of greater importance.
- A clear preference can be appreciated on the part of hunters for staying in hotel-type accommodations, which accounted for the highest proportion of the supply and demand. In this sense it should be mentioned that differences exist between the network of accommodation establishments in Sierra de San Pedro and Monfragüe. In Sierra de San Pedro, which is influenced by the city of Cáceres, hotels constitute most of the supply and demand, while in Monfragüe the supply is much more evenly distributed among hotels and rural lodgings, which does not prevent the former from continuing to be preferred by hunters.
- According to the results of the survey, hunting tourists showed interest in carrying out activities other than hunting. The practice most in demand was that of visiting protected natural areas, which is a direct consequence of the magnificent landscape of both territories. Together with this activity, in the Monfragüe area there was a significant interest in local gastronomy, which was not true to the same extent in Sierra de San Pedro. To a lesser extent, the managers and employees of the lodgings indicated in the survey that they had detected a certain interest on the part of hunters in activities of cultural and rural tourism.
- Finally, in both destinations hunters spent short stays varying between one and two nights, in most cases on the weekend.

There is no doubt that as the socioeconomic impact is one of the aspects quoted to defend hunting in the current context, the carrying out of studies of this kind should be encouraged so as to determine whether establishments located in rural areas are the main beneficiaries of the expenses incurred by hunters. This knowledge can become a tool for the management and capture of flows of hunters in the future.

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References

1. Eagles, P.F.J.; McCool, S.F.; Haynes, C.D. *Sustainable Tourism in Protected Areas. Guidelines for Planning and Management*; IUCN: Gland, Switzerland; Cambridge, UK, 2002; p. 183.
2. Agency European Environment. *Protected Areas in Europe an Overview*; Publications Office of the European Union: Luxembourg, 2012; p. 136.
3. Tolón, A.; Lastra, X. Los Espacios Naturales Protegidos. Concepto, evolución y situación actual en España. *Rev. Electrónica De Medioambiente* **2008**, *5*, 1–25.

4. Possingham, H.; Wilson, K.A.; Andelman, S.J.; Vynne, C.H. Protected areas: Goals, limitations, and design. In *Principles of Conservation Biology*, 3rd ed.; Groom, M.J., Meffe, C.R., Carrol, G.K., Eds.; Sinauer Associates: Sunderland, MA, USA, 2006.
5. UICN. *Informe Anual 2018*; 2018. Available online: https://www.iucn.org/es/acerca-de-la-uicn/programa-de-trabajo-e-informes/informes-anuales (accessed on 20 November 2019).
6. Comisión Europea. 2018. Available online: https://ec.europa.eu/commission/index_es (accessed on 20 December 2019).
7. EUROPARC. *Anuario 2018 del estado de las Áreas Protegidas en España*; EUROPARC: Madrid, Spain, 2018.
8. Dirección General de Turismo. Datos propios. 2019.
9. Sánchez, J.M.; Rengifo, J.I. Evolución del Sector turístico en la Extremadura del Siglo XXI: Auge, crisis y recuperación. *Lurralde* **2019**, *42*, 19–50.
10. Danzberger, J.B. La caza un elemento esencial en el desarrollo rural. *Mediterráneo Económico: El Nuevo Sist. Agroaliment. En Una Crisis Glob.* **2009**, *15*, 183–203.
11. Comisión Europea. *Documento Orientativo Sobre la caza de Conformidad con la Directiva 79/409/CEE del Consejo Relativa a la Conservación de las aves Silvestres*; Publicaciones Unión Europea: Brussels, Belgium, 2008; p. 102.
12. Rengifo, J.I.; Sánchez, J.M. Caza y espacios naturales protegidos en Extremadura. *Investig. Geográficas (Esp)* **2016**, *65*, 57–73. [CrossRef]
13. Leader-Williams. *Recreational Hunting, Conservation*; Blackwell Publishing: Oxford, UK, 2009; p. 386.
14. Bauer, J.; Herr, A. Hunting and fishing tourism. In *Wildlife Tourism, Impacts, Management and Planning*; Sustainable Tourism Cooperative Research Centre, 2004; pp. 57–78.
15. Lovelock, B. *Tourism and the Consumption of Wildlife: Hunting, Shooting and Sport Fishing*; Routledge: London, UK, 2007; p. 313.
16. MacDonald, K. Global hunting grounds: Power, scale and ecology in the negotiation of conservation. *Cult. Geogr.* **2005**, *12*, 259–291. [CrossRef]
17. Lindsey, P.A.; Roulet, P.A.; Romanach, S.S. Economic and conservation significance of the trophy hunting industry in sub-Saharan Africa. *Biol. Conserv.* **2007**, *134*, 455–469. [CrossRef]
18. Heffelfinger, J.R.; Geist, V.; Wishart, W. The role of hunting in North American wildlife conservation. *Int. J. Environ. Stud.* **2013**, *70*, 399–413. [CrossRef]
19. Crosmary, W.G.; Côté, S.D.; Fritz, H. The assessment of the role of trophy hunting in wildlife conservation. *Anim. Conserv.* **2015**, *18*, 136–137. [CrossRef]
20. Fischer, A.; Tibebe Weldesemaet, Y.; Czajkowski, M.; Tadie, D.; Hanley, N. Trophy hunters' willingness to pay for wildlife conservation and community benefits. *Conserv. Biol.* **2015**, *29*, 1111–1121. [CrossRef]
21. Călina, A.; Călina, J.; Miluț, M.; Stan, I. Research on the practice of rural tourism specialized in sport and image hunting in Cergău area, Romania. *Agrolife Sci. J.* **2018**, *7*, 18–24.
22. Mbaiwa, J.E. Effects of the safari hunting tourism ban on rural livelihoods and wildlife conservation in Northern Botswana. *S. Afr. Geogr. J.* **2018**, *100*, 41–61. [CrossRef]
23. Brainerd, S.M. *European Charter on Hunting and Biodiversity*; Council of Europe: Strasbourg, France, 2007; p. 28.
24. Secretaría del Convenio sobre la Diversidad Biológica. *Principios y Directrices de Addis Abeba Para la Utilización Sostenible de la Diversidad Biológica*; Secretaría del Convenio sobre la Diversidad: Montreal, QC, Canada, 2004; p. 21.
25. Rengifo, J.I. *Turismo y caza. Referencias al singular ejemplo de la caza del Boc balear en Mallorca*; Monografies de la societat d' història natural de las Balears: Mallorca, Spain, 2018; Volume 28, pp. 101–114.
26. Sas-Rolfes, T. African wildlife conservation and the evolution of hunting institutions. *Environ. Res. Lett.* **2017**, *12*, 115007. [CrossRef]
27. Dickman, A.; Cooney, R.; Johnson, P.J.; Louis, M.P.; Roe, D. Trophy hunting bans imperial biodiversity. *Science* **2019**, *365*, 874. [PubMed]
28. Di Minin, E.; Leader-Williams, N.; Bradshaw, C.J.A. Banning Trophy Hunting Will Exacerbate Biodiversity Loss. *Trends Ecol. Evol.* **2016**, *31*, 99–102. [CrossRef]
29. Marchand, P.; Garel, M.; Bourgoin, G.; Dubray, D.; Maillard, D.; Loison, A. Impacts of tourism and hunting on a large herbivore's spatio-temporal behavior in and around a French protected area. *Biol. Conserv.* **2014**, *177*, 1–11. [CrossRef]

30. Packer, C.; Brink, H.; Kissui, B.M.; Maliti, H.; Kushnir, H.; Caro, T. Effects of trophy hunting on lion and leopard populations in Tanzania. *Conserv. Biol.* **2011**, *25*, 142–153. [CrossRef]
31. Packer, C.; Kosmala, M.; Cooley, H.S.; Brink, H.; Pintea, L.; Garshelis, D.; Purchase, G.; Strauss, M.; Swanson, A.; Balme, G.; et al. Sport Hunting, Predator Control and Conservation of Large Carnivores. *PLoS ONE* **2009**, *4*, e5941. [CrossRef]
32. Akama, J.S. *Controversies surrounding. Tourism and the Consumption of Wildlife: Hunting, Shooting and Sport Fishing*; Lovelock, B., Ed.; Routledge: London, UK, 2007; pp. 73–86.
33. Junta de Extremadura. Extremambiente. [En línea] 19 de 06 de 2019. Available online: http://extremambiente.juntaex.es/index.php?option=com_content&view=article&id=1288&Itemid=459 (accessed on 15 December 2019).
34. Gallardo, M.; Rodero, S.; Gómez, M.; Gallardo, J.M.; Arroyo, V.; Durán, J.A. *Situación de la caza en Extremadura: Informe Anual Temporada 2016/17*; Federación Extremeña de caza: Badajoz, Spain, 2018.
35. Consejo Económico y Social de Extremadura. *Reto Demográfico y Equilibrio Territorial en Extremadura*; Junta de Extremadura: Mérida, Mexico, 2019; p. 311.
36. Andueza, A.; Lambarri, M.; Urda, V.; Prieto, I.; Villanueva, L.F.; Sánchez-García, C. *Evaluación del Impacto Económico y Social de la Caza en España. Informe de Resultados 2016*; Fundación Artemisan: Ciudad Real, Spain, 2016.
37. Andueza, A.; Lambarri, M.; Urda, V.; Prieto, I.; Villanueva, L.F.; Sánchez-García, C. *Evaluación del Impacto Económico y Social de la Caza en Castilla-La Mancha*; Fundación Artemisan: Ciudad Real, Spain, 2016; p. 76.
38. PACEC. *The Value of Shooting. The Economic, Environmental and Social Contribution of Shooting Sports to the UK*; PACEC: Cambridge, UK, 2014; p. 28.
39. U.S. Fish & Wildlife Service. *2016 National Survey of Fishing, Hunting and Wildlife-Associated Recreation*; U.S. Fish & Wildlife Service: Falls Church, VA, USA, 2017; p. 24.
40. Muposhi, V.K.; Gandiwa, E.; Bartels, P.; Makuza, S.M. Trophy hunting, conservation, and rural development in Zimbabwe: Issues, options, and implications. International. *J. Biodivers.* **2016**, *16*. [CrossRef]
41. Booth, V.R. *The Contribution of Hunting Tourism: How Significant is This to National Economies? in Contribution of Wildlife to National Economies*; Joint publication of FAO and CIC: Budapest, Hungary, 2010; p. 72.
42. Instituto Nacional de Estadística. Encuesta de Movimientos turísticos en fronteras (FRONTUR) y Encuesta de Gasto turístico (EGATUR). 2012. Available online: http://estadisticas.tourspain.es/es-ES/estadisticas/egatur/Anuales/Movimientos%20Tur%C3%ADsticos%20en%20Fronteras%20(Frontur)%20y%20Encuesta%20de%20Gasto%20Tur%C3%ADstico%20(Egatur)%202012.pdf (accessed on 3 December 2019).
43. Instituto Nacional de Estadística. Encuesta de Turismo de Residentes. 2018. Available online: https://www.ine.es/dyngs/INEbase/es/operacion.htm?c=Estadistica_C&cid=1254736176990&menu=ultiDatos&idp=1254735576863 (accessed on 3 December 2019).
44. Torres, E.J. *El sistema de actividades turísticas. Estructura de mercados turísticos*; UOC, 2006; pp. 15–75.
45. Petroman, I.; Bâlan, I.; Matiuti, A.; Bâla, E. The role of Hunting Tourism managment in the conservation of biodiversity. *Sci. Pap. Anim. Sci. Biotechnol.* **2009**, *42*, 495–500.
46. Rengifo, J.I. Un segmento del turismo internacional en auge: El turismo de caza. *Cuad. De Tur.* **2008**, *22*, 187–210.
47. Mulero, A. Turismo y caza en España. Estado de la cuestión. *Agric. Soc.* **1991**, *58*, 147–171.
48. METRA SEIS. *Turismo Cinegético en España*; Secretaria General de Turismo: Madrid, Spain, 1985; p. 276.
49. IUCN. *IUCN SSC Guiding Principles on Trophy Hunting as a Tool for Creating Conservation Incentives*; IUCN: Gland, Switzerland, 2012; p. 11.
50. IUCN. *Informing Decisions on Trophy Hunting*; IUCN: Gland, Switzerland, 2016; p. 23.
51. Terrón, M. *De la panorámica de la caza en Extremadura. Los Libros de la Caza Española*; Terrón, M., Ed.; Orel: Madrid, Spain, 1975; pp. 473–520.
52. Alvarado, E. La actividad cinegética en Extremadura. *Agric. Y Soc.* **1991**, *58*, 215–240.
53. Coca, J.L.; Álvarez, P.; Hernández, J.M. El turismo cinegético como recurso económico de primer orden para el desarrollo sostenible de Extremadura: Modalidades de montería y ojeos de perdiz. In *Competencia Sin Frontera. La Empresa Familiar*; Hernández, R.Y., Postigo, V., Eds.; 2007; pp. 453–470.
54. Ministerio para la transacción ecológica. Monfragüe: Área de Influencia Socioeconómica. 2017. Available online: https://www.miteco.gob.es/es/red-parques-nacionales/nuestros-parques/monfrague/area-influencia/default.aspx (accessed on 24 December 2019).

55. Junta de Extremadura. Plan General de Caza de Extremadura. 2015. Available online: http://extremambiente.juntaex.es/files/Informacion%20Publica/2015/octbre/Anteproyecto%20PGCEx%20-%20optimizado.pdf (accessed on 20 December 2019).
56. Jefatura del Estado. *Ley 1/2007, de 2 de marzo, de declaración del Parque Nacional de Monfragüe*; Boletín Oficial del Estado: Madrid, Spain, 2007; p. 54.
57. Martín, L.M.; Rengifo, J.I.; Sánchez, J.M. El modelo de caza social: Evolución y caracterización en Extremadura. *Boletín de la Asociación de Geógrafos Españoles* **2019**, *82*, 1–37.
58. Bielsa, J. *La caza mayor como alternativa de desarrollo en zonas deprimidas de Extremadura. Cáceres: La caza en Extremadura. Comunicaciones con motivo del I Congreso Internacional de caza en Extremadura*; Diputación Provincial de Cáceres: Cáceres, Spain, 1987; pp. 167–187.
59. Instituto Nacional de Estadística. Padrón. Población por municipios. 2018. Available online: https://www.ine.es/dyngs/INEbase/es/categoria.htm?c=Estadistica_P&cid=1254734710990 (accessed on 15 January 2020).
60. Datos.macro.com. Available online: https://datosmacro.expansion.com/ (accessed on 15 January 2020).
61. Consejería de Fomento, Vivienda, Ordenación del Territorio y Turismo. *Decreto 65/2015, de 14 de abril, por el que se establece la ordenación y sistema de clasificación de los alojamientos de turismo rural de la Comunidad Autónoma de Extremadura*; Diario Oficial de Extremadura: Extremadura, Spain, 2015; p. 74.
62. Rengifo, J.I.; Campesino, A.-J.; Sánchez, J.M. El turismo en la ciudad de Cáceres (1986–2010): Un cuarto de siglo emblemático. *Boletín De La Asoc. De Geógrafos Españoles* **2015**, *67*, 375–401. [CrossRef]
63. Federation of Associations for Hunting and Conservation of the EU (FACE). The hunters in Europe. Available online: https://www.kora.ch/malme/05_library/5_1_publications/P_and_Q/Pinet_1995_The_hunters_in_Europe.pdf (accessed on 18 February 2020).
64. Consejería de Medio Ambiente y Rural, Políticas Agrarias y Territorio. *ORDEN de 21 de agosto de 2017 General de Vedas de Caza para la en Extremadura*; Documento Oficial de Extremadura: Extremadura, Spain, 2018; p. 163.
65. Ocaña, J. La red de cotos de caza en los Parques Naturales de la Sierra de Hornachuelos y Subbéticas de Córdoba: Dos modelos cinegéticos en Espacios Naturales Protegidos. In *EUROCAZA: Caza como recurso económico y turístico*; Caja de Badajoz: Badajoz, Spain, 2003.
66. Baldus, R.; Kibonde, B.; Sioge, L. Seeking conservation partnerships in the Selous game reserve, Tanzania. *Parks* **2003**, *13*, 50–61.
67. Kenward, R.; Sharp, R. Use nationally of wild resources across Europe (UNWIRE). In *GEMCONBIO: Governance and Ecosystem Management for Conservation of Biodiversity*; Anatrack Ltd.: Grecia, Spain, 2008; pp. 117–123.
68. Wilkie, D.S.; Carpenter, J.F. The potential role of safari hunting as a source of revenue for protected areas in the Congo Basin. *Oryx* **1999**, *33*, 339–345. [CrossRef]
69. *RESOLUCIÓN de 25 de octubre de 2017, de la consejera, por la que se aprueba el Programa de acción selectiva de ungulados en el Parque*; Diario Oficial de Extremadura: Extremadura, Spain, 2017; p. 223.

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Rural Districts and Business Agglomerations in Low-Density Business Environments. The Case of Extremadura (Spain)

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Abstract: The strategy of the institutionalization and development of business agglomerations, in any of its analytical aspects (industrial district, local production system, cluster, etc.), has not had great results in Spanish regions with low business-density, probably due to the difficulty of finding an adequate implementation framework in administrative, geographic, and institutional terms. Based on the limitations presented by the identification methodologies of business agglomerations in low business-density territories, in this work we propose some methodological corrections that allow for reconciling these economic realities with the institutional and geographical framework offered by the local action groups (LAGs). This reconciliation is a useful tool to take advantage of the economies of agglomeration and, consequently, to explore the possibilities of endogenous development in rural areas, so that it can be a factor to take into account when planning and executing the public strategy of local and rural development. Finally, the results obtained for the specific case of Extremadura, the only Spanish region listed as a less developed one in European rural development policies, are presented.

Keywords: local action group; rural development; industrial district; local productive system; rural district

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1. Introduction

The local action groups (hereinafter LAG) have become the main tool of the European Union for structuring the local and rural development strategy [1,2], this being the reason why industrial or rural development policies in areas with low business-density, or rural areas, must consider them. In a way, they exemplify the open participation of the main economic agents with a presence in each territory at the county level, bringing community decisions on rural development closer to the rural territories of the member states. Conceived as a strategic tool, LAGs emerged with a dual function: on the one hand, they should be in charge of planning and channeling funds for the European rural development strategy in the territories, and on the other, they must contribute to the dynamism of the socioeconomic fabric of rural regions, directly attacking structural problems that affect them, such as depopulation and inequalities in living standards with respect to the urban environment [3] (p. 596), [4]. One way to face such challenges is by enhancing and optimizing the region's endogenous resources [5] (p. 230), [6], wherein the correct definition of productive specialization seems crucial to us. In this sense, the tools offered by the theory of business agglomerations for shaping the LAG strategy cannot be ignored; as such, we consider its adaptation to the rural environment necessary.

"Business agglomerations" is a generic way of referring to the different terminologies that have been defined by the literature to define the grouping of firms around a certain territory (industrial districts, cluster, local productive systems, rural districts, quality agri-food districts, . . .). Each of these concepts presents its nuances, although they all start from the same premise: the concentration of companies that are dedicated to the same product or productive chain in a given territory. Broadly speaking, the industrial districts (IDs) [7,8] and, more generically, the local productive systems (hereinafter LPSs) [9,10], are socioeconomic realities that are based on taking advantage of the endogenous industrial growth capacity that certain geographical enclaves have, which constitutes an attraction factor that favors the location of companies and, consequently, the formation of specialized business agglomerations in a certain product or branch of activity, in rural areas that have set up a so-called rural district [11]. These realities generate a series of competitive advantages, allowing small and medium-sized companies, which by themselves would not have the financial capacity to invest in technology or to execute an internationalization strategy [12–14], to do so, being able to balance, through cooperation and agglomeration, the scale economies associated with large companies, in Chandlerian terminology [15]. Undoubtedly, this favors the generation of employment and income, allowing local and rural development [16–26] and, even if it is only for an arithmetic effect, regional development too [27–32]. Thus, the aforementioned concepts of ID and LPS have evolved towards newer and more recent theoretical notions such as the rural district (RD) or the quality agri-food district (AFD), more appropriate to the nature and characteristics of the rural regions and environments [33] (Legislative Decree No. 228 (18 May 2001) relative to the Italian normative), or even as "bio" districts [34,35].

Given the above, the main objective of this work is to evaluate the theoretical and practical lessons of business agglomerations and to facilitate their incorporation into the rural development strategy by LAGs, particularly with regard to the detection and identification of the endogenous productive capacities of the territories to which they are circumscribed, so that they can enhance the comparative advantages associated with them, and may also prioritize investments, allowing a better use of resources to achieve the objectives of income and employment generation and fixation of the rural territories. In summary, we seek to find the tool that allows one to localize business agglomerations into the LAG regions without giving up the postulates of the economies of agglomeration; that is, to locate municipal or supramunicipal business agglomerations with a capacity for generating incomes and employment and with influence and significance throughout the LAG region, so that they can be used as an economic engine for it, as well as being a focus for the attraction of new investment. To meet this objective, the text has been structured into four sections, in addition to this introduction. In the first, the reasons that in our opinion explain the poor practical development of theories of the Italian school of industrial districts in Spain, or at least their lesser degree of consideration compared to the Italian case when articulating rural development, are analyzed. In the second section, we reflect on various ID or LPS identification methodologies, and in particular, on their advantages and limitations when used in the LAG development strategy. In the third section, we propose some methodological adaptations that would facilitate, in our opinion, such use. Finally, in the fourth section, we outline the main conclusions of the investigation.

2. From Theory to Practice, from the Industrial District to the Rural District

This article arises from the authors' conviction that in Spain, the enormous scientific and theoretical efforts that many regional researchers have made in the last two decades in the field of business agglomeration analysis are not translating into applied results in regions with low business-density (district effect [36–41], i-district effect [42,43], social capital [44–48]). As an example, and unlike what has happened in other nations, Italy is, without a doubt, a reference in this field, not only for the remarkable development of the existing research in this regard [49–53], but for the broad regulatory development that the industrial districts have had in this country, which are already a relevant element in industrial policy planning [54,55]. The creation of the National Observatory of Industrial Districts (http://www.osservatoriodistretti.org/ (accessed on 1 May 2020)) is clear proof of this, which denotes the institutional commitment decided by the promotion of this type of economic reality. There has not been a regulatory or institutional development in Spain that efficiently explores the potential of these agglomerations, and this has been the case even in the regions where the greater historical development of such industrial agglomerations has been evidenced, which have also been those on which scholars have focused most of the research efforts in this regard, namely, the Valencian region [39,56–58], Catalonia [59–62], and the Basque Country [59,63–66].

The previous reflection, which seems clear despite the fact that the elements that should serve as the basis for the inclusion of industrial agglomerations in the country's industrialization strategy are known with some precision, is even more true if we refer to the agrarian field, where the whole path, including the scientific one, has yet to be covered. In this sense, at least three aspects seem relevant to us, which, if given their full value, would contribute to the better planning of productive activities in rural areas. The first one is the adaptation of the concept of business agglomeration to the reality that we find in agricultural environments. This aspect has already been partially resolved by the Italian school of industrial districts, having coined the concept of the rural district, whose theoretical specifications are assimilable to the rural agglomerations that we find in Spain and other Mediterranean countries [67,68]. In our opinion, this is crucial, since it determines, for example, the methodology to be applied for the identification and detection of these rural agglomerations, as well as in defining the tools to be used in their empirical analysis and in developing other not-yet-studied concepts, such as the so-called quality agri-food districts, which are also linked to a greater extent to the agrarian environment.

The second aspect to take into account is the absence of specific legislation that protects and develops these realities in rural areas. It should be noted that Spain has been applying legislation for a number of years to promote industrial districts under the name of innovative business groups ((hereinafter IBGs, http://www.minetad.gob.es/PortalAyudas/AgrupacionesEmpresariales/Paginas/Index.aspx (accessed on 1 May 2020)). These realities, which have already been analyzed in the context of Spanish industrial policy by Trullén and Callejón [69], bring together different forms of agglomeration, namely, industrial districts, value chains, knowledge-intensive activities and ICT-intensive activities, and tourism [70] (p. 380). In our opinion, this legislation, in its current formulation, is not adequate to link economic activity to the territory, something that should be a priority in the rural development strategy [71,72]. In fact, the need to have a sufficient critical mass to access the financing lines included in the regulations has led to the association of companies from different provinces and regions, so that the IBGs have ended up being institutions without a clear link to a certain locality or region [73,74]. The correlation between the detected business agglomerations and the IBGs existing in the Extremadura region is presented in Table 1.

Table 1. Business agglomerations vs. innovative business groups (IBGs) listed in Extremadura, 2013.

Agglomeration (Sector and County)	LPS and ID [1]	IBG [2]
Agri-food in Don Benito	Yes	No
Agri-food in Jaraíz de la Vera	Yes	No
Agri-food in Montijo	Yes	No
Agri-food in Valle del Jerte	Yes	No
Meat in Fregenal de la Siera	Yes	No
Meat in Higuera la Real	Yes	No
Cork in San Vicente de Alcántara [3]	Yes	No
Packaging in Mérida	No	Yes
Energy in Badajoz	No	Yes
Metal in Badajoz and Jerez de los Caballeros [4]	Yes	Yes
Health in Cáceres	No	Yes
ICT in Cáceres	No	Yes
Tourism in Cáceres	No	Yes
Various in Navalmoral de la Mata	Yes	No

[1] Local Productive Systems (LPS) and Industrial Districts (ID). [2] In the public funds program for IBGs in 2008, the Extremaduran Federation of Furniture and Wood Entrepreneurs (http://www.fedexmadera.com/es/.html (accessed on 1 May 2020); consultation May 2020), which is currently not recognized as an IBG, appeared among the beneficiary institutions. The same occurred with the Extremadura Construction Materials Cluster, which in 2008 also received funds due to its status as an IBG, which it no longer has. [3] The Extremadurian Cork Cluster, based in San Vicente de Alcántara, was a beneficiary of the IBG funds program in 2007. However, it has subsequently lost the status of IBG. It is important to mention that this IBG term contains companies from all over the country, which minimizes the agglomeration effect in competitive terms. [4] The metal IBG is based in Badajoz. It is, however, the industrial agglomeration of metal located by Boix and Galletto [75] in Jerez de los Caballeros. Source: Own elaboration.

Finally, the third aspect has a methodological nature, and refers to the fact that the ID or LPS identification, detection, and analysis methodologies usually take the so-called local workforce systems (LWS) [76] as spatial reference. This term fits, more or less, with the municipal term, and in no case adheres to the region or the LAG territory-of-influence. This factor must be corrected if what is intended is to incorporate the theory of business agglomerations into the strategic planning of LAGs. In addition, its correction is also desirable to assess the regional relevance of the agglomeration, its impact on the economic and social development of the region, and its supramunicipal area of influence; in short, to evaluate and measure the agglomeration effect of the region.

To sum up, when looking for a methodology for the detection of business agglomerations in the rural world, the most appropriate type of agglomeration is the so-called rural district. In this sense, Castillo and García [67] suggested that the basic territorial unit that best adheres to the theoretical definition of this type of agglomeration is the local action group.

3. Methodological Limitations for Regional Analysis of Rural Agglomerations

Starting from the existing methodologies for the identification and detection of business agglomerations, in Table 2 we have tried to synthesize the advantages and disadvantages that these present for their adaptation to the territorial analytical framework proposed here; that is, the areas of influence of the current LAGs. Broadly speaking, if we do an overall analysis, we find four major methodological limitations for the analysis of business agglomerations at the county level or within the geographic demarcation associated with LAGs. The first of these is the delimitation of the productive specialization of the territory. In this sense, the existing methodologies usually start from the search for a productive specialization in a smaller geographical area of the region, usually municipal or close to it, when taking the LWS as a functional administrative (and geographical) unit [77].

The second major limitation that these methodologies present as regards being useful in the LAG strategy is their industrial orientation. That is, these methodologies usually ignore the fact that productive specialization is not necessarily limited to the industrial field, and may be found in activities in the agricultural or service sector. Furthermore, they do not contemplate the existence of branches or value chains that include agricultural, industrial, and tertiary activities (from the production of raw materials to the commercialization of manufactures), despite the fact that one of the main lessons of the theory of business agglomerations is the promotion of the vertical integration of processes, or the integration of the value chain of products. This aspect is key to the identification of the comparative advantages in rural areas, which are usually found in the availability of a certain raw material or natural resource, regardless of whether its industrial transformation has developed in the region.

Table 2. Industrial districts (IDs) and/or local productive systems (LPS) identification methodologies and their adaptation to the local action group (LAG) geographical area.

Methodology [1]	Strong Points for Its Application to LAG	Weaknesses for Its Application to LAG
Courlet and Pecqueur [2] [21,78]	It uses the municipality. It only detects the industrial branch but is easily integrated into a value chain analysis	It uses variables for specialization and a minimum requirement of establishments, leaves variable outputs out of analysis Comparative based on the national total.
Sforzi-ISTAT [3] [75,76]	Institutional recognition. Academic recognition. Wide use and notoriety.	LWS as territorial unit. Only focused in industrial sector. Its prevalence index rules out polyspecialized districts. It rules out protodistricts. Based only in employment.
Sforzi-ISTAT for big business systems [4] [79,80]	Same as in the previous case.	Same as in the previous case. The predominant type of company in rural areas is the SME.
Laine [81] [5] [77,82]	Identifies LWS and ID. Greater flexibility than previous methodologies. Even starting from a criterion such as LWS, its noninclusion allows localized realities to maintain the characteristics of an LPS.	It omits the economic importance of the dominant activity of the LPS. It does not include an international competence criterion of the LPS. Quite restrictive methodology, excluding other forms of agglomeration such as protodistricts.
Hernández, Fontrodona, and Pezzi [83]	Greater flexibility than previous methodologies. It includes identification criteria based on internationalization and economic importance. It does not consider the LWS as a territorial unit. It detects all types of business agglomerations.	It does not take employment into account, giving too much importance to the variable number of companies. It does not clearly define a scale of the types of companies or specialities. It lacks criteria that distinguish between large companies and SMEs.
Integrative methodology Puig, Plá, and Linares [84]	Identifies LWS and ID. Greater flexibility than previous methodologies.	Uses variable occupation leaving out variables from other interesting studies.
Italian experimental methodology [6]	It uses quality variables normally associated with regions (protected designations of origin or protected geographical indications)	It is based on variables relative to the land factor. Almost exclusively linked to agriculture and livestock. Low weight of variables such as employment in industry.

[1] We leave out of the analysis of the methodologies used [85–92] as they have already been improved, in our opinion, by more recent methodologies. [2] Adapted by Climent for the study of La Rioja. [3] The Sforzi-ISTAT methodology, although it has undergone several updates, is considered here in its ISTAT version [93,94]. This is one of the most contrasted methodologies in the existing literature, whose results have served as the basis for other research. [4] Sforzi-ISTAT methodology, but changing the criterion related to the size of the dominant industry from SMEs to large companies. [5] Corrected by [77,81]. [6] We use the version provided by Legislative Decree No. 228 (18 May 2001). In Spain, and specifically in the case of Castilla-La Mancha [67,68], it has been used to analyze rural districts, but is very focused on population movements, and not on productive specialization and business concentration. We have ignored it in this analysis.

The third limitation is the use of the national context as a frame of comparison when determining the productive specialization of the territory in a given productive activity. In our opinion, this prevents the detection of business agglomerations that show some relevance in rural areas but appear less significant in the national context. As an example, an agglomeration of 20 companies that generate 200 jobs will be significant and should be considered in a hypothetical regional development strategy if it is located in a certain rural region, but it will probably be diluted if it is located in the metropolitan area of a large city. Failure to take this aspect into account supposes the exclusion of business agglomerations from rural development policies, which, although not very relevant at the national level, constitute or may constitute an economic engine for some rural areas.

The last limitation has to do with the restrictive nature of the businesses that make up the agglomerations being studied. Normally, the existing methodologies adopt criteria oriented towards the identification of agglomerations of small and medium-sized companies, without prejudice toward the existence of works that have been concerned with the locations of large company districts [66,67]. In our case, we understand that this "SME vs. large company" approach is unhelpful, since the existence of an agglomeration of SMEs is as relevant to the development of a rural environment as the location of an agglomeration led by one or more large companies. Thus, the methodology to be used should be flexible enough to include both realities.

Source: Expanded from [26] (p.129).

4. Methodological Adaptation to Regions with Low Manufacturing Density

The exercise carried out in the previous section leads us to conclude that the methodology most easily adaptable to the geographical area of the LAG is that designed by Lainé [81], with the improvements that have been introduced by other authors [33,77,82]. The resulting methodology can be applied to geographical areas wider than that delimited by the LWS, without the detected agglomerations losing the theoretical characteristics of LPSs—those that empower them to achieve competitive advantages. However, this methodology continues to be quite restrictive, since it does not identify realities such as protodistricts [95–98] nor does it allow the detection of extended value chains, since it focuses solely on industrial activity. Furthermore, it requires a high business-density for the location of the agglomeration, which makes it difficult to apply it to the regions with the highest rurality and depopulation index, as is the case of Extremadura [99–101]. It is difficult to identify LPSs based on this methodology in regions with little or no industrialization, such as Extremadura in Spain [102–105], not only for the reason of industrial arithmetic (scarcity of industries, low active population in the secondary sector, etc.), but also due to the scarcity of sources available on a regional scale. For this reason, we consider a methodological adjustment that emerges from Hernández, Fontrodona, and Pezzi [83] to be appropriate, which is useful when we work with regions with a low manufacturing density, such as Extremadura.

In this section, we make a methodological proposal that allows for a better adjustment to the reality of the least economically developed regions, allowing the identification of LPSs in more ruralized and not strictly industrialized environments. This proposal does not invalidate the aforementioned methodologies, but it is based on them, particularly the one used by Hernández, Fontrodona and Pezzi [83] for Catalonia. Furthermore, it seems to us a more flexible proposal, since it does not predetermine either the territorial unit of reference for the analysis or the codification of the activities with which to work. In this sense, it allows for by-county and regional analyses and exercises to identify LPSs of the value chain and polyspecialized ones, thus not adhering to the mere detection of manufacturing LPSs (it would, in fact, allow for the identification of rural LPSs specialized in the agriculture, livestock, or extractive industry).

In accordance with the above, a previous step to adapt the methodology is to choose the geographic level to which it will be applied. As we have seen, the way to integrate LPSs into the European regional development strategy is to use the LAG's territory-of-influence as a geographical unit. For the analysis of the productive specialization of the possible LPS identified, we understand that it is better to use an aggregated classification of the branches of activity, since, although it lacks specificity, it facilitates the identification of value chain LPSs, that is, agglomerations, that work in different parts of the production chain of a specific branch. In this sense, it seems appropriate to use the sectoral grouping of activities proposed by the CNAE 2009 (Table 3), which would distinguish 16 major productive branches with various activities, each representing the vertical integration that exists within them.

Table 3. Sectoral classification of the CNAE 2009 activities proposed.

Classification	CNAE 2009
Agri-food industry	01. Agriculture, livestock, hunting, and related services (Except 0116. Plant cultivation for textile fibers and 0128. Cultivation of spices, aromatic, medicinal and pharmaceutical plants) 03. Fishing and aquaculture 10. Food industry 11. Manufacture of beverages 12. Tobacco industry 462. Wholesale trade of agricultural raw materials and live animals (4624. Wholesale trade of leather and skins) 463. Wholesale trade of food products, beverages and tobacco
Forestry and forest products	02. Silviculture and forest exploitation 16. Wood and cork industry, except furniture; basketry and plaiting
Chemical, plastic, and petrochemical industries	05. Extraction of anthracite, coal, and lignite 06. Extraction of crude oil and natural gas 091. Support activities for the extraction of oil and natural gas 19. Coke ovens and oil refining 20. Chemical industry 22. Manufacture of rubber and plastic products 4671. Wholesale trade of solid, liquid, and gaseous fuels, and similar products 4675. Wholesale trade of chemical products
Metallurgical industry	07. Extraction of metallic minerals 24. Metallurgy; manufacture of iron, steel, and ferroalloy products 25. Manufacture of metal products, except machinery and equipment 4672. Wholesale trade of metals and metal ores 4677. Wholesale trade of scrap metal and waste products
Nonmetallic mineral product industries	08. Other extractive industries 099. Support activities for other extractive industries 23. Manufacture of nonmetallic mineral products
Textile and clothing	0116. Plant cultivation for textile fibers 13. Textile industry 14. Manufacture of clothing 4641. Wholesale trade of textiles 4642. Wholesale trade of clothing and footwear
Leather and footwear	15. Leather and footwear industry 4624. Wholesale trade of leather and skins
Paper, publishing, and graphic arts	17. Paper industry 18. Graphic arts and reproduction of screen-printed media
Pharmaceutical manufacturing	0128. Cultivation of spices, aromatic, medicinal, and pharmaceutical plants 21. Manufacture of pharmaceutical products 4645. Wholesale trade of perfumery and cosmetic products 4646. Wholesale trade of pharmaceutical products
Manufacture of computer and communications products	26. Manufacture of computer, electronic, and optical products 27. Manufacture of electrical material and equipment 465. Wholesale trade of equipment for information and communication technologies

Table 3. *Cont.*

Classification	CNAE 2009
Machinery manufacturing	28. Manufacture of machinery and equipment. Not included elsewhere 33. Repair and installation of machinery and equipment 466. Wholesale trade of other machinery, equipment, and supplies
Automotive industry	29. Manufacture of motor vehicles, trailers, and semitrailers 30. Manufacture of other transport material
Products for domestic use	31. Manufacture of furniture 4643. Wholesale trade of household appliances 4644. Wholesale trade of porcelain, glassware, and cleaning articles 4647. Wholesale trade of furniture, rugs, and lighting appliances 4648. Wholesale trade of clocks and jewelery 4649. Wholesale trade of other articles for domestic use
Other types of industries	32. Other manufacturing industries
Supplies and waste management	35. Supply of electrical energy, gas, steam, and air conditioning 36. Collection, purification, and distribution of water 37. Collection and treatment of wastewater 38. Collection, treatment, and disposal of waste; valorization 39. Decontamination activities and other waste management services

Source: Own elaboration from Galetto and Boix (2006: 8) and from the table of equivalences between CNAE 93 Rev. and CNAE 2009 Rev. of the Spanish National Institut os Statistics.

Once the statistical information has been compiled according to the regional territorial demarcation (LAG) and the proposed classification of activities (Table 4), our proposal suggests the following three steps: (1) look for the productive specialization of the LAG territories and verify the relative importance of this (that is, the LPS that is identified) in the economy at the regional or sectoral level; (2) once the previous one has been verified, look for formal (or informal) signs of collaboration or cooperation between the companies that make up the LPS; and (3) verify the international character of the LPS companies, that is, their exporting vocation (this has to happen at least for some of the companies that make up the agglomeration).

Table 4. Description of indicators.

Indicator	Description	Period
Number of employees	Extremadura companies included in SABI	Average data: 2012–2014 Lifecycle: 1993–2018
Number of companies	Businesses and establishments (SABI)	Average data: 2012–2014 Lifecycle: 1993–2018
Income	Operating income from SABI-listed Extremadura companies	Average data: 2012–2014 Lifecycle: 1993–2018
Internationalization	International company SABI indicator	Indicator without temporary referece
Social Capital	Formal relations between companies (participated, shareholder, etc.) reflected in SABI	Indicator without temporary referece

Source: Own elaboration.

The first of the steps suggests slightly modifying the specialization index set forth in the criteria used in other methodologies, so that it is sensitive to the size of the companies. This is achieved by calculating the index based on the number of companies and the number of employees, and not only using the number of firms that work in the productive activity considered; that is, converting the equation of criterion 6 into the following two equations.

Equation (1): Depending on the number of firms

$$L1_{ij} = \frac{\frac{E_{ij}}{E_j}}{\frac{E_i}{E}} \tag{1}$$

where:

$L1_{ij}$ is the specialization index in territory i and in sector j measured in terms of the number of companies ("territory i" being understood as the LWS or LAG territory considered, and "sector j" as the productive activity on which we apply the methodology);

E_{ij} is the number of firms of sector j in territory i;

E_j is the total number of firms in sector j in the geographical area that we are going to take as a reference (we consider it convenient to take the region or autonomous community, and not the nation, as the top territorial reference unit, in order to make the agglomerations' detection process more flexible);

E_i is the total number of firms in territory i (of all the productive sectors);

E is the total number of firms in the territory taken as a reference (that is, the number of firms in all sectors in the region, which serves as reference).

Equation (2): Depending on the number of employees

$$L2_{ij} = \frac{\frac{L_{ij}}{L_j}}{\frac{L_i}{L}} \tag{2}$$

where:

$L2_{ij}$ is the specialization index in territory i and in sector j measured in terms of number of employees ("territory i" being understood as the LWS or LAG territory considered, and "sector j" as the productive activity on which we apply the methodology);

L_{ij} is the number of employees of sector j in territory i;

L_j is the total number of employees in sector j in the geographical area that we are going to take as a reference (we consider it convenient to take the region or autonomous community, and not the nation, as the top territorial reference unit, in order to make the agglomerations detection process more flexible);

L_i is the total number of employees in territory i (of all the productive sectors);

L is the total number of employees in the territory taken as a reference (that is, the number of employees in all sectors in the region, which serves as reference).

Specialization will be verified when the specialization index in both cases is greater than 1, as this would indicate that, in terms of both firms and employment, the LAG territory considered presents a degree of specialization higher than the upper reference territory (in this case, region). This step must also verify, as Hernández, Fontrodona, and Pezzi [83] maintain, that the LPS has an important influence at the regional and/or sectoral level. These authors propose that the relative weight of the productive branch in the LPS should be greater than 15% of the productive branch in the reference space (region), or what is the same, that the production of the main productive branch in the LAG territory represents more than 15% of the total of the same productive branch at the regional level. The relative importance of the LPS would also be verified if it represents more than 0.1% of the set of productive activities in the region under study. Both seem adequate to us, so we endorse them.

To correct the limitations presented by any methodology relative to the specialization index, two criteria enunciated by Laine are proposed [81].

Criterion Number of employees. This criterion is complementary to the previous one, since it serves to verify the productive specialization of the territory through the active population. In addition, following Giner, Santa María, and Fuster [65], and taking again their more restrictive criterion, we consider that a LAG contains an LPS if it has at least 200 employees directly dedicated to a specific branch of activity, in which the territory would be specialized.

Criterion Business density. This criterion tries to verify the presence of a high geographic concentration of businesses that are dedicated to the production of the same product or to the same branch of activity in the analyzed LAG territory. For this to be verified, the number of firms dedicated to the same productive activity per km^2 in the LAG territory under consideration must be higher than the average of the same indicator in the geographical area chosen to establish the comparison (the region or autonomous community, preferably, in this case).

Finally, following Hernandez, Fontrodona and Pezzi [83], the existence in the LPS of social capital is desirable for a better result, ensuring for it, for instance, business cooperation. Such a factor has a positive impact on competent performance of firms at the international level, and it can be verified with the following two criteria.

Criterion Internationalization. One of the main characteristics of LPSs is that they provide a competitive advantage that allows companies, even if they are small, to compete in the international market. That is why the acceptance of this criterion requires the verification of the existence of companies belonging to the agglomeration that compete in the international market, that is, that export all or part of their production.

Criterion Business cooperation. Another characteristic that the theory of industrial districts assumes is the existence of business cooperation between the companies that make up the agglomeration, in such a way that the existence of business cooperation must be a sine qua non condition to identify an LPS. The measurement of business cooperation can be verified formally and informally, although we understand that a simple way to do it is verifying the existence of agreements between companies or the participation of some of them in the capital of others.

In short, this methodology allows us to identify business agglomerations of a local or regional nature with contrasting importance in terms of employees, number of companies and income generated, and with a significant influence at the LAGlevel and a high level of business cooperation and presence in international markets.

As the intention is to enable the construction of local development strategies covered by the rural development strategy at the European level, it is necessary to understand at what stage of its life cycle the agglomeration is, that is, whether it is in an incipient development stage or in a mature or decline stage. This is important because the actions to be implemented in each case are different due to what the LPS and the companies inside it really need from an institutional point of view [106–113]. In this sense, to identify this we will use the methodology described by Branco and Lopes [106], and Rangel [113], which uses the indicators of employees, number of companies, and income generated to catalogue each of the agglomerations previously detected.

5. Result for the Extremadura Case

The local sources available for deriving the indicators that we have been describing are difficult to find. As such, we use the database built by Rangel [26], which is described in the following table.

The use of this methodology shows us up to 22 productive specializations in Extremadura with a root at the local or regional level, considering their relative importance in terms of number of companies, employment, and level of generated income. These 22 LPSs are located in 13 LAG territories, which implies that there is polyspecialization in some of them. Mostly, we find that the LPSs that start from an advantage in agriculture and livestock (rural districts) are very relevant, as reflected in Table 5.

Table 5. Rural districts (LPS) in Extremadura.

Specialization—Location	Companies	Companies Specialization Index	Employment	Employment Specialization Index	Income Generated (EUR)	Sector Weight (%) [1]	Extremadura Weight (%) [2]
Campiña Sur—Meat	139	1.80	454	1.64	125,466,662.82	3.90	0.92
Campo Arañuelo—Agri-food	136	1.24	1124	1.60	198,770,797.48	4.92	1.45
Campo Arañuelo—Metallurgical	20	1.21	293	2.18	59,028,949.83	4.57	0.43
Jerte—Agri-food	34	1.39	333	2.52	80,197,505.10	1.98	0.59
La Serena—Meat	146	1.33	473	1.07	145,678,973.43	3.60	1.06
La Serena—Granite	76	6.16	413	7.31	34,735,251.07	11.63	0.25
La Siberia—Meat	80	1.59	266	1.34	74,187,954.75	1.84	0.54
La Vera—Agri-food	111	1.40	434	1.59	98,016,876.79	2.43	0.72
Lácara—Agri-food	202	1.49	1174	1.64	153,603,726.12	3.80	1.12
Miajadas-Trujillo—Agri-food	109	1.18	657	1.49	157,331,112.82	3.89	1.15
Sierra Grande-Tierra de Barros—Agri-Food	305	1.16	1461	1.21	373,502,535.69	9.24	2.73
Sierra San Pedro-Los Baldíos—Cork	68	15.55	466	20.73	113,633,209.54	58.80	0.83
Sierra Suroeste—Meat	154	1.65	718	1.00	149,821,763.41	3.71	1.09
Sierra Suroeste—Jewelry	10	1.18	326	16.76	80,706,681.30	68.67	0.51
Sierra Suroeste—Metallurgical	28	2.01	892	6.48	948,623,622.58	73.41	6.93
Tentudía—Meat	119	2.01	354	1.86	55,735,863.99	1.38	0.41
Tierra de Barros—Metallurgical	80	2.01	421	1.83	86,487,143.35	6.69	0.63
Vegas Altas—Agricultural Machinery	50	1.48	203	1.63	25,288,543.43	15.04	0.18
Vegas Altas—Agri-food	357	1.32	3193	1.69	746,653,970.96	18.47	5.46
Vegas Altas—Chemical produtcs	36	1.46	228	1.82	107,941,686.10	32.32	0.79
Zafra-Río Bodión—Agri-food	80	1.24	266	1.49	74,187,954.75	8.14	2.40
Zafra-Río Bodión—Metallurgical	31	1.35	363	2.12	47,373,551.59	3.67	0.35
Total	2371		14,512		3,936,974,336.90		

[1] Percentage of the total revenue generated by LPS in the Extremadura sector to which the specialization belongs. [2] Percentage of total revenue generated by LPS in the total Extremadura economy. Source: Own elaboration.

Finally, we present the life cycle status results for each of the LPSs, represented in Table 6. This analysis is based on the parent trend by income, employment and business indicators from 1993 to 2018.

Table 6. Life cycle of Extremaduran rural districts.

Agri-food and meat districts		
Growing	**Maturity**	**Decline**
Vegas Altas—Agri-food Zafra-Río Bodión—Agri-food	Campo Arañuelo—Agri-food	Lácara—Agri-food Miajadas-Trujillo—Agri-food
Agri-food and meat quality district		
Growing	**Maturity**	**Decline**
La Vera—Agri-food Tentudía—Meat Sierra Grande-Tierra de Barros—Agri-Food Jerte—Agri-food	Sierra Suroeste—Meat Campiña Sur—Meat La Serena—Meat	La Siberia—Meat
Other districts		
Growing	**Maturity**	**Decline**
Campo Arañuelo—Metallurgical Vegas Altas—Agricultural Machinery Vegas Altas—Chemical products	Sierra Suroeste—Jewelry	Sierra San Pedro-Los Baldíos—Cork Zafra-Río Bodión—Metallurgical La Serena—Granite Sierra Suroeste—Metallurgical Tierra de Barros—Metallurgical

Source: Own elaboration.

In our study, the intention is not to analyze the impact of the LEADER program through the LAG territories, because this fact is already perfectly well described in the research developed by Nieto and Cárdenas for the case of Extremadura [3–5,114–116]; nor is our intention to define the location of Extremadura's industry [117], but it is instead to check whether the methodology described allows us to identify and detect productive specializations and business agglomerations at the local or regional level whose economic influence is significant at the LAG level, so that this specialization can be enhanced in the rural development strategy.

In the Extremadura case, unlike regions with high business-density, we find that the business agglomerations and productive specializations that have been detected have a moderate level of employment and generated income, as shown in Table 5. However, some cases, particularly those with a special link to agri-industry, have a clear growing trend. In them, taking into account economic theory, it can be understood that they have a certain competitive advantage that favors companies and projects linked to productive specialization. Following the Italian example described by Toccaceli [118], these territories considered to be rural districts fit into policies developed through LEADER projects (LAG) or in the Common Agricultural Policy.

6. Discussion and Conclusions

The local productive systems identified in Extremadura by the methodology proposed in this paper are characterized by their modest contribution to the regional level in terms of employment and number of firms, this being much lower than the contribution evidenced by the industrial districts identified in other studies at the national level [15,75,76,78]. In this sense, what is verified is that these agglomerations have a great impact in terms of income and employment when the analytical and comparative territorial framework is local, and even regional [33], as evidenced, for example, in the business agglomeration dedicated to the cork manufacturing found in the Sierra de San Pedro-Los Baldíos, located in the west of the Extremadura region. Its importance has led to the fact that, facing the decline stage of the agglomeration, all the agents that comprise it (employers, workers, institutions, research units, etc.) have worked in unison to reverse the situation [119], in what can be classified as an effect of the social capital that the agglomeration possesses.

Among the productive specializations that have been identified for Extremadura, we find a common nexus, namely, they are all based on the possession and use of natural resources, which gives the territory a uniqueness in the form of a comparative advantage that can be used in international trade. We observe this fact in other similar studies carried out at the national and international levels, and in particular in studies carried out in regions such as Andalusia [21] or Castilla-La Mancha [120], where the same phenomenon happens. Even in Italy, a paradigm of the economic literature on agglomeration economies, we already refer to agri-food industrial districts or rural districts [118], and there is also a similar pattern that links business agglomeration with the exploitation of endogenous natural resources, especially in regions with a high incidence of rural areas, such as Sardinia [121].

Another aspect that should be highlighted from the results obtained is the verification of polyspecialization in several of the Extremadura territories. Indeed, the existence of more than one productive specialization has been found in several Extremadura regions, which has positive effects on their economic development, perfectly described by Ruíz [122], as observed in the greater dynamism that regions such as Vegas Altas del Guadiana (one of those in which polyspecialization has been more clearly evidenced) present [12].

In line with the foregoing, 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 [123]. In this sense, we find that the agglomeration of activity identified in Extremadura around a product or branch of activity permits a capacity for the integration of the value chain, ranging from primary activities to wholesale trade, and in some cases passing for the complete transformation of the products. This fact, which can be presented as a common behavior pattern in border regions [124], invites us to think that the clusters detected exhibit the behavior described by industrial ecosystems, in accordance with green and circular economy policies.

All of the above contributes to the design of a bottom-up development strategy for Extremadura, since the methodology allows for locating local productive systems in rural areas with a significant influence on employment, number of firms and income generated at the local and regional level (or in the territories of influence of the local action group), based on the unique production and resource endowment that some Extremadura territories have, and with the possibility of developing primary, secondary and even tertiary branch activities around these products or resources. In short, transforming natural resources into value-added products makes possible the development of services linked to these productive specializations, in particular of a touristic nature, a fact that would lead to a full use of LEADER development strategies, which have been put into practice in Extremadura as regards rural tourism as well [125].

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References

1. Canete, A.J.; Navarro, F.; Cejudo, E. Territorially unequal rural development: The cases of the LEADER Initiative and the PRODER Programme in Andalusia (Spain). *Eur. Plan. Stud.* **2018**, *26*, 726–744. [CrossRef]
2. Chmieliński, P.; Faccilongo, N.; Fiore, M.; La Sala, P. Design and implementation of the Local Development Strategy: A case study of Polish and Italian Local Action Groups in 2007–2013. *Stud. Agric. Econ.* **2018**, *120*, 25–31. [CrossRef]
3. Nieto, A.; Cárdenas, G. Los Grupos de Acción Local en el programa de programación FEADER (2017–2013). *Rev. De Estud. Extrem.* **2015**, *LXXI*, 595–628.
4. Cárdenas, G. La Política de Desarrollo Rural en Extremadura. Periodo de Programación 2007–2013. Ph.D. Thesis, Universidad de Extremadura, Cáceres, Spain, 2018.
5. Nieto, A.; Gurría, J.L. Las políticas rurales europeas y su impacto en Extremadura. *BAGE Bol. Asoc. Geógr. Esp.* **2008**, *48*, 225–246.
6. Brańka, P. Managing Development Based on Endogenous Potential in Rural Areas in Malopolska Region. In *Knowledge Economy Society. Challenges and Development Trends of Modern Economy, Finance and Information Technology*; Malina, A., Oczkowska, R., Kaczmarek, J., Eds.; Foundation of the Cracow University of Economics: Cracow, Poland, 2015; pp. 493–500.
7. Marshall, A. *Principios de Economía. Un Tratado de Introducción*; Aguilar: Madrid, Spain, 1963; original edition, *Principles of Economics*; Londres, Macmillan and Co.: Londres, Spain, 1890.
8. Becattini, G. *La Oruga y la Mariposa. Un Caso Ejemplar de Desarrollo en la Italia de Los Distritos Industriales: Prato (1954–1993)*; Carrión, J., Translator; Secretariado de Publicaciones e Intercambio Editorial de la Universidad de Valladolid: Valladolid, Spain, 2005.
9. Garofoli, G. Áreas de especialización productiva y pequeñas empresas en Europa. *Doc. D ´anàlisi Geogr.* **1986**, *8–9*, 143–172.
10. Garofoli, G. Les systèmes de petites entreprises: Un cas paradigmatique de développement endogène. In *Les Régions Qui Gagnent. Districts et Réseaux: Les Nouveaux Paradigmes de la Géographie Économique*; Benko, G., Lipietz, A., Eds.; Presses Universitaires de France: Paris, France, 1992; pp. 57–80.
11. Nugroho, P. Spatial Distribution on the search for economic externalities acquisition in rural industry clustering: A study of emerging batik industry clusters in lagging regions of Wonosobo Regency and Purworejo Regency, Indonesia. *IOP Conf. Ser. Earth Environ. Sci.* **2019**, *313*, 012032. [CrossRef]
12. Rangel, J.F.; Parejo, F.M.; Cruz, E. Distrito rural y ciclo de vida. El caso de la comarca de Vegas Altas del Guadiana, Extremadura, España. *Espacios* **2019**, *40*, 13.
13. Ruíz, M.J. Influencia de las economías externas de distrito sobre la productividad empresarial: Un enfoque multinivel. *Investig. Reg. J. Reg. Res.* **2009**, *18*, 61–82.
14. Helmsing, A.H.J. Teorías de desarrollo industrial regional y políticas de segunda y tercera generación. *Eure—Rev. Latinoam. Estud. Urbano Reg.* **1999**, *25*, 5–39. [CrossRef]
15. Boix, R.; Trullen, J. Industrial districts, innovation and I-district effect: Territory or industrial specialization? *Eur. Plan. Stud.* **2010**, *18*, 1707–1729. [CrossRef]
16. Climent, E.A.; Ruíz, E. Sistema productivos locales de pequeña y mediana empresa en Aragón: Identificación y delimitación. In *Aportaciones Geográficas en Memoria del Profesor Miguel Yetano Ruiz*; Universidad de Zaragoza: Zaragoza, Spain, 2002; pp. 99–110.
17. Méndez, R. Sistemas Productivos Locales y Políticas de Desarrollo Rural. *Rev. De Estud. Reg.* **1994**, *39*, 93–112.
18. Chandler, A. *Escala y Diversificación. La Dinámica del Capitalismo Industrial*; Prensas Universitarias de Zaragoza: Zaragoza, Spain, 1996.
19. Sforzi, F. La teoría marshalliana para explicar el Desarrollo Local. In *Manual de Desarrollo Local*; Rodríguez, F., Ed.; Ediciones Trea: Gijón, Spain, 1999; pp. 13–32.
20. Pezzini, M. Sistemas productivos locales de pequeñas empresas como estrategias para el desarrollo local. Los casos de Dinamarca, Emilia-Romagna y la Comunidad Valenciana. *Econ. Ind.* **2006**, *359*, 185–202.
21. Juste, J.J. Desarrollo Local y Mercado Global: Los Sistemas Productivos Locales y la Industria Agroalimentaria en Castilla y León. Ph.D. Thesis, Universidad de Valladolid, Valladolid, Spain, 2001.
22. Ruíz, M.J. *Distritos Industriales y Desarrollo Local—Un Análisis Aplicado a Castilla-La Mancha*; Colección Economía-Estudios, Civitas: Cizur Menor, Spain, 2009.
23. García, O. Sistemas Productivos Locales y Desarrollo Local en Andalucía (1998–2012). Estudio del Caso de la Aceituna de Mesa de Morón de la Frontera. Ph.D. Thesis, Universidad de Sevilla, Sevilla, Spain, 2006.
24. Climent, E.A. *Los Sistemas Productivos Locales de La Rioja: Identificación, Dinámica Interna y Mercado*; Gobierno de la Rioja, Ediciones Instituto de Estudios Riojanos: Logroño, Spain, 2000.
25. Larrea, M. *Sistemas Productivos Locales en la Comunidad Autónoma del País Vasco*; Gobierno Vasco, Servicio Central de Publicaciones: País Vasco, Spain, 2000.
26. Larrea, M. Análisis de la Estructura Industrial en los Sistemas Productivos de la Comunidad Autónoma del País Vasco. Ph.D. Thesis, Universidad de Deusto, Bilbao, Spain, 1999.
27. Juste, J.J. Industria agroalimentaria, desarrollo rural y sistemas productivos locales en Castilla y León. *Cuad. Estud. Agroaliment.* **2011**, *2*, 219–252.
28. Storper, M.; Sabel, C.F.; Piore, M.J. Distritos industriales y desarrollo regional: Límites y posibilidades. *Sociol. Trab.* **1991**, *1*, 181–230.
29. Pyke, F. Pequeñas empresas, distritos industriales y desarrollo regional. *Econ. Ind.* **1992**, *287*, 107–112.

30. De Luca, J.A.; Soto, G.M. *Los Distritos Industriales Como Estrategia de Desarrollo Regional*; CajaMurcia, Obra Social: Murcia, Spain, 1995.
31. Sforzi, F.; Boix, R. What about Industrial District(s) in Regional Science? *Investig. Reg. J. Reg. Res.* **2015**, *32*, 61–73.
32. Longás, J.C. Formas organizativas y espacio: Los distritos industriales, un caso particular en el desarrollo regional. *Rev. Estud. Reg.* **1997**, *48*, 167–188.
33. Rangel, J.F. Los Sistemas Productivos Locales en Extremadura: Aportaciones a la Política de Desarrollo Industrial y Rural. Ph.D. Thesis, Universidad de Extremadura, Badajoz, Spain, 2018.
34. Guareschi, M.; Maccari, M.; Sciurano, J.P.; Arfini, F.; Pronti, A. A Methodological Approach to Upscale Toward an Agroecology System in EU-LAFSs: The Case of the Parma Bio-District. *Sustainability* **2020**, *12*, 5398. [CrossRef]
35. Truant, E.; Broccardo, L.; Zicari, A. Organic companies' business models: Emerging profiles in Italian bio-districts. *Br. Food J.* **2019**, *121*, 9. [CrossRef]
36. Vila, J. Distritos industriales y renta económica: El efecto distrito—Renta. *Pap. De Eur.* **2019**, *32*, 67–80.
37. Dei Ottati, G. El efecto distrito: Algunos aspectos conceptuales de sus ventajas competitivas. *Econ. Ind.* **2006**, *359*, 73–79.
38. López, M. Empresa Innovadora, Conocimiento y Distrito Industrial. Ph.D. Thesis, Universitat Politècnica de València, Valencia, Spain, 2010.
39. López, M.; Tomás, J.V.; Expósito, M. Conocimiento y efecto distrito en las empresas innovadoras. Un estudio en la región valenciana. *Rev. Estud. Reg.* **2014**, *101*, 189–218.
40. Cuculelli, M.; Storai, D. Industrial districts, district effect and firm size: The Italian evidence. *Camb. J. Econ.* **2018**, *42*, 1543–1566. [CrossRef]
41. Lazzeretti, L.; Capone, F. Industrial District Effects and Innovation in the Tuscan Shipbuilding Industry. IERMB Working Paper in Economics. 2009. Available online: https://iermb.uab.cat/es/workinpapers/industrial-district-effects-and-innovation-in-the-tuscan-shipbuilding-industry-w-p-in-economics-09-03-2/ (accessed on 1 May 2020).
42. Galletto, V.; Boix, R. Distritos industriales, innovación tecnológica y efecto I-distrito ¿Una cuestión de volumen o de valor? *Investig. Reg.* **2014**, *30*, 27–51.
43. Boix, R.; Galletto, V. Innovation and Industrial Districts: A First Approach to the Measurement and Determinants of the I-District Effect. *Reg. Stud.* **2009**, *43*, 1117–1133. [CrossRef]
44. Ruíz, M.J.; Parra, G.; García, P.M. Do Territorial Agglomerations Still Provide Competitive Advantages? A Study of Social Capital, Innovation, and Knowledge. *Int. Reg. Sci. Rev.* **2016**, *39*, 259–290. [CrossRef]
45. Cainelli, G.; Mancinelli, S.; Mazzanti, M. Social capital and innovation dynamics in district-based local systems. *J. Socio-Econ.* **2007**, *36*, 932–948. [CrossRef]
46. Nicolau, J. *La Influencia del Capital Social y el Conocimiento en los Procesos de Explotación/Exploración e Innovación en las Empresas del Distrito Industrial. Una Aplicación al Textil Valenciano*; Universidad Politécnica de Valencia: Valencia, Spain, 2013.
47. Parra-Requena, G.; Ruiz-Ortega, M.J.; Garcia-Villaverde, P.M. Social Capital and Effective Innovation in Industrial Districts: Dual Effect of Absorptive Capacity. *Ind. Innov.* **2013**, *20*, 157–179. [CrossRef]
48. Molina-Morales, X.; Capó-Vicedo, J.; Martínez-Fernández, M.T.; Expósito-Langa, M. Social capital in industrial districts: Influence of the strength of ties and density of the network on the sense of belonging to the district. *Pap. Reg. Sci.* **2013**, *92*, 773–789. [CrossRef]
49. Becattini, G. Del distrito industrial marshalliano a la «teoría del distrito» contemporánea. Una breve reconstrucción crítica. *Investig. Reg. J. Reg. Res.* **2002**, *1*, 9–32.
50. Becattini, G. *Industrial Districts: A New Approach to Industrial Change*; Edward Elgar Publishing, Inc.: Northampton, MA, USA, 2004.
51. Becattini, G. From Marshall's to the Italian "Industrial Districts". A Brief Critical Reconstruction. In *Complexity and Industrial Clusters. Dynamics and Models in Theory and Practice*; Quadrio, A., Fortis, M., Eds.; Springer: New York, NY, USA, 2002; pp. 83–106.
52. Sforzi, F. The Industrial District and the 'New' Italian Economic Geography. *Eur. Plan. Stud.* **2002**, *10*, 439–447. [CrossRef]
53. Sforzi, F.; Mancini, M. The Reinterpretation of the Agri-Food System and Its Spatial Dynamics through the Industrial District. *Agric. Econ. Zemědělská Ekon.* **2012**, *58*, 510–519.
54. Zecca, F.; Al Am, A.; Capocchi, E. Dai distretti alle reti d'impresa: Soluzioni chiave per lo sviluppo territoriale. *Riv. Econ. Agrar.* **2014**, *69*, 227–243.
55. Carminati, M. *La Legislazione Italiana e Regionale Sui Distretti Industriale: Situazione ed Evoluzione*; Università Cattolica del Sacro Cuore, Centro di Ricerche in Analisi economica e sviluppo economico internazionale (CRANEC): Milano, Italy, 2006.
56. Fuster, A. La Resiliencia de los Distritos Industriales Durante La Gran Recesión: Un Análisis del Caso Valenciano. Ph.D. Thesis, Universidad de Alicante, Alicante, Spain, 2019.
57. Santa María, M.J. *Pequeñas Empresas y Distritos Industriales: El Textil-Confección en la Comunidad Valenciana*; Instituto de Cultura Juan Gil Albert: Alicante, Spain, 1999.
58. Soler, V. Verificación de las hipótesis del distrito industrial: Una aplicación al caso valenciano. *Econ. Ind.* **2000**, *334*, 13–23.
59. Ahedo, M. Business Systems and Cluster Policies in the Basque Country and Catalonia (1990–2004). *Eur. Urban Reg. Stud.* **2006**, *13*, 25–39.
60. Duch, N. La organización de la industria en Cataluña. El papel de los distritos industriales. *Bol. Econ. Ice* **2008**, *2952*, 73–82.

61. Blázquez, M.L. La Importancia de los Clusters en la Competitividad en España. El Caso Específico de la Región Catalana. Ph.D. Thesis, Universidad Pontificia Comillas, Madrid, Spain, 2010.
62. Hernández, M. Pasado, presente y futuro de la política de clústers el caso de Cataluña y su encuadramiento europeo. *Econ. Ind.* **2013**, *387*, 147–158.
63. Ahedo, M. Cluster policy in the Basque country (1991–2002): Constructing 'industry–government' collaboration through cluster-associations. *Eur. Plan. Stud.* **2004**, *12*, 1097–1113. [CrossRef]
64. Extabe, I.; Valdaliso, J.M. Measuring structural social capital in a cluster policy network: Insights from the Basque Country. *Eur. Plan. Stud.* **2016**, *24*, 884–903.
65. Aranguren, M.J.; De la Maza, X.; Davide, M.; Vendrell, F.; Wilson, J.R. Nested Methodological Approaches for Cluster Policy Evaluation: An Application to the Basque Country. *Reg. Stud.* **2014**, *48*, 1547–1562. [CrossRef]
66. Elola, A.; Valdaliso, J.M.; Franco, S.; López, S.M. Public policies and cluster life cycles: Insights from the Basque Country experience. *Eur. Plan. Stud.* **2017**, *25*, 539–556. [CrossRef]
67. Castillo, J.S.; García, M.C. Los distritos rurales. Un nuevo concepto de desarrollo territorial. Modelos Centro-Periferia en Castilla-La Mancha. *Estud. Econ. Apl.* **2011**, *29*, 165–188.
68. Castillo, J.S.; García, M.C. Del distrito industrial al distrito rural; implicaciones teóricas para el desarrollo territorial. *Econ. Agrar. Y Recur. Nat.* **2011**, *11*, 7–32.
69. Trullen, J.; Callejón, M. Las Agrupaciones de Empresas Innovadoras. In *Los Distritos Industriales*; Soler, V., Ed.; Caja Rural del Mar (Cajamar): Almería, Spain, 2008; pp. 459–478.
70. Ybarra, J.A.; Doménech Sánchez, R. Las Agrupaciones de Empresas Innovadoras y la política industrial española basada en el territorio. *Econ. Ind.* **2011**, *380*, 143–152.
71. García, A. Agrupaciones Empresariales Innovadoras Como Factor de Competitividad de las Empresas de Castilla y León. Diploma Thesis, Universidad de Valladolid, Valladolid, Spain, 2014.
72. Rivero, P. Redes Empresariales y Estrategia Empresarial Pyme. Análisis de la Oferta y Demanda de Servicios de las Agrupaciones de Empresas Innovadoras (AEI). Ph.D. Thesis, Universidad de Extremadura, Badajoz, Spain, 2013.
73. Ivars, J.A.; Rodríguez, I.; Vera, J.F.; Acebal, A. Nuevos enfoques en la gestión turística: El programa de agrupaciones empresariales innovadores en España. *Bol. Asoc. Geógr. Esp.* **2014**, *66*, 369–395.
74. Ivars, J.A.; Vera, J.F.; Acebal, A. Políticas de innovación en turismo y desarrollo de clusters: La percepción gerencial en el programa Agrupaciones Empresariales Innovadoras (AEIs). *Cuad. Tur.* **2014**, *33*, 97–120.
75. Boix, R.; Galletto, V. *Identificación de Sistemas Locales de Trabajo y Distritos Industriales en España*; MITYC: Madrid, Spain, 2005.
76. Boix, R.; Galletto, V. Sistemas locales de trabajo y distritos industriales marshallianos en España. *Econ. Ind.* **2006**, *359*, 165–184.
77. Giner, J.M.; Santa María, M.J.; Fuster, A. Los sistemas productivos locales en la Comunidad Valenciana: Análisis para su identificación y localización territorial. In *La Economía Regional Ante la Globalización*; Fuster, A., Giner, J.M., Santa María, M.J., Eds.; Publicaciones de la Universidad de Alicante: Alicante, Spain, 2006; pp. 109–126.
78. Courlet, C.; Pecqueur, B. Les systèmes industriels localisés en France: Un nouveau modèle de dèveloppment. In *Les Régions Quigangent. Districts et Réseaux: Les Nouveaux Paradigmes de la Géographie Économique*; Benko, G., Lipietz, A., Eds.; Presses Universitaires de France: Paris, France, 1992; pp. 81–102.
79. Boix, R.; Trullén, J. La relevancia empírica de los distritos industriales marshallianos y los sistemas productivos locales manufactureros de gran empresa en España. *Investig. Reg. J. Reg. Res.* **2011**, *19*, 75–96.
80. Trullén, J. Distritos industriales marshallianos y sistemas locales de gran empresa en el diseño de una nueva estrategia territorial para el crecimiento de la productividad en la economía española. *Econ. Ind.* **2006**, *359*, 95–112.
81. Lainé, F. Agglomérations Spécialisées d´Établissements et Systèmes Localisés de Production: Une Gricul Statistique. INSEE, Direction de la Diffusion et de l´Action Regionale, Départament de l´Action Régionale, Division "Etudes Territoriales". 2000. Available online: https://www.epsilon.insee.fr/jspui/handle/1/51913 (accessed on 1 May 2020).
82. Parejo, F.M.; Rangel, J.F.; Branco, A. Aglomeración industrial y desarrollo regional. Los sistemas productivos locales en Portugal. *Eure—Rev. Latinoam. De Estud. Urbano Reg.* **2019**, *45*, 147–168. [CrossRef]
83. Hernández, M.; Fontrodona, J.; Pezzi, A. *Mapa de los Sistemas Productivos Locales en Cataluña*; Secretari d´Indústria, Departament de Treball i agricultu, Generalitat de Catalunya: Barcelona, Spain, 2005.
84. Puig, F.; Pla, J.; Linares, E. Los distritos industriales como unidad de análisis: Una propuesta metodológica para su identificación. *Icade Rev. Fac. Derecho Y Cienc. Econ. Y Empres.* **2008**, *73*, 321–345.
85. Santacana, F.; Guinjoan, M.; Pellicer, P.; Vázquez, A. *Áreas Rurales Con Capacidad de Desarrollo Endógeno*; Ministerio de Obras Públicas y Urbanismo: Madrid, Spain, 1987.
86. ITUR. *Industrialización en Áreas Rurales*; Ministerio de Obras Públicas y Urbanismo: Madrid, Spain, 1987.
87. AGE: Grupo de Geografía Industrial. *Actas de la II Reunión de Geografía Industrial*; AGE: Santiago de Compostela, Spain, 1988.
88. Celada, F. *Los Sistemas Productivos Locales de Carácter Industrial en España*; IMPI: Madrid, Spain, 1991.
89. Costa, M.T. Cambios en la organización industrial: Cooperación local y competitividad internacional. Panorama general. *Econ. Ind.* **1992**, *286*, 19–36.
90. Ybarra, J.A. Entre la cooperación y la competencia, los distritos industriales en el País Valenciano. *Econ. Ind.* **1992**, *286*, 72–74.
91. CEP Excel. *Cooperación Entre Empresas y Sistemas Productivos Locales*; Ministerio de Industria, Comercio y Turismo: Madrid, Spain, 1993.

92. Gil, J.M.; Mecha, R.; Melguizo, I.; Palacios, J.R.; De la Hoz, A.F. Los procesos de industrialización en las áreas rurales. La mesa de Ocaña (Toledo). *Estud. Territ.* **1994**, *102*, 609–616.
93. ISTAT. *Sistemi Locali del Lavoro. Censimento 2001. Dati Definitivi*; ISTAT: Roma, Italy, 2005.
94. ISTAT. *Distretti Industriali e Sistemi Locali del Lavoro 2001*; ISTAT: Roma, Italy, 2006.
95. De Propis, L. Los distritos industriales en el mundo anglosajón. El caso británico. In *Los Distritos Industriales*; Soler, V., Ed.; Fundación Cajamar: Almería, Spain, 2008; pp. 203–224.
96. Brusco, S.; Paba, S. Per una storia dei distretti italiani dal secondo dopoguerra agli anni novanta. In *Storia del Capitalismo Italiano*; Barca, F., Ed.; Doncelli: Roma, Italy, 1997; pp. 265–333.
97. Venacio, L. Globalización, Desarrollo Local y Sociedad Civil: El Partenariado Transnacional Como Base Para la Internacionalización del Desarrollo Local. Eumed.net. 2007. Available online: www.eumed.net/libros/2007a/221/ (accessed on 1 May 2020).
98. Levin, I. Los Distritos Industriales y los debates de la estrategia económica y política en Rusia. *Econ. Ind.* **2006**, *359*, 127–146.
99. Pérez, A.; Leco, F.; Barrientos, G. *Población y Despoblación en Extremadura*; Gederul: Cáceres, Spain, 2012.
100. Leco, F.; Pérez, A.; Mateos, A.B. Crisis demográfica en la Extremadura rural: Valoración a través de los Grupos de Acción Local (2007–2014). *Cuad. Geogr.* **2017**, *56*, 76–100.
101. Pérez, A.; Leco, F. La despoblación: Una amenaza para el medio rural extremeño. In *Informe. La Agricultura y la Ganadería Extremeña*; Coleto, J.M., González, R., Muslera, E., Pulido, F.C., Eds.; Fundación Caja de Badajoz: Badajoz, Spain, 2013; pp. 75–91.
102. Zapata, S. *La Industria de Una Región No Industrializada: Extremadura, 1750–1990*; Servicio de Publicaciones de la Universidad de Extremadura: Cáceres, Spain, 1996.
103. Parejo, F.M.; Rangel, J.F. La economía extremeña en perspectiva histórica: Crecimiento, convergencia y cambio estructural. In *Treinta Años de Economía y Sociedad Extremeña (1983–2013)*; De la Macorra, L.F., Ed.; Diputación de Badajoz: Badajoz, Spain, 2015; pp. 13–30.
104. Linares, A.M. Extremadura en democracia (1975–2017): Luz y contraluz de una historia económica regional. *Rev. Estud. Extrem.* **2017**, *73*, 955–966.
105. De la Calle, A. Situación del tejido empresarial de Extremadura. *Rev. Estud. Econ. Empres.* **2015**, *27*, 43–68.
106. Branco, A.; Lopes, J.C. Cluster and business performance: Historical evidence from the Portuguese cork industry. *Investig. Hist. Econ. Econ. Hist. Res.* **2018**, *14*, 43–53. [CrossRef]
107. Capó Vicedo, J. Análisis del ciclo de vida y las políticas de desarrollo de los clusters de empresas. *Rev. EURE Rev. Estud. Urbano Reg.* **2011**, *37*, 59–87. [CrossRef]
108. Belussi, F.; Sedita, S.R. Life Cycle vs. Multiple Path Dependency in Industrial Districts. *Eur. Plan. Stud.* **2009**, *17*, 505–528. [CrossRef]
109. Menzel, M.; Fornahl, D. Cluster life cycles- dimensions and rationales of cluster evolution. *Ind. Corp. Chang.* **2009**, *19*, 205–238. [CrossRef]
110. Popp, A.; Wilson, J. Life Cycles, Contingency, and Agency: Growth, Development, and Change in English Industrial Districts and Clusters. *Environ. Plan. A Econ. Space* **2007**, *39*, 2975–2992. [CrossRef]
111. Branco, A.; Lopes, J.C. The economic performance of clustered and non clustered firms along the different phases of the cluster life cycle: The Portuguese cork industry case. In *Working Papers Department of Economics del ISEG*; Universidade Técnica de Lisboa: Lisbon, Portugal, 2013; p. 26.
112. Elola, A.; Valdiso, J.M.; López, S.M.; Aranguren, M.J. Cluster Life Cycles, Path Dependency and Regional Economic Development: Insights from a Meta-Study on Basque Clusters. *Eur. Plan. Stud.* **2012**, *20*, 257–279. [CrossRef]
113. Rangel, J.F. El ciclo de vida del distrito industrial de San Vicente de Alcántara (Badajoz). El negocio del corcho. *Rev. Estud. Econ. Empres.* **2018**, *30*, 37–72.
114. Nieto, A.; Cardenas, G. The Rural Development Policy in Extremadura (SW Spain): Spatial Location Analysis of Leader Projects. *ISPRS Int. J. Geo-Inf.* **2018**, *7*, 1–16.
115. Cárdenas, G.; Y Nieto, A. Rural space governance in Extremadura (SW Spain). Analysis of the leader approach. *Eur. Countrys.* **2020**, *12*, 448–468.
116. Cárdenas, G.; Nieto, A. El Enfoque LEADER en el nuevo FEADER 2014–2020 en Extremadura. *Cuad. Geogr.* **2020**, *59*, 5–27.
117. Cortés, M.A. Análisis Económico de la Localización Industrial Agroalimentaria Extremeña. Una Perspectiva Comparada. Ph.D. Thesis, Universidad Rey Juan Carlos, Madrid, Spain, 2015.
118. Toccaceli, D. Agricultural districts in the Italian regions: Looking toward 2020. *Agric. Food Econ.* **2015**, *3*, 1. [CrossRef]
119. Rangel, J.F.; Tejeda, A.; Parejo, F.M. *Plan Estratégico Para la Especialización en la Transformación de Productos Corcheros*; OCICEX: Badajoz, Spain, 2016.
120. Mecha, R. Sistemas Productivos Locales e Industrialización Rural en Castilla-La Mancha. Ph.D. Thesis, Universidad Complutense de Madrid, Madrid, Spain, 2002.
121. Gruppo di Lavoro Della Ricerca. *Sughero, Lattiero-Caseario, Graito. I Distetti Industriali del Nord Sardegna. Protagonisti, Relazioni, Prospetitive*; Associazione degli Industriali dela Provincia di Sassari: Sassari, Italy, 1996.
122. Ruiz, M.J. La poliespecialización como fuente de dinamismo del distrito industrial. In *Los Distritos Industriales*; Soler, V., Ed.; Fundación Cajamar: Almería, Spain, 2008; pp. 139–157.

123. Seva, P. Distritos Industriales y Competitividad Empresarial: Un Análisis Aplicado a los Distritos Industriales Alimentarios (DIA) en España. Ph.D. Thesis, Universidad de Alicante, Alicante, Spain, 2019.
124. Pizzarro-Gómez, A.; García-Delgado, F.J.; Pérez-Mora, C. Cambios en la industria de transformación del cerdo ibérico en la Sierra de Huelva (2002–2020). *Cuad. Geogr.* **2021**, *60*, 203–224.
125. Nieto, A.; Rios, N. Rural Tourism as a Development Strategy in Low-Density Areas: Case Study in Northern Extremadura (Spain). *Sustainability* **2020**, *13*, 239. [CrossRef]

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Enhancing the Territorial Heritage of Declining Rural Areas in Spain: Towards Integrating Top-Down and Bottom-Up Approaches

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Abstract: The population of a considerable number of rural areas in the interior of Spain is in decline. Faced with this problem, various institutions are launching initiatives to enhance the territorial heritage (natural and cultural) of these areas and, starting with a minimum of economic diversification, help to reverse these depopulation processes and promote local development overall. Two specific initiatives are analysed here: the Almadén Mining Park and the Molina-Alto Tajo District Geopark, both of which are located in central-southern Spain and have been officially recognised by UNESCO as World Heritage Sites. These two examples allow us to demonstrate, as our main objective, the today importance of territorial revival processes that were initiated by institutions (top-down approach) and then backed up by increasing participation by the local communities (bottom-up approach), encouraged by, among other factors, rural development programmes. In this regard, two aspects are important: the need for an interrelationship between the two approaches in terms of collaborative governance, in order to minimise the current processes of depopulation and territorial dislocation; and the use of the potential synergy between the resources in these two districts to ensure the viability of the initiatives and provide visitors with a high-quality experience.

Keywords: territorial heritage; rural areas in decline; rural enhancement; top-down approach; bottom-up approach; collaborative governance

1. Introduction

Territorial cohesion is one of the European Union's current fundamental objectives [1–6]. In addition to the essential social and economic cohesion proposed by the EU since its origins, territorial cohesion was included in the 2007 Lisbon Treaty to call for the balanced and harmonious development of all European territories on the basis of their strengths [1,7,8]. In order to achieve this objective, the European Union recognises that there is a uneven pattern of land occupation, as urban areas, especially the major cities, continue to take in the majority of the population, while a considerable number of rural areas, located in remote places or far from urban centres, are in gradual demographic decline [9,10]. It is evident that better-endowed rural areas with good communications that are within the area of influence of an urban centre have a greater capacity for setting up more balanced territorial development projects, as compared to other areas, in which a declining population hampers territorial cohesion and aggravates the social, economic and territorial problems that they have been experiencing for decades. These problems include the risks of poverty and social exclusion, difficulties with preserving their natural and cultural heritage and a limited response to the impact of globalisation, climate change and other environmental risks [11–14]. An essential role in the ability to adapt to each of these challenges is played by the demographic issue and, in particular, the processes of ageing and rural depopulation, which, according to the European Territorial Agenda 2020, constitute one of the main challenges in the immediate future of territorial cohesion [14] (p. 6). Although the ageing of society is a reality found in all geographical contexts, in rural areas it is interpreted as being a direct consequence of the large-scale migration from the countryside to the city that has occurred in recent decades. Rural depopulation is, therefore, limited to the areas that have been suffering from this rural exodus, one of the main factors behind social and spatial change in rural areas today, in addition to the phenomenon of counter-urbanisation and intra-European migration [15].

1.1. Demographic Problems in Rural Europe

Europe's regional development policy, which is embodied in a variety of community initiatives, including Interreg and LEADER, and also implemented through successive territorial agendas (European Territorial Strategy 1999, the 2008 Green Paper on Territorial Cohesion, and the recent Territorial Agenda of the European Union 2020), emphasises the strengthening of inter-territorial and social cooperation to promote the competitiveness of the territories and, as a result, reverse the trend towards depopulation. While such policies are based on a very firm diagnosis of territorial imbalances in general, they are not, strictly speaking, policies aimed at reversing depopulation [16]. In the case of LEADER, its main objectives are to improve the quality of life in rural areas through economic diversification, the participation of local stakeholders, inter-territorial cooperation, the redistribution of financial resources and the enhancement of endogenous heritage, in order to contribute to stabilising the population [17,18]. The absence of specific policies to counter depopulation is one of the reasons several institutions, such as the European Committee of the Regions, the Demographic Change Regions Network and the Northern Sparsely Populated Areas network, have been insisting on prioritising the problem of depopulation in European regional policy and, more specifically, on taking it into consideration when allocating structural funds for the next financial period, 2021–2027 [18]. This concern has resulted in recent debates in the European Parliament, where it was accepted that each member state of the union should receive 5% of these funds for areas with a demographic crisis. In principle, the northern regions of Europe start from a more than favourable situation for benefiting from such initiatives, although it should be clarified that they have not suffered as rapid a population loss as the southern and eastern regions of Europe [10].

For example, in Spain, rural depopulation has been particularly important since the second half of the 20th century. The population living in rural municipalities has shrunk by almost five million people since 1950, from 40.3% of the total population in that year, to only 12.1% of the total in 2018, according to official population censuses. This rural exodus is related to the demand for urban employment, which accelerated during the dictatorship of General Franco (1939–1975) as a result of the Stabilisation Plan (1959) [19], and coincided in time with a lack of job opportunities in rural areas, an increasing shift to a service-based economy and growing mechanisation of agricultural tasks [20,21]. From the spatial point of view, the process resulted in the emptying out of the interior of Spain and a dense population around the periphery and in the main metropolitan centres [21]. This ongoing emptying out of rural areas simply corroborates two facts: firstly, widespread neglect of the demographic problems of rural areas, a situation similar to that experienced in other European countries [22] (p. 355) [23]; and, secondly, confirmation of the fact that Spanish regional policy has not implemented measures to promote true spatial planning to correct these imbalances, nor has it been able to adapt to the changes and increasing complexity of the rural environment resulting from the effects of globalisation [24] (p. 278).

1.2. The Enhancement of Territorial Heritage, Top-Down and Bottom-Up Approaches and Collaborative Governance

The problem of depopulation that we have just described represents one of the demographic challenges with the greatest social and political significance in Spain today. In fact, the Government Commission for the Demographic Challenge and the Ministry for the Ecological Transition and the Demographic Challenge were created in 2017 to specifically address these processes. Both bodies are working to amass a set of proposals, measures and actions that will balance the population pyramid, in collaboration with other institutions, such as the Autonomous Regions and the Spanish Federation of Municipalities and Provinces (SFMP). In general, the provision of basic services, access to the digital society, job creation, improved accessibility and economic diversification are some of the basic aspects on which decision making will focus in the immediate future [25–27].

Many of these initiatives have a strong territorial component, which is why they are also shared by the European Territorial Agenda 2020, so as not only to promote territorial balance but also to ensure the overall competitiveness of the regions [14]. In this task, the enhancement of cultural and natural heritage is a strategic factor in the global–local dialectic. At the local level, it can serve as a catalyst for economic diversification and, as a result, improve accessibility and service infrastructure. At the global level, it can, in relation to the Territorial Agenda, reduce vulnerability to external forces by protecting and improving all its assets, especially in vulnerable territories [14], thereby playing an essential role in maintaining the population of rural areas. This role has also been reflected in the importance that European rural development policy has attached to heritage resources. Currently, of the six priorities for rural development policy set out for the financial period 2014–2020, the measures dedicated to fostering the enhancement of heritage occupy a very significant place in Priority 6 (social inclusion and economic development) and, specifically, in intervention 6B (promoting local development in rural areas). In fact, according to the reports published by the *European Network for Rural Development*, there have been more than 9600 initiatives dedicated to natural and cultural heritage throughout the period [28].

When we talk about natural and cultural heritage, we are referring, overall, to territorial heritage as a concept that clearly groups together the set of resources that have value (as legacy or heritage) in a given territory and can serve, when properly valued, as an instrument for socio-economic revitalisation and dynamism, especially in disadvantaged areas. We start from the leading role that the territory, and its landscapes, acquired at the turn of the century as "a strategic element of the highest order to guarantee adequate levels of development and quality of life for citizens" [29] (p. 43), for which the European Union calls for "intelligent management" [8]. In the new cultural attitude towards territory, the consideration of heritage as a "non-renewable, essential and limited asset" and a "complex and fragile reality" that "contains ecological, cultural and heritage values that cannot be reduced to the price of the land" [30] is key to understanding its role in development strategies. In turn, we view the expansion of the concept of heritage [31] (pp. 1730–1731) from a partial concern for protecting elements recognised as belonging to this category, especially material and architectural elements, to a more overarching view that encompasses elements of intangible culture, such as traditions and ways of life, along with landscapes, historical sites, sites and built environments, biodiversity, groups of diverse objects, past and present traditions, and vital knowledge and experiences [32].

From this premise of understanding territory as heritage, territorial heritage addresses not only the built object but also the "construction of the space" [33] (p. 33) and a new paradigm is formed as it becomes a complex cultural asset whose value lies in its material and intangible attributes (vectors through which heritage status can be gained), around which institutional and/or social identification operates. This recognition of the heritage value of a territory has been increasing in rural areas with the continual attention that has been paid to agricultural heritage, following H. Capel [34] (pp. 73–74), which we will analyse here from the bottom-up perspective, referring to the value given to it by the local population, and top-down, the value attributed to it by institutions, in a process of gaining heritage status in two ways or collaborative governance [35].

All this has a direct connection with territorial identity, since heritage, especially cultural heritage [36], is a cornerstone of local, regional, national and European identity. Its appreciation and protection are essential for sustainability, as they will ensure the preservation of European values for future generations and the continuity of traditions and knowledge. The role played by local communities in preserving this legacy must also not be forgotten. European rural development initiatives, and, more specifically, Links Between Actions for the Development of the Rural Economy (LEADER) have contributed decisively to this objective. Since its launch in 1991, LEADER has proposed a rural development model in which the revival of indigenous territorial resources has played a key role. This reappraisal was made possible thanks to a new rural governance model based on the participation of all the local stakeholders in a district, which makes it possible to speak of a real democratisation of decision making [37–40]. The fact that a territorial strategy is designed in the interests of the local community allows us to demonstrate the importance of the bottom-up approach as the main sign of identity in the LEADER approach, along with other important aspects, such as participation, a territorial approach as the basis for an endogenous development model, multi-level cooperation and networking [16,41].

The appropriateness of the bottom-up approach to the design of development strategies in depressed areas is reflected in numerous published studies. In general, the advantages of this methodology are discussed over top-down approaches, which mostly correspond to decisions made by national and regional governments. The lack of knowledge regarding the territorial reality, the mismatch between the measures planned and the actual interests of the local community, the assessment of the success of these initiatives in terms of efficiency at the national or regional level, with no direct benefit to local communities [42,43], and other issues relating to the lack of participation by and cooperation between the social and economic agents are deficiencies that the bottom-up approach has tried to overcome [38], [41] (p. 313), [42,44,45], [46] (p. 108). In short, the LEADER methodology favours development strategies based on the local population playing a leading role, as it is best placed to understand its own territory and resources and their potential for development.

Other studies point to the possibilities for cooperation between the two perspectives (top-down and bottom-up), within neo-endogenous reflections that emphasise participation at all possible levels, both from the administrative and the territorial point of view [47,48]. It is evident that, with this approach, local and institutional stakeholders are connected by multiple forms of collaboration, with an emphasis on the fulfilment of common objectives or respect for a single regulatory and administrative framework, above all others. As a result, we find ourselves in a situation where the distinction between bottom-up and top-down approaches would be merely illusory [49] (p. 91). An example of these connections is the implementation of European rural development policies, the objectives of which are shared by a number of interconnected decision-making areas and are subject to the same regulatory framework. The inclusion of local development strategies within regional or national rural development programmes would determine the greatest likelihood of success for the measures proposed [41].

The interaction between top-down and bottom-up working methods is the main feature of so-called collaborative governance, the study of which has had a broad theoretical and practical influence in recent years. Its relevance has been analysed in studies on rural tourism [50,51], rural areas in general [52], mountainous regions [53] and studies in the field of public management [54]. These investigations value strengthening the interactions between the public stakeholders, who stand at the peak of the top-down approach, and the private stakeholders, who, in the case of the countryside, would make up the essential local partnership required to promote the development of their districts from below. Collaboration between institutional and social stakeholders at different decision-making levels, but with common objectives, would strengthen the trust between the two, improve decision making, be very effective in resolving potential conflicts and become an appropriate working methodology for intervening in depressed areas or those with structural deficits [50,53]. In these areas, the top-down approach would be responsible for the design of appropriate policy frameworks, advocate the integration of sectoral policies involving the territory and coordinate initiatives based on cooperation with other national and international networks working along the same strategic lines of development. The bottom-up approach would, at the same time, focus on strengthening the structure of local governance and carrying out the relevant territorial diagnoses to shape the strategies mentioned above, a task in which local action groups would be the main protagonists.

Under these premises, based on collaborative governance, we present two initiatives in declining rural areas of Spain in which collaboration of various kinds was essential. Here, the collaborative governance stems, initially, from different institutions of an international, national or regional character, that is, from the "top down", which created heritage enhancement initiatives of some importance. At the same time, these initiatives are being used by local or district associations to promote their own development strategy in the territory, from the "bottom up". Our starting hypothesis is, therefore, that in the consolidation of these initiatives there is a two-speed process of collaborative governance: first institutional, and then local. We will analyse what happened at the *Almaden Mining Park*, which is listed as a World Heritage Site by UNESCO under the title "Mercury Heritage: Almadén and Idrija" and in the *Molina-Alto Tajo District Geopark*, which belongs to the UNESCO Geopark Network, both located in the Autonomous Region of Castilla-La Mancha, which borders on the region of Madrid and, therefore, the country's capital. The choice of these territories is based, therefore, on their representativeness as areas in rural decline with an important recognized heritage. The objective centres around the importance today of territorial revival processes that are initiated by institutions (top-down approach) and then endorsed by increasing participation by local communities (bottom-up approach). In this regard, two aspects are important: the first is theoretical, based on the need for an interrelation between the two approaches in terms of collaborative governance, in order to minimise the current processes of depopulation and territorial dislocation; the second is applied, focusing on the characterisation of each initiative and on using the synergy of the resources that exist in the territory to ensure the viability of these initiatives and provide visitors with a high-quality experience. The results are, therefore, presented for two districts that are depressed in both demographic and socio-economic terms, with synergies from heritage resources for offering a combined package (rural, nature and/or cultural tourism) and in which the processes of gaining heritage status through collaborative governance are contributing to promoting the diversification of their activities.

2. Materials and Methods

The analysis starts with a necessary literature review of the concepts put forward. We highlight, in Section 1, the importance of natural and cultural heritage in achieving territorial revival and the opportunities that collaborative governance presents for rural development. When we refer to collaborative governance, we believe it is necessary to define the concepts of bottom up and top down. The bibliographical references on this topic are very extensive, although, in selecting them, priority has been given to those that reflect on the growing interconnection between the public and private stakeholders involved in rural development processes, both endogenous and exogenous. In discussing territorial heritage, we consider as indispensable the contributions of several expert Spanish geographers, such as N. Ortega Valcárcel [33], Rocío Silva and Víctor Fernández Salinas [55], together with documents such as the *Manifesto for a "New Cultural Territory"* (2006) and its *Addendum* (2018), because of the importance of taking a heritage approach to a territory and its landscapes, as well as the volume *The Heritage Landscapes of Spain* [56].

This initial phase of the research, as mentioned in the introduction to this paper, serves to contextualise the study of two initiatives located in rural areas that exemplify, to a large extent, the relationships raised. The discussion is structured on two levels: the first deals with the recognition process for these initiatives (Almadén Mining Park and Molina-Alto Tajo District Geopark), highlighting the role played by public stakeholders based on administrative opinions that were the starting point for the process of territorial enhancement and, as a result, led to the recognition of the two parks as World Heritage sites by UNESCO. Next, we analyse the main synergies of the territorial resources existing in each area that, in short, shape the wealth and uniqueness of their heritage, making them unique examples on a global scale, in addition to strengthening their viability.

On the second level, the extent to which the local communities have adapted to these processes is studied. The reference areas will be both the associations of municipalities that are managing the LEADER community initiative through their respective Local Action Groups (LAG): the *Association for the Development of the Almadén Montesur District*, in the case of the Mining Park; and the *Molina de Aragón-Alto Tajo Rural Development Association* in the case of the Geopark; the activities generated within the management bodies for each of them; and also the assistance of other local associations that are reappraising certain resources on a regional scale. The level of cooperation between the bottom-up and top-down approaches established in the two districts is assessed through two essential tasks. The first is an analysis of the territorial strategies employed by each group, in order to see the extent to which the initiatives have been included in the local development process. The second is based on the information obtained from four semi-structured interviews with the managers of the Local Action Groups and the managers of the heritage enhancement initiatives (Mining Park and Geopark). The design of the interview was based on the theoretical principles of collaborative governance, with the aim of discovering the degree of cooperation between the levels. The questions referred to the degree of inter-administrative coordination, the steps taken to strengthen participation, the benefits to the territory and the local population, the contribution made by both actions to consolidating a territorial identity, an assessment of the opportunities that are open to each district within the current context of globalisation and the crisis caused by the COVID-19 pandemic, and the main weaknesses identified throughout the process.

The results of these interviews, together with an assessment of the entire process implemented under the top-down approach, will allow us to assess, in the discussion section, the degree of consolidation between these forms of collaborative governance, their direct impact on the development of the territories selected and the viability of the two initiatives based on the use of the rest of the existing territorial resources in each district.

3. Results

The results of the research centre around an analysis of two case studies located in two districts in the interior of Spain, both within the Autonomous Region of Castilla-La Mancha (Figure 1). In both locations, the processes of applying for heritage status from an institution, in this case UNESCO, together with local initiatives through the LEADER rural development programmes, made it possible to implement highly worthwhile actions leading to their socio-economic revival, given that these are rural areas in decline. We mentioned that the first case study is the *Almaden Mining Park*, listed as a World Heritage Site by UNESCO under the title "Mercury Heritage: Almadén and Idrija". The park is located in the geographical district of the Sierra Morena and Valle de Alcudia, in the municipality of Almadén (Ciudad Real), in south-western Castilla-La Mancha. The second is the *Molina-Alto Tajo District Geoport*, which forms part of the network of UNESCO Geoparks and is located in the high moorland region surrounding Molina de Aragon (Guadalajara), in north-eastern Castilla-La Mancha.

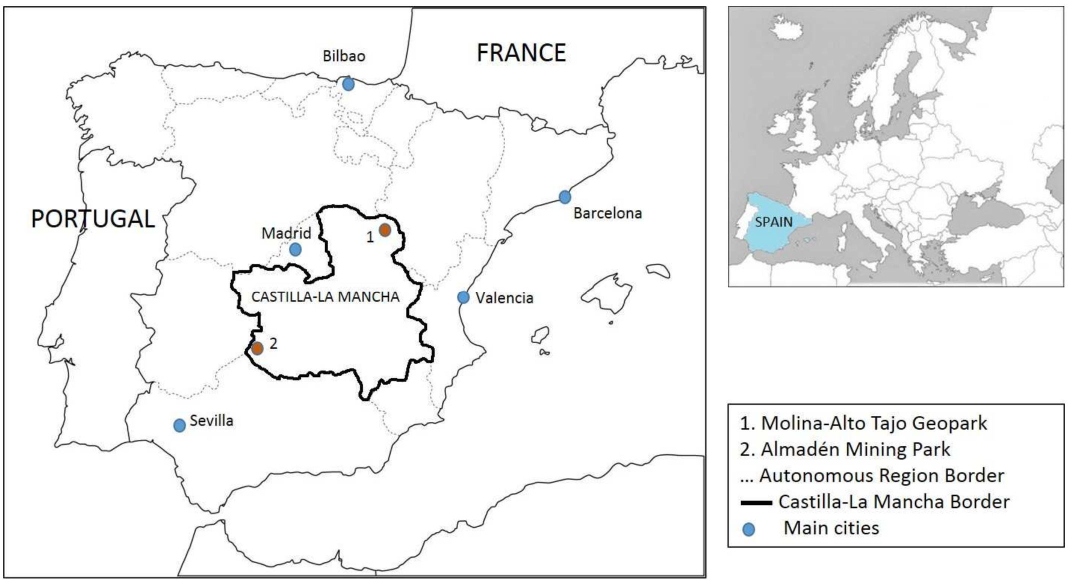

Figure 1. Location of the case studies. Created by the authors.

These are two areas that the Castilla-La Mancha regional government had already included in 2008 in the *Strategic Plan for the Sustainable Development of Rural Areas in Castilla-La Mancha*, in which a large number of the municipalities in both districts were categorised as "Rural Areas to be Revitalised". These areas are characterised by "low population density, a high reliance on agricultural activity, and significant geographical isolation or with limited territorial cohesion" [57] (p. 46), aspects that they all share, along with depopulation, the absence of urban settlements and an ageing population. These limitations were, to a large extent, addressed by rural development programmes that diversified their economies, as far as possible, and profited from the endogenous resources linked with their territorial heritage, which gives them a certain individuality as compared to other areas. These resources must be understood as forming "a whole unit" [58] (p. 72), related with the landscape and closely linked to the identity of the people who inhabit them and must survive in it.

The subsequent *Strategy for the Development of Areas with Depopulation and Socio-Economic Decline in Castilla-La Mancha (2014–2020)* includes a number of municipalities in both districts in the five geographic areas with specific developmental needs that require integrated territorial investments (ITI), making it possible to receive both regional government funds and European structural and investment funds (ESIF). The objective of the strategy is to promote activities in particularly depressed areas and to move towards the socio-demographic recovery of areas classified as requiring ITI, using three vectors: digital connectivity, the promotion of economic activity and the sustainable use of the resources available in these areas [59].

3.1. The Almadén Mining Park (Ciudad Real)

The Almadén Mining Park, which includes the former Almadén Cinnabar-Mercury Mines, is located in the *Sierra Morena and Valle de Alcudia*, a geographical district in south-western Castilla-La Mancha. Important local towns include Puertollano and Almadén (pop. 5312 in 2019). The area is composed of small, semi-rural population centres (Almodóvar del Campo, Argamasilla de Calatrava, Almadén, etc.) and, above all, small villages (Cabezarados, Mestanza, Solana del Pino, etc.). It has a very low population density and its socio-economic base, despite a shift towards the service sector, remains largely linked to the rural environment. Around 33% of population are over 65 years old and only 6% have higher education. All the region decreases population since 2001. Its main city, Almadén, goes from 6975 inhabitants to 5312 in 2019. Its level of development is far from that of some nearby urban centres like Ciudad Real (pop. 74,746), the provincial capital and, above all, Puertollano (pop. 47,035), the main town in the Functional Urban Region that has been defined for this area [60] (pp. 269–270) and acts as a service provider. The communication routes are arranged around a central axis, the N-420 road that crosses the region from north to south, and numerous ancillary regional and local roads. In addition, there are the conventional railway line (Madrid-Badajoz with stations in Puertollano and Brazatortas) and the high-speed line (the Madrid-Seville AVE with a station in Puertollano), which also cross this area in a north–south direction.

3.1.1. The Process for Gaining Heritage Status for the Almadén Mining Park

The process for gaining institutional recognition for its heritage status began by recognising the value of one of the most important mines in the world. It is more than 2500 years old and one-third of the cinnabar mined around the world has been extracted from this mine [61]. The mines in Almadén and also those in Almadenejos, which started in pre-Roman times, were important during Roman times due to the use of vermilion (extracted from cinnabar) as a dye and under Arab rule, when mercury metallurgy began. The mines experienced their greatest boom following the discovery of America, as mercury was used to amalgamate the silver and gold from the New World. They were also active later on, in the 20th century, supplying the mercury used in thermometers and in the chemical industry. Later, the introduction of the European Mercury Strategy forced the closure of this type of mining owing to environmental issues. The end of activities at the beginning of this century marks the beginning of measures to enhance the mine's material (buildings, furnaces, galleries, etc.) and intangible (mining culture) heritage, to help in regional development and alleviate the low socio-economic attractiveness of a highly rural area with a low population density, where a variety of Rural Development Programmes have been implemented over the 1990s.

The creation of the Almadén Polytechnic University School Geological Mining Group in 1984 is the first major benchmark in the protection of this type of heritage, together with the creation of the Francisco Pablo Holgado Historical Mining Museum (1989) and the Royal Forced Labour Prison Interpretation Centre (1995). In fact, the involvement of the University of Castilla-La Mancha was important in inventorying the elements with heritage value (Ecotourism in the Valle de Alcudia Strategic Planning Project-Futures Programme, Mining-Industrial Route in Ciudad Real province). In addition, a private initiative organised through the Almadén District Tourism Society (1995) began to promote tourism in the area. However, the action that finally raised the local people's collective awareness and pushed them to defend something that had, until then, gone almost unnoticed was the Manifesto for the Rehabilitation of the Historical-Mining Heritage of the Almadén District, published by the Spanish Society for the Defence of Geological and Mining Heritage (SEDPHM) in 1996 [62] (pp. 14–17). This was joined by the Association for the Defence of the Historical Heritage in Almadén (1998), the first PRODER Rural Development Programme (1998), now superseded by the LEADER programme, and, shortly after, the formation of the Almadén Round Table (2002), in which all government bodies (local, provincial, regional and national), trade unions, employers and the regional university participated.

The mining complex was added to the *National Industrial Heritage Plan* in 2002, under the Spanish Historical Heritage Institute (now the Spanish Cultural Heritage Institute, Ministry of Culture and Sport), with a philosophy that can be summarised as the need for the protection, conservation and social projection of this heritage. The plan was a fundamental statement of the need to understand and document a key period in our history and establish the basis for its conservation, due to its rapid transformation and deterioration. This is how the state, through this agency, and the company that owns the mine (Mayasa) became involved in implementing the first tools to plan for and prepare the mine for tourist visits, through the drawing up of a *Master Plan*, which was commissioned from the company Quality System and presented in 2003. It was fundamental for shaping the future Mining Park and restoring some of its most important elements [63] (pp. 359–360) in the period 2004–2007, with funding of EUR 10 million. Sometime later, the Almadén Mining Complex (Ciudad Real) was included as one of the *49 elements selected* by the National Plan, as one of the assets related to industrial activity in Spain. It was declared an Asset of Cultural Interest in 2008, and since 2011 the Almadén mining landscape has also formed part of the travelling exhibition *100 Elements of Spanish Industrial Heritage* promoted by TICCIH-Spain (International Committee for the Conservation of Industrial Heritage) as one of the most important mining complexes in the Castilla-La Mancha region.

The creation of the Mining Park in 2004 (it was officially opened in 2008) sought to offer a high-quality cultural, educational and tourist space. Its main aim was to reverse the decline that set in when the mine was no longer economically viable and to show visitors the mining and metallurgical processes associated with mercury production along routes around the mine. The park exists within the context of initiatives to "reinvent" closed mining basins and includes many elements with great heritage value related to mining activity (which took place in both shafts and opencast pits). These activities were located in a space delimited by the mine walls that served to demarcate the mines, and some of the gates in these walls have been preserved and restored, such as the Charles IV Gate. This initiative allows part of the excavations to be visited and visitors can go down to underground galleries (forced labour gallery, etc.) and enter some of the buildings (former Quicksilver Warehouse, now the Mercury Museum). The tour underground makes it possible to visit a real mine and see a reconstruction of the mining work, as well as a number of points of geological interest. In addition, the tour of the aboveground areas allows visitors to see some items of great technological interest that are still preserved, including the two Alludel or Bustamante furnaces (1720–1928), used to convert the cinnabar ore into mercury (Figure 2), which are an example of the technological exchanges between Spain and the New World. There is also the 18th-century San Carlos horse mill on the surface and San Andrés horse mill underground, which are masonry structures used to raise the minerals from the mine.

Figure 2. Buildings at the Almadén Mining Park (aludel kilns and Mercury Museum). Source: María del Carmen Cañizares Ruiz.

However, the most important initiative to publicise and introduce the site to cultural tourism circuits was linked to the recognition of its "outstanding universal value" as a site that should be protected for the benefit of humanity when it was registered, on 6 July 2012, on UNESCO's World Heritage List under the title *Mercury Heritage: Almadén and Idrija*, after two unsuccessful attempts. This registration includes two of the world's largest mercury holdings that provide a valuable heritage in Europe [63] (p. 360). It is particularly noteworthy that this mineral was mined in a very limited number of mines, of which the two largest were Almadén (Spain) and Idrija (Slovenia), where the activity took on an international, strategic dimension and where the exchanges were both economic, financial and related to technical knowledge (Criterion ii); and that both mines constitute the most important legacy of intensive mercury mining, especially in modern and contemporary times (Criterion iv).

In June 2015, after a process of analysis to demonstrate the authenticity of the site and the attractiveness and quality of the experience in regard to the selection criteria, the Almadén Mining Park was also included on the *European Route of Industrial Heritage* (ERIH), as an Anchor Point of exceptional historical importance, offering a high-quality experience to its visitors [64], who have exceeded 170,000 since its opening. In 2019, this route was declared a Council of Europe Cultural Itinerary.

In the town of Almaden, it is also possible to visit the restored Royal San Rafael Miner's Hospital (18th century), Spain's first hospital specialising in mining-related diseases. It houses the Mining Museum, where tools, implements, cartography and mining machinery are exhibited; the Hospital Museum, which recreates the hospital's healthcare functions; and the Historical Mines Archive, which holds important documentation from the company Minas de Almadén and Arrayanes (Mayasa), which owns the mines. Here, we can also find Spain's first Academy of Mines (1777) and one of the oldest bullrings in Spain (1752) with a hexagonal shape whose origin was related with the mines.

3.1.2. Synergy of Land Resources around the Almadén Mining Park

The geographical district in which the Mining Park is situated, the Sierra Morena and Valle de Alcudia (Ciudad Real), has a great wealth of natural and cultural elements with heritage value. From the viewpoint of the natural environment, its location on the northern slope of the Sierra Morena, on the border with Andalusia, stands out. In relation to cultural aspects, in addition to the mining tradition, there are the remains of a prehistoric settlement and agricultural landscapes.

The main *natural heritage resources* are linked, first of all, with an almost undisturbed territorial environment characterised by the presence of gentle hills and shallow depressions, which are typical of the areas raised by the Hercynian orogeny on the Iberian Peninsula, in the western, mountainous sector of the Castilla-La Mancha region. There are also some interesting volcanic outcrops in the area. Two large natural landscapes can be distinguished: the Alcudia valley with its holm oaks and livestock pastures, and the sierras and mountains of the southern area, where the Almadén area is located. Their identifying signs [65] (pp. 411–412) can be summarised as the presence of Mediterranean hills on a siliceous substrate, a hydrographic network that includes rivers, streams, riverside copses and marshes belonging to the Guadiana basin to the North, and the Guadalquivir basin to the south. It also has a great wealth of fauna, since it constitutes "a European paradise for bird watching" [66] (p. 85), with great potential for ornithological tourism.

A large part of the area is part of the *Network of Protected Areas of Castilla-La Mancha* and the *Natura 2000 network*. Since 2011, the creation of the *Valle de Alcudia and Sierra Madrona Natural Park* has been one of the main resources, given the excellent degree of conservation of its ecosystems and its exceptional importance for the geological heritage, biodiversity and landscape of Castilla-La Mancha. It covers 149,463 hectares, spread over eight municipal districts to the north-east of Almadén. The natural park contains gently eroded Paleozoic mountains and ridges, gorges, ravines, boulder fields and valleys, as well as Mediterranean vegetation that combines holm oaks, cork oaks, gall oaks, Pyrenean oak, juniper and strawberry trees, and an enormous biodiversity of fauna (wolves, Iberian goats, etc.) and especially birds, with more than 160 species [67], including the imperial eagle and black stork. In addition, associated with this great natural wealth we find a number of intangible resources of some importance, such as the "Valle de Alcudia Crane Festival", the third edition of which was held in January 2020. All this makes it possible, today, to maintain a service-based economy associated with rural tourism, eco-tourism, green and nature tourism that contributes to the diversification of the local economies. We can also add two Special Protection Areas for birds (SPAs) and five Special Protection Areas for flora and fauna with mammals, amphibians and reptiles, fish, invertebrates, plants and plant communities of interest, plus four important areas for birds designated by the International Birdlife Programme.

In addition, the main *cultural heritage resources* are linked to the presence of humans in this area, from prehistory to the present, both in the Paleolithic and, mainly, in the Neolithic periods. Numerous examples of schematic cave paintings from the latter period can now be visited that are included in the Mediterranean Arch UNESCO World Heritage Site (sites at La Batanera, Penaescrita, etc.), to which we can add late Bronze Age funerary steles (Alamillo, Almaden, Chillón, etc.). Settlement became more consolidated during the pre-Roman era and especially with Romanisation, when the Alcudia valley, which is rich in minerals, took advantage of its strategic location between Toledo and Cordoba. This is the reason that these *archaeological heritage* resources are complemented by sites such as La Bienvenida, formerly Sisapo, which was the management centre for the Almadén mines in Roman times.

Over the centuries, the activities that have given the area its uniqueness have been agriculture, predominantly sheep herding, because of the wealth of its pastures, and mining, due to the existence of lead, argentiferous galena and coal. For agriculture, its privileged position on the route between Castile and Andalusia during the Middle Ages and part of the modern age, when it was under the rule of the Order of Calatrava, made it into a centre for the herds of La Mesta, the guild of sheep herders, giving it a certain prosperity. This situation would change later on, when the route was diverted in the 18th century through the Despeñaperros gorge, improving communications between the centre and the south of the Peninsula but resulting in its subsequent isolation, which, together with land seizures during the 19th century, reinforced its rural character with the dominant presence of large estates [68] (p. 116). Today, this "district is characterised by the presence of large farms engaged in rain-fed agriculture dedicated mostly to pasture and sheep farming" [69] and hunting estates, forming a humanised landscape (Figure 3) which currently provides resources associated with the *agricultural heritage* such as pasture and, specifically, with what has been called the "heritage of transhumance" related to livestock routes (drovers' roads, byways, paths, troughs, inns, etc.).

Figure 3. Agricultural landscape in the Valle de Alcudia. Source: M. A. Serrano de la Cruz.

In terms of the resources associated with the area's *mining heritage*, in addition to the Mining Park there are other sites, including Almadenejos with its reconstructed mine wall, as well as the remains of numerous mines dedicated to the extraction of lead and argentiferous galena (a mixture of lead and silver), whose origin dates back to the Roman period (Mina Diógenes, Fundición de Valderrepisa, etc.) and to the 18th and 19th centuries (Minas de Horcajo, etc.), which, for the most part, are in a precarious state of conservation; or more recently, in the late 19th and early 20th centuries, the coal mines around Puertollano where the Mining Museum is located.

To the above we can add outstanding examples of *vernacular, civil and religious architecture*, such as inns (the "Venta de la Inés" mentioned in Don Quixote) and their environs, manor houses and civil buildings (the Academy of Mines in Almadén) and bridges and parish churches (Nuestra Sra. de la Asuncion in Almodóvar del Campo). Finally, in the realm of immaterial resources related with the *ethnographic heritage*, important examples include the Santa Bárbara Mining Festival (Puertollano, Almadén, Hinojosas de Calatrava, Almodóvar del Campo, Cabezarrubias del Puerto and Almadén) and the Virgin of the Mine Festival (Almaden), the San Antón Livestock Festival (Villamayor de Calatrava), the San Isidro, San Antón and San Sebastian agricultural festivals throughout the district, and the feast days (Cabezarrubias del Puerto), along with the Festival of the Relic in San Lorenzo, the running of the bulls in Almodóvar del Campo, and the Carnival in Almadén. The cuisine has a certain variety of cheeses and dishes linked to livestock farming, such as *migas* and *gachas* and dishes of Arab origin in the area around Almadén (*pisto de alboronía*). The most important handicrafts include forging, carpentry, leather work and horn and wood carving.

3.1.3. The Mining Park and the Revival of Local Development

We have now had the opportunity to see how the mining complex at Almadén represents a key reference point in the identity of the district due to its historical, economic and social implications. The announcement of the closure of the mines and the socio-economic decline of many of the municipalities in the district led a number of social agents to decide to collaborate to create the Mining Park, as we have explained above. This was a clear example of collaborative governance between institutions, private initiative and the local population.

One of the associations created to promote the development of the district under the auspices of the rural development programmes was the *Association for the Development of the Almadén Montesur District* [70]. It was formed in 1996 and two years later it began to manage an Operational Programme for Rural Development (PRODER) and, since 2007, the EU's LEADER initiative, currently LEADER

Axis 19 (2014-2020). The association includes eight municipalities with a population of just over 11,000 inhabitants, with an average density of 10.02 inhabitants/Km^2. Although the Participative Territorial Strategy of the Local Action Group (LAG) points to the decline of mercury mining as the most important event in the district, the recognition of the park as a World Heritage Site was a milestone in their planning, "marking the future of rural development". This idea is reflected in the existence of a number of initiatives by the mining company, the LAG and the town council intended to promote ecotourism. They include a Heritage and Tourism Round Table, which puts considerable effort into heritage conservation and tourism promotion, a commitment to training industrial heritage and mining guides, support for the establishment of tourism enterprises associated with the Park, and the use of the district's rich resources, including the *Dehesa de Castilseras* natural areas belonging to Mayasa, where the 2nd Trail and MTB race (a race combining running and cycling) was held.

The interconnections between the different public and private organisations were very beneficial during this period. Currently, there are applications for inclusion in a variety of interregional networks, such as the *Interregional Mineland Project*, which, in collaboration with other local action groups in other Spanish autonomous regions (Aragon and Andalusia), seeks to promote tourism to this type of destination. Interconnection with the regional government is considered a key factor here, as this collaboration requires the appropriate institutional permits. There are also collaborations at the national level, including the group's possible inclusion in the *Integral Quality System for Spanish Tourist Destinations (SIGTED)*, which is a national initiative (Secretariat of State for Tourism) that seeks to improve the quality of tourist destinations through a holistic approach, something that is particularly important in times of crisis like the current one. The fact that this proposal for inclusion in SIGTED was made with the joint collaboration of the LAG, Almaden Town Council and the Mining Park shows the level of local cooperation achieved and the efforts being made to implement measures to improve local tourism through collaborative governance.

On the part of the Park, there is a willingness to continue, as far as possible, pursuing all the pending actions to protect and increase its tourist resources. Funding has been requested for this from the Ministry of Public Works to refurbish the San Carlos horse mill in Almadenejos. Two old buildings are also being refurbished for use by the museum in order to increase the exhibition area dedicated to the miners and the training in printing that their children received at the school for the workers' children. However, the pandemic in 2020 will no doubt jeopardise the future of this initiative, which was already experiencing problems regarding its economic viability. It may take two or three years for the number of tourists visiting to return to that seen in 2019 and it may not bring about economic recovery in the tourism sector—it would simply minimise the losses, as it is difficult for visitors to find accommodation in the area. It is, therefore, considered to be highly necessary to make use of all the resources in the district (natural and cultural) in order to offer a high-quality destination and experience to visitors.

3.2. The Molina-Alto Tajo District Geopark (Guadalajara)

The Molina-Alto Tajo District Geopark is located in the high moorland areas surrounding Molina de Aragón, which is one of the most attractive natural areas in the interior of the Iberian Peninsula. Historically, the town of Molina de Aragón (pop. 3275 in 2019), in north-eastern Castilla-La Mancha, was the seat of the Lord of Molina-Alto Tajo. This area is characterised by a very low population density, since in just over 4400 km^2 there is a population of some 7000. It is one of the least densely populated areas in Spain, which has led to its being called the "Spanish Siberia" or the "ground zero of European Union depopulation". The town of Molina De Aragon itself does not have the rank of urban nucleus but its function is crucial in organising a territory that acts as a second level dependent area in the Guadalajara functional urban area [60] (p. 265), in an isolated area with altitudes of over 1400 m. Three-quarters of the municipalities contain below 100 inhabitants, and 45% population are over 65 years old. Molina de Aragón, as the main city, continues to absorb the population lost by smallest municipalities, going from 3244 inhabitants to 3275 in 2019. The region's economic base continues to be mainly linked to rural, forestry and livestock activities, among which rural tourism is gaining weight. It has a level of development far from that offered by the city of Guadalajara (pop. 85,871) and the industrial and service activities of the Henares corridor that connects it with Madrid. Here too, the roads are organised around a central axis, the N-211 road that crosses the area from north-east to south-west, and numerous ancillary regional and district roads. There are no railway lines in the area.

3.2.1. The Process to Gain Heritage Status for the Molina-Alto Tajo District Geopark

The natural wealth of the north-eastern area of the province of Guadalajara, especially in relation to its geology, has been decisive in the process of gaining heritage status that culminated with the creation of the Geopark in 2014. The area is characterised by its rich geological heritage and remarkable geodiversity, including the mountain ranges of the north-eastern Castilla-La Mancha Alpine chains, specifically the mountains that extend through the provinces of Guadalajara and Cuenca, alternating with deep valleys, ravines, canyons, high moorland and high plains. Over many decades, numerous research groups have highlighted the geological value of this territory. This district was even the subject of one of the oldest geological studies, as the monk Joseph Torrubia made a number of palaeontological and mineralogical findings, which he published in his work *Apparatus For Spanish Natural History* (1754), considered to be the first treatise on Spanish palaeontology. A significant part of the area forms part of the *Protected Areas of Castilla-La Mancha Network* and the *Natura 2000* network and there are several Special Protection Areas for birds (SPAs) and Special Protection Areas for flora and fauna. This degree of protection demonstrates the area's geomorphological value (Alto Tajo, the lakes and high moorland around Señorío de Molina, Parameras de Maranchón, Hoz del Mesa and Argoncillo), and biogeographical value (the savin juniper groves around Alustante-Tordesilos), among others. The Sierra de Caldereros has been declared a Natural Monument and Special Protection Areas for flora and fauna.

In 2000, the first step was taken to enhance the local territorial heritage by protecting part of this area; the *Alto Tajo Natural Park* was created in an area stretching across the border between the provinces of Guadalajara and Cuenca. The natural space, now protected, includes the ravines linked to the Tajo river network, as well as its geological and biogeographical resources, with one of the clearest examples of a karst landscape in the interior of the Iberian Peninsula. In addition, its excellent degree of conservation is demonstrated by the presence in its pine forests and riparian forests of birds of prey, small mammals, reptiles, nine classes of amphibians and seven native species of fish [71]. Today, it has become a national benchmark due to the implementation of numerous initiatives relating to geo-conservation, geological heritage inventories and geological outreach under programmes promoting the public use of natural heritage areas. These include the Geo-Routes Project, which began in 2006 with the aim of providing a set of interpretation resources relating to the protected area—namely, nine self-guided geological interpretation routes (with a total of 120 km and 91 stops equipped with boards and panels)—to which two outside the park, in the Valle del Mesa and Sierra de Caldereros, have been added more recently. Other inclusions are a collection of 10 brochures for visiting these routes, an internationally recognised geological guide to the Natural Park, and geological information in the four Interpretation Centres in the Natural Park. The work undertaken by the *Molina District Museum* for more than a decade has been fundamental in popularising disciplines such as palaeontology, mineralogy, archaeology and the natural sciences, with exhibitions, publications, seminars and many other activities (more than 200 in the last 5 years). These include promoting inventories of the palaeontological and archaeological sites in the area and excavations to recover specimens in places threatened with destruction or theft, which are then exhibited in the museum's collection.

To understand the path followed until the creation of the Geopark and, therefore, its universal recognition by UNESCO, it is essential to point out that—as in other areas—the geological heritage on which this initiative focuses can become a fundamental part of the social and economic welfare of its environment. It can also effectively contribute to the sustainable development of the rural environments in which is usually located, as the *Girona Declaration on the Protection of Geological Heritage* [72] shows. However, its recognition is limited and it is not exempt from the difficulties that stem from a lack of awareness regarding the need for conservation and protection by government departments and society, or the problems of finding funding for interpretation centres and/or museums. Even so, in the last two decades, international networks have proliferated that promote their recognition [73] (p. 24). In 2001, under the auspices of UNESCO, the *Global Geoparks Network* (GGN) was established, which began operating in 2004 as a legal, non-profit organisation whose members undertake to work together, exchange ideas for best practices and take part in joint projects to raise the quality standards of products and practices. Ratified in 2014 as part of UNESCO's International Earth Science Programme, it is currently managed in collaboration with the Global Geoparks Network International Association. Initially made up of 17 parks in Europe and two in China, today it groups together 141 UNESCO World Geoparks in 38 countries, whose collaboration and cooperation are crucial [74]. In this context, the *European Geoparks Network* (EGN) was formed in 2011 as "the most important initiative for the conservation and promotion of geological heritage in the European Union" [75]. It began at the turn of the century as an idea for grouping together four areas that shared important geological heritage and a sustainable territorial development strategy linked to the LEADER rural development programme. Today, it includes 74 territories listed as such in 24 countries and aims to offer support to its members on sustainable territorial development. In this context, each Geopark is responsible for a management and action plan describing its operation and activities regarding the identification and assessment of land heritage sites, the validation of items of natural and cultural heritage, geosite protection and geoconservation, heritage interpretation and geotourism infrastructure and activities, environmental education tools, advocacy, support for local businesses, oversight and international relations [76] (p. 114-115). In Spain, the global and European network is represented by the *Spanish Geoparks Forum*, which consists of 12 territories characterised by having a unique geological heritage, their own development strategy, defined boundaries and sufficient geographical area in which to generate their own economic development, taking into account the quality of life of their inhabitants [77].

The Molina-Alto Tajo District Geopark project was proposed in this context to combine the efforts of the abovementioned bodies in a Natural Park and Museum, establishing effective cooperative links through a top-level organisational structure that would allow work to be undertaken in coordination with each other and in cooperation with other government departments and institutions, guaranteeing quality and scientific and social criteria. The official application was prepared by a team made up of representatives from the Guadalajara Provincial Council, Alto Tajo Natural Park (the Castilla-La Mancha regional government's Agriculture Department), the Spanish Geological and Mining Institute (SGMI) and the Molina-Alto Tajo Rural Development Association, all coordinated by the Friends of the Molina Museum Association, the promoter of the Geopark. The Museum and the Natural Park function independently and devote part of their work to meeting, jointly, the objectives relating to geo-conservation, awareness raising and the promotion of tourism that define a Geopark [78]. In fact, we should emphasise that this initiative allows the objectives established for Spanish Geoparks, to "explore, develop and promote the relationships between their geological heritage and all other heritage aspects—whether natural, cultural or intangible—present in the area" [79], to be pursued from a comprehensive viewpoint that we are linking here to territorial heritage.

3.2.2. Synergy between Territorial Resources around the Molina-Alto Tajo District Geopark

The Molina-Alto Tajo District Geopark is located in the Molina (Guadalajara) high moorlands geographical region, which also presents a great wealth of natural and cultural elements with heritage value. Geographically it is located in the foothills of the Iberian System on the border between Castilla-La Mancha and Aragon, while its cultural aspects include a tradition of forestry and agriculture and traces of prehistoric settlements and a number of unusual mining sites, along with important civil and defensive buildings [79].

Its main *natural heritage resources* are linked, first and foremost, with an almost unpopulated and, therefore, mostly unaltered territorial environment in which the *geological heritage resources* include the presence of important stratigraphic series from the Paleozoic (Ordovic and Siluric) and Mesozoic (Triassic, Jurassic and Cretaceous). Significant examples include the lower Silurian section, which is a global biostratigraphic reference; the section with the Toarcian-Aalenian boundary in Fuentelsaz, one of the three Global Boundary Stratotype Section and Point (GBSSP) reference points in Spain that have been approved by the International Union of Geological Sciences (IUGS); the fossilised trees from the Permian period in the Sierra de Aragoncillo; the aragonite type locality; the Permian-Triassic section in the Barranco de la Hoz (Figure 4); and the folds near Orea and Cuevas Labradas.

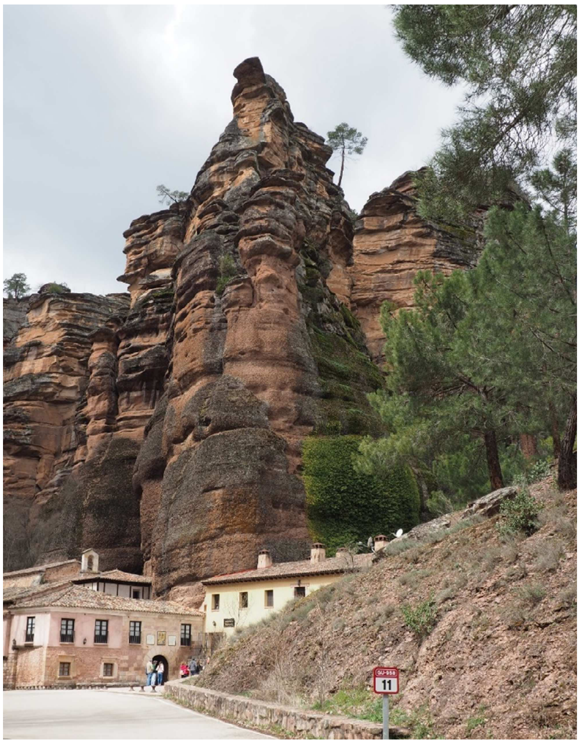

Figure 4. Barranco de la Hoz. Source: María del Carmen Cañizares Ruiz.

The main features of the landscape, together with the beauty of the mountains and river valleys associated with the Tajo basin, include great lithological diversity (with rocks over 400 years old), the existence of various mineral deposits, particularly aragonite (El Portezuelo and Morro Gorrino in Molina, Los Callejones in Riba de Saelices, etc.), and palaeontological diversity (Argoncillo Fossil Forest), a number of tectonic faults (ravines, canyons, etc.) and a great geomorphological diversity that produces the varied landscapes found in the area. It also has a significant biogeographical richness, especially in its pine forests (wild pine, black pine, maritime pine, etc.), pyrenean and gall oak, together with holm oak and especially juniper groves in the high moorland areas (Spanish juniper, Phoenicean juniper and savin juniper). The geopark is also home to avian fauna (griffon vulture, Egyptian vulture, golden eagle, Bonelli's eagle, peregrine falcon, etc.) including Dupont's lark and mammals (rabbits, hares, roe deer, wild boar, etc.), and aquatic species (trout, crabs, etc.). Many of these resources support hiking trails, with a number of viewing points (Barranco de Hoz, Pellejero, Machorrillo, etc.), as well as various active and/or nature tourism initiatives that are linked with canyoning (Pozo Verde in Embid and Barranco de Las Covatillas), canoeing, cycling, etc. and even astronomical observation (Peralejos de las Truchas).

The main *cultural heritage resources* are linked to human presence in this area, from prehistory to the present. The *archaeological heritage* includes Paleolithic cave paintings (Cueva de los Casares and La Hoz), and schematic Levantine art (Rillo I and II), the latter listed as a UNESCO World Heritage

Site. From later periods there are remains of Celtiberian (El Ceremeño, Los Rodiles, etc.) and Roman (Zaorejas) sites, and medieval and modern defensive constructions.

We should highlight the uniqueness of the varied *industrial heritage*. Starting with *mining*, because of the mineral wealth of this area (iron, copper, silver, salt, etc.), there are numerous remains of mine workings, although they are in a precarious state of conservation. However, the remains of the rock salt mines (ponds, warehouses, mills, etc.) have great importance. Most of them were started during the Roman period, including those in Armallá, Saelices de la Sal (Figure 5) and Terzaga, and reached their peak in the second half of the 18th century when the Crown took over the management of salt. The remains of old factories linked with traditional crafts such as resin collecting are also representative of the region's industrial heritage. These remains were very important in the late 19th and early 20th century and are displayed in the Orea Interpretation Centre. Timber production and log transportation on the Tajo can be seen in the Zaorejas Interpretation Centre, together with some lime kilns, and there is the Jorge Bande Museum in Corduente, in a former munitions factory.

Figure 5. Remains of salt mines in Saelices de la Sal. Source: The authors.

Regarding *agricultural heritage*, we should note the presence of some huts (with remains in Ablanque and Escalera), which were built to protect the livestock and have a singular beauty. They were made of limestone, wood and branches of savin juniper to shelter the shepherds and their flocks. Some fulling mills and flour mills can also be found, most of them in disuse.

The *defensive, civil and religious architecture resources* include some that need to be taken into account in development strategies. The first include mediaeval castles and fortresses (Molina De Aragon, Santiuste, Zafra, etc.) and stately towers and watchtowers (Torre de Aragón, La Yunta, Ponce de Leon, etc.). The most significant examples of vernacular and civil architecture, generally, are houses in the vernacular style (the Stone House in Alcolea) and those popularly called "casas molinesas" or fort houses (Casa Grande in Valhermoso, Casa Fuerte Vega de Arias, etc.), the remains of the Roman aqueduct in Zaorejas and the Romanesque bridge in Molina de Aragón. Finally, in the sphere of religious architecture we should note some monasteries, such as the Cistercian Madre de Dios in Buenafuente de Sistal, Renaissance and Baroque churches (Santo Domingo de Guzman in Argar De Mesa, etc.) and numerous examples of "paírones", monoliths of Celtic and Roman origin that served as religious and orientational markers (Argar De Mesa, Amayas, Cillas, Embid, etc.)

Finally, in relation to immaterial resources, the *ethnographic heritage* includes the festivities around the Parade of the Military Brotherhood of Carmen and the Gancheros Festival, both in Molina de Aragón, the Spears and the Praises to the Virgin de la Hoz in Corduente, the Soldadescas parades in Codes and Hinojosa, the Procession of the Virgin of Montesinos in Cobeta, the Chants to St. Timothy in Alcoroches and the Carnival of the Devils in Luzón. In terms of cuisine, we should mention the resources of the area, which include kid and lamb, trout, truffle dishes, oyster mushrooms, chanterelle and boletus mushrooms, pork products, *morteruelo* (a dish with pork liver and game meats) and, to top it all, cow's foot. The local crafts are the work of leather embossers, stonemasons, sculptors in stone and wood, blacksmiths and potters.

3.2.3. The Geopark and the Revival of Local Development

As we have already indicated above, a variety of social agents and institutions were actively involved in the official bid for geopark status, coordinated by the Friends of Molina Museum Association. This capacity for dialogue around a joint project shows the significant degree of dynamism and social participation invested at the local level in the enhancement of the natural and cultural heritage. Among the institutions that have played a more decisive role in spreading these heritage values are the Alto Tajo Natural Park and the Molina de Aragón District Museum. The park offers a wide-ranging programme of initiatives focusing on geoconservation, with the already mentioned Geo-Routes Project as the main exponent. The District Museum has the important job of welcoming visitors and providing information at all levels. There is also collaboration with the district's state primary and secondary schools, with the Geopark forming a cross-curriculum theme in the schools' syllabuses with content on archaeology, geomorphology, cave paintings, etc., to reinforce the regional identity of the local population. A number of experts and professionals are also collaborating in the growth and promotion of the museum along its different thematic lines (entomology, palaeontology, wildlife, archaeology and human evolution), using the most visible resources in the Geopark.

The commitment to participation in and the dissemination of natural and cultural values is reflected in the Geopark's two management bodies: the Executive Committee, which has representatives from the local, provincial and regional governments, as well as the Natural Park and various local associations, and the Scientific Committee, which includes 30 professionals from different academic branches with the aim of outlining strategies for scientific dissemination. Both bodies participated in drafting the *Geopark Master Plan*, deciding on the actions to be coordinated with other institutions. The projects proposed are aimed at bringing about strong coordination between local and provincial stakeholders and institutions, especially within the Guadalajara Provincial Council and the Alto Tajo Rural Development Group, which manages a LEADER initiative, while relations with other government bodies (both regional and national) are much more limited. The links with the regional government are based on regulatory compliance and the financing possibilities that have opened up now that the whole district has been declared an Integrated Territorial Investment (ITI) area. The ITI programme aims at a more effective use of the Structural Funds in areas with depopulation problems, and participation in tourism promotion strategies in general. The Geopark's managers indicate that the geographical distance from the headquarters of the regional government (in Toledo) plays an essential role in weakening relations. In addition, the influence of the Madrid metropolitan area also limits interactions with other institutions, such as the Regional University. Collaboration with the national government and organisations such as UNESCO is rated as very low key. While it is true that the UNESCO stamp confers an identifying mark of the highest order, the Geopark's managers interpret it as being more a distinction that serves to underpin a broader territorial revitalisation scheme. This is demonstrated by the varied nature of the actions carried out in recent years, including opening new visitor centres, promoting employment plans and the abovementioned educational projects, which strongly involve the local population. In short, it is intended that the "Geopark" emblem should not be a simple label with no applied functionalities or for strictly commercial purposes. These latter issues reinforce our view that, in order to ensure the viability of the initiative, it is essential to harness the synergy of resources that form part of the territorial heritage.

4. Discussion

The cases analysed show how the enhancement of natural and cultural resources, which took place under the auspices of international, national or regional institutions, has led to the rapid involvement of the local communities. The level of commitment achieved shows that there is sufficient human capital, with some leaders organised around local associations, who are energising their areas with the help of other socio-economic agents. The commitment to endogenous resources as a tool for economic diversification and territorial development is ingrained in the philosophy of rural development programmes and, in the cases that concern us, with two territorial initiatives recognised by UNESCO. The effort must be redoubled, by taking advantage of the complementarity of territorial resources with great potential and because there is a lack of exogenous investments to promote development in the area. It is therefore necessary for coordination, trust, cooperation and promotion to be the cornerstones of relations between the different government departments that have jurisdiction over the territory, in order to optimise collaborative governance, as we have explained with the two case studies analysed.

The results of the interviews show that the relations are much stronger and more fruitful with nearby areas, i.e., between the municipalities, local associations and the Provincial Council, first and foremost. The involvement of the local population in the process of gaining heritage status was made possible by the local associations, coordinated by the units that manage the LEADER initiative and a variety of groups, such as the Association for the Defence of Historical Heritage in Almadén in the former and the Friends of Molina de Aragon Museum Association in the latter. The fact that heritage enhancement is not just focused on LEADER enriches the debate on the territorial model by introducing new social actors who are not represented in the Local Action Groups. In addition, the management bodies of the parks themselves are also involved and they promote a variety of projects in collaboration with the aforementioned organisations, demonstrating that the social fabric of each district has sufficient strength to coalesce around common objectives, as shown by the Local Action Groups Participatory Development Strategies. We are, therefore, in both cases, dealing with territorial development processes that are based on three factors: Local Action Groups, local associations and specific initiatives (Mining Park and Geopark). At the local level, their involvement favours the creation of interesting projects, such as educational ones, which have multiple benefits in addition to mere knowledge, among them the construction of territorial identity and the enhancement of key social and economic resources. Additionally, stronger collaboration at the local level reinforces a series of intangible links that play a vital role in rural enterprises: personal contact increases feelings of solidarity, belonging and identity around common resources, which leads to a greater ability to adapt the socio-economic fabric in times of crisis, such as the current one. Despite this solid collaboration, we can find some administrative limitations, such as in the Almadén Mining Park, which belongs to a SIHC (State Industrial Holding Corporation) so that any collaboration with the Montesur LEADER initiative cannot be financial, although it can take the form of promotion. In addition, the LAG cannot act in relation to the company that manages the park because the latter has more than 50 employees (currently there are 61).

In their relations with other institutions, both the Mining Park and the Geopark are a good example of how initiatives planned by national, regional and provincial governments can tie in with the local population's developmental and resource-related objectives. However, the interviews confirmed that the level of cooperation with these bodies is still far from optimal. At the Almadén Mining Park it was said that neither the central nor the regional governments have met their commitments. In addition to this, collaboration with these two government bodies is reduced to quite specific or unimportant issues, and the same financial support has not been received as other world heritage cities in the region. These limitations are also mentioned by the LAG itself, as efforts to strengthen the regional identity are sometimes met with little national and regional support. This gap is filled by a search for greater visibility for the territory and its riches at tourism fairs (FITUR) and fairs of other kinds (Fair of Flavours). In the case of the Molina-Alto Tajo District Geopark, we have already indicated how relations at the national level are non-existent and that, at the regional level, they are limited to issues of regulatory compliance or access to special funds to combat depopulation. We believe that the relatively isolated geographical location of the Geopark partly explains the absence of real avenues for collaboration with the regional government. However, the proximity of Madrid, which belongs to a different region, determines the district's functional relationships with the national capital in such important aspects as institutional relations, tourist behaviour (visitors from the Madrid metropolitan area), the attraction of labour into the active population of the capital, etc. In addition, the isolation of the park is compounded by its being situated on the border with other autonomous regions and by its distance from the headquarters of the regional government (Toledo). Given these shortcomings, new technologies are gaining importance in promoting territorial and economic development, although there are still areas, especially forests, where Internet access is not yet available.

The Almadén Mining Park and Molina-Alto Tajo District Geopark projects represent an opportunity for the territories in which they are located, given the wealth of existing resources. Both initiatives are understood to be territorial development projects by the local stakeholders. Far from being a simple label for sectoral or restricted purposes, they have become resources on which to base and promote policies with a territorial impact. In the case of the Mining Park, the company that owns the mines has proposed including a more district-wide tourism project to pull in visitors by offering a wider range of attractions based on the existing resources. In short, there are opportunities for high-value endogenous development, by encouraging heritage rehabilitation that will help to preserve the identity of many of its municipalities, such as Almadén and Almadenejos, which are both known worldwide, as well as offering an opportunity to generate employment in the tourism sector. In the case of the Molina-Alto Tajo District Geopark, this translates into multiple activities related with accessibility, lifelong learning, research, promotion and economic diversification. The district now has 400 workers in the hospitality sector and the Molina Museum itself received a total of 10,800 visitors last year. The opportunities for heritage enhancement are also complemented by the quality of the environment in both districts as they are relatively unaltered and have great landscape value.

With regard to the main weaknesses identified, we note that both initiatives have significant gaps in transport infrastructure that could improve accessibility, not only by road but also by rail; population ageing is also an issue that affects the labour markets, as is the absence of a genuine business culture. These are common structural factors in sparsely populated areas, the solution to which requires much more ambitious frameworks for action. Each of these districts also has other specific problems. In the case of the Mining Park, the limited investment in promotion should be noted, which is in proportion to the resources available. It can be said that the design of the Mining Park affects its viability, as it has high maintenance costs and, despite being a priority in terms of tourism, is still unfinished. These issues are compounded by the sparse population of the area and the limited services available. For the Molina-Alto Tajo District Geopark, the imbalances in the district's agricultural structure, the absence of a solid business community, the seasonality of many of its villages, which are uninhabited for several months a year, and the greater dynamism of the county town compared to the other towns and villages result in the problems of territorial structuring that are associated with a widely dispersed population.

To sumarise, two initiatives have been presented that have great value, given the wealth of their heritage and the limited anthropogenic transformation of the territories in which they are located, but where the implementation is still far from having the national or regional, or even local, recognition warranted by the possibilities that they offer. Undoubtedly, this is an area in which work will continue to be done based on collaborative governance, as it is essential for this to occur so that the local population makes identifying the value of the assets with which it identifies a priority. It is especially necessary to bridge the gap between the potential value of the existing natural and cultural resources, as we analysed in the section on synergies, and the actual income from the development of these areas. In this sense, the main weaknesses that must be overcome include improving the marketing strategies, optimising the accommodation structures and, above all, increasing accessibility. To do so will require the involvement of other government departments and/or other sectoral policies, since collaboration should not only be intersectoral. In other words, to promote high-quality tourism, or to share experiences, with the demonstrable results achieved by other groups, we advocate the consolidation of true collaborative governance that is comprehensive in terms of its territorial scope and takes into account all areas of management, namely, socio-educational infrastructure, accessibility, demographic revitalisation, diversification of activities, etc., something that still needs to be worked towards jointly and with greater involvement from the population.

The results related to the potential generated by the territorial resource synergies in the case-studies analysed can be extrapolated to other Spanish territories with similar characteristics, mainly those areas classified as Geoparks by Unesco. This is the case with Las Loras Geopark, located in the provinces of Palencia and Burgos, with a population of around 10,000 inhabitants (similar to the Geopark Comarca de Molina-Alto Tajo). The mountain landscape and canyons of the Ebro River are complemented by agricultural landscapes and the agri-food industry, numerous archaeological sites, and the oil farms of Ayoluengo. The results achieved could be applied, with some limitations, to the Villuercas-Ibores-Jara Geopark (province of Cáceres), where the landscape of mountains and valleys aligned with resources derived from agriculture, phosphate mining farms and the pilgrimage route through the heart of Guadalupe is combined. All of these Geoparks have local associations of rural development that promote local community revitalisation.

5. Conclusions

Combating the depopulation of rural areas necessarily involves incorporating comprehensive policy frameworks that, on the one hand, are capable of interpreting the major overall demographic dynamics and, on the other, are committed to coordination and cooperation between all the sectoral policies that are directly involved in the structure of the area. The enhancement and conservation of the rich natural and cultural heritage of many of these rural areas could play an important role in this structuring and in mitigating depopulation processes. The results of this study show that collaborative governance models would be, a priori, the most appropriate and rational way to promote the enhancement of territorial resources. However, coordinating and optimising these relationships is not an easy task, so we can conclude that there are significant limitations to the implementation of true collaborative governance and that it is necessary to incorporate all the existing resources into a joint strategy that is cost-effective for the local population. The main shortcomings observed at the interface between governments responsible for decision making and local communities include inadequate promotion of the initiatives proposed; a need to strengthen the means for participation; the monitoring of the possible harmful effects of other sectoral policies that affect the area; the elimination of unequal or preferential treatment for other initiatives based on the same territorial protection or distinctiveness; and, lastly, the adequacy of the formulas required to support the proposals and decisions of the social actors in rural areas. This social capital, which is characterised by the capacity for leadership of some of its members, is and will be the driving force behind the revitalisation of rural communities, strengthening their territorial identity and economic diversification, always based on the integration of all the resources that make up the enormously valuable territorial capital of the two cases analysed, which serve as examples of what is happening in other rural areas in the interior of the country.

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Abbreviations

The following abbreviations are used in this manuscript:

APRODERVI	Association for the Promotion and Rural Development of the UNESCO World Geopark of Villuercas-Ibores-Jara
EFSI	European Fund for Structural and Investment
EGN	European Geoparks Network
ERIH	European Route of Industrial Heritage
FITUR	International Tourism Trade Fair
GBSSP	Global Boundary Stratotype Section and Point
GGN	Global Geoparks Network
ITI	Integrated Territorial Investment
IUGS	International Union of Geological Sciences
LAG	Local Action Group
LEADER	Liaison Entre Actions de Développement de l'Économie Rurale
PRODER	Operational Programme for Rural Development
SEDPGYM	Spanish Society for the Defence of Geological and Mining Heritage
SFMP	Spanish Federation of Municipalities and Provinces
SIGTED	Integral Quality System for Spanish Tourist Destinations
SIHC	State Industrial Holding Corporation
SPAs	Special Protection Areas
TICCIH	International Committee for the Conservation of Industrial Heritage
UNESCO	United Nations Educational, Scientific and Cultural Organization

References

1. Faludi, A. La Política de cohesión territorial de la Unión Europea. *Boletín de la Asociación de Geógrafos Españoles* **2005**, *39*, 11–30.
2. Fernández, A.; Pedregal, B.; Rodríguez, J.C.; Pita, M.F.; Zoido, F. El concepto de cohesión territorial. Escalas de aplicación, sistemas de medición y políticas derivadas. *Boletín de la Asociación de Geógrafos Españoles* **2009**, *50*, 157–172.
3. Pillet, F.; Cañizares, M.C.; Ruiz, A.R.; Martínez, H.S.; Plaza, J.J.; Santos, J.F. Los indicadores de la cohesión territorial en el análisis de la escala supramunicipal o subregional: Policentrismo y áreas funcionales urbanas (FUAS). *Ería* **2013**, *90*, 91–106.
4. Medeiros, E.; Rauhut, D. Territorial Cohesion Cities: A policy recipe for achieving Territorial Cohesion? *Reg. Stud.* **2020**, *54*, 120–128. [CrossRef]
5. Pillet, F.; Cañizares, M.C.; Ruiz, A.R.; Martínez, H.S.; Plaza, J.J. Dinámicas demográficas y su relación con la cohesión territorial en las áreas funcionales urbanas de Castilla-La Mancha (España). *Boletín de la Asociación de Geógrafos Españoles* **2018**, *76*, 153–182. [CrossRef]
6. *Tratado de Lisboa*; European Union: Lisboa, Portugal, 2007.
7. *Estrategia Territorial Europea*; European Union: Bruselas, Bélgica, 1999.
8. *Informe Intermedio Sobre la Cohesión Territorial*; European Union: Luxemburgo, Luxemburgo, 2004.
9. European Union. Demographic Trends in EU Regions. European Parliamentary Research Service. 2019. Available online: https://ec.europa.eu/futurium/en/system/files/ged/eprs-briefing-633160-demographic-trends-eu-regions-final.pdf (accessed on 24 May 2020).
10. European Union. How Can Regional and Cohesion Policies Tackle Demographic Challenges? Directorate-General for Internal Policies. 2013. Available online: https://op.europa.eu/en/publication-detail/-/publication/68dcf076-c1b4-4bfa-8515-f04e65a5ecf2 (accessed on 14 April 2020).

11. Pedroli, B.; Pinto Correia, T.; Primdahl, J. Challenges for a shared European countryside of uncertain future. Towards a modern community-based landscape perspective. *Landsc. Res.* **2016**, *41/4*, 450–460. [CrossRef]
12. Tickamyer, A.R. Rural poverty. In *Handbook of Rural Studies*; Clocke, P., Marsden, T., Mooney, P., Eds.; Sage Publications: London, UK, 2006; pp. 411–426.
13. Woods, M. *Rural Geography*; Sage Publications: London, UK, 2005.
14. *Territorial Agenda of the European Union 2020, Towards an Inclusive, Smart and Sustainable Europe of Diverse Regions*; European Union: Gödölló, Hungary, 2011.
15. Labianca, M.; Navarro, F. Depopulation and aging in rural areas in the European Union: Practices starting from the LEADER approach. *Perspect. Rural Dev.* **2019**, *3*, 223–252.
16. Navarro, F.A.; Woods, M.; Cejudo, E. The LEADER Initiative has been a victim of its own success. The decline of the Bottom-Up approach in rural development programmes. The cases of Wales and Andalusia. *Sociol. Rural.* **2016**, *52/2*, 270–288. [CrossRef]
17. García, J.L.; Febles, M.F.; Zapata, V.M. La iniciativa comunitaria LEADER en España. *Boletín de la Asociación de Geógrafos Españoles* **2005**, *39*, 361–398.
18. Sparsely populated and Underpopulated Areas. 2016. Available online: https://www.europarl.europa.eu/RegData/etudes/BRIE/2016/586632/EPRS_BRI(2016)586632_EN.pdf (accessed on 26 May 2020).
19. García, R.; Espejo, C. El círculo vicioso de la despoblación en el medio rural español: Teruel como caso de estudio. *Estudios Geográficos* **2019**, *80*, 1–5.
20. Collantes, F.; Pinilla, V. Lugares que no importan? In *La despoblación de la España rural desde 1900 hasta el Presente*; Prensas de la Universidad de Zaragoza: Zaragoza, Spain, 2019.
21. Molinero, F. El espacio rural de España: Evolución, delimitación y clasificación. *Cuadernos Geográficos* **2019**, *58*, 19–56. [CrossRef]
22. Stockdale, A. Migration: Pre-requisite for rural economic regeneration? *J. Rural Stud.* **2006**, *22*, 354–366. [CrossRef]
23. Pinilla, V.; Ayuda, M.A.; Sáez, L.A. Rural depopulation and the migration turnaround in mediterranean Western Europe: A case study of Aragon. *J. Rural Commun. Dev.* **2008**, *3*, 1–22.
24. Molina de la Torre, I.; Martínez, L.C. La normativa de ordenación del territorio en áreas rurales de baja densidad demográfica: Una revisión desde la Geografía. *Polígonos* **2014**, *26*, 277–320. [CrossRef]
25. Federación Española de Municipios y Provincias (FEMP). Listado de medidas para luchar contra la despoblación en España. Documento de Acción. Comisión de despoblación. 2017. Available online: http://www.femp.es/sites/default/files/multimedia/documento_de_accion_comision_de_despoblacion_9-05-17.pdf (accessed on 21 April 2020).
26. Gobierno de España. *Estrategia Nacional Frente al Reto Demográfico. Directrices Generales*; Ministerio de política territorial y función pública: Madrid, Spain, 2019.
27. Gobierno de Castilla-La Mancha. Pacto Contra la Despoblación en Castilla-La Mancha. 2020. Available online: https://retodemografico.castillalamancha.es/sites/retodemografico.castillalamancha.es/files/2020-03/PACTO_CONTRA_LA_DESPOBLACION_DE_CASTILLA-LAMANCHA.pdf (accessed on 2 April 2020).
28. ENRD-European Network for Rural Development. Rural Development Programmes 2014–2020, Key Facts & Figures. Focus Area 6B: Fostering Local Development. 2019. Available online: https://enrd.ec.europa.eu/sites/enrd/files/focus-area-summary_6b.pdf (accessed on 14 April 2020).
29. Farinós, J. La Estrategia Territorial Europea en el nuevo paradigma de la territorialidad. In *Una Nueva Cultura del Territorio*; Tarroja, A., Camagni, Y., Coords, R., Eds.; Diputació de Barcelona: Barcelona, Spain, 2006; pp. 43–68.
30. Asociación de Geógrafos Españoles y Colegio de Geógrafos. Manifiesto por una "Nueva Cultura del Territorio". Madrid. 2006. Available online: https://www.age-geografia.es/site/manifiesto-nueva-cultura-del-territorio/ (accessed on 29 April 2020).
31. Cañizares, M.C. Paisaje, Patrimonio e Identidad Territorial: Claves históricas y desafíos actuales. In *Naturaleza, Territorio y Ciudad en un Mundo Global*; Asociación de Geógrafos Españoles, Universidad Autónoma de Madrid: Madrid, Spain, 2017; pp. 1725–1744.
32. ICOMOS (International Council on Monuments and Sites). Carta Internacional del Turismo Cultural. 1999. Available online: https://www.icomos.org/charters/tourism_sp.pdf (accessed on 29 April 2020).
33. Ortega, N. El Patrimonio Territorial: El territorio como recurso cultural y económico. *Ciudades* **1998**, *4*, 33–48.
34. Capel, H. *El Patrimonio: La Construcción del Pasado y del Future*; Ediciones del Serbal: Barcelona, Spain, 2014.

35. Silva, R.; Fernández Salinas, V. El nuevo paradigma del patrimonio y su consideración con los paisajes: Conceptos, métodos y prospectivas. *Documents d'Anàlisi Geogràfica* **2017**, *63*, 129–151. [CrossRef]
36. Comité de las Regiones Europeo. Dictamen "Hacia un Enfoque Integrado del Patrimonio Cultural Europeo". 2015. Available online: http://eur-lex.europa.eu/legal-content/ES/TXT/?uri=CELEX%3A52014IR5515 (accessed on 29 April 2020).
37. Goodwin, M. The governance of rural areas: Some emerging research issues and agendas. *J. Rural Stud.* **1998**, *14*, 5–12. [CrossRef]
38. Ray, C. The EU LEADER Programme: Rural Development Laboratory. *Sociol. Rural.* **2000**, *40*, 163–171. [CrossRef]
39. Thuesen, A.A.; Nielsen, N.C. A territorial perspective on EU's Leader approach in Denmark: The added value of community-led local development of rural and coastal areas in a multi-level governance settings. *Eur. Countrys.* **2014**, *4*, 307–326. [CrossRef]
40. Esparcia, J.; Escribano, J.; Serrano, J.J. From development to power relations and territorial governance: Increasing the leadership role of LEADER Local Action Groups in Spain. *J. Rural Stud.* **2015**, *42*, 29–42. [CrossRef]
41. Storey, D. Issues of integration, participation and empowerment in rural development: The case of LEADER in the Republic of Ireland. *J. Rural Stud.* **1999**, *15*, 307–315. [CrossRef]
42. Li, Y.; Westlund, H.; Zheng, X.; Liu, Y. Bottom-up initiatives and revival in the face of rural decline: Case studies from China and Sweden. *J. Rural Stud.* **2016**, *47*, 506–513. [CrossRef]
43. Fraser, E.D.G.; Dougill, A.J.; Mabbe, W.E.; Reed, M.; McAlpine, P. Bottom up and top down: Analysis of participatory processes for sustainability indicator identification as a pathway to community empowerment and sustainable environmental management. *J. Environ. Manag.* **2006**, *78*, 114–127. [CrossRef] [PubMed]
44. Esparcia, J.; Noguera, J.; Pitarch, M.D. LEADER en España: Desarrollo rural, poder, legitimación, aprendizaje y nuevas estructuras. *Documents d'Anàlisi Geogràfica* **2000**, *37*, 95–113.
45. Böcher, M. Regional Governance and Rural Development in Germany: The implementation of LEADER+. *Sociol. Rural.* **2008**, *48*, 372–388.
46. High, C.; Nemes, G. Social Learning in LEADER: Exogenous, Endogenous and Hybrid Evaluation in Rural Development. *Sociol. Rural.* **2007**, *47*, 103–119. [CrossRef]
47. Ray, C. Neoendogenous rural development in the EU. In *Handbook of Rural Studies*; Clocke, P., Marsden, T., Mooney, P., Eds.; Sage Publications: London, UK, 2006; pp. 278–291.
48. Marsden, T. Mobilities, vulnerabilities and sustainabilities: Exploring pathways from denial to sustainable rural development. *Sociol. Rural.* **2009**, *49*, 113–131. [CrossRef]
49. Bowler, I.R. Promoting sustainable agriculture and rural development. In *Regional Sustainable Developmet Review: Europe*; Mather, A., Bryden, J., Eds.; Encyclopedia of Life Support Systems UNESCO: Oxford, UK, 2004; pp. 80–104.
50. Keyim, P. Tourism Collaborative Governance and Rural Community Development in Finland: The Case of Vuonislahti. *J. Travel Res.* **2018**, *57*, 483–494. [CrossRef]
51. Hall, C.M. A typology of governance and its implications for tourism policy analysis. *J. Sustain. Tour.* **2011**, *19*, 437–457. [CrossRef]
52. Jones, O.; Little, J. Rural Challenge(s): Partnership and New Rural Governance. *J. Rural Stud.* **2000**, *16*, 171–183.
53. Eckerberg, K.; Bjärstig, T.; Zachrisson, A. Incentives for Collaborative Governance: Top-Down and Bottom-Up Initiatives in the Swedish Mountain Region. *Mt. Res. Dev.* **2015**, *35*, 289–298. [CrossRef]
54. Emerson, K.T.; Nabatchi, T.; Balogh, S. An Integrative Framework for Collaborative Governance. *J. Public Admin. Res. Theory* **2012**, *22*, 1–29. [CrossRef]
55. Silva, R.; Fernández, V. The limitess concept: The new heritage paradigm and its relation to space. In *Territorial Heritage and Spatial Planning. A Geographical Perspective*; Manero, F., y García Cuesta, J.L., Eds.; Thomson Reuters Aranzadi: Pamplona, Spain, 2017; pp. 57–84.
56. Molinero, F.; Tort, J. Coords. Paisajes Patrimoniales de España. In *Ministerio de Agricultura y Pesca*; Alimentación y Medio Ambiente: Madrid, Spain, 2018.
57. Junta de Comunidades de Castilla-La Mancha. Plan Estratégico de Desarrollo Sostenible del Medio Rural en Castilla-La Mancha (2008–2013). 2008. Available online: https://www.castillalamancha.es/sites/default/files/documentos/20120511/plan20estrategico20de20desarrollo20sostenible202008-2013,pdf (accessed on 4 May 2020).

58. Calderón, B.; García, J.L. Patrimonio y Territorio en España, fundamentos y estrategias para la gestión de la cultura territorial. In *Patrimonio Cultural y Desarrollo Territorial*; Manero, F., y García, J.L., Eds.; Coords. Thomson Reuters/Aranzadi: Pamplona, Spain, 2016; pp. 51–105.
59. Junta de Comunidades de Castilla-La Mancha. Pacto Contra la Despoblación en Castilla-La Mancha. 2020. Available online: https://retodemografico.castillalamancha.es/sites/retodemografico.castillalamancha.es/files/ (accessed on 20 May 2020).
60. Pillet, F.; y Cañizares, M.C. (Eds.) *Policentrismo y áreas Funcionales de Baja Densidad*; Síntesis: Madrid, Spain, 2017.
61. Cañizares, M.C. El atractivo turístico de una de las minas de mercurio más importantes del mundo: El Parque Minero de Almadén (Ciudad Real). *Cuadernos Turismo* **2008**, *21*, 9–31.
62. Mansilla, L. El Parque Minero de Almadén. Un modelo de recuperación del patrimonio minero industrial. *Her. Mus.* **2011**, *3*, 13–24.
63. Cañizares, M.C. La correcta valoración del Patrimonio industrial minero: El Parque Minero de Almadén (Patrimonio Mundial). In *Patrimonio Cultural y Desarrollo Territorial*; Manero, F., y García Cuesta, J.L., Eds.; Coords. Thomson Reuters Aranzadi: Pamplona, Spain, 2016; pp. 339–369.
64. Parque Minero de Almadén. Available online: http://www.parqueminerodealmaden.es/ (accessed on 29 April 2020).
65. Cañizares, M.C. Patrimonio, Minería y Rutas en el Valle de Alcudia y Sierra Madrona (Ciudad Real). *Estudios Geográficos* **2013**, *275*, 409–437. [CrossRef]
66. Gosálvez, R.U. El Valle de Alcudia y Sierra Madrona. Paraíso europeo para la observación de aves. In *Una Propuesta de Turismo Ornitológico*; Asociación para el Desarrollo Sostenible del Valle de Alcudia: Ciudad Real, Spain, 2009.
67. Junta de Comunidades de Castilla-La Mancha. Red de áreas Protegidas. Available online: https://areasprotegidas.castillalamancha.es/rap/espacios-naturales-protegidos/enp-parque-natural/parque-natural-valle-de-alcudia-y-sierra (accessed on 4 May 2020).
68. Pillet, F. *Planificación Territorial. Propiedad y Valoración Catastral (España 1750–2010)*; Biblioteca Nueva: Madrid, Spain, 2012.
69. Pillet, F. La diversidad de Castilla-La Mancha: La comarcalización geográfica y sus municipios. In *Las Escalas de la Geografía: Del Mundo al lugar*; Cebrián, F., Pillet, F., y Carpio, J., Eds.; Ediciones de la Universidad de Castilla-La Mancha: Cuenca, Spain, 2010; pp. 25–48.
70. Asociación para el Desarrollo Sostenible de la Comarca de Almadén. Available online: http://www.comarcamontesur.com/asociacion/ (accessed on 25 May 2020).
71. Junta de Comunidades de Castilla-La Mancha. Parque Natural de Alto Tajo. Available online: https://areasprotegidas.castillalamancha.es/rap/espacios-naturales-protegidos/enp-parque-natural/148/visita-y-disfruta (accessed on 5 May 2020).
72. Declaración de Girona sobre la Protección del Patrimonio Geológico. Available online: https://www.igme.es/patrimonio/links/declaracionGirona.htm (accessed on 29 April 2020).
73. Palacio, J.L. Geositios, geomorfositios y geoparques: Importancia, situación actual y perspectivas en México. Investigaciones Geográficas. *Boletín del Instituto de Geografía UNAM* **2013**, *82*, 24–37.
74. Global Geoparks Network. Available online: http://www.globalgeopark.org/ (accessed on 5 May 2020).
75. European Geoparks Network. Available online: http://www.europeangeoparks.org/ (accessed on 5 May 2020).
76. Cañizares, M.C. Visibilidad y promoción del patrimonio minero en algunos Geoparques españoles. *Documents d'Anàlisi Geogràfica* **2020**, *66*, 109–131.
77. Foro Español de Geoparques. Available online: http://geoparques.eu/ (accessed on 5 May 2020).
78. Geoparque Comarca de Molina-Alto Tajo. Available online: http://www.geoparquemolina.es/web/guest/el-geoparque (accessed on 29 April 2020).
79. Perruca, M.; Caravilla, L. *Coords. Guía turística del Geoparque de la Comarca de Molina-Alto Tajo*; Asociación de Desarrollo Rural Molina de Aragón-Alto Tajo: Guadalajara, Spain, 2015.

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Driving Factors of the Industrial Land Transfer Price Based on a Geographically Weighted Regression Model: Evidence from a Rural Land System Reform Pilot in China

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Abstract: More and more studies on land transfer prices have been carried out over time. However, the influencing factors of the industrial land transfer price from the perspective of spatial attributes have rarely been explored. Selecting 25 towns as the basic research unit, based on industrial land transfer data, this paper analyzes the influencing factors of the price distribution of industrial land in Dingzhou City, a rural land system reform pilot in China, by using a geographically weighted regression (GWR) model. Eight evaluation factors were selected from five aspects: economy, population, topography, landform, and resource endowment. The results showed that: (1) Compared with the traditional ordinary least squares (OLS) model, the GWR model revealed the spatial differentiation characteristics of the industrial land transfer price in depth. (2) Factors that have a negative correlation with the industrial land transfer price include the proportion of cultivated land area and distance to the city. Factors that have a positive correlation with the industrial land transfer price include the population growth rate, economic growth rate, population density, and number of hospitals per unit area. (3) The results of GWR model analysis showed that the impact of different factors on the various towns of different models had significant spatial differentiation characteristics. This paper will provide a reference for the sustainable use of industrial land in developing countries.

Keywords: industrial land; price; geographically weighted regression model; driving factors; rural land system reform pilot

1. Introduction

With the continuous development of the economy, as an important value judgment standard for the operation of the land market, the land transfer price has become increasingly prominent in optimizing the allocation of land resources [1]. In order to adapt to the new normal of economic development, optimize the land supply structure, and ensure the rational and healthy development of industrial land, China has successively issued a series of policy documents on optimizing the industrial structure for the rational use of industrial land [2]. In December 2015, the Chinese government called for "coordinating the three major structures of space, scale and industry", and proposed that the urban land supply structure and industrial structure evolution should match each other. In April 2016, the 13th Five-Year Plan for Land and Resources, proposed by the Ministry of Land and Resources, required reasonable arrangements for various types of land use, strengthening the synergy between industry and land use, and further adjusting the structure of industrial land. Therefore, it is of great practical significance and academic value to deeply analyze the operating price and mutual relationship between the industrial land transfer price and various factors.

Recently, some important achievements have been made in the study of the influencing factors of land price [3,4]. Based on the systematic analysis of the influencing factors of the spatial change of residential, industrial, and commercial land use, some scholars have pointed out that spatial autocorrelation and the policy system are the most important factors affecting the urban land price [5]. Some scholars have also found the important influence of supply and terminal consumption on urban land prices [6]. Other scholars believe that the location factor is the most important factor affecting the spatial pattern of the urban land price, and the study of the spatial distribution characteristics of land prices is the organic combination of land location theory and land rent and land price theory [7]. Because of the perfection of the land market and the activity of land transactions in early developed countries, conducting research on the spatial distribution of the urban land price is very popular. However, with the maturity of land systems and urbanization, there have been few achievements in land price research in developed countries in recent years [8]. Synthetically, due to the fact that developed countries enable mainly private ownership of land and have a lack of complete, authoritative land supply data, most of the research focuses on the early theoretical exploration [9], especially research on the influencing factors of the urban land price and the spatial pattern of small scale [10].

With the gradual improvement of the land market in China, Chinese scholars have set off an upsurge in urban land price research [11]. According to the principle of maximum land income and the principle of best use, Ni et al. (2004) evaluated the comprehensive benchmark land price by using competitive rent theory and the marginal analysis method [12]. Based on the systematic analysis of the spatial distribution of the urban land price, Wang (1997) explored the evolution law and motivation of urban land price time-series and constructed the framework of the four-dimensional spatial theory of the urban land price [13]. Song et al. (2011) quantitatively analyzed the influence of different influencing factors on the urban land price and land price growth rate from the point of view of urban land supply and demand, and macro policy [14]. Gao et al. (2013) analyzed the statistical characteristics and spatial distribution characteristics of land transaction prices by using traditional statistics and geostatistics methods, taking the transfer prices of housing, industry, and commercial services as samples [15]. Synthetically, the research of Chinese scholars mainly focuses on the evaluation of the land price, the spatial structure of the land price, and its influencing factors [16].

According to research on the spatial characteristics of the urban land price, the existing research on the analysis of influencing factors pays too much attention to the characteristic of plot location, but lacks consideration of the land natural supply and social and economic purchasing power [17]; moreover, there is a lack of a complete theoretical analysis framework, and most of the studies mainly select explanatory variables according to experience; the combination with theoretical analysis is lacking [18,19].

In order to provide a reference for future urban land development, this paper uses a geographically weighted regression model to quantitatively analyze the main influencing factors of the industrial land transfer price in Dingzhou City, China, in 2016. Specifically, the remainder of this paper is structured as follows: Section 2 overviews the Chinese land market and influencing factors of the land price. Section 3 introduces the case study area and data that will be utilized in the empirical analysis of the driving factors of the industrial land transfer price. Section 4 introduces the driving factors' selection and the method used. Section 5 is the results of the empirical analysis. Section 6 discusses the spatial driving patterns from the empirical analysis; Section 7 concludes the paper.

2. Literature Review

2.1. Chinese Land Market

China implements urban land whole-people ownership and rural land collective ownership. The land of the city is owned by the state. Concretely, the land in rural and urban suburbs is collectively owned by the peasants, except where the land is owned by the state as prescribed by law; the homestead, the reserved land, and the mountains are collectively owned by the farmer. Therefore, the land market in China refers to the land-use-right market [20]. The market of the land use rights of urban land in China has been gradually formed and perfected, with the continuous promotion of the land system and the deepening of its practice [21].

In 1987, the land use system reform began as a pilot in Shenzhen, Shanghai, Tianjin, Guangzhou, Xiamen, Fuzhou, and other cities. In December 1987, China held its first auction of land use rights in Shenzhen, which pioneered the transfer of state-owned land use rights. No organization or individual can encroach on, buy, sell, or illegally transfer land in any other form. The land use right can be transferred in accordance with the provisions of the law [22]. Meanwhile, the land management law formally proposes to separate the right of land use and land ownership, which lays the legal foundation for the formation of the land market. In 1990, it was further clearly stipulated that land use rights can be transferred by agreement, bidding, and auction [23]. With the continuous reform of the land system, the land use right market began to form.

In the 1990s, urban land was transferred by agreement and market at the same time. However, the price of an agreement transfer was obviously lower than that of a market transfer, which caused many problems, such as land market speculation. In 2002, it was determined that commercial, tourist, recreational, and commercial residential land had to be sold by tender, auction, or listing [24]. However, non-market-based transfer is still more common in some cities. In 2004, the Chinese government stipulated that all operating land must be sold by open bidding. Since then, almost all cities in China have been transferred in a market-oriented way, and the marketization of urban land in China has begun to form and gradually improve.

For different land markets, the meaning of the land transfer price is also different [20]. According to the use of the land, it can be divided into the residential land price, commercial land price, and industrial land price. According to the transaction level, it can also be divided into the primary land market price and secondary land market price. According to the calculation method, it can be further divided into the floor land price, unit land price, and total price. In this paper, the transaction event of each plot is studied. The land transfer price refers to the floor price of the final transaction of each plot, which is calculated by dividing the total transaction price of the plot by the total construction area of the plot.

2.2. Land-Price-Influencing Factors

According to the theory of land supply and demand, in a completely competitive market, the curve of land supply and demand determines its price, as well as the corresponding supply and demand [25]. From the perspective of geography, land demand is mainly affected by market factors, location conditions, and supporting facilities [26]. The natural supply of land is mainly affected by the local natural landscape, geology, and geomorphology [26]. Meanwhile, monopoly group manipulation and government macro-control will also have an impact on urban land prices (Figure 1).

Figure 1. Framework of influencing factors of land price [15].

The demand factors that affect the land price include market influence and location conditions. The market mainly plays a role through economic development and population increases [27]. Under the premise of certain other conditions, the larger the scale of local economic activities is, the stronger the development momentum and the greater the land demand will be; thus, the land price is driven higher [27]. The reserve land resources in China are limited, and the expansion of the land demand market, driven by the industrialization process, is bound to stimulate the rise of land prices.

As one of the most important factors affecting the quality of urban land, location conditions have an impact on the urban land price through traffic location and convenience of supporting facilities [28]. Traffic location can be further divided into urban internal traffic accessibility and external traffic accessibility [29]. The basic assumption of urban geography is that the farther away from the urban center the land is, the lower the intensity of land development and the lower the corresponding land price will be [30]. Meanwhile, the density of the road network in the area and the convenience of traffic nodes, such as main bus stations and rail transits, will have an impact on the urban land price; this impact is more significant in the suburbs of the city [31]. The influence of external transportation on the urban land price is mainly manifested in industrial land, due to high-speed communication, railway stations, airports, and other foreign transportation hubs. The lower the transportation cost of industrial enterprises is, the higher the corresponding land price is [32]. The convenience of infrastructure mainly affects the urban land price by influencing residential and commercial land [33]. The more convenient it is to go to schools, hospitals, scenic spots, and other supporting facilities, the higher the price of residential and commercial service land will be [34].

According to the neoclassical urban competitive rent model, the city is a homogeneous plain, but in reality, the background natural environments of urban plots are quite different, which directly affects the natural supply of land in the area, then having an impact on land price [35]. With lower elevations, slower slopes, and more stable geological conditions come lower costs of development and construction along with higher land price [36]. However, the price of residential land in hilly areas is higher than that of shady slopes [37]. The natural landscape mainly affects residential and industrial land by affecting residents' housing preferences and enterprise development costs [38]. However, commercial service land is relatively less affected [39]. The closer land is to a water body, the better the living environment is, which makes the enterprise discharge more convenient, resulting in the land price of residences and industry increasing to a certain extent [40]. However, most of the areas with more cultivated land resources are located in remote suburban counties far from urban areas, and the prices of residential land and industrial land are lower [41]

The so-called oligopoly manipulation is a kind of market structure which includes both monopoly and competition but is closer to a monopoly [42]. Its striking feature is that there are only a few manufacturers (enterprises) in an industry, and the individual size of these few manufacturers (enterprises) is large enough to affect market prices [43]. Urban land transfer is not only a basic industry, closely related to social production and life, but is also a highly concentrated industry that is relatively prone to oligopoly, especially in the residential land market, driven by the real estate industry [44]. The land expropriation monopoly policy of low price-expropriation and high price-transfer makes the land market structure of China a first-level land market monopolized by the government [45]. Although the monopoly of government land supply can rapidly gather the funds needed for the industrialization and urbanization of the country under the condition of limited national financial resources, the government, especially local governments, can effectively solve the problem of insufficient financial resources [46]. However, compared with a competitive state, the land balance price under the government's land supply monopoly is higher, and the land balance quantity is less, which drives the land price higher [47]. There are many kinds of land transfer methods, such as allocation, agreement, bidding, auction, and so on. No matter what kind of land transfer mode is used, the government is the only land supplier [48]. The supply under a government monopoly gives the Chinese government absolute initiative compared with other countries in regulating urban land prices. Therefore, government macro-control will also have a very important impact on the change of urban land prices [49].

Under the current tax-sharing financial system in China, local governments are facing the dual pressures of improving both financial and political performance [50]. Because the transfer of industrial land cannot achieve a large amount of land transfer in the short term, it can generate a more stable tax revenue in the long run, which local governments prefer. Therefore, on the premise that capital between different cities is close to full flow, the industrial land market can be approximately regarded as a "buyer's market" and as a price recipient [51]. Therefore, local governments need to utilize the opportunity to attract capital in the capital competition between regions to create GDP and political achievements. When they transfer industrial land, they will tend to issue preferential terms such as "low land-price" or even "zero land-price", which will cause distortion of the land price [52].

3. Study Area and Data

3.1. Study Area

The study area is located between 38°14′–38°40′ N and 114°48′–115°15′ E. Dingzhou City is in the west of Hebei Province (Figure 2). Dingzhou City, including 25 towns (Nancheng, Beicheng, Xicheng, Liuzao, Qingfengdian, Pangcun, Zhuanlu, Mingyuedian, Dingningdian, Dongting, Daxinzhuang, Dongwang, Gaopeng, Xingyi, Liqingu, Ziwei, Kaiyuan, Changanlu, Zhoucun, Xizhong, Dongliuchun, Haotouzhaung, Yangjiazhuang, Daluzhaung, and Xicheng), is one of the pilots of the national rural land system reform in China [53]. With a total area of 1283 km^2 and a total population of 1.3 million, it is the most populous city in Hebei Province, China.

In 2016, Dingzhou had a total production value of 30.02 billion yuan. The added value of secondary industry increased by 10.5% compared with that in 2015. Dingzhou City not only has traditional industries, such as equipment manufacturing, energy and chemical industries, food processing, steel mesh production, and plastic processing, but also has emerging industries, such as new energy vehicles, photovoltaic power generation, electronic information, and energy conservation. The development of secondary industry has led to the continued expansion of industrial land. Industrial land increased by 166.67 hectares in 2015 and by 124.67 hectares in 2016.

Figure 2. Location of Dingzhou City.

3.2. Data

The main topography of Dingzhou City is plains, and the geomorphological conditions and land use data were collected from satellite remote sensing images through the Geospatial Cloud Platform (http://www.gscloud.cn/). Using the ArcGIS space selection function, the areas of various topographic and landform files in each town were measured, and the largest type of area was used as the topography type of the town [15]. The proportion of cultivated land was obtained from satellite remote sensing images through the Geospatial Cloud Platform (http://www.gscloud.cn/), and the Network Analysis module of the ArcGIS software was used to measure the distance from each town to city seat. The land transfer price data in 2016 were from Dingzhou Municipal Finance Bureau (http://dz.hbzwfw.gov.cn/). Data related to relevant socioeconomic driving factors were mainly from the Dingzhou Statistical Yearbook of 2016 [54].

4. Methods

4.1. Selection of Driving Factors

The land price is the result of the combination of social supply and demand. Based on the above literature review, according to relevant research and Dingzhou City's development conditions, this paper described the influencing factors of the industrial land transfer price based on economic level, population size, traffic location, public facilities, and natural resources [53]. Eight impact factors (economic growth rate, population density, population growth rate, distance to downtown, number of hospitals per unit area, road density, number of schools per unit area, and proportion of cultivated land) were selected to explain the economic conditions, traffic conditions, population conditions, infrastructure conditions, and resource conditions (Table 1).

Table 1. Selection, variance inflation factor (VIF), and tolerance test of driving factors.

Target	Element	Type	Variables	Symbol	Definition	Collinearity Statistics	
						Tolerance	VIF
Industrial land transfer price	Demand	Economic conditions [14–17]	Economic growth rate	GDP	GDP growth rate of each town	0.29	3.445
		Population size [18–20,27]	Population density	Pod	Total population/town's area	0.187	5.351
			Population growth rate	Pog	Annual growth rate of resident population of each town	0.443	2.258
		Traffic location [29,31,32]	Distance to downtown	Dic	Distance from a town to city seat	0.236	4.246
		Public facilities [38,40,52]	Number of hospitals per unit area	Hon	Number of hospitals/town's area	0.178	5.606
			Road density	Rod	Length of road/town's area	0.000	/
			Number of schools per unit area	Scn	Number of schools/town's area	0.098	10.216
	Supply	Natural resources [15,38]	Proportion of cultivated land	Lap	Rural settlements' area/cultivated land's area of the town	0.204	4.904

The spatial distribution of the values of the eight variables shows significant regional differences (Figure 3). In 2015, 10 towns achieved positive economic growth rate (GDP) out of the 25 towns of Dingzhou City, with Qingfengdian Town having the highest GDP (17.21%). There were eight towns with a population density (Pod) greater than 1000 people per km^2; Xicheng Town had the highest, (2155.39 people per km^2). There were five towns with a population growth rate (Pog) greater than 1%; Beicheng Town had the highest (1.56%). There were five towns with road density (Rod) greater than 1 km/km^2, and Nancheng Town had the highest (3.73 km/km^2). There were seven towns with a distance to downtown (Dic) less than 10 km, with Nancheng Town being the nearest to downtown. There were two towns with a number of hospitals per unit area (Hon) greater than 0.05 per km^2, namely, Xicheng Town and Beicheng Town. There were three towns with a number of schools per unit area (Scn) greater than 0.1 per km^2, namely, Beicheng Town, Xicheng Town, and Nancheng Town. There were 19 towns with a proportion of cultivated land (Lap) greater than 50%, with Xizhong Town having the highest (89.94%).

When performing regression analysis, the variance inflation factor (VIF) and tolerance test of the impact factor could reduce the multicollinearity of the influence factor in the regression process [55]. When a variable's VIF value is greater than 10, it indicates that there is variable redundancy between it and other variables, and it should be excluded when performing GWR analysis [56,57]. The results of the VIF test of the eight impact factors are shown in Table 1. The variable Rod (road density) was eliminated due to its tolerance value being 0.000. The variable Scn (the number of schools per unit area) had a VIF value greater than 10, which indicates that there was multiple collinearity or collinearity between the factors. It was also excluded. The remaining six variables had VIF values less than 7.0, indicating that there was no multicollinearity or weak collinearity between the variables. Therefore, the remaining six variables were presented as the driving factors of the industrial land transfer price.

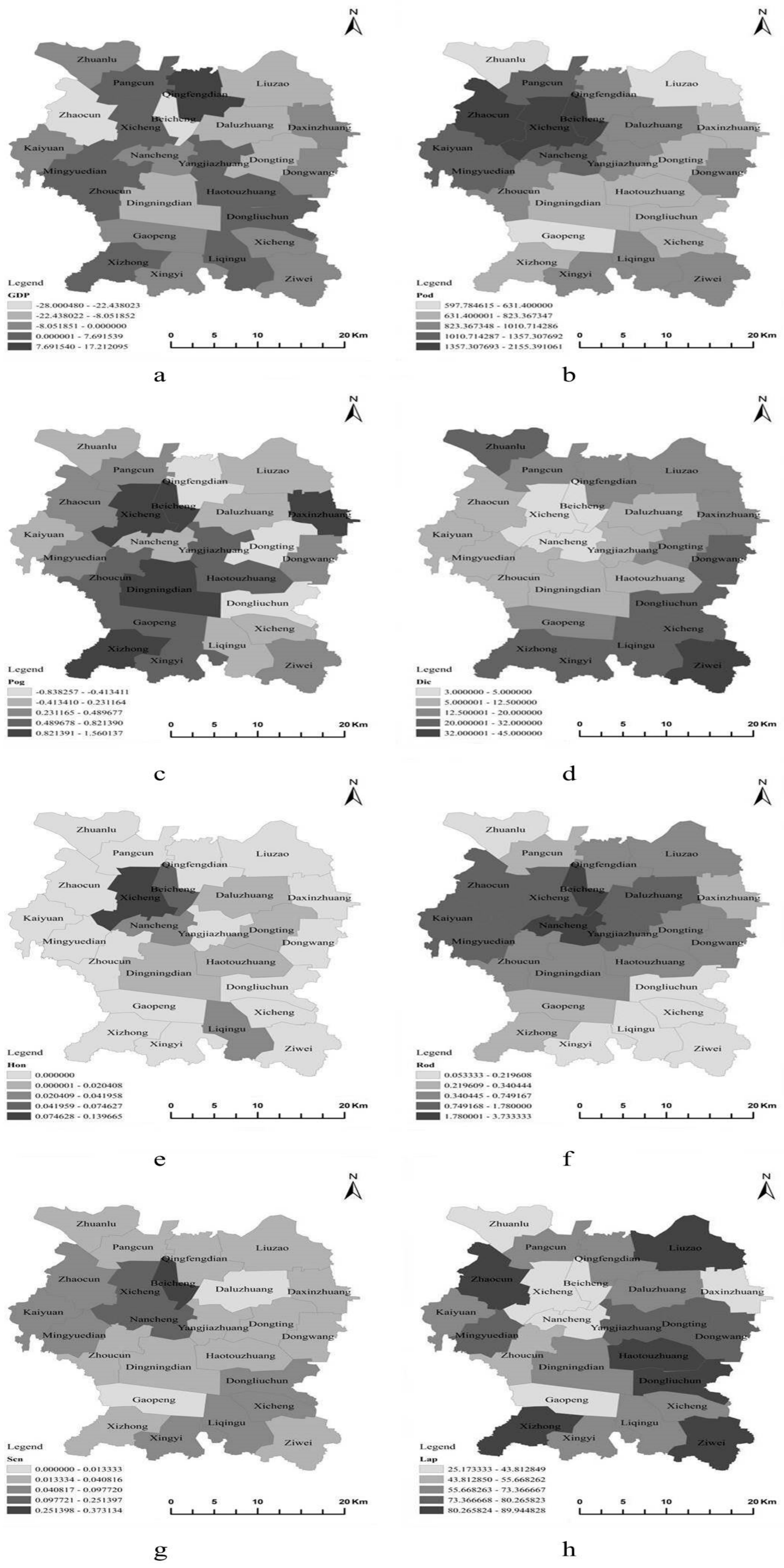

Figure 3. Spatial distribution of the eight impact factors. (**a**) GDP; (**b**) Pod; (**c**) Pog; (**d**) Dic; (**e**) Hon; (**f**) Rod; (**g**) Scn; (**h**) Lap.

4.2. Industrial Land Transfer Price's Spatial Distribution Features in Dingzhou City

The industrial land transfer price's spatial distribution features were examined by using OpenGeoDa1.6.5. software. The results showed that Moran's *I* (0.028), significance level <5%; Z (*I*) = 2.06, Z (*I*) > 1.96, indicating that the distribution of the industrial land transfer price in Dingzhou City had a significant correlational relationship.

Thus, the industrial land transfer price's distribution of Dingzhou City had a strong spatial correlation. Based on local spatial autocorrelation analysis results (Figure 3), the spatial agglomeration types of the industrial land transfer price in Dingzhou City included high–high (HH), low–low (LL), and high–low (HL). The HH area was mainly located in Daluzhuang Town; the LL area was mainly located in Nancheng Town. There are many industrial parks in these towns (Figure 4). Additionally, the Dingzhou Municipal Government and its public service department are located in Nancheng Town.

Figure 4. Industrial parks of Dingzhou in Nancheng Town: (**a**) Hebei Height Auto Parts Co., Ltd.; (**b**) Hebei Changan Automobile Co., Ltd.

4.3. OLS and GWR Method

The traditional regression model performed the estimation of parameters based on the ordinary least squares (OLS) method. In formulating independent variable x and global variable y_i, OLS could count the estimation value. It had the advantage of spatial stationary data regression estimation. However, it was not ideal for spatial nonstationary data regression estimation. Proposed by the British scholar Fotheringham in the field of spatial nonstationarity, geographically weighted regression (GWR) extended the traditional regression model $y_i = \beta_0 + \sum_k \beta_k x_{ik} + \varepsilon_i$ [58]. This extension was due to the advantage that, by applying the spatial weight matrix to the linear regression model, GWR could display spatial structure differentiation [59,60]. Based on the GWR model, Equation (1) was established:

$$\begin{gathered} y_i = \beta_0(u_i, v_i) + \sum_{j=1,k} \beta_1 (u_i, v_i) x_{ij}(GDP) + \sum_{j=1,k} \beta_2 (u_i, v_i) x_{ij}(Pod) + \\ \sum_{j=1,k} \beta_3 (u_i, v_i) x_{ij}(Pog) + \sum_{j=1,k} \beta_4 (u_i, v_i) x_{ij}(Dic) + \sum_{j=1,k} \beta_5 (u_i, v_i) x_{ij}(Hon) + , \\ + \sum_{j=1,k} \beta_6 (u_i, v_i) x_{ij}(Lap) + \varepsilon_i \end{gathered} \quad (1)$$

where y_i denotes the industrial land transfer price of town i; (u_i,v_i) denotes the geographical coordinates of town i's administrative center; and β_i (u_i,v_i) denotes the regression coefficient of town j.

Adaptive spatial kernels was used for the GWR model, as calculated by Equation (2):

$$w_{ij} = \begin{cases} \exp^{\frac{-1}{2}\left(\frac{d_{ij}}{b}\right)^2}, d_{ij} < b \\ 0, d_{ij} \geq b \end{cases}, \quad (2)$$

where d_{ij} denotes the Euclidean distance from regression point i to data point j; and b refers to the bandwidth.

Owing to its size directly affecting the spatial variation of the GWR model, the determination of the bandwidth was very important for the establishment of the GWR model. The bandwidth could be treated as a smooth parameter; the larger the bandwidth was, the smoother the parameter was [61,62]. An overly smooth model made the parameters in the entire study area tend to be similar, while it made no difference between the parts. The best bandwidth should fall between these two situations [63–65]. Methods for bandwidth determination include cross validation (CV), Akaike's information criterion (AIC), Akaike's information criterion corrected (AICc), and BIC/MDL [66,67]. This paper determined the bandwidth by using AICc method.

5. Results

5.1. Results of OLS

OLS results were obtained after the industrial land transfer price was chosen as a dependent variable and the six variables were chosen as independent variables (Table 2).

Table 2. Results of ordinary least squares (OLS).

Variable	Coefficient	p-Value	Significance (Sig.)
Con	0.000	0	***
GDP	0.128	0.027	**
Pod	0.073	0.612	-
Pog	0.278	0.002	***
Dic	−0.062	0.004	***
Hon	0.009	0.095	*
Lap	−0.042	0.072	*

Note: ***, **, and * indicate significance at the 0.1%, 1%, and 5% levels.

According to the coefficient value, variables showing a negative correlation with the industrial land transfer price included Dic and Lap. Variables showing a positive correlation with the industrial land transfer price included GDP, Pod, Pog, and Hon.

5.2. Parameter Estimation Results by the OLS Model and GWR Model

Using the GWR module in SAM software, the parameter estimation results were obtained (Table 3). GWR explained 89.6% of the industrial land transfer price's degree of variation rate, while OLS explained 64.1%; GWR's AICc was −229.362, while OLS's AICc was 46.499. Residual (4.13) by the OLS model was greater than the 1.45 obtained by using the GWR model. Moran's I (0.015, $p < 0.001$) indicated that GWR's residuals were randomly distributed [68–71] (Figure 5). Therefore, GWR was superior to OLS.

Table 3. Diagnostic statistic testing of geographically weighted regression (GWR) and OLS.

Method	R^2	AICc	p-Value	Residual
OLS	0.641	46.499	<0.001	4.13
GWR	0.896	−229.362	<0.001	1.45

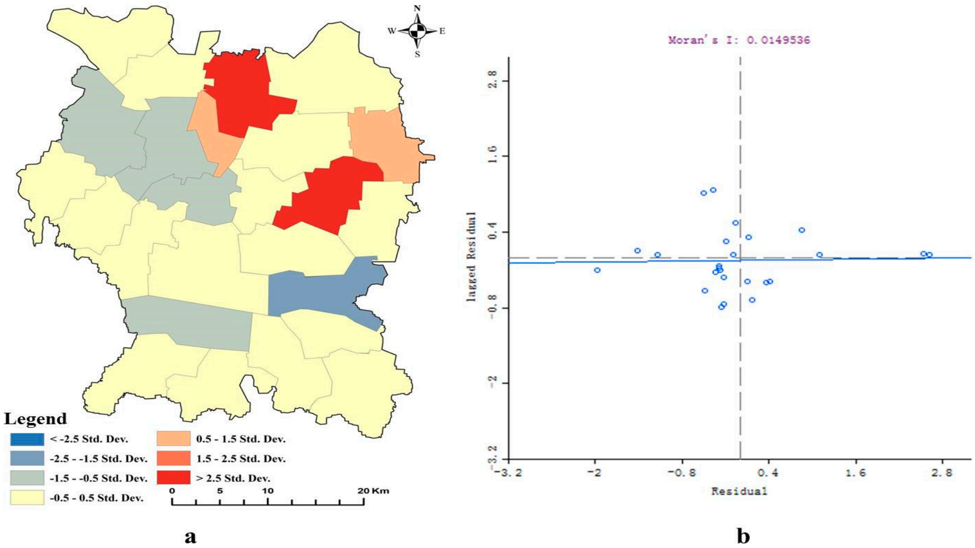

Figure 5. Parameter estimation results of GWR. (**a**) Residual of GWR's distribution; (**b**) Moran's *I*.

Using the GWR model, the driving variables' regression coefficients were estimated (Table 4). The regression coefficients of Pod, Pog, Dic, and Hon showed opposite characteristics, except GDP and Lap, reflecting that the driving factors of the industrial land transfer price were complicated modes under diverse spatial conditions.

Table 4. Descriptive statistics by GWR.

Variable	Minimum	Lower Quartile	Median	Upper Quartile	Maximum
Con	−0.33172	−0.14121	0.06055	0.10399	0.22170
GDP	0.12796	0.12805	0.12819	0.12825	0.12853
Pod	−0.07349	−0.07346	−0.07342	−0.07339	−0.07330
Pog	−0.27862	−0.27855	−0.27844	−0.27835	−0.27804
Dic	−0.06175	−0.06175	−0.06168	−0.06167	−0.06159
Hon	−0.00902	−0.00901	−0.00895	−0.00894	−0.00886
Lap	0.04142	0.04146	0.04162	0.04169	0.04193

Number of observations = 25.

6. Driving Factors' Spatial Interaction Modes by the GWR Method

The spatial pattern of the industrial land price will be affected by the level of regional economic development, traffic conditions, natural geographical conditions, and government policies [72,73]. According to the results of the spatial regression of the industrial land price, Gao et al. (2014) proposed that the price of industrial land is affected by the economic development level, the traffic conditions, the supporting facilities, the geological landform, and landscape ecology [74]. Their research method mainly draws on the characteristic price model commonly used in the real estate market, and although it can reflect the relationship between the characteristics of different elements and the land price to a certain extent, its mechanism still needs to be further demonstrated [75].

6.1. Spatial Driving Pattern by Economy Conditions

The higher the economic growth rate of an area is, the greater its potential for economic development will be [2,76]. A high-economic-growth area will attract more and more industrial layout sites, thus raising the price of industrial land [2,15]. The per capita fiscal revenue can objectively reflect the financial level of the local government. The more abundant the local government finances are, the less dependent it is on the land. On the contrary, a government with tight finances relies too much on "land finance", thus blindly raising the price of industrial land in order to obtain more financial revenue [15].

GDP could affect the industrial land transfer price [77–79]. In our study area, the industrial land transfer price was centered on the Zhuanlu Town and Pangcun Town in the north of Dingzhou City and decreased from the northwest to the southeast. In the south, Zizi Town, Lijiagu Town, Xingyi Town, and Xicheng Town formed four low-value centers. The results showed that the economic situation had a greater effect on industrial land transfer prices in Zhuanlu Town and Pangcun Town than in the other 23 towns, but the impact on Ziwei Town, Liqingu Town, Xingyi Town, and Xicheng Town was not obvious (Figure 6).

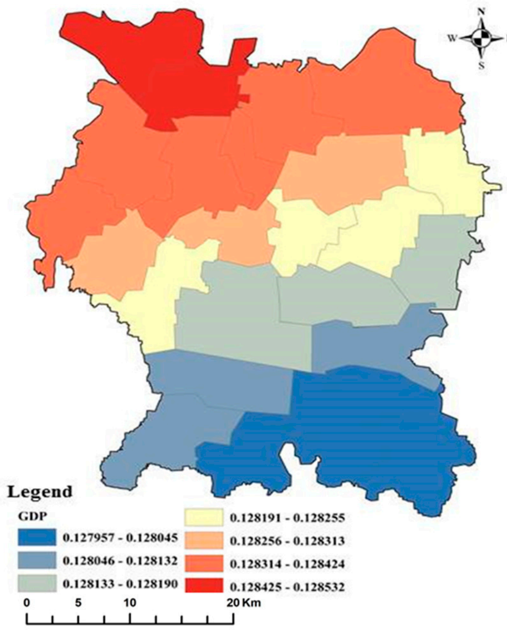

Figure 6. Regression coefficient of GDP.

6.2. Spatial Driving Pattern by Population Conditions

Pod's regression coefficient distribution centered on the north of Zhuanlu Town and Pangcun Town; it had a layered decline from the northwest to the southeast and formed four low-value centers in Ziwei Town, Liqingu Town, Xingyi Town, and Xicheng Town. This showed that the population density status had a greater effect on industrial land transfer prices in Zhuanlu Town and Pangcun Town than in the other 23 towns, but the impact on Ziwei Town, Liqingu Town, Xingyi Town, and Xicheng Town was not obvious (Figure 7). Specifically, a higher population density supports a greater workforce and more factories. This finding confirms that these towns have a large population density, a greater demand for land, and higher land prices.

The regression coefficient distribution of Pog centered on the south of Xizhong Town, Ziwei Town, Liqingu Town, and Xingyi Town; it had a layered decline from the south to the north and formed four low-value centers in Zhuanlu Town, Qingfengdian Town, Pangcun Town, and Liuzao Town. This indicated that the population growth situation had a significantly greater effect on the price of industrial land transfer in Xizhong Town than in the other 21 towns, but the impact on Zhuanlu Town, Qingfengdian Town, Pangcun Town, and Liuzao Town in the north was not obvious (Figure 8). This also confirms that the population, as the main consumer of land, and its growth, have a significant positive impact on regional residential land prices.

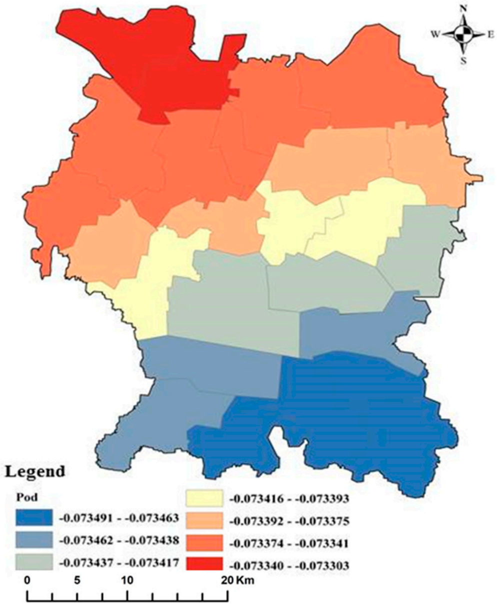

Figure 7. Regression coefficient of Pod.

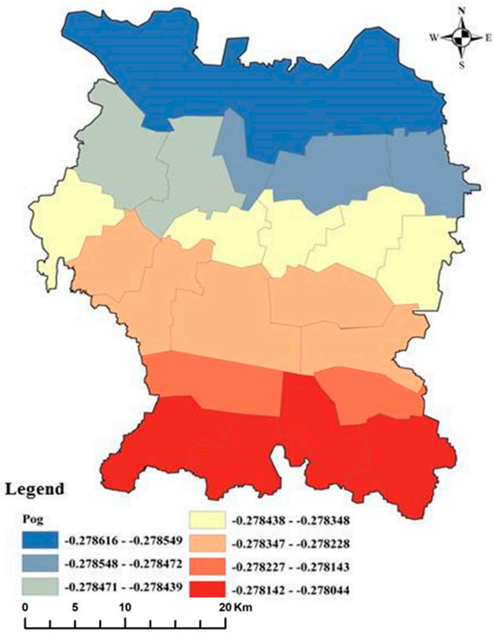

Figure 8. Regression coefficient of Pog.

6.3. Spatial Driving Pattern by Location Conditions

Due to the existence of agglomeration benefits and scale benefits, the distance to the development zone affects the spatial pattern of the industrial land price in study area [2,80]. The traffic road network mainly improves the location conditions of industrial land, so as to reduce the transportation cost of enterprise layout, and thereby affects the price of regional industrial land [2].

Distance from the economic center also plays an important role in the industrial land transfer price [81–84]. Dic's regression coefficient distribution centered on the south of Xizhong Town; it had a layered decline from the southeast to the northwest and had two low-value centers in Liuzao Town and Daxinzhaung Town in the north. This indicated that the distance from a town to the city seat had a significantly greater effect on the price of industrial land transfer in Xizhong Town than in the other 24 towns, but the impact on Liuzao Town and Daxinzhuang Town was not obvious (Figure 9).

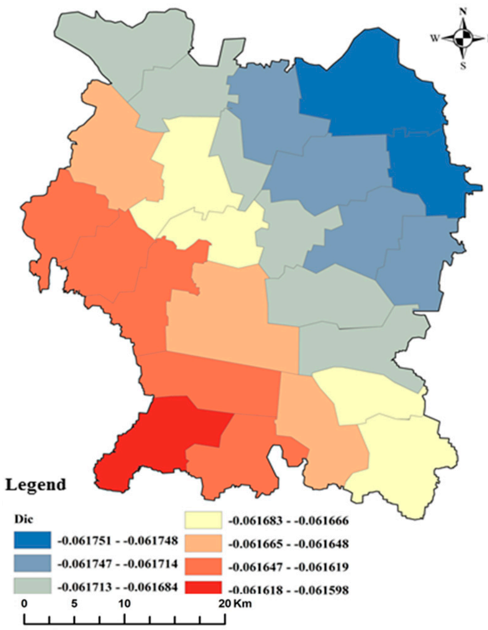

Figure 9. Regression coefficient of Dic.

6.4. Spatial Driving Pattern by Infrastructure Conditions

The distance to the hospital and schools affects the choice of the layout of enterprises by affecting their employees' medical treatment and children's education, thereby affecting the price of industrial land [15].

Hon's regression coefficient distribution centered on the southwest of Xizhong Town and Xingyi Town; it had a layered decline from the southeast to the northwest, and there were two low-value centers in Liuzao Town and Daxinzhaung Town in the north. This indicated that the number of hospitals per unit area had a significantly greater effect on the price of industrial land transfer in Xizhong Town and Daxinzhuang than in the other 23 towns, but the impact on Liuzao Town and Daxinzhuang Town was not obvious (Figure 10).

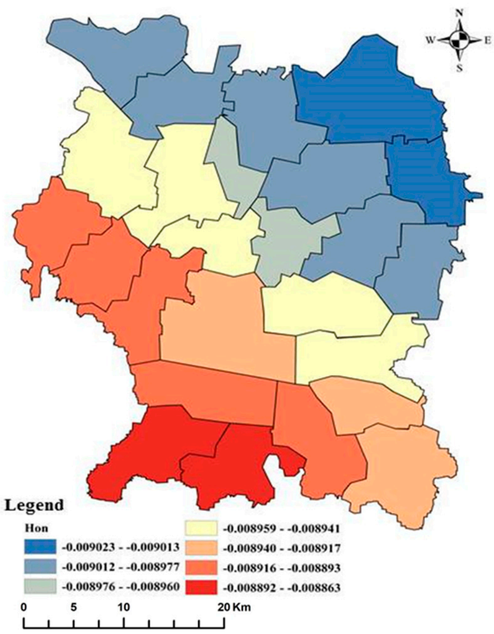

Figure 10. Regression coefficient of Hon.

6.5. Spatial Driving Pattern by Natural Resource Conditions

The effect of the proportion of cultivated land on the price of industrial land is the same as that of residential land. As this is most important reserve resource of construction land, higher proportions of industrial land result in lower prices of industrial land [85–89].

Lap's regression coefficient distribution centered on the southwest of Xizhong Town and Xingyi Town; it had a layered decline from the southeast to the northwest, and two low-value centers in Liuzao Town and Daxinzhaung Town in the north. This indicated that the proportion of cultivated land had a significantly greater effect on the price of industrial land transfer in Xizhong Town and Daxinzhuang than in the other 23 towns, but the impact on Liuzao Town and Daxinzhuang Town was not obvious (Figure 11).

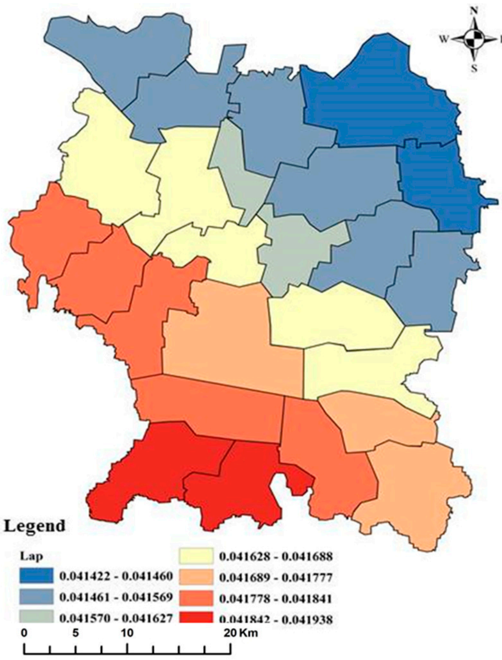

Figure 11. Regression coefficient of Lap.

7. Conclusions

The price of industrial land transfer is a product of various factors, such as the social economy, resource endowment, and geological conditions. This paper selected eight factors from four aspects (economic conditions, population conditions, traffic conditions, and topographic conditions) and analyzed the influencing factors of the industrial land transfer price in Dingzhou City, China, by using the OLS and GWR models. There are three main conclusions: (1) Compared with the traditional OLS model, the GWR model can reveal spatial differentiation features of influencing factors affecting the industrial land transfer price. (2) Factors that have a negative correlation with the industrial land transfer price included the proportion of cultivated land area and the distance to the city. Factors that have a positive correlation with the industrial land transfer price included the population growth rate, economic growth rate, population density, and number of hospitals per unit area. (3) The results of the GWR model showed that each driving factor had different impact patterns on each town; there were significant spatial differentiation characteristics. For different towns, the economic conditions, population conditions, traffic conditions, terrain conditions, and other factors had different degrees of influence on the industrial land transfer price. A town should undertake corresponding measures based on its own weak conditions.

Based on the above analysis, the development of the land market in Dingzhou City in recent years has been relatively orderly. The local government monopolizes the land, guides the development of the land market by regulating and transferring the land price, promotes the rational and effective utilization of the limited land resources in urban areas, and adjusts the layout of the industrial structure. In the land market, the price difference of different township land use types, different locations, and different land grades is obvious, which reflects the differential income of the land. The model of influencing land prices obtained in this study is not only the result of the combination of government regulation and land market development, but also the basis for further regulation and control of the land price. According to the current distribution and changing trends of the land price, combined with urban planning, industrial policy, and other factors, the government can guide reasonable changes of the land price through the land market. With the implementation of the paid land transfer mode, e.g., bidding and auctions, the government should not control the transfer land price in terms of the specific price [90]. The land price is mainly determined by the market. The government should make relevant land price policies in a timely and effective manner and guide the land users to use the land considering the aspects of infrastructure, public service, supporting the environment, and maintaining farmland reserve resources.

Because villages and towns are used as the minimum analysis unit, the influence of government regulation and control policy on the land transfer price may be somewhat masked, which restricts the accuracy of the analysis results to a certain extent [15]. Due to the continuous development of the city, the urban land price changes with time. The price data of a certain year can only objectively reflect the average trend of the urban land price and cannot analyze the evolution law of the urban land price on any time scale. Therefore, one of the key points of future research will be to study the changes of the main factors that affect the spatial pattern of the land price based on different periods of time.

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References

1. Zhao, S.; Xiao, X. Analysis on the Land Price Factors in the Context of Macro-level Framework. *China Land Sci.* **2012**, *26*, 4–11.
2. Li, C.; Gao, X.; He, B.-J.; Wu, J.; Wu, K. Coupling Coordination Relationships between Urban-industrial Land Use Efficiency and Accessibility of Highway Networks: Evidence from Beijing-Tianjin-Hebei Urban Agglomeration, China. *Sustainability* **2019**, *11*, 1446. [CrossRef]
3. Demartini, E.; Gaviglio, A.; Gelati, M.; Cavicchioli, D. The effect of biogas production on farmland rental prices: Empirical evidences from Northern Italy. *Energies* **2016**, *9*, 965. [CrossRef]
4. Ayazli, I.E. An Empirical Study Investigating the Relationship between Land Prices and Urban Geometry. *ISPRS Int. J. Geo-Inf.* **2019**, *8*, 457. [CrossRef]
5. Cellmer, R.; Kobylińska, K.; Bełej, M. Application of Hierarchical Spatial Autoregressive Models to Develop Land Value Maps in Urbanized Areas. *ISPRS Int. J. Geo-Inf.* **2019**, *8*, 195. [CrossRef]
6. Zhuang, X.; Zhao, S. Effects of land and building usage on population, land price and passengers in station areas: A case study in Fukuoka, Japan. *Front. Archit. Res.* **2014**, *3*, 199–212. [CrossRef]
7. Burian, J.; Macků, K.; Zimmermannová, J.; Kočvarová, B. Spatio-Temporal Changes and Dependencies of Land Prices: A Case Study of the City of Olomouc. *Sustainability* **2018**, *10*, 4831. [CrossRef]

8. Nakamura, H. Relationship among land price, entrepreneurship, the environment, economics, and social factors in the value assessment of Japanese cities. *J. Clean. Prod.* **2019**, *217*, 144–152. [CrossRef]
9. Glumac, B.; Herrera-Gomez, M.; Licheron, J. A hedonic urban land price index. *Land Use Policy* **2019**, *81*, 802–812. [CrossRef]
10. Shirota, T. What is the major source of business cycles: Spillovers from land prices, investment shocks, or anything else? *J. Macroecon.* **2018**, *57*, 138–149. [CrossRef]
11. Li, S.; Zhao, Z.; Du, Q.; Qiao, Y. A GIS- and Fuzzy Set-Based Online Land Price Evaluation Approach Supported by Intelligence-Aided Decision-Making. *ISPRS Int. J. Geo-Inf.* **2016**, *5*, 126. [CrossRef]
12. Ni, S.X.; Wang, L.X. A prelinary study on the approach to assessing integrated datum price of urban land. *Geogr. Res.* **1994**, *13*, 36–42.
13. Wang, M.C. On spatial developing rule of urban land price and its driving factors. *Trop. Geogr.* **1997**, *17*, 347–353.
14. Song, J.N.; Jin, X.B.; Tang, J.; Zhang, Z.; Zhao, J.; Zhou, Y. Analysis of influencing factors for urban land price and its changing trend in China in recent years. *Acta Geogr. Sin.* **2011**, *66*, 1045–1054.
15. Gao, J.L.; Chen, J.L.; Yang, D.H. Spatial distribution of urban land prices in Nanjing. *Prog. Geogr.* **2013**, *32*, 361–371.
16. Mou, Y.; He, Q.; Zhou, B. Detecting the Spatially Non-Stationary Relationships between Housing Price and Its Determinants in China: Guide for Housing Market Sustainability. *Sustainability* **2017**, *9*, 1826. [CrossRef]
17. Li, C.; Meng, Y.; Li, Y.; Ge, J.; Zhao, C. Inter-Metropolitan Land-Price Characteristics and Patterns in the Beijing-Tianjin-Hebei Urban Agglomeration in China. *Sustainability* **2019**, *11*, 4726. [CrossRef]
18. Yang, S.; Hu, S.; Li, W.; Zhang, C.; Torres, J.A. Spatiotemporal Effects of Main Impact Factors on Residential Land Price in Major Cities of China. *Sustainability* **2017**, *9*, 2050. [CrossRef]
19. Huang, D.; Yang, X.; Liu, Z.; Zhao, X.; Kong, F. The Dynamic Impacts of Employment Subcenters on Residential Land Price in Transitional China: An Examination of the Beijing Metropolitan Area. *Sustainability* **2018**, *10*, 1016. [CrossRef]
20. Ren, C.; Zhang, J.; Jia, S. An Empirical Study on the Effects of Land Price Signals on the Price of the Newly-built Residential Housing in a Region. *China Land Sci.* **2011**, *25*, 60–65.
21. Ren, C.; Gu, J.; Zhang, J.; Jia, S. The spatial and temporal diffusion of housing price dynamics induced by land price signal. *Geogr. Res.* **2013**, *32*, 1121–1131.
22. National People's Congress. Amendment to the Constitution of the People's Republic of China. 1988. Available online: http://www.npc.gov.cn/zgrdw/npc/zt/qt/gjxfz/2014-12/03/content_1888097.htm (accessed on 12 April 1988).
23. State Council of the People's Republic of China. Provisional Regulations on the Transfer and Transfer of the Right to Use of State Owned Land in People's Republic of China. Available online: http://www.dhyj.gov.cn/gtj/Web/_F0_0_28D02IRFAF3D34QY7BL717POM9.htm (accessed on 19 May 1990).
24. Ministry of Land and Resources. Provisions on the Transfer of the Right to the Use of State-Owned Land by Agreement. Available online: http://www.tdzyw.com/2012/0813/18783.html (accessed on 1 August 2003).
25. Wang, H.; Wu, X.; Wu, D.; Nie, X. Will land development time restriction reduce land price? The perspective of American call options. *Land Use Policy* **2019**, *83*, 75–83. [CrossRef]
26. Qu, S.; Hu, S.; Li, W.; Zhang, C.; Li, Q.; Wang, H. Temporal variation in the effects of impact factors on residential land prices. *Appl. Geogr.* **2020**, *114*, 102124. [CrossRef]
27. Liu, Z.; Miao, J.; Zha, T. Land prices and unemployment. *J. Monet. Econ.* **2016**, *80*, 86–105. [CrossRef]
28. Wu, Y.; Zhang, X.; Skitmore, M.; Song, Y.; Hui, E.C.M. Industrial land price and its impact on urban growth: A Chinese case study. *Land Use Policy* **2014**, *36*, 199–209. [CrossRef]
29. Kim, K.S.; Park, S.J.; Kweon, Y. Highway traffic noise effects on land price in an urban area. *Transp. Res. Part D Transp. Environ.* **2007**, *12*, 275–280. [CrossRef]
30. Wu, W.; Zhang, W. PLS path model building: A multivariate approach to land price studies—A case study in Beijing. *Prog. Nat. Sci.* **2009**, *19*, 1643–1649. [CrossRef]
31. Zhong, S.; Wang, S.; Jiang, Y.; Yu, B.; Zhang, W. Distinguishing the land use effects of road pricing based on the urban form attributes. *Transp. Res. Part A Policy Pract.* **2015**, *74*, 44–58. [CrossRef]
32. Zhuge, C.; Shao, C.; Gao, J.; Dong, C.; Zhang, H. Agent-based joint model of residential location choice and real estate price for land use and transport model. *Comput. Environ. Urban Syst.* **2016**, *57*, 93–105. [CrossRef]

33. Komarek, A.M.; Shi, X.; Heerink, N. Household-level effects of China's Sloping Land Conversion Program under price and policy shifts. *Land Use Policy* **2014**, *40*, 36–44. [CrossRef]
34. Bigelow, D.P.; Plantinga, A.J. Town mouse and country mouse: Effects of urban growth controls on equilibrium sorting and land prices. *Reg. Sci. Urban Econ.* **2017**, *65*, 104–115. [CrossRef]
35. Hu, S.; Yang, S.; Li, W.; Zhang, C.; Xu, F. Spatially non-stationary relationships between urban residential land price and impact factors in Wuhan city, China. *Appl. Geogr.* **2016**, *68*, 48–56. [CrossRef]
36. Huang, Z.; Du, X. Holding the market under the stimulus plan: Local government financing vehicles' land purchasing behavior in China. *China Econ. Rev.* **2018**, *50*, 85–100. [CrossRef]
37. Xin, L.; Li, X. Rental rates of grain land for consolidated plots and their determinants in present-day China. *Land Use Policy* **2019**, *86*, 421–426. [CrossRef]
38. Huang, J.; Shen, G.Q.; Zheng, H.W. Is insufficient land supply the root cause of housing shortage? Empirical evidence from Hong Kong. *Habitat Int.* **2015**, *49*, 538–546. [CrossRef]
39. Jahanshahloo, L.; Salahshour, S. Fuzzy effects of urban landscapes on land prices. *Procedia Comput. Sci.* **2011**, *3*, 595–599. [CrossRef]
40. Gao, H. Public land leasing, public productive spending and economic growth in Chinese cities. *Land Use Policy* **2019**, *88*, 104076. [CrossRef]
41. Wen, L.; Butsic, V.; Stapp, J.R.; Zhang, A. What happens to land price when a rural construction land market legally opens in China? A spatiotemporal analysis of Nanhai district from 2010 to 2015. *China Econ. Rev.* **2018**. [CrossRef]
42. Zhang, X.; Lin, Y.; Wu, Y.; Skitmore, M. Industrial land price between China's Pearl River Delta and Southeast Asian regions: Competition or Coopetition? *Land Use Policy* **2017**, *61*, 575–586. [CrossRef]
43. Du, J.; Peiser, R.B. Land supply, pricing and local governments' land hoarding in China. *Reg. Sci. Urban Econ.* **2014**, *48*, 180–189. [CrossRef]
44. Liang, W.; Lu, M.; Zhang, H. Housing prices raise wages: Estimating the unexpected effects of land supply regulation in China. *J. Hous. Econ.* **2016**, *33*, 70–81. [CrossRef]
45. Shen, X.; Huang, X.; Li, H.; Li, Y.; Zhao, X. Exploring the relationship between urban land supply and housing stock: Evidence from 35 cities in China. *Habitat Int.* **2018**, *77*, 80–89. [CrossRef]
46. Tan, Y.; Wang, Z.; Zhang, Q. Land-Use Regulation and the Intensive Margin of Housing Supply. *J. Urban Econ.* **2019**, 103199. [CrossRef]
47. Wang, R.; Hou, J.; He, X. Real estate price and heterogeneous investment behavior in China. *Econ. Model.* **2017**, *60*, 271–280. [CrossRef]
48. Liu, M.; Dries, L.; Heijman, W.; Zhu, X.; Deng, X.; Huang, J. Land tenure reform and grassland degradation in Inner Mongolia, China. *China Econ. Rev.* **2019**, *55*, 181–198. [CrossRef]
49. Du, H.; Ma, Y.; An, Y. The impact of land policy on the relation between housing and land prices: Evidence from China. *Q. Rev. Econ. Financ.* **2011**, *51*, 19–27. [CrossRef]
50. Yuan, F.; Wei, Y.D.; Xiao, W. Land marketization, fiscal decentralization, and the dynamics of urban land prices in transitional China. *Land Use Policy* **2019**, *89*, 104208. [CrossRef]
51. Wang, Y.; Potoglou, D.; Orford, S.; Gong, Y. Bus stop, property price and land value tax: A multilevel hedonic analysis with quantile calibration. *Land Use Policy* **2015**, *42*, 381–391. [CrossRef]
52. Tang, L.; Ma, X.; Zhou, Y.; Shi, X.; Ma, J. Social relations, public interventions and land rent deviation: Evidence from Jiangsu Province in China. *Land Use Policy* **2019**, *86*, 406–420. [CrossRef]
53. Li, C.; Xi, Z. Social Stability Risk Assessment of Land Expropriation: Lessons from the Chinese Case. *Int. J. Environ. Res. Public Health* **2019**, *16*, 3952. [CrossRef]
54. Dingzhou Bureau of Statistics. *Dingzhou Statistical Yearbooks 2016*; China Statistical Press: Dingzhou, China, 2017.
55. Li, C.; Wu, K. Driving forces of the villages hollowing based on geographically weighted regression model: A case study of Longde County, the Ningxia Hui Autonomous Region, China. *Nat. Hazards* **2017**, *89*, 1059. [CrossRef]
56. Weatherhead, E.; Howden, N. The relationship between land use and surface water resources in the UK. *Land Use Policy* **2009**, *26*, 243–250. [CrossRef]
57. Brown, S.; Versace, V.L.; Laurenson, L.; Ierodiaconou, D.; Fawcett, J.; Salzman, S. Assessment of spatiotemporal varying relationships between rainfall, land cover and surface water area using geographically weighted regression. *Environ. Model. Assess.* **2012**, *17*, 241–254. [CrossRef]

58. Du, J.; Thill, J.; Peiser, R.B. Land pricing and its impact on land use efficiency in post-land-reform China: A case study of Beijing. *Cities* **2016**, *50*, 68–74. [CrossRef]
59. Tsutsumi, M.; Seya, H. Measuring the impact of large-scale transportation projects on land price using spatial statistical models. *Pap. Reg. Sci.* **2008**, *87*, 385–401. [CrossRef]
60. Chao, L.; Zhang, K.; Li, Z.; Zhu, Y.; Wang, J.; Yu, Z. Geographically weighted regression based methods for merging satellite and gauge precipitation. *J. Hydrol.* **2018**, *558*, 275–289. [CrossRef]
61. Silva, A.R.; Lima, A.O. Geographically Weighted Beta Regression. *Spat. Stat.* **2017**, *21*, 279–303. [CrossRef]
62. Soler, I.P.; Gemar, G. Hedonic price models with geographically weighted regression: An application to hospitality. *J. Destin. Mark. Manag.* **2018**, *9*, 126–137. [CrossRef]
63. Fotheringham, A.S.; Brunsdon, C.; Charlton, M. *Geographically Weighted Regression: The Analysis of Spatially Varying Relationships*; Wiley: Chichester, UK, 2002; Volume 13.
64. Fotheringham, A.S.; Charlton, M.E.; Brunsdon, C. Spatial variations in school performance: A local analysis using geographically weighted regression. *Geogr. Environ. Model.* **2012**, *5*, 43–66. [CrossRef]
65. Shao, Y.; Li, M.; Chen, Z.; Yang, K.; Cai, D. Simulation on Regional Spatial Land Use Patterns Using Geographically Weighted Regression: A Case Study of Menghe Town, Changzhou. *Sci. Geogr. Sin.* **2010**, *30*, 92–97.
66. Wang, X.; Kong, Y. Local Linear Geographically Weighted Regression Analysis on the Urban Housing Price: A Case Study of Huangshi City, Hubei Province. *China Land Sci.* **2015**, *29*, 82–89.
67. Sultana, S.; Pourebrahim, N.; Kim, H. Household Energy Expenditures in North Carolina: A Geographically Weighted Regression Approach. *Sustainability* **2018**, *10*, 1511. [CrossRef]
68. Lewandowska-Gwarda, K. Geographically Weighted Regression in the Analysis of Unemployment in Poland. *ISPRS Int. J. Geo-Inf.* **2018**, *7*, 17. [CrossRef]
69. Wang, J.; Wang, S.; Li, S. Examining the spatially varying effects of factors on PM2.5 concentrations in Chinese cities using geographically weighted regression modeling. *Environ. Pollut.* **2019**, *248*, 92–803. [CrossRef] [PubMed]
70. Zhou, Q.; Wang, C.; Fang, S. Application of geographically weighted regression (GWR) in the analysis of the cause of haze pollution in China. *Atmos. Pollut. Res.* **2019**, *10*, 835–846. [CrossRef]
71. Wang, Y.; Li, X.; Kang, Y.; Chen, W.; Zhao, M.; Li, W. Analyzing the impact of urbanization quality on CO2 emissions: What can geographically weighted regression tell us? *Renew. Sustain. Energy Rev.* **2019**, *104*, 127–136. [CrossRef]
72. Chun, H.; Chi, S.; Hwang, B.G. A Spatial Disaster Assessment Model of Social Resilience Based on Geographically Weighted Regression. *Sustainability* **2017**, *9*, 2222. [CrossRef]
73. Yan, S.; Ge, X.J.; Wu, Q. Government intervention in land market and its impacts on land supply and new housing supply: Evidence from major Chinese markets. *Habitat Int.* **2014**, *44*, 517–527. [CrossRef]
74. Patricia, A.; Inma, A. Farmland prices and land-use changes in periurban protected natural areas. *Land Use Policy* **2012**, *29*, 674–683.
75. Peng, S.; Wang, Y.; Chen, C.; Wei, H.; Wang, J.; Wu, X. Analysis of the economic rationality of local government's downtick of the industrial land: Evidence from the municipalities in Guangdong Province. *J. Nat. Resour.* **2015**, *30*, 1078–1091.
76. Blachowski, J. Application of GIS spatial regression methods in assessment of land subsidence in complicated mining conditions: Case study of the Walbrzych coal mine (SW Poland). *Nat. Hazards* **2016**, *84*, 997. [CrossRef]
77. Wang, A.; Miao, B.; Chen, S. Spatial differentiation and impact factors of industrial land-use in Guangzhou. *Trop. Geogr.* **2007**, *27*, 132–138.
78. Nasr, K.; Boris, A.P. Economic, demographic and environmental factors affecting urban land prices in the Arab sector in Israel. *Land Use Policy* **2016**, *50*, 518–527.
79. Yang, J.; Yang, Q. Growth pressures, stimulus plan and industrial land transfer. *Econ. Res.* **2016**, *51*, 99–113.
80. Chen, W.; Shen, Y.; Wang, Y. Does industrial land price lead to industrial diffusion in China? An empirical study from a spatial perspective. *Sustain. Cities Soc.* **2018**, *40*, 307–316. [CrossRef]
81. Chen, W.; Shen, Y.; Wang, Y.; Wu, Q. How do industrial land price variations affect industrial diffusion? Evidence from a spatial analysis of China. *Land Use Policy* **2018**, *71*, 384–394. [CrossRef]
82. Chen, W.; Chen, W.; Ning, S.; Liu, E.-n.; Zhou, X.; Wang, Y.; Zhao, M. Exploring the industrial land use efficiency of China's resource-based cities. *Cities* **2019**, *93*, 215–223. [CrossRef]

83. Gao, J.; Chen, J.; Su, X. Influencing factors of land price in Nanjing Proper during 2001–2010. *Prog. Geogr.* **2014**, *33*, 211–221.
84. Chen, W.; Shen, Y.; Wang, Y.; Wu, Q. The effect of industrial relocation on industrial land use efficiency in China: A spatial econometrics approach. *J. Clean. Prod.* **2018**, *205*, 525–535. [CrossRef]
85. Huang, J.; Chen, L.; Zhang, Y.; Zhao, A. Research on the relationship between local government economic behavior and industrial land price under different industrial structure. *Ind. Econ. Res.* **2017**, *3*, 81–90.
86. Kuang, W. Expectation, Speculation and Urban Housing Price Volatility in China. *Econ. Res. J.* **2010**, *45*, 67–78.
87. Schaffartzik, A.; Haberl, H.; Kastner, T.; Wiedenhofer, D.; Eisenmenger, N.; Erb, K.H. Trading land: A review of approaches to accounting for upstream land requirements of traded products. *J. Ind. Ecol.* **2015**, *19*, 703–714. [CrossRef] [PubMed]
88. Bertoni, D.; Aletti, G.; Ferrandi, G.; Micheletti, A.; Cavicchioli, D.; Pretolani, R. Farmland Use Transitions After the CAP Greening: A Preliminary Analysis Using Markov Chains Approach. *Land Use Policy* **2018**, *79*, 789–800. [CrossRef]
89. Yang, J.; Guo, A.; Li, Y.; Zhang, Y.; Li, X. Simulation of landscape spatial layout evolution in rural-urban fringe areas: A case study of ganjingzi district. *GISci. Remote Sens.* **2018**, *56*, 388–405. [CrossRef]
90. Chen, Y.; Zhou, S. Research on spatial-temporal variation of the price of land leased in the city of Nanjing. *Soil* **2003**, *35*, 216–221.

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