

Special Issue Reprint

Economic Development of Rural Areas in Border Territories

Threats and Opportunities

Edited by
Francisco Javier Castellano-Álvarez, Paulo Ferreira, Luís Carlos Loures
and Rafael Robina-Ramírez

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Economic Development of Rural Areas in Border Territories: Threats and Opportunities

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Guest Editors

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Editorial

Economic Development of Rural Areas in Border Territories: Threats and Opportunities

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Given the focus of this publication, most of the works included are case studies that address different issues related to the development of border areas: energy transition, food sufficiency, tourism development, social capital, the balance between innovation and tradition in primary production systems, digital economy, etc. This multitude of topics is complemented by an enriching international perspective, derived from 14 contributions that analyze territories with heterogeneous characteristics belonging to more than 10 different countries.

Regardless of their national focus, the case studies included in this publication refer to rural areas. It is therefore not surprising that, from their different perspectives, endogenous rural development processes are the main object of study in many of the articles presented. In this sense, with its frontier character, this Special Issue could be considered a second edition of the one entitled “Rural Areas Facing the Challenge of Economic Diversification: Threats and Opportunities” [1].

Within this set of works analyzing rural development policies, Castellano-Álvarez et al. [2], based on a case study of the Sierra de San Pedro-Los Baldíos region (Extremadura, Spain), conclude that European rural development programs do not seem to have taken the border nature of this region into account when implementing their development strategy. If this approach is repeated in other border territories, it would jeopardize not only their development potential, but also the effectiveness of this type of program. In their analysis of the development strategy, the authors also note the excessive importance of tourism projects within the total investments made. This would constitute a second paradox in the conclusions of this study, since this type of investment has the highest number of failed projects; these results would be in line with those achieved by these same authors in their previous studies [3–6]. In all of these studies, as in the study on the Sierra de San Pedro-Los Baldíos, the region constitutes the geographical scope of the study [7].

The analysis of the circumstances under which rural tourism constitutes an element of development for border areas is a prominent theme in this Special Issue. In fact, in addition to the contribution by Castellano-Álvarez et al. [2], the publication also includes research by Monaco et al. [8], Vujko et al. [9], Gherdan et al. [10], Gkoltsiou [11], and Robina-Ramírez et al. [12], who address this issue from different perspectives.

Monaco et al. [8], taking Vesuvius National Park as a reference, analyze how traditional agriculture can boost rural tourism and local development, given its capacity to preserve biodiversity and strengthen territorial identity. Similarly, Vujko et al. [9] confirm the possibilities offered by the transformation of primary products in environments of

special natural value. Based on the example of Roquefort-sur-Soulzon cheeses (France), these authors confirm the relevance of the production of these cheeses in strengthening the cultural identity of the territory and rural tourism. Both contributions highlight the relevance of traditional production practices as an instrument of development. Along the same lines is the contribution by Gherdan et al. [10] on the practice of agrotourism in a mountainous region of Romania. For all these authors, in these rural border areas of special environmental value, the practices of tourism and agrotourism are essential drivers of economic development, while also ensuring the preservation of cultural and natural heritage. In their conclusions, these three studies agree that one of the challenges for tourism development in these regions is the balanced distribution of tourism across the entire territory and not just in certain enclaves with special tourist significance.

Robina-Ramírez et al. [12] also address the delicate balance between tourism, heritage preservation, and residents' perceptions in their analysis of the phronetic management of tourist accommodations located along the Portuguese–Spanish border. In their conclusions, the authors emphasize the importance of integrating ethical leadership with operational excellence to ensure sustainable tourism in rural border areas. Like Monaco et al. [8] in some of their previous work, Robina-Ramírez et al. [13] are interested in analyzing rural tourism in areas of special environmental value.

The analyses by Gkoltsiou [11] and Arana and Pérez [14], evaluating the capacity of natural and heritage resources to drive economic development in different border areas, complete the research gathered in this Special Issue on a question that is highly relevant to the main topic addressed in this publication. Gkoltsiou [11] takes the Ano Mirabello area in Crete as a reference, while Arana and Pérez [14], like Robina-Ramírez et al. [12], study various regions along the south of the Portuguese–Spanish border. The conclusions of both analyses highlight the importance that traditional productive activities have had historically, and continue to have today, for the conservation of these areas.

Mendoza and Domínguez-Mujica [15] study the role of international immigration in sustaining the economies of two border regions in Spain and analyze how these border conditions influence their demographic dynamics. The authors suggest that international migration, in addition to strengthening the social fabric of these territories, can drive their economic, social, and demographic revitalization. In their analysis, the authors also use the European rural development programs as a reference, within which the so-called intangibles of rural development [16] and the activation of social capital [17–20] are undoubtedly relevant. Closely related to this issue of social capital is the work by Albornoz-Arias et al. [21], who, focusing on the structural and sociocultural constraints faced by women in rural areas, study their leadership experiences based on a case study of the cocoa production chain in Tibú, Norte de Santander (Colombia).

From an international perspective, a comprehensive study of rural development in border regions requires the incorporation of research on the impact of agriculture in these territories. This is addressed in the contributions by Mabugu and Fofana [22] and Maharjan et al. [23], who, using different approaches, focus on agricultural practices in less developed countries. The former [22], applying an approach based on the Sustainable Development Goals, assess the levels of economic growth that South Africa would need to achieve in order to alleviate poverty and eradicate hunger in its rural areas. However, the conclusions of this work highlight that the achievement of these goals requires the integration of agricultural, labor, and welfare policies. Maharjan et al. [23] focus on the continuity of Environmental Conservation Agriculture (ECA) practices among rice terrace in the Ifugao region (Philippines). The findings of this study reveal that while access to resources such as high-yield seeds, modern agricultural machinery, and financial support is important for the adoption of CEA, the transition to high-yield varieties has contributed

to a decline in the cultivation of Tinawon rice, which is vital for preserving biodiversity, soil health, and cultural identity. In addition, the authors highlight the role of community support systems, market access, and financial incentives as key factors in maintaining CA practices. Climate change presents both challenges and opportunities for adaptation, making it essential to integrate traditional knowledge with modern techniques. Based on two case studies, these two contributions represent a small sample of the challenges facing agriculture in Asian and African countries. As is well known, the paradigm of primary production systems in these types of economies is very different from that of rich countries with powerful agricultural stimulus policies [24,25].

Three cross-cutting contributions complete this Special Issue. One consists of a bibliometric analysis of the rural economy and family businesses. In this work, Al-cázar-Blanco et al. [26] use scientific maps to visualize the intellectual structure of these topics and evaluate scientific output using bibliometric indicators to extract the main research topics through an analysis of keyword co-occurrence. Their results show that research on family businesses and the rural economy is booming, especially focusing on family businesses with higher productivity and performance. Regarding the main topics studied, land management in cross-border environments emerges as a potential line of research. Bibliometric analyses have repeatedly shown [27,28] that they can be a very useful tool for defining the theoretical framework of the subject to be analyzed.

Deng et al. [29], using county-level panel data from China, defined a Rural Revitalization Index and conducted empirical tests in combination with the Digital Village Index. The authors frame this initiative in a context in which the digital economy is fundamental to driving strong economic growth, which is essential for achieving comprehensive rural revitalization. Their results show that the establishment of digital villages improves the progress of rural revitalization significantly. A more detailed analysis shows that the enabling effect of building digital villages on rural revitalization is more pronounced in counties that are not major grain producers and have extensive road networks. Therefore, it is essential to promote digital villages, identify integration points based on rural functional roles and resource endowments, and explore ways to fully leverage their enabling effects on rural revitalization.

Finally, energy sufficiency and transition processes, two issues of considerable relevance for many remote and poorly connected rural areas (also from an energy perspective), are studied by Kozera [30] based on a case study of the eastern regions of Poland.

Having summarized the different contributions that make up this Special Issue, their methodological heterogeneity deserves a final comment, as it shows how case studies often require the adaptation of research methodologies without compromising scientific rigor: TOPSIS models, qualitative analyses based on semi-structured interviews, in-depth interviews, factor analyses, structural equation models (SEMs), statistical inference, and correspondence analysis are good examples of this diversity of approaches.

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Article

Rural Development Strategies in Border Areas: The Case of Sierra de San Pedro—Los Baldíos (Extremadura, Spain)

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Abstract

Taking as a reference a region located on the border between Spain and Portugal, this paper analyses how European rural development programs take into account this borderline nature in order to implement their development strategies. The case study methodology allows for an in-depth analysis of the investments implemented and the assessments of the entrepreneurs who carry them out. The results show the relevance of tourism projects within the investments made; however, the paradox is that it is precisely this type of project, and especially those aimed at creating rural accommodation, which have the highest percentage of failed investments. The results confirm the growing relevance of ‘non-productive’ actions led by local entities and aimed at the provision of public services. The interviews with the promoters show that, with the exception of some of the agricultural valorization actions, the vast majority of the projects carried out lack a cross-border vision. The development strategy of this county is not substantially different from that implemented by any other county. This is an interesting lesson since, if the same were happening in other border territories, the development strategies implemented would ignore the specific potentialities of this type of border region.

Keywords: rural development programs; border region; investments; tourism projects

1. Introduction

Since the 1980s, the European Commission (EC), drawing on a series of key publications (including Guidelines for European Agriculture [1], the CAP Green Paper [2], the Communication ‘The Future of Rural Areas’ [3], and the Report ‘The Development and Future of the Common Agricultural Policy’ [4]) identified clear signs of the exhaustion within an agricultural policy framework marked by a dual productivist and protectionist orientation. Against this backdrop, the early 1990s witnessed the first major reform of the policy, undertaken in part to meet the binding commitments arising from the GATT Uruguay Round negotiations on international agricultural trade [5,6]. The Common Agricultural Policy (CAP) thus embarked on a prolonged process of transformation, transitioning from a productivist model (one that unequivocally equated rural development with agricultural development) to an income-support framework characterized by decoupled payments. This reorientation connected the development aspirations of the European rural milieu to an emerging paradigm aimed at promoting the economic diversification of rural territories. This was the context in which the EC approved the LEADER I Initiative [7], endorsing the aforementioned strategy of economic diversification with the objective of mitigating

the adverse effects that the impending CAP reforms were expected to have on rural and agricultural incomes.

The LEADER I call for proposals emerged at a time when, according to the European Economic and Social Council [8], it had become evident that ‘the Structural Funds were unable to achieve the economic and social cohesion referred to in the Single Act’. Since then, the implementation of the Leader methodology has remained a constant feature of rural development in Europe. Following LEADER I, the LEADER II [9] and LEADER + [10] initiatives were adopted, consolidating an endogenous, participatory, multisectorial, and integrated development model known as the ‘Leader Approach’, whose characteristics have been extensively analyzed [11–21]. Moreover, the expectations generated by the initial LEADER calls prompted several countries, including Spain, to promote programs inspired by the Leader model that would allow regions excluded from the Initiative to apply the same development strategies, giving rise to PRODER I [22] and PRODER II [23].

However, despite the considerable interest shown by the European rural milieu in the implementation of these programs, their budgetary allocations remain negligible compared with other types of interventions characteristic of regional or agricultural policies [24–29]. Confronted with this paradox, González Regidor [30] argues that the true added value of these programs lies in the methodology applied rather than in the volume of investment involved. Elements such as the territorial scope of intervention [31], population participation [32–40], social capital [41–51], and the so-called intangibles of rural development [52,53] are particularly significant within this methodological framework.

To address the long-standing objective of economic diversification, these programs are structured around investments classified into “productive” and “non-productive” measures. Two measures fall into the ‘non-productive’ category. The first is intended to finance the operating costs of the Local Action Group (LAG) and the Rural Development Centre (CEDER), which constitute the organizational and technical bodies responsible for decision-making and for implementing the development strategy. The second measure encompasses a broad range of actions aimed at restoring cultural heritage and providing various public services; these initiatives are promoted by public authorities (either the LAG itself in the case of supra-local actions, or local councils for local-level projects). In turn, there are three ‘productive’ measures which adopt a cross-cutting approach to the development of different economic sectors: rural tourism; SMEs, crafts and services; and agricultural valorization and marketing of agricultural products [54].

Among the aforementioned productive measures, the one aimed at promoting rural tourism has arguably received the greatest attention from the scientific community. Bryden [55] explored the potential of this sector as an instrument of rural development; Patmore [56] and Butler et al. [57], highlighted the emerging recreational demands placed on rural areas and the opportunities these created for the tourism sector; Lane [58], Sharpley and Roberts [59], through their efforts to conceptualize and define this new phenomenon of rural tourism, may be considered some of the pioneers in the study of this topic. Other contributions could also be added, such as those of Perdue et al. [60], which have become essential references for scholars interested in local residents’ perception of the tourism phenomenon [61]. Indeed, the multiple interactions between the activation of social capital and the practice of rural tourism currently constitute a prominent line of research [62–64], alongside many others which, beyond the scope of endogenous rural development programs, underscore the academic interest that this subject continues to generate. Some of these lines of inquiry focus on the relationship between the rural environment and the various ways in which tourism makes use of its resources through the pursuit of health and well-being [65], culture [66], wine tourism [67,68], and agritourism [69–71], among others. Beyond the different modalities of tourism in rural areas, another notable area of

research concerns the management of tourist establishments [72] and the role that ethical considerations may play in their management [73,74].

However, if we set aside the aforementioned diversity of research lines and analyze the literature that specifically links rural tourism to the implementation of endogenous development programs, it quickly becomes evident that numerous contributions (often descriptive in nature) seek to quantify the impact of these programs on the tourism development of the areas where they are implemented. There are countless examples of such studies, both at the international level [75–78] and focused on different regions within the same country in which the study area is located [79–87]. Although rural tourism has been the productive measure to which the greatest share of resources has been allocated in many iterations of these programs, this prominence does not necessarily translate into positive outcomes. In their analysis of the limitations of tourism as an instrument of regional development, Castellano-Álvarez et al. [88] emphasize the risks incurred by regions that, relying on their natural, cultural or heritage resources, adopt tourism as the cornerstone for their development strategy. Indeed, it is within this type of action (particularly in investments aimed at creating new rural accommodation) that these authors identify the highest number of failed projects and the lowest assessment made by project promoters regarding the viability of the investments undertaken [89].

The academic interest generated by the implementation of the other two productive measures is minimal compared with that sparked by the rural tourism and, in any case, should be situated within analyses of the overall implementation of this type of program [90–94] or within studies specifically focused on strengthening the business fabric in rural areas [95,96] and on agricultural modernization and commercialization [97].

Having outlined this brief review of the literature, which constitutes the theoretical framework for the research, the objective of this study is to analyze the development strategy implemented by the Sierra de San Pedro—Los Baldíos region (Extremadura, Spain). This region forms part of a territory defined by its rural, peripheral and borderland character where, historically, there has been a close connection between the populations on both sides of the border, without this having led to a dynamic of development; this region constitutes a paradigmatic example of the territories that make up the extensive Portuguese-Spanish border. To achieve the aforementioned objective, the following research questions are posed: (a) In which sectors or activities have the investments derived from the aforementioned development strategy materialized?; (b) what is the long-term survival rate of these investments? (c) even in the case of projects that remain operational, how do the promoters assess the viability of their investments?; and (d) what is the cross-border orientation of the operational projects? This final question enables an assessment of the extent to which the border nature of this region, with its inherent limitations and opportunities, has been incorporated into the development strategy.

This research introduces two noteworthy contributions: (1) it examines the issue of economic development in border areas from the perspective of endogenous rural development programs implemented by the European Union (EU); consequently, its findings may offer valuable insights for those territories which, sharing the characteristics of the case study, have been applying these incentives; and (2) the methodology employed acknowledges the criticisms raised by Navarro et al. [98] regarding the quality of the official evaluations of these programs and, indeed, seeks to transcend them. In this regard, the study aligns with other authors who focus on the long-term survival of the projects implemented [99] or on the factors underlying their failure [100].

Following this introduction, which outlines the theoretical framework of the research, the next section describes the study's approach and methodology, the third section presents

the results obtained in response to the research questions, and the final section sets out the conclusions and discusses them in relation to the existing literature.

2. Research Approach and Methodology

2.1. The Sierra de San Pedro—Los Baldíos Region as a Case Study

Located in the south–west of the province of Cáceres and north–west of Badajoz, the Sierra de San Pedro—Los Baldíos is a natural region whose western boundaries coincide with the frontier with Portugal. This Local Action Group (LAG) is the only one in Extremadura (Spain) comprising municipalities from both provinces; specifically, 12 municipalities that together cover an area of 2547.76 km². As shown in Figure 1, Albuquerque (723.23 km²) and Valencia de Alcántara (594.83 km²) are the largest municipalities, collectively accounting for nearly half of the region’s surface area.

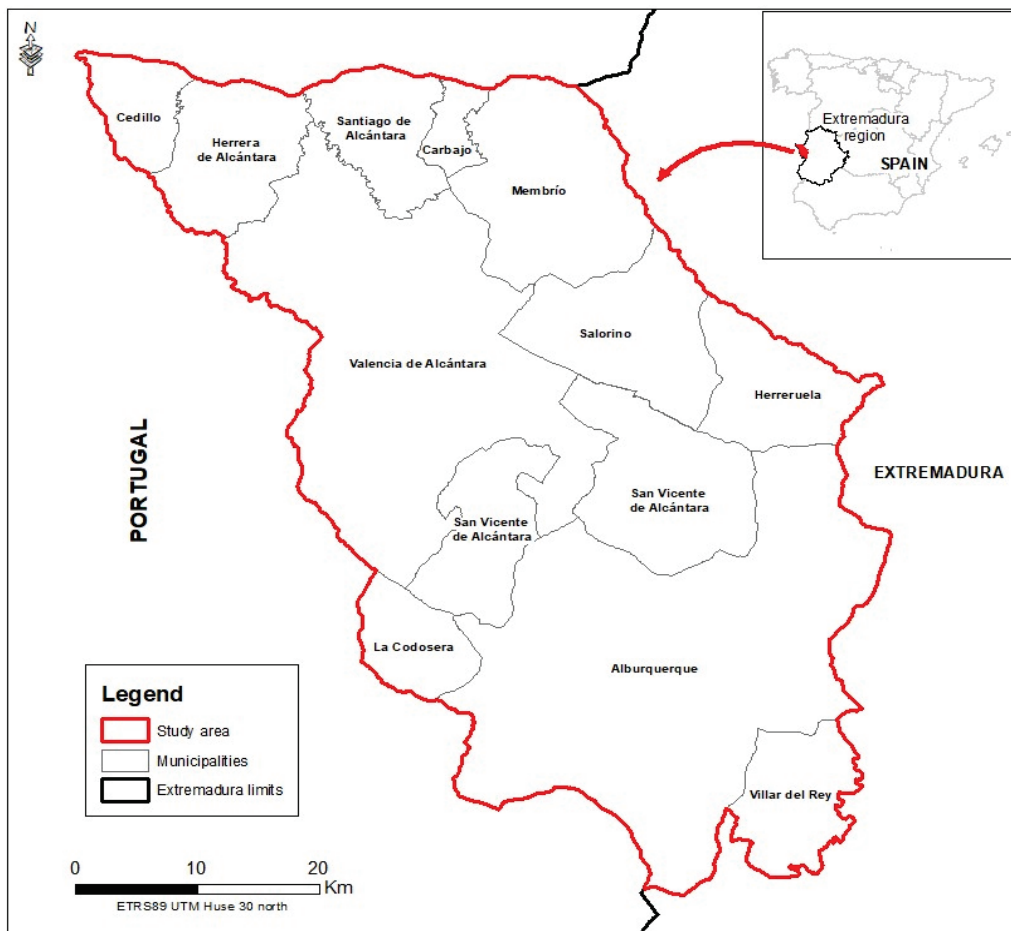


Figure 1. Sierra de San Pedro—Los Baldíos region. Source: Own elaboration.

In demographic terms, the region has a total population of 22,492 inhabitants [101], nearly 60% of whom are concentrated in three towns: Albuquerque, San Vicente de Alcántara and Valencia de Alcántara, none of which plays a clearly predominant economic role. It is true that the presence of various public services in Valencia de Alcántara means that it acts as the regional capital, at least as far as the municipalities belonging to the province of Cáceres are concerned. Table 1 presents the area, population and population density of the municipalities in the region. As can be inferred from the aggregate figures, Sierra de San Pedro—Los Baldíos is characterized by a low population density (8.83 res./km²), markedly below the regional average (25.32 res./km²).

Table 1. Population by municipality Sierra de San Pedro—Los Baldíos (2023).

Municipality	Residents	Area (Km ²)	Density (Res./Km ²)
Alburquerque	5063	723.23	7.00
Carbajo	179	27.94	6.40
Cedillo	433	61.56	7.03
Herrera de Alcántara	228	121.61	1.87
Herreruela	321	113.72	2.82
La Codosera	2004	69.63	28.78
Membrío	572	207.74	2.75
Salorino	538	157.65	3.41
Santiago de Alcántara	475	95.67	4.96
San Vicente de Alcántara	5262	275.31	19.11
Valencia de Alcántara	5236	594.83	8.80
Villar del Rey	2181	99.0	22.03
Total	22,492	2547.76	8.83

Source: Spanish Statistical Institute.

Taking the start of PRODER I as a reference and analyzing the evolution of the regional population in the period 1996–2023, a decrease of 18.27% can be observed [101]. In fact, the region as a whole is classified as a disadvantaged area due to depopulation, in accordance with European Council Directives 75/268/EEC and 86/466/EEC [102].

Regarding the selection of the Sierra de San Pedro—Los Baldíos region as the study area, Coller [103] argues that the use of case study methodology requires the research subject to have clearly defined boundaries and to be suitable for comparison with the phenomenon under investigation. The delimitation of the Sierra de San Pedro—Los Baldíos region is unequivocal and, with respect to the validity of the chosen case, it should be noted that this region meets all the conditions for the successful implementation of the endogenous rural development programs under analysis.

The Sierra de San Pedro—Los Baldíos region is characterized by pastureland landscapes where extensive livestock farming predominates. The agri-food industries linked to pork processing, meat products derived from the region’s abundant resources, and the auxiliary industries associated with livestock farming itself offer opportunities to promote investment aimed at agricultural development and marketing.

The hunting resources of the Sierra de San Pedro also provide significant support for rural tourism, an activity for which the region possesses outstanding assets: prehistoric dolmens forming the most important dolmen complex in Europe; magnificently preserved medieval castles that bear witness to the Christian Reconquest; cave paintings; Gothic quarters and Jewish synagogues that, due to their exceptional state of preservation, have been declared Historic-Artistic Sites; outstanding natural resources such as the Tajo International Natural Park, designated a Biosphere Reserve. . . all of this complemented by the inherent appeal of a border territory, clearly reflected in its heritage.

2.2. Time Frame of the Research

As stated above, the overarching objective of this research is to analyze the implementation of the rural development strategy in the Sierra de San Pedro—Los Baldíos region. Particular attention is given to assessing the long-term survival of the investments supported by these programs. To do so, it is essential to adopt a long-term time perspective that makes it possible to examine the continuity of the projects once the subsidy eligibility period has ended (during which promoters who failed to keep their projects operational would be required to repay the funds received). For this reason, the study covers the period from the second half of the 1990s (when the rural development programs became

widely implemented across rural Europe) up to 2013, the year in which the so-called Leader Approach [104] came to an end. This timeframe thus encompasses the three six-year programming periods during which the Sierra de San Pedro—Los Baldíos region implemented the Proder I (1996–2001) and Proder II (2002–2007) programs, as well as the aforementioned Leader Approach (2007–2013).

2.3. Research Methodology and Phases

Methodologically, this study draws on the proposals of Castellano-Álvarez et al. [88,105] or Castellano-Álvarez and Robina-Ramírez [89] concerning the analysis of the long-term effects of rural development programs, an aspect these authors describe as the “footprint” of such programs on the territory. Their contributions are grounded in the application of the case study methodology, a research approach examined by various scholars, including Baxter and Jack [106], Durán [107] and Jiménez and Comet [108].

Yin [109] recommends this research methodology when the phenomenon under study is closely intertwined with its context. This is the case in the present research: the outcomes of the rural development strategies implemented in the study area cannot be understood without first considering the defining characteristics of the territory. Likewise, the implementation of such strategies entails the revalorization of the territory’s resources.

With regard to its phases, this research is grounded in extensive fieldwork in which three distinct stages (each involving different approaches) can be identified:

- (1) A preliminary phase involving the establishment of contact with the technical staff of the LAG responsible for managing the programs under analysis, as well as the examination of the development strategies employed. During this phase, the investments made were analyzed and quantified, together with their distribution across areas of intervention, their objectives, and other relevant aspects. In addition, in preparation for the second phase of fieldwork, the contact details of the promoters who had received funding from the program were located.
- (2) Analysis of projects and interviews with their promoters. In his studies on qualitative research, Yin [110] advocates the usefulness of interviews as a research tool and source of information, given that they enable interaction with the interviewees, allow their opinions to be contextualized, and thereby enhance the understanding of the information and evaluations they provide.

Given the large number of projects carried out during the three six-year programming periods under analysis, it was necessary to select a sample based on the following criteria: (1) the majority of the investment had to be private, meaning that the research focuses on the so-called ‘productive measures’ and, within these, on projects led by private promoters; (2) the subsidy received had to be at least 12,000 €; and (3) the subsidy had to be relevant to the overall investment, accounting for at least 20% of the project’s total cost. These three criteria aim to focus attention on projects which, given their size (and therefore greater impact on regional development), demonstrate the capacity of this type of program to mobilize endogenous resources in the region, given the amount of the grant received and the percentage it represents of the total investment made.

Applying these criteria resulted in a final sample of 70 projects. Table 2 presents the total number of private projects implemented in comparison with those selected for the sample, as well as the relative weight of the latter in terms of total investment.

Table 2. Sample of private projects. Sierra de San Pedro—Los Baldíos region.

Program and Measure	Private Projects	Sample Projects	Total Investment Sample Projects	% Investment Sample Projects Out of the Total Investment of the Measure
Proder I	45	24	1,902,193.67	64.78
Rural tourism	25	17	1,415,782.22	83.23
SMEs, crafts and services	11	4	309,509.34	36.49
Agricultural valorization	9	3	176,902.11	45.69
Proder II	55	29	5,103,331.89	84.63
Rural tourism	24	14	2,589,868.63	80.45
SMEs, crafts and services	15	7	1,871,288.32	90.30
Agricultural valorization	16	8	642,174.94	86.95
Enfoque Leader	55	17	2,454,217.30	76.75
Rural tourism	14	4	583,124.53	65.98
SMEs, crafts and services	39	11	1,222,089.52	73.40
Agricultural valorization	2	2	649,003.25	100.00
Total	155	70	9,549,742.86	78.51

Source: Own elaboration.

As shown in Table 2, the criteria used to define a series of investments that represent around 45% of the projects implemented, account for almost 80% of productive investment during the three six-year programming periods that constitute the research time frame. This sample allows the second phase of the fieldwork to be undertaken without conditioning the generalization of the conclusions reached.

For the aforementioned second phase of fieldwork, semi-structured interviews were selected from among the various interview models available. This type of interview represents an intermediate option between closed surveys (which are unable to capture potentially valuable contributions that may arise spontaneously from interviewees within the interactive setting of an interview) and fully open interviews (which lack a script and therefore make it difficult to focus the interviewee's attention on the aspects most relevant to the research, as well as to process the information obtained thereafter).

The questionnaire used is structured into five sections: The first defines the profile of the promoter and the project (age, gender, origin, place of residence, educational level, type of activity and type of project); the second section focuses on the characteristics of the investment (motivations, objectives, amount, and form of financing) as well as the relevance of the program and of grant managers in the execution of the project. The third section examines the importance of the project for the promoter's income, while the fourth aims to capture the promoters' assessment of the program's contribution to their economic sector and to the region as a whole. Finally, in the last section of the interview, respondents are invited to provide any additional comments they consider relevant to the research.

- (3) Triangulation of results. Given the qualitative nature of the research and the long period of time that had elapsed between the implementation of the projects and the interviews, in order to avoid any bias on the part of the interviewees, the final stage of the fieldwork involved comparing the conclusions initially obtained in the previous phase with the assessment provided by the technical managers of the LAG responsible for implementing the three programs under analysis. These individuals constitute privileged witnesses to both the region's evolution and the development strategy applied therein.

3. Analysis of the Implementation of the Rural Development Strategy

3.1. In Which Sectors or Activities Have the Investments Materialized?

Table 3 shows the investment made for each of the measures comprising the PRODER I, PRODER II and LEADER Approach programs, as well as their relative importance within the total investment committed by them.

Table 3. Investment by measures in PRODER I and II programs and LEADER Approach.

	PRODER I	%	PRODER II	%	LEADER A.	%
Technical support for development	580,974.97	13.24	1,074,412.85	13.24	1,192,179.85	18.36
Rural heritage restoration	872,103.42	19.87	1,008,252.63	12.43	2,104,916.63	32.41
Unproductive measures	1,453,078.39	33.11	2,082,665.48	25.67	3,297,096.48	50.77
Rural tourism	1,701,042.59	38.75	3,219,015.16	39.68	883,749.12	13.61
SMEs, crafts and services	848,077.02	19.32	2,072,206.66	25.54	1,664,875.69	25.63
Agricultural valorization	387,187.83	8.82	738,544.51	9.11	649,003.25	9.99
Productive measures	2,936,307.44	66.89	6,029,766.33	74.33	3,197,628.06	49.23
Total	4,389,385.83		8,112,431.82		6,494,724.54	

Source: Own elaboration based on the final implementation reports for the various programs.

Compared with its first edition, PRODER II almost doubled the investment allocated under by PRODER I. However, the implementation of the LEADER Approach shows a decline in the resources mobilized. This reduction may be attributable either to the limited funds assigned to the program or to the implementation capacity of the LAG itself. Comparison with other LAGs yield mixed and inconclusive results [88]. In the case of this LAG, however, an analysis of the allocation of resources by measure reveals a marked contraction in investment in productive measures, which, under the LEADER Approach, were able to commit only slightly more than half of the resources invested in the previous six-year period.

Among the productive measures, the most pronounced decline in the capacity to commit resources is observed in the measure aimed at promoting rural tourism, where the resources invested amount to less than 30% of those allocated under PRODER II. This represents a substantial loss of relative importance for this measure and may underscore the limitations of tourism promotion as an instrument of economic diversification in this region [105]. It is noteworthy that nearly 40% of all resources invested in PRODER I and PRODER II were allocated to rural tourism; however, under the LEADER Approach, the resources devoted to this measure account for less than 15% of the total. This is an issue that the present study seeks to address.

Although the commitments for the other two productive measures also fall short of the amounts achieved in PRODER II, they nonetheless manage to maintain their relative importance within the program during the implementation of the LEADER Approach.

On the other hand, given a certain containment in the resources committed to unproductive measures between PRODER I and PRODER II, the most evident consequence of decline in productive investment under the LEADER Approach is the increase in resources allocated to the two unproductive measures and, in particular, to the measure concerning the restoration of rural heritage (under which various local projects are carried out, mainly promoted by the local councils themselves). Despite the reduction in resources committed by the LEADER Approach compared to the previous six-year period, the funds allocated for this type of action during the 2007–2013 are twice those committed by PRODER II

for the same purpose. As a result, the aforementioned rural-heritage restoration actions account for one-third of the total investment.

Given the inability of the productive measures to stimulate private investment, it appears that this has been the strategy followed by the GAL to commit its resources. Without questioning its contribution to the social welfare of the rural population, it is worth considering whether the importance assigned to this type of unproductive project constitutes an anomaly in the implementation of this development program.

For its part, the measure for technical support for rural development shows a modest increase in the resources committed compared to previous editions. This measure covers the operating costs of the Rural Development Centre (CEDER), including office maintenance and staff salaries, as well as the implementation of training activities and/or the preparation of studies on the territory.

In addition to the resources allocated to these two unproductive measures, there are also public projects promoted by the various local councils as part of productive measures, as well as other actions of general interest managed directly by the LAG. Taken together, these actions account for 1,353,045.16 €, meaning that public or non-productive projects represent 43% of the total investment executed across the three programs.

Figure 2 illustrates the distribution of productive investment by measure over the entire period under analysis. Despite the aforementioned decline in investment in the promotion of rural tourism under the LEADER Approach, the figure highlights the importance of this measure in the overall implementation of the development strategy during the period studied. Notably, as previously mentioned, this measure accounted for nearly 40% of all investments made under PRODER I and II.

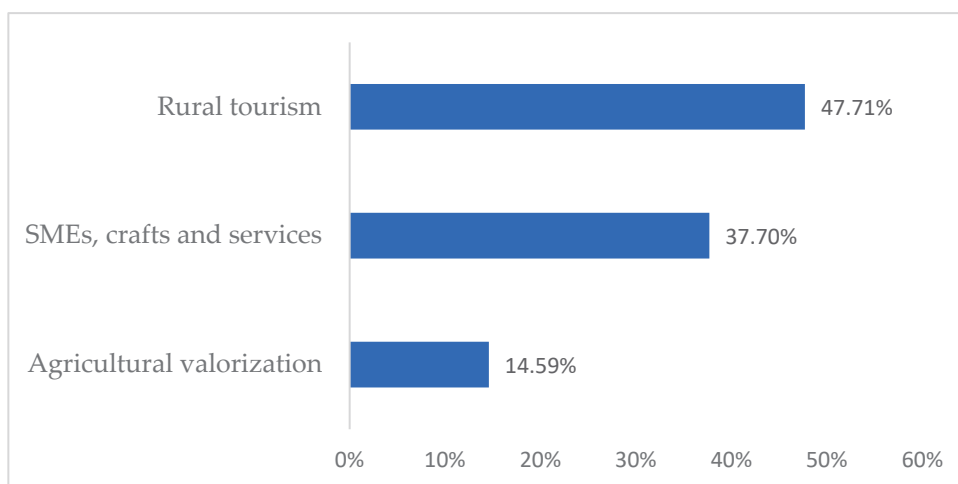


Figure 2. Distribution by productive investment measures. Source: Own elaboration.

The projects carried out under the SME, crafts and services measure are highly diverse. Despite differences in implementation between the two editions of PRODER and compared with the promotion of rural tourism under the LEADER Approach, this measure assumes a certain relative importance. It should be emphasized that this is due more to the shortcomings of tourism investments than to the commitments made under the SME, crafts and services measure, given that under the LEADER Approach, the final investment in this measure was 20% lower than that achieved in PRODER II.

The agricultural valuation measure, for its part, continues to play a modest role in productive investment across the three programs under analysis. It is highly likely that promoters of this type of investment would find a better fit for their projects within other lines of Community and/or regional support. However, it should be noted that this imbalance in the implementation of the various productive measures also occurs in other

regions of Extremadura, where, at the same time, agricultural valuation projects account for the highest proportions of operational investments [89].

Having obtained an overview of the distribution of investment across the three programs analyzed, as well as the relative importance of each of their productive measures, we now turn to an analysis of the type of project implemented within each program in order to gain a deeper understanding of their sectoral orientation. It should be borne in mind that one of the main objectives of these programs is the economic diversification of rural areas.

3.1.1. Rural Tourism

An analysis of the distribution of investment in rural tourism by activity further enriches the results obtained thus far. One idea clearly stands out in this analysis: 70% of resources were allocated to the creation and/or modernization of tourist accommodation by private promoters; if we add to this the resources invested in public initiatives with the same purpose, the conclusion is that three-quarters of all investment in rural tourism was concentrated on the creation of tourist accommodation. In the initial phase of the development strategy, it may even be reasonable to place special emphasis on this type of project, but the truth is that this concentration of investment not only continued during the implementation of PRODER II but was even accentuated. Given the importance of this measure for the region's development strategy, analyzing the viability of this type of project will make it possible to assess its success more accurately.

Figure 3 shows the distribution of investment in rural tourism by activity, although it does not reflect the changes recorded across the three programs implemented. In this regard, it should be noted that under the LEADER Approach, despite the reduction in resources allocated to this measure, investments in the creation of accommodation remain similar in importance to those achieved in the two PRODER editions; the same cannot be said of restaurant-related projects, for which no investment was made, an aspect that may constitute a weakness in the tourism development strategy, as it limits the promotion of the region's gastronomy and traditional products as a valuable cultural and tourist resource.

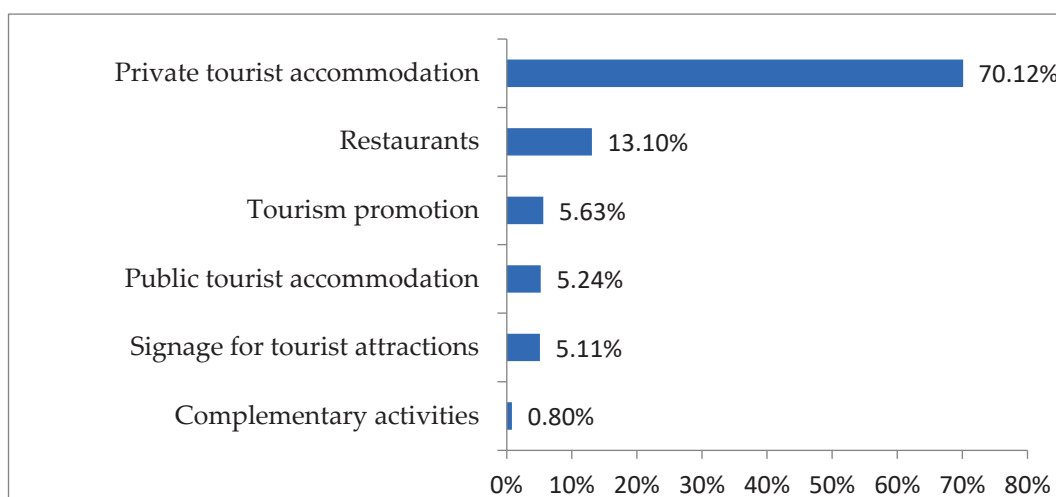


Figure 3. Distribution by activity of investment in rural tourism. Source: Own elaboration.

A direct consequence of concentrating resources on the creation or modernization of accommodation is the lack of investment in other types of actions that are equally important for promoting tourism development in the region: resources allocated to tourism promotion and those devoted to signage and the restoration of tourist assets each account for only 5% of total investment.

The virtual absence of projects aimed at promoting a broad range of complementary activities, as well as the resources committed to public accommodation, are additional factors that raise concerns after analyzing the distribution of tourism investment by project type. Regarding the former, it is essential for the region to offer activities and services that enhance its appeal and make it accessible to those interested in enjoying its tourism resources. The development strategy implemented by this LAG does not appear to have stimulated private developers' interest in providing such services, thereby jeopardizing the region's tourism development. Furthermore, the presence of the public sector is not limited to the aforementioned unusual prominence of non-productive measures; rather, in both editions of PRODER, several local councils in the region competed with private developers for funding under the productive measures. Under the heading of rural tourism promotion, more than 300,000 € was allocated during the two PRODER editions to the creation of tourist accommodation through six municipal projects. Only two of these projects, representing barely 20% of the investment, remain operational.

3.1.2. SMEs, Crafts and Services

Depending on the type of economic activity, Figure 4 classifies the projects financed under this measure and shows the relative importance of each category.

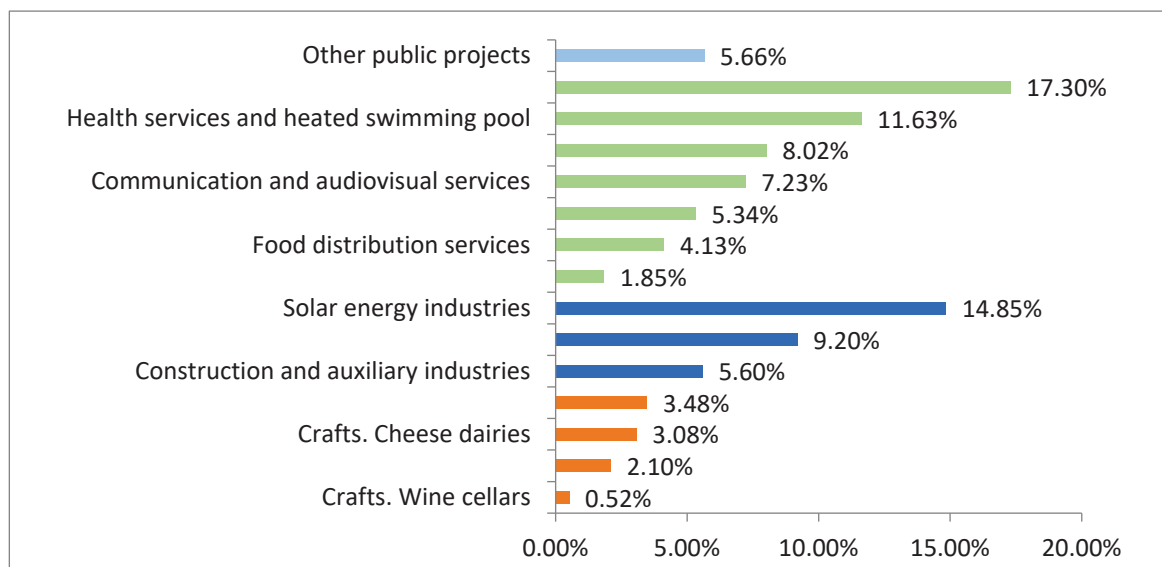


Figure 4. Sectoral distribution of investment in SMEs, crafts and services. Source: Own elaboration.

Almost all of the companies benefiting from the program are SMEs. Figure 4 displays several lines of action in support of this, including:

- Support for crafts based on the processing of local products. These actions, which are more characteristic of agricultural development measures, target a wide variety of products but are of limited significance as they account for only 9% of the resources committed to this measure.
- Industrial promotion that adds value to local resources of particular importance to the regional economy, such as cork, while also supporting more innovative projects, such as the creation of a solar park. The commitment to solar energy production is concentrated in a single project. However, actions aimed at cork processing are widely distributed among the various industries in the region. The same is true of initiatives that foster the modernization of auxiliary industries in the construction sector. Industrial projects account for 30% of the investment made under this measure.

- (c) Projects aimed at creating or modernizing services account for just over half of the total investment and support a wide range of activities which, together with the other measures, reinforce the objective of economic diversification inherent in these programs. From support for retail trade to the provision of physiotherapy services, and from the modernization of consultancy firms to that of training centers, the sectoral diversity of these projects is undeniable. Two issues merit comment: (1) health-related services would account for barely 2% of the total investment under this measure if the funds allocated to the creation of a heated swimming pool (a failed project) were excluded; and (2) in assessing the demographic and economic dynamics of the region, it is both striking and revealing that funeral services are the activity that mobilizes the largest share of resources under this measure and, apart from investments in rural accommodation, arguably the program as a whole.

The analysis of the sectoral distribution of investments requires acknowledging these 'other public projects', which amount to just over 250,000 € and represent 5.66% of the total investment in this measure. As with the measure aimed at rural tourism, local councils compete with private developers for program funding. The nature of these public projects is heterogeneous: 70% of the resources are allocated to four initiatives intended to promote local industries, none of which are operational; a further three projects, accounting for an additional 25% of resources, involve the air conditioning of municipal facilities for welfare purposes; and finally, there is a small number of actions implemented directly by the LAG to support businesses. Both the long-term viability of this type of initiative and the welfare-oriented purpose of those that remain operational once again call into question the involvement of local councils in a productive measure.

3.1.3. Agricultural Valorization and Commercialization

As noted above, this measure has limited significance in terms of productive investment (Table 3); nevertheless, the investments made target all of the region's characteristic products (cheese, pork, wine, olive oil, honey, game-derived meat products, etc.), while also supporting more innovative initiatives, such as the production and marketing of partridges, rabbits, eggs or the curing of hams. As shown in Figure 5, not all activities mobilize the same level of resources; the cheese, meat and wine industries are particularly dynamic, with some projects demonstrating notable economic relevance.

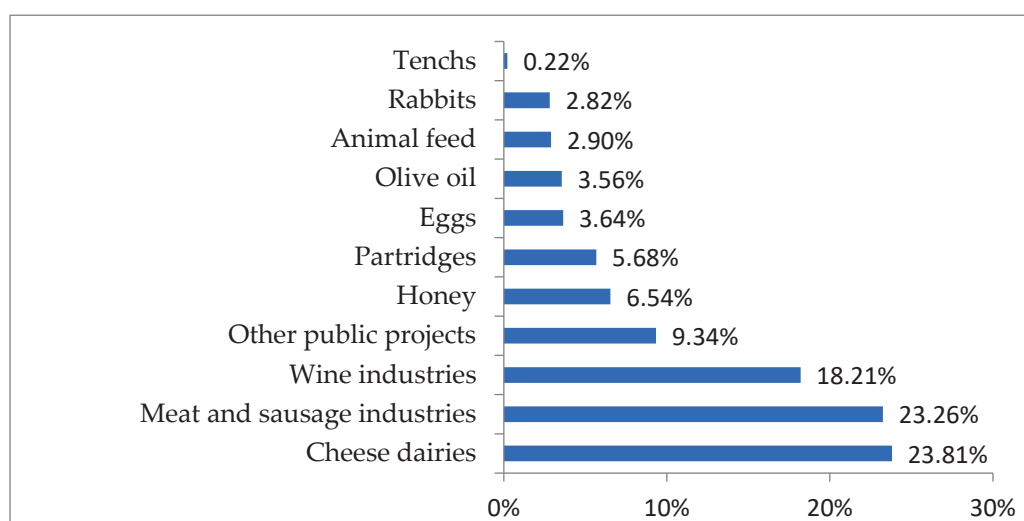


Figure 5. Sectoral distribution of investment in agricultural valuation measures. Source: Own elaboration.

As shown in Figure 5, local councils in the region once again implemented projects funded through the resources allocated to this area of action. On this occasion, a total of seven projects accounted for just over 9% of the investment. Most of these initiatives involved the creation of cold storage facilities linked to municipal slaughterhouses; two other projects aimed to enhance the agricultural value of typical local products (such as cheese and tench); and one final project was implemented directly by the LAG. Fieldwork revealed that none of the municipal projects remain operational, representing 90% of the more than 160,000 € allocated to this type of initiative.

3.2. What Is the Long-Term Survival Rate of the Projects Implemented?

Focusing on the analysis of the long-term impact of rural development programs on the territory, and using as a reference the projects included in the samples obtained for the three programs under analysis (Table 2), Table 4 provides an overview of the status of each project, classifying them as operational, failed, or transferred.

Table 4. Operational, failed and transferred projects.

	PRODER I	PRODER II	LEADER A.	TOTAL
Operational projects	8	17	13	38
Investment in operational projects	797,850.03	2,881,592.54	2,015,649.58	5,695,092.15
% investment on the sample	8.35%	30.17%	21.11%	59.63%
Failed projects	15	12	3	30
Investment in failed projects	1,064,437.04	2,221,739.35	354,337.32	3,640,513.71
% investment on the sample	11.15%	23.26%	3.71%	38.12%
Transferred projects	1	0	1	2
Investment in transferred projects	39,906.60	0	84,230.40	124,137.00
% investment on the sample	0.42%	0.00%	0.88%	1.30%

Source: Own elaboration.

As shown in the table above, regarding the implementation of the two editions of PRODER, the number of failed projects exceeds that of operational projects, and the proportion of investment allocated to both types remains similar. However, the application of the LEADER Approach improves this situation to some extent. Although the total number of failed projects remains considerable compared to operational ones, the investment involved in each shows a notable difference: almost 60% of the total investment in the projects selected for the sample remains operational, compared with 38% associated with failed projects; this difference is particularly significant for the projects implemented under the two editions of PRODER.

An analysis of operational, failed, and transferred projects, classified according to the measure under which they were implemented, reveals differences between tourism projects and those promoted under the other two productive measures. Table 5 illustrates the evolution of projects carried out under the rural tourism measure: while operational projects account for 52.52% of all productive investment executed in PRODER I and II, they represent 45.97% of investment within the rural tourism measure. In contrast, investment associated with failed projects accounts for 53.03% under the rural tourism measure, compared with 46.91% recorded across all productive measures.

The analysis of the long-term viability of projects carried out in rural tourism presents a less favorable picture than that of the program as a whole. Indeed, among the projects selected in the sample, the two editions of PRODER resulted in just over two million euros in failed tourism investments. This likely explains why the program was reoriented with the implementation of the LEADER Approach. Nevertheless, even during this latter period,

the proportion of investment associated with failed projects exceeds that of operational projects. These findings call into question the development strategy implemented by this LAG: the measure receiving the largest share of resources is also the one with the highest number of failed projects by far.

Table 5. Operational, failed and transferred projects in the rural tourism measure.

	PRODER I	PRODER II	LEADER A.	Total
Operational projects	6	6	2	14
Investment in operational projects	672,149.10	1,169,187.22	275,182.68	2,116,519.00
% investment on the sample	14.65%	25.48%	6.00%	46.12%
Failed projects	10	8	2	20
Investment in failed projects	703,726.52	1,420,681.41	307,941.85	2,432,349.78
% investment on the sample	15.33%	30.96%	6.71%	53.00%
Transferred projects	1	0	0	1
Investment in transferred projects	39,906.60	0	0	39,906.60
% investment on the sample	0.88%	0.00%	0.00%	0.88%

Source: Own elaboration.

The long-term viability of the projects implemented under the other two productive measures yields very different results. Tables 6 and 7 classify the projects included in the samples for these two measures according to their operational status.

Table 6. Operational and failed projects in SMEs, crafts and services measure.

	PRODER I	PRODER II	LEADER A.	Total
Operational projects	1	5	9	15
Investment in operational projects	57,234.17	1,210,030.76	1,091,463.65	2,358,728.58
% investment on the sample	1.68%	35.56%	32.07%	69.31%
Failed projects	3	2	1	6
Investment in failed projects	252,275.17	661,257.56	46,395.47	959,928.20
% investment on the sample	7.41%	19.43%	1.36%	28.21%
Transferred projects	0	0	1	1
Investment in transferred projects	0	0	84,230.40	84,230.40
% investment on the sample	0.00%	0.00%	2.48%	2.48%

Source: Own elaboration.

Table 7. Operational and failed projects in the agricultural valorization measure.

	PRODER I	PRODER II	LEADER A.	Total
Operational projects	1	6	2	9
Investment in operational projects	68,466.76	502,374.56	649,003.25	1,219,844.57
% investment on the sample	4.66%	34.22%	44.21%	83.09%
Failed projects	2	2		4
Investment in failed projects	108,435.36	139,800.38		248,235.74
% investment on the sample	7.39%	9.52%		16.91%

Source: Own elaboration.

As shown in Table 6, for SMEs, crafts and services, operational projects account for 69.31% of investment executed; In terms of agricultural valorization (Table 7), this percentage rises to 83.09%, both figures being substantially higher than those recorded for rural tourism. The long-term viability of projects aimed at agricultural valorization aligns with the conclusions reached by Castellano-Álvarez and Robina-Ramírez [89] in their analysis of

the implementation of rural development programs in La Vera region (Extremadura, Spain), and reinforces the idea that such projects should play a more prominent role within rural development strategies. It is paradoxical that the productive measure showing the highest percentage of operational investment and the lowest percentage of failed investment is the one with the least relative importance within the development strategy implemented by this LAG during the period analyzed (Table 3).

3.3. In Operational Projects, How Do Developers Assess the Viability of Their Investments?

Table 8 summarizes the promoters' assessment of the viability of their projects, their level of commitment to them—whether as main (FT) or complementary (PT) activity—and the importance of receiving a grant for carrying out the investment. The responses reveal certain differences depending on the scope of the projects, as well as the interrelationship between some of these three aspects.

Table 8. Can you make a living from your project? How much time do you devote to it? How relevant is the grant?

	Viability		Dedication		Execution Without Subsidy?		
	YES	NO	FT	PT	YES	NO	NR/DK
Rural tourism	4	10	4	10	4	7	3
SMEs, crafts and services	15	-	15	-	9	4	2
Agricultural valorization	9	-	9	-	3	4	2

Source: Own elaboration.

As Table 8 shows, the rural tourism measure includes all promoters who negatively assess the profitability of their projects. Furthermore, the capacity of tourism projects to generate employment appears more limited than that of the other two productive measures, whose promoters, in addition to being fully dedicated to their projects, report having employees. Likewise, depending on the productive measure in question, there are differences in the importance that receiving a subsidy has in the promoters' decision-making process: in the measure aimed at promoting rural tourism, a clear majority acknowledge that the subsidy was a decisive factor in the implementation of their projects, whereas the opposite is true for the SMEs, crafts and services measure.

In turn, projects aimed at promoting rural tourism show certain differences depending on their nature. Of the ten interviewees who negatively assess the viability of their investments, the vast majority are involved in projects related to the creation of accommodation. For these promoters, the returns obtained from running their businesses are complementary to their main source of income, as is their level of dedication to them. Some of the responses gathered during the fieldwork interviews provide insight into their mindset. For example, promoter 1, who created his accommodation with support from PRODER I and later went on to carry out two other projects in the subsequent programming periods, replied as follows when asked about the possibility of making a living from a rural guest house: *“no, perhaps with several guesthouses, but in our case it is a complementary activity; even more than complementary, it is auxiliary”*.

Note that, in his response, this promoter points to the possibility that the size and number of accommodations may determine whether developers can make a living from them. Promoter 2 takes a similar stance when he responds, *“from only one, perhaps not”*. Promoter 3 provides an answer to this dilemma. This promoter is undertaking an ambitious investment to create four rural guesthouses as part of an agritourism project. When asked the same question, *Can you make a living from a rural guesthouse?*, the answer is the same: *“in our case, no. For a rural guesthouse to be profitable, you cannot have staff. We had very high*

labor costs. *It is very difficult to make a living solely from rural guesthouses; there are more and more guesthouses and increasing competition*". When asked about the relevance of the income derived from the operation of their accommodation within their total income, she states: *"for us, the income from rural guesthouses is merely complementary to our main activity"*.

The assessment offered by the aforementioned promoter reflects the general sentiment among this group of interviewees: promoter 4 denies the possibility of making a living from a rural guesthouse: *"No. It is a supplementary source of income. Perhaps, with many sacrifices, it would be possible to subsist"*; in similar terms, interviewee 5 responds: *"No. That's why I don't want my children to take over the business. My intention is to sell it. I feel sorry, but the most sensible thing would be to close it"*; promoter 6 also notes: *"No, you can't make a living solely from the rural guesthouse; you need other sources of income"*. Along the same lines, promoters 7 and 8 state: *"No. No. It's hardly even a complement"*. Contrary even to the conclusions reached by Castellano-Álvarez et al. [88,105] or Castellano-Álvarez and Robina-Ramírez [89], those promoters who modernized long-established businesses and whose project involves complementarity between restaurant and accommodation activities also give a negative response to this question: *"the investment is not profitable even with the combination of both businesses"*.

Only two interviewees, both involved in projects aimed at creating accommodation, offer a positive view of the potential for this type of investment to serve as a main source of income; however, it is worth noting that both belong to the second generation that inherited already-operational accommodation businesses and are not burdened by debt.

For their part, the profiles of the two restaurant businesses are very different. Their promoters are dedicated to them full-time, employ staff, and regard investments as their primary source of income.

With regard to the subsidy's ability to encourage investment in tourism, those developers who acknowledge that they would not have undertaken their projects without receiving financial support offer similar reflections, although their responses differ somewhat: interviewees 6, 7 and 8 express clear refusal, while others are more hesitant. Promoter 3, for example, notes that *"perhaps not. The investment was very large; in any case, the project would have been more modest"* and promoter 5 states that *"he would probably have undertaken his project, but with greater difficulty"*.

Although the predominant profile of tourism promoters (based on the questions analyzed in Table 8) is that of individuals who view the viability of their investment negatively, work on their projects part-time, and would not have undertaken them without receiving a grant, the interviewees' assessments are diverse. There are accommodation promoters who view the viability of their businesses positively but would not have carried out their projects without a subsidy, and the opposite case also exists: those who would have undertaken the modernization of their accommodation, with or without a subsidy, while acknowledging that the return on their investment is very limited.

For their part, projects implemented under the SME, crafts, and services measure, as well as those aimed at agricultural valorization and marketing, are characterized by both a positive assessment of their economic viability and the exclusive dedication of their promoters. With regard to the latter point, some differences appear in the agricultural valorization projects depending on their scale: smaller projects generally involve the full-time dedication of the promoter (often as self-employment), whereas in larger projects, the investment serves as an option for income diversification for a promoter who allocates only part of their time to the project, which in turns allows for the hiring of a significant number of workers. Indeed, this latter type of investment includes some of the most relevant projects implemented by this LAG (ham drying facility, olive oil mill, feed mill, wineries); and likely has had a greater impact on agricultural incomes, given the collective nature

of some promoters or the boost they provide to the transformation and valorization of raw materials.

Other projects notable for the volume of investment mobilized are financed under the SME, crafts, and services measure: the construction of a solar park and the infrastructure for funeral services are two prominent examples. However, this measure also encompasses considerable heterogeneity in project size, with a significant number of smaller projects aimed at providing various services being promoted under its funding.

The scale of the projects may explain the differences in the promoters' assessments of the other two productive measures regarding the importance of receiving a grant for carrying out their investment: paradoxically, the grant was more significant for the more modest projects. Some responses from promoters who acknowledge that they would not have undertaken their project without the grant include: *"I don't think so, they gave a little but it was very helpful"*; *"No, we wouldn't have been able to, it was a very attractive incentive; then you realize that an incentive is not aid. In five years we have paid back that supposed aid in taxes"*; *"I wouldn't have done it. I decided because of the financial boost the aid provided, but it arrived too late and was inadequate."* As can be seen, some of these responses contain mild criticism regarding the delay in the disbursement of the aid (a concern also shared by some promoters of larger projects, who did not make the execution of their investment conditional on receiving the subsidy), or even about having fallen into the "trap" of launching an investment to receive "aid" that they later do not regard as such.

However, some responses from promoters who acknowledge they wouldn't have pursued their projects without receiving a grant also emphasize the benefits of such aid as a catalyst for investment. Examples include a baker who states, *"No. My oven was holding up, but when they offered me a grant covering around 40% of the necessary investment, I decided to modernize it."*; or a promoter involved in creating infrastructure for funeral services who justifies his firm refusal as follows: *"Not at that time. It was very important for us; we were in the midst of the 2008 crisis and the flow of bank credit was completely shut off. Without the boost from the grant, we wouldn't have been able to make the investment"*.

3.4. What Is the Border-Oriented Focus of the Operational Projects?

Regardless of the specific production measure in question, the main conclusion concerning this issue is the lack of a cross-border focus in the projects promoted under the development strategy of this region.

In terms of measures, it is striking that only one of the 14 promoters who still operate their tourism projects acknowledges having always considered the Portuguese market: *"around 35–40% of our clients come from Portugal"*. Others, while admitting to hosting guests from the neighboring country and recognizing that *"Portugal and the border are an attraction for the region"*, maintain that *"we've never actively sought out Portuguese clients. We've always focused on Spanish clientele, especially those from Madrid"*. At the very least, the reflection of one accommodation promoter could be considered paradoxical. After denying any cross-border focus for his project, he states: *"Valencia de Alcántara relied heavily on Portugal for a long time; it used to, but when the border opened, business declined significantly"*. Valencia de Alcántara is the main town in the region of this Local Action Group (LAG) located in the province of Cáceres. In this town, the existence of the border led to the creation of a whole range of commercial, administrative, and security services that, over time, have been lost with the disappearance of the border. This presents quite a paradox regarding the role of the border as a driver of development.

Promoters within the framework of SMEs, crafts, and services also demonstrate a limited cross-border perspective. Only one of the 15 interviewed acknowledges maintaining regular commercial relationships with clients across the border; others, despite having

attempted to do so, claim that the results were not as expected: *“I’ve been to markets in Portugal, but it didn’t quite convince me. Since it didn’t generate the expected business, it ended up being a huge waste of time, and in Spain, I had plenty of work”*. Regulatory and legislative issues, as well as the presence of strong competition in Portugal, are among the reasons cited by the interviewees to justify their lack of interest in Portuguese markets.

However, three of the nine project promoters focused on agricultural valorization acknowledge that Portuguese clients are highly important to their business. These projects are diverse—feed mills, meat processing, and honey production—but all share a cross-border perspective. The representative of the Valencia de Alcántara cooperative, which is modernizing its feed mill with funding from the PRODER II program, admits that *“we sell 40% of our feed to Portuguese buyers. Feed is much cheaper here, and besides, in Portugal, they don’t produce feed in meal form; it’s all pelleted. Portugal doesn’t have small feed mills for areas such as the Alentejo; their market is dominated by large brands”*. Although less significant in terms of overall revenue, the promoter of a meat processing project states that Portugal’s potential was considered from the outset of their investment: *“In fact, 10% of our clientele is Portuguese”*. For her part, the promoter of a honey production project cannot specify a percentage of her clientele but assures that *“we sell a lot of honey to Portugal and, currently, we have many clients from that country”*.

4. Discussion and Conclusions

If we compare the implementation of programs managed by the Sierra de San Pedro—Los Baldíos region with that of other districts in Extremadura, the first thing that stands out is the modest level of implementation. This is particularly evident in the LEADER approach, where districts such as La Vera or Tajo Salor [88] committed around 40% more resources. Furthermore, it is worth noting that, in Sierra de San Pedro—Los Baldíos, the resources mobilized through the implementation of the LEADER approach were 20% lower than in the previous six-year period. The significant increase in resources allocated to non-productive measures further calls into question the implementation of this latter program. These two points suggest a certain “exhaustion” of this district’s capacity to mobilize investment. In line with the conclusions reached by Castellano-Álvarez and Robina-Ramírez [31], it may be advisable to reconfigure it as a unit of action from which to implement this type of development strategy.

The study of the development strategy in the Sierra de San Pedro—Los Baldíos also reveals a dual bias in the distribution of investment: on the one hand, resources devoted to the promotion of rural tourism account for almost 50% of productive investment; on the other hand, 70% of this investment is concentrated in a single type of action: the construction of new accommodations. The abrupt shift observed in the LEADER Approach regarding the resources allocated to this measure implicitly acknowledges that the bias of the program in the two PRODER editions may have been a mistake.

The analysis of the long-term viability of the projects reveals a major paradox in the concentration of investment in rural tourism promotion: 53% of the resources are allocated to failed projects. This proportion is significantly higher than the investment in similar projects under the other two productive measures. These findings are consistent with the conclusions reached by Castellano-Álvarez et al. [105] regarding the limitations of rural tourism as a development tool and corroborate the inherent risks of development strategies that depend on the opportunities offered by this sector. Likewise, in line with Castellano-Álvarez and Robina-Ramírez [89] in their analysis of the long-term survival of projects undertaken within the framework of these rural development programs, the investments mobilized under the agricultural valorization measure demonstrate the greatest viability, followed by those executed under the SMEs, crafts and services [111].

However, the most striking aspect of rural tourism investments is not merely the high proportion of resources committed to failed projects, but the negative assessment of the viability of operational projects expressed by their promoters. Indeed, all promoters who question the profitability of their investments are those involved in tourism projects focused on creating or modernizing accommodation. Consequently, the double bias that characterizes the distribution of investment in the development programs of the Sierra de San Pedro—Los Baldíos is unequivocally highlighted by the findings of this study.

However, in line with Castellano-Álvarez et al. [88,105] or Castellano-Álvarez and Robina-Ramírez [89], the viability of tourism projects clearly depends on their nature. In contrast to the negative assessment of those who undertook projects to create or modernize accommodation, promoters involved in the restaurant sector report satisfaction with their projects. The former acknowledge that the returns from managing their businesses are merely supplementary to their main source of income, as is their level of dedication. Conversely, the promoters of restaurant businesses state that managing their projects constitutes their primary activity and main source of income. In contrast to the limited capacity of tourism investments to constitute a primary source of income and employment, the projects implemented under the SMEs, crafts and services and Valorization of agriculture products measures, are characterized both by a positive assessment of their economic viability and by the exclusive dedication of their promoters [89].

Furthermore, depending on the specific measure, differences arise in the importance that receiving a subsidy has on the promoters' decision-making process: among rural tourism promoters, a clear majority acknowledge that the subsidy was a decisive factor in the execution of their projects, whereas the opposite is true for SMEs, crafts, and services. This finding provides an lesson for managers of such programs, as promoters of projects with lower viability and a more limited capacity to generate employment report that the subsidy constituted a greater incentive for their investment decisions.

The final research question concerned the border-oriented nature of the projects. The interviews with project promoters reveal the absence of a cross-border vision in their investments. The introductory section characterized the region of Sierra de San Pedro—Los Baldíos as a rural, peripheral and border territory. However, in essence, the development strategy implemented is no different from that applied by any other region in Extremadura or Spain that meets only the first two characteristics. The development potential inherent in the border area has therefore been overlooked.

In theory, the numerous documents drawn up to shape the region's development strategy should have ensured that all the territory's potential was incorporated into it; however, the conclusions reached suggest otherwise. It is worth asking whether the management and implementation of these programs on both sides of the border, based on a national approach, may have hindered this cross-border vision. Throughout the research period, and even to this day, two LAGs have been operating in the same territory: on the Spanish side, Sierra de San Pedro—Los Baldíos; on the Portuguese side, the Association for Rural Development of Northern Alentejo (ADER-AL). What if truly cross-border LAGs were created in these types of areas? Not the sum of those on one side and those on the other, but a single LAG that implements, across the whole territory, the development opportunities offered on both sides of the border. The participation of local actors from both sides of the border in the decision-making bodies of these LAGs would allow for their full activation and interaction with a totally cross-border focus. The territory is the same, so why should bureaucratic or administrative issues divide it?

The limitations of this research arise from the methodology employed. Case studies do not allow for the universal extrapolation of their conclusions, although the results obtained may offer useful lessons for territories that share characteristics with the region under study.

Moreover, the considerable time that has passed between the implementation of the projects and the interviews may affect the promoters' ability to provide fully accurate accounts of events that occurred long ago; this subjective component should also be considered a potential limitation of the study. Despite these limitations, the research has enabled a deeper understanding of the outcomes achieved by rural development programs and an analysis of their long-term impact on the territory. In this regard, and in line with the criticisms made by Navarro et al. [98], some of the shortcomings of traditional evaluation systems have been overcome.

In the future, it would like to address two lines of research. With regard to the cross-border issue, this research would continue with an analysis of the development strategy implemented by ADER-AL. Maintaining the idea that it is the same territory, this would make it possible to learn about the projects carried out on both sides of the border, analyze possible differences and, in doing so, multiply the investment opportunities offered by this border area as a whole. With regard to the general analysis of rural development programs, following the work of Navarro et al. [99] or Cañete et al. [100], it could be highly interesting to focus on failed projects, analyzing their causes and the factors that influenced them. This would also make it possible to build upon and complete some of the contributions made by these authors [88,89,105].

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Article

Energy Transition at the EU Peripheries: Investment of Rural and Urban–Rural Communes in Border Regions of Eastern Poland

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Abstract

Energy transition has become a priority in public policy; however, knowledge of its progress in peripheral, border regions of Eastern Poland—particularly in rural and urban–rural communes—remains sketchy. Research gaps concern both the scale and intensity of investments co-financed from European Union (EU) funds, as well as the effect of their locations in relation to the state border and their position in reference to Functional Urban Areas (FUAs) on the level and character of the discussed investment activity. The primary aim of this study was to assess how the location of a border region and its relation to FUAs diversifies the investment activity and level of investment co-financed from EU funds aimed at developing the low-carbon economy in rural and urban–rural communes of the Eastern Macroregion. The analysis was conducted in two complementary dimensions: (i) a comparative nationwide assessment, covering all macroregions of Poland, within the two most recent, completed EU financial frameworks; i.e., the years 2007–2013 and 2014–2020 and (ii) an in-depth analysis of the Eastern Macroregion, with particular attention to rural and urban–rural communes, their affiliation with Functional Urban Areas (FUAs), and the typology defined by the Delimitation of Rural Areas (DRA). The aim of the conducted analyses was to respond to the research hypothesis assuming that “in the Eastern Macroregion the spatial conditions, i.e., the border location and the location in relation to functional urban areas (within an FUA vs. outside an FUA) significantly diversify the investment activity of rural and urban–rural communes aimed at the low-carbon economy co-financed from EU funds”. Empirical studies were conducted based on data from the Ministry of Development Funds and Regional Policy and Statistics Poland, which were processed applying methods of descriptive statistics and statistical inference and also using correspondence analysis. The analyses confirmed that in Eastern Poland the process of energy transition moved from the pilot phase to the common implementation of low-carbon measures, to a considerable extent thanks to the activity of rural and urban–rural communes. The results indicate that spatial factors, particularly location in relation to Functional Urban Areas and population density, significantly diversify intensity of investments in rural and urban–rural communes in the spatial context, whereas no such relationship was found for the investment level per capita.

Keywords: low-carbon economy; local investments; rural areas; border regions; Eastern Poland

1. Introduction

At present, energy transition represents one of the key directions of development policies, both globally and in the European context [1–3]. In view of climate challenges,

growing energy demand and the need to reduce greenhouse gas emissions (GHGs), the importance of investments in renewable energy sources (RES) and other actions supporting the development of low-carbon economy is increasingly being recognized [4,5]. It is envisaged as a development model limiting GHG emissions (particularly CO₂) thanks to the decarbonization of the energy generation system, improved energy efficiency, and substitution of fossil fuels with RES in key sectors such as construction and transportation [6,7]. Such a paradigm promotes lower consumption of energy and resources, as well as the modernization of manufacturing processes [8]. In respective EU documents the development of RES and enhanced energy efficiency are treated not only as an instrument promoting environmental protection, but also as an impulse towards local and regional development [9,10].

A major group of entities implementing measures aimed at the development of the low-carbon economy comprises local government units, responsible for planning and execution of investments adapted to local conditions [11–17]. The commune, as the basic local government unit in Poland, is the creator of local development within the three pillars of sustainability—social, economic, and environmental. The importance of local government units as agents in climate policy has been confirmed by the growing body of research analyzing the scope and local conditions for investments aimed at climate neutrality [18–22]. Local governments finance these actions using both their own funds and—to a considerable degree—EU funds (including, e.g., cohesion policy and territorial cooperation programs). As a consequence, within the discussed scope the assessment of their investment activity constitutes a useful, empirical measure for the progress attained by these regions in the implementation of low-carbon economy measures.

Studies conducted to date concerning investments made by local government units in RES and the low-carbon economy in Poland have focused primarily on the national perspective, divided into administration types of communes, or on the regional level. However, there is a shortage of in-depth studies covering the unique conditions found in communes located in the border regions of Poland, particularly the voivodships (Polish: województwa, provinces) comprising the Eastern Macroregion (i.e., Podlaskie, Lubelskie, and Podkarpackie). This area constitutes a continuous EU border zone (the borders with Lithuania and Slovakia) and the external border of the EU (Belarus and Ukraine), which significantly modifies their development conditions: market accessibility, costs of infrastructure, and directions of public cooperation (e.g., Interreg) concerning the environment, energy, and climate. According to a report by Statistics Poland (Polish: Główny Urząd Statystyczny, GUS) [23], these regions belong to the peripheral areas with the lowest level of socio-economic development in the country (quantified based on GDP per capita), a relatively important role of agriculture (the highest share of population employed in agriculture), and lesser accessibility, as well as limited technological infrastructure. An additional challenge is connected to their depopulation (the highest negative net migration) and population aging, which hinder implementation of advanced technological solutions and reduce the endogenous potential of local government units [23]. On the other hand, these areas are equipped with considerable natural (environmental) capital (protected areas, high forest cover, and water resources) and they utilize cross-border cooperation mechanisms, providing them with potential alternative pathways to economic growth, including investments in RES and the low-carbon economy. Filling the above-mentioned research gap is of significant importance, since in the peripheral regions, energy transition may constitute both an additional burden and a chance to strengthen local economies.

In the Eastern Macroregion, rural areas cover the vast majority of the territory and have a markedly higher share of rural communes in their structure of local government units compared to the national average. Thus, the percentage of the population inhabiting

rural areas is one of the highest in Poland, accounting for approximately 53% compared to slightly over 40% on the national scale [23]. According to the Delimitation of Rural Areas (DRA) [24], a considerable part of these communes belongs to non-agglomeration zones of low population density, which additionally enhances their peripheral character. For this reason, this analysis focuses on rural and urban–rural communes, as those areas experience accumulated diverse developmental challenges, e.g., adverse demographic trends (depopulation and population aging), scattered settlements and low population density, higher unit costs of infrastructure, and limited fiscal potential, which makes it more difficult for them to raise capital for investments. Additionally, energy poverty is more prevalent (related to obsolete housing, individual high-emission heating sources, etc.) and grid barriers (limited grid capacity and grid accessibility). Analysis focused on rural and urban–rural communes provides a more reliable presentation of the unique character of the peripheral regions of Eastern Poland, reducing the bias resulting from overgeneralizations made based on data concerning cities. It also makes it possible to assess to what degree investments in RES and the low-carbon economy may mitigate the indicated structural deficits.

The process of energy transition has a distinct territorial dimension, as its course is closely interlinked with the spatial structure of development and the relationships between settlement units. The literature emphasizes that the functional linkages between communes and urban centers determine their developmental and investment potential [25,26]. According to the classical theories of spatial development—the growth pole theory [27], the core–periphery model [28], and the theory of cumulative causation and spread–backwash effects [29]—economic impulses generated in urban areas tend to diffuse into adjacent territories, reinforcing their investment activity. From this perspective, the analysis of relationships between rural communes and urban centers becomes particularly relevant in peripheral regions such as the Eastern Macroregion of Poland. Although these areas are characterized by limited economic and infrastructural potential, they display substantial internal diversity in terms of functional connections, which may influence their capacity to implement investments in the low-carbon economy. Contemporary studies indicate that communes maintaining stronger linkages with urban centers are more likely to participate in modernization processes related to sustainable development and energy transition [30–32]. Therefore, the spatial position of communes with respect to large cities and their integration within functional networks can be regarded as an important factor differentiating investment activity in the field of the low-carbon economy in Eastern Poland’s peripheral regions.

The primary aim of this study was to assess how location in a border region and relation to FUA diversify investment activity and level of investment co-financed by EU funds aimed at developing the low-carbon economy in rural and urban–rural communes of the Eastern Macroregion. The analysis was conducted in two complementary dimensions: (i) a comparative nationwide assessment covering all macroregions of Poland within the two most recent, completed EU financial frameworks, i.e., the years 2007–2013 and 2014–2020 and (ii) an in-depth analysis of the Eastern Macroregion, with particular attention to rural and urban–rural communes, their affiliation with Functional Urban Areas (FUAs), and typology defined by the Delimitation of Rural Areas (DRA). The investigations aimed to provide an answer to the research hypothesis, assuming that “in the Eastern Macroregion the spatial conditions, i.e., the border zone and the location in relation to Functional Urban Areas (within an FUA vs. outside an FUA), significantly diversify the investment activity of rural and urban–rural communes in projects co-financed by EU funds and aimed at the low-carbon economy”.

In order to address the research problem in a coherent and comprehensive manner, the article is organized as follows. Section 2 establishes the theoretical background by

reviewing the literature on energy transition in peripheral, rural, and border regions, thereby embedding the analysis within the broader framework of spatial development and local climate policy. Section 3 describes the data sources, spatial classifications, and research methods applied, ensuring the transparency and reproducibility of the empirical approach. Section 4 presents and interprets the empirical results, examining the spatial differentiation of investment activity in low-carbon projects, both in comparison with other macroregions of Poland and within the Eastern Macroregion in relation to Functional Urban Areas. Finally, Section 5 synthesizes the findings, verifies the research hypothesis and discusses the key implications for regional and local development policy in peripheral border areas.

2. Review of the Literature: Local Government Units Facing Challenges of Energy Transition—The Context of Rural and Peripheral Communes

For decades the development of peripheral regions, including border zones, has been investigated by researchers specializing in spatial economics, socio-economic geography, and regional policy. Classical concepts of core vs. periphery and New Economic Geography (NEG) underline that the stability of differences in development result from cumulative mechanisms, such as feedback from agglomerations, costs of transport, and economies of scale [29,33–38]. In this approach the urban core attracts investments, residents, and innovations, while peripheries, lacking similar stimuli, suffer from increasing dependence and structural deficits.

In view of the classical concepts of unbalanced growth [29,33] and core–periphery theory, rural and agricultural areas are perceived as spaces with limited access to developmental stimuli, dominated by urban cores as centers for the diffusion of innovation and capital flow. In turn, Myrdal [29] indicated the action of spread effects and backwash effects, which reinforce the advantage of urban centers at the expense of peripheries. Hirschman [33] supplemented this approach with the concept of unbalanced growth, in which economic processes develop selectively, concentrating around the so-called growth poles.

New Economic Geography [34,36] has been developing these assumptions, indicating that stability of peripherality results from cumulative mechanisms, such as economies of scale, costs of transport, and effects of agglomeration. The NEG models show that in the case of the absence of compensation factors, such as transportation infrastructure, access to external markets or institutional support, peripheries develop at a much slower pace [39]. In the context of rural areas, this means that structural inequalities in access to investments, innovations, and capital are strengthened, resulting in lesser potential to participate in energy transition processes.

The literature on the subject also underlines that peripherality is not solely a geographical category, rather being relational in character—it includes deficits in infrastructure, limitations in terms of social and human capital, demographic problems and absence of institutional development [40]. Such understood peripherality is structural and functional in character, which means that peripheral areas remain dependent on the urban cores of development, not only spatially, but also economically and institutionally.

Border zones, being both spatial and political peripheries, experience these barriers particularly often. Medeiros [41] pointed to the fact that the state border in Europe may act both as an isolating barrier and as a factor opening new opportunities thanks to the mechanisms of cross-border cooperation. In view of regional development, the key role is played by market accessibility, which determines the movement of goods, people, and knowledge. Its low level is considered to be one of the primary causes for inferior economic outcomes of border regions [36,42].

In contemporary research, peripherality is increasingly interpreted—not only in geographical but also in functional terms—as a limited degree of integration of individual territorial units with the main centers of development [38,40]. Within this framework, the location of communes in relation to cities and the intensity of their interactions within Functional Urban Areas (FUA) play a crucial role. The FUA concept, developed by the OECD and the European Commission, assumes that the urban core and its surrounding communes form an integrated socio-economic system based on the flows of population, labor, goods, and services [24,25,43]. This functional proximity influences the accessibility of infrastructure, as well as financial and institutional resources, which in turn affects the capacity of local government units to implement investment projects [44,45].

Classical theories of spatial development—growth poles [27], development centers [33], and the core–periphery model [28,29]—emphasize that economic and innovative impulses generated in cities may diffuse to their surroundings, provided that efficient channels of functional linkages exist [46,47]. At the same time, these theories point out that in the absence of such connections, peripheral areas may experience resource drain effects and deepening dependence on central regions.

In the case of Eastern Poland, characterized by a dispersed settlement network and limited infrastructural accessibility, it can be assumed that the location in relation to major urban centers significantly affects the variation in investment potential among communes. Those located closer to regional capitals may exhibit greater capacity to undertake investments in the low-carbon economy, whereas more remote units may face institutional and infrastructural constraints. In this context, the functional location of local government units can be regarded as a key dimension of peripherality—one that both reflects spatial differentiation in developmental potential and shapes the diversity of investment activity related to the low-carbon economy in the peripheral regions of Eastern Poland.

As a consequence, peripherality in present-day terms is perceived not only as a static characteristic of space, but as a result of interactions between geographical, institutional, and functional factors. It was these conditions, i.e., limited accessibility, poor economic links, and lower institutional potential, that constituted a starting point for the analysis of energy transition in the peripheral and border communes, which suffer from developmental deficits, while at the same time searching for new activation pathways based on the low-carbon economy.

Energy transition is becoming one of the most important present-day challenges for the development of peripheral areas. The literature sources on the subject underline that this process is not solely technological in character, but rather constitutes a profound structural change in the functioning of local economies and spatial systems [48]. The low-carbon economy, based on energy efficiency and renewable energy sources, may serve the function of a new developmental factor, enhancing local resources, institutional capacities, and energy independence [16,49].

In rural and border regions investments in the low-carbon economy, including renewable energy sources, contribute to the creation of new jobs, improve the quality of technological infrastructure, and enhance socio-economic resilience [50,51]. At the same time, as indicated by Golubchikov and O’Sullivan [48], spatial diversification of transition processes leads to the formation of so-called energy peripheries, in which the pace and scale of changes are limited by institutional, infrastructural, and financial factors.

In the most recent literature published after 2020, energy transition in peripheral and rural regions is increasingly analyzed through the lens of spatial justice, institutional capacity, and socio-technical change. Contemporary studies demonstrate that peripheral regions often experience delayed and uneven energy transition due to weaker administra-

tive capacity, limited access to financing, and underdeveloped grid infrastructure [48,52,53]. In this context, the concept of “energy peripheries” highlights how spatially remote areas may remain structurally disadvantaged in low-carbon transformation processes despite possessing significant renewable energy potential [48]. At the same time, recent empirical research confirms that renewable energy investments in rural and border regions may significantly strengthen local resilience, reduce energy poverty and stimulate endogenous economic development, provided that adequate governance frameworks and stable financial instruments are in place [54–57].

In this context a particularly important role is played by initiatives based on the cooperation of local actors, including energy communities [58], which facilitate diffusion of innovations and incorporation of local communities in the transition processes. As a consequence, the low-carbon economy is becoming not only an instrument of climate policy, but also a new paradigm for endogenous development, offering opportunities to strengthen the potential of peripheral and rural areas in the EU territorial structure.

For rural and border communes, this transition constitutes both a challenge for investment and an opportunity to overcome peripherality thanks to the development of local energy markets and improvement in the standard of technological infrastructure, as well as the activation of their economy based on endogenous resources [59,60]. Local government units, as entities implementing energy and climate policy, play an important role in this process. Their involvement in thermal upgrade projects, investments in renewable energy sources, local heating networks, or sustainable transport, fulfils not only the objectives of the EU and national climate strategies, but also supports the long-term socio-economic development of peripheral regions [61].

Within the EU climate policy rural areas serve dual roles. On the one hand, they are significant sources of greenhouse gas emissions, e.g., agriculture in Poland is responsible for approximately 8.5% of total GHG emissions, including 37.5% of methane and over 80% of nitrous oxide [62]. On the other hand, they are equipped with considerable potential for the development of renewable energy sources and sustainable resource management [12,63]. Local resources, such as biomass and biogas, constitute an important basis for local power systems, including heating networks and energy clusters [64,65]. At the same time, wind and solar energy are gaining in importance in rural areas, where planning the locations for respective installations while respecting spatial conditions is feasible [66]. The latest data confirm rapid increases in the number and capacity of small renewable energy installations (PV, wind, and biogas), which is manifested in increased energy self-reliance [67], while providing tangible fiscal benefits for local government units. As a result, investments in biogas plants, wind farms and photovoltaic farms support the diversification of the local economy and improve the standard of the technological infrastructure, enhancing the socio-economic resilience of peripheral areas [68].

From the perspective of local government units, low-carbon investments implemented in rural communes may also interact indirectly with the functioning of the agricultural sector, particularly in areas where bioenergy projects or biomass-based heating systems are developed [69,70]. Such projects can influence local patterns of land use and the availability of biomass resources, which in turn may shape production conditions for farms [71]. At the same time, bioenergy-related initiatives may contribute to income diversification and support rural development, as documented in studies on agricultural biogas and renewable energy uptake in rural areas [72]. Therefore, in rural communes, the assessment of low-carbon investment policies should take into account not only energy and climate objectives, but also their potential indirect linkages with rural development processes.

However, implementation of such investments requires adequate institutional and financial potential, as well as a stable legal environment. In practice many communes

continue to face financial, procedural and social barriers resulting from their limited fiscal potential, lack of sufficiently adapted transmission networks, ambiguous regulations, or lack of social acceptance (e.g., for the location of investments in renewable energy sources). Studies indicate that a major barrier for investments in RES in communes is connected with insufficient development of electricity grids. For example, Kryszk et al. [73] showed that the availability of so-called hosting capacity constitutes a key limiting factor. In turn, investigations conducted by Kata and Pitera [15] indicate that investments in energy transition made by communes in Poland are strongly dependent on subsidies and are faced with considerable fiscal barriers. In rural and peripheral areas, research has indicated that a lack of initiative on the part of local government units, excessively bureaucratic procedures, and limited social acceptance constitute significant barriers to the development of the green economy [74].

Energy transition in peripheral regions is implemented under multi-level governance (MLG), which assumes cooperation of local, regional, national and EU institutions [75]. Since the transition process requires both strategic decisions and implementation at the commune level, MLG facilitates coordination of climate and energy policies at all these levels. In such a system local government units are both beneficiaries and initiators of actions promoting reduction of GHG emissions and improved energy efficiency, as confirmed by studies on regional energy transition processes [76].

Contemporary studies strongly emphasize the role of local governments as key intermediaries in steering energy transition in peripheral regions after 2020. Recent empirical evidence indicates that municipalities play a decisive role in initiating renewable energy projects, coordinating local stakeholders and facilitating access to public support schemes and EU climate funds [55,77,78]. At the same time, research consistently points to persistent institutional and socio-spatial asymmetries between urban cores and peripheral communes, which translate into differentiated administrative capacities, financial resources and planning potential for the implementation of low-carbon investments [48].

Despite the growing number of analyses concerning the role of communes in the low-carbon economy, the literature on the subject indicates a lack of research referring to the unique character of border regions. The scope of a marked majority of studies is the national or provincial scale, while analyses concerning communes are scarce. However, it is in those regions that energy transition processes may be of particular importance, constituting both a financial and organizational burden, and a chance to utilize local environmental resources and improve investment and tourism attractiveness in the areas. The location within the border zone may have a dual effect: as a barrier to development (transportation exclusion, limited market accessibility, poor technological infrastructure, and adverse demographic trends), but also factors providing unique opportunities, facilitating the use of cross-border cooperation mechanisms [79]. In this respect the Interreg programs are of particular importance (e.g., Poland–Lithuania, Poland–Ukraine, and Poland–Slovakia), as they support investments aimed at energy efficiency and renewable energy sources [80].

In recent years an increasingly important role in the development policies in these areas has been played by energy transition, which is becoming a new paradigm for endogenous development. As was observed by Furmankiewicz et al. [81], the present-day concept of neoendogenous growth assumes the utilization of local resources and social and natural potential in the establishment of sustainable foundations for development at the commune level. According to a European Commission report [82], investments in RES financed within the cohesion policy in the years 2021–2027 are key instruments supporting the sustainable development of peripheral regions. In turn, the policy document European Funds for Eastern Poland 2021–2027 [83] indicates that energy transition is considered to be the primary direction for economic and social modernization in Eastern regions of Poland.

In recent years, border regions have attracted growing attention in research on energy transition, particularly in the context of cross-border governance, infrastructure integration, and regulatory coordination [84]. Studies indicate that cross-border peripheral areas face specific challenges related to institutional fragmentation, infrastructure discontinuity and exposure to geopolitical risks [85], which strongly affect their low-carbon transformation pathways. At the same time, EU territorial cooperation frameworks, including the Connecting Europe Facility, are identified as key instruments supporting cross-border renewable energy projects and energy infrastructure investments [86]. These findings confirm that border location may simultaneously constrain and stimulate local energy transition pathways.

In this context, rural and urban–rural communes in the border regions of Eastern Poland increasingly often serve the role of laboratories for local transition, utilizing EU funds, local sources of renewable energy, and cross-border cooperation. However, there is still a shortage of systemic analyses showing to what degree spatial factors, such as location within the border region and location in relation to Functional Urban Areas (FUA), diversify the scale and character of investments in the low-carbon economy. It is necessary to fill this gap in order to assess the diversification of the trajectory of energy transition in Eastern Poland, as well as to design effective instruments of this policy adapted to specific local conditions and supporting sustainable development of peripheral regions.

3. Materials and Methods

The investigations covered communes (basic local government units) in Poland, with the Eastern Macroregion (comprising the Podlaskie, Lubelskie, and Podkarpackie voivodships, i.e., the border regions of Eastern Poland) constituting the primary area of analysis and a reference point in comparisons to the rest of Poland. The settlement structure of the Eastern Macroregion, with its predominance of rural communes (approximately 70% compared to approximately 60% on the national scale) as well as a considerable share of non-agglomeration units with a low population density (almost 40%), justifies the selection of rural and urban–rural communes as the main object of analysis [24,87].

Studies on the level and diversification of investment activity in communes aimed at the low-carbon economy in the Eastern Macroregion were conducted using the classification developed by Statistics Poland (GUS), i.e., Delimitation of Rural Areas (Polish: Delimitacja Obszarów Wiejskich, DOW), which was prepared using the typology of functional urban areas (FUA), covering urban cores and their commuter belts. The Delimitation of Rural Areas classifies rural communes and rural parts of urban–rural communes, including the impact of large urban centers on these communes, and it is a two-layer analysis [24]:

- Level 1—the location of communes within FUAs of provincial cities or other cities of ≥ 150 thousand inhabitants (two categories are distinguished here, i.e., agglomeration and non-agglomeration communes).
- Level 2—population density—in each of the groups of communes distinguished according to Level 1, units of high density (greater than the national average in the case of agglomeration communes or greater than 1/3 national population density in the case of non-agglomeration communes) and those of low population density (equal to or lower than the national average in the case of agglomeration communes or equal or lower than 1/3 national population density in the case of non-agglomeration communes).

Since the Delimitation of Rural Areas ascribes classes separately for the urban and rural parts of the urban–rural communes, while available data on implemented investments in the low-carbon economy concerns communes as a whole, it was necessary to adopt one class of the Delimitation of Rural Areas for an entire urban–rural commune. In the analyses,

the urban–rural communes were ascribed the class within the Delimitation of Rural Areas typical for their rural part (TERYT = 5).

According to the adopted classification of rural and urban–rural communes, analyses were conducted concerning the number and value of EU funds acquired for purposes related to the low-carbon economy, while the intensity of executed investments is presented per capita and area units. Data concerning the projects came from the databases of the Ministry of Development Funds and Regional Policy (concerning the financial frameworks of 2007–2013 and 2014–2020) [88,89]. From several dozen thousand projects, those classified as low-carbon economy were selected. The other data were collected from the Local Data Bank (Polish: Bank Danych Lokalnych GUS) of Statistics Poland [87]. The data quoted in the text were converted according to the National Bank of Poland’s average exchange rate [90]. The calculations were performed using Statistica software (version 13.3).

Empirical studies conducted in two stages were required to attain the assumed aim of the study (Figure 1). The first stage analyses, in order to assess investment activity aimed at the development of the low-carbon economy, concerned both the activity and the number and value of respective projects acquired by rural and urban–rural communes of the Eastern Macroregion compared to the other macroregions of Poland. In the study, a combined approach to investment expenditures related to the development of the low-carbon economy was adopted, which made it possible to capture the overall level of investment activity of communes in this area. It should be noted, however, that particular types of investments—those related to energy efficiency, renewable energy sources, transport, or municipal infrastructure—differ in terms of cost scale and financing mechanisms. This constitutes an important interpretative limitation and an indication for further research. At this stage of the analysis, methods of descriptive statistics and statistical inference (non-parametric tests for comparisons of several independent samples—the Kruskal–Wallis test) were applied for this purpose [91,92].

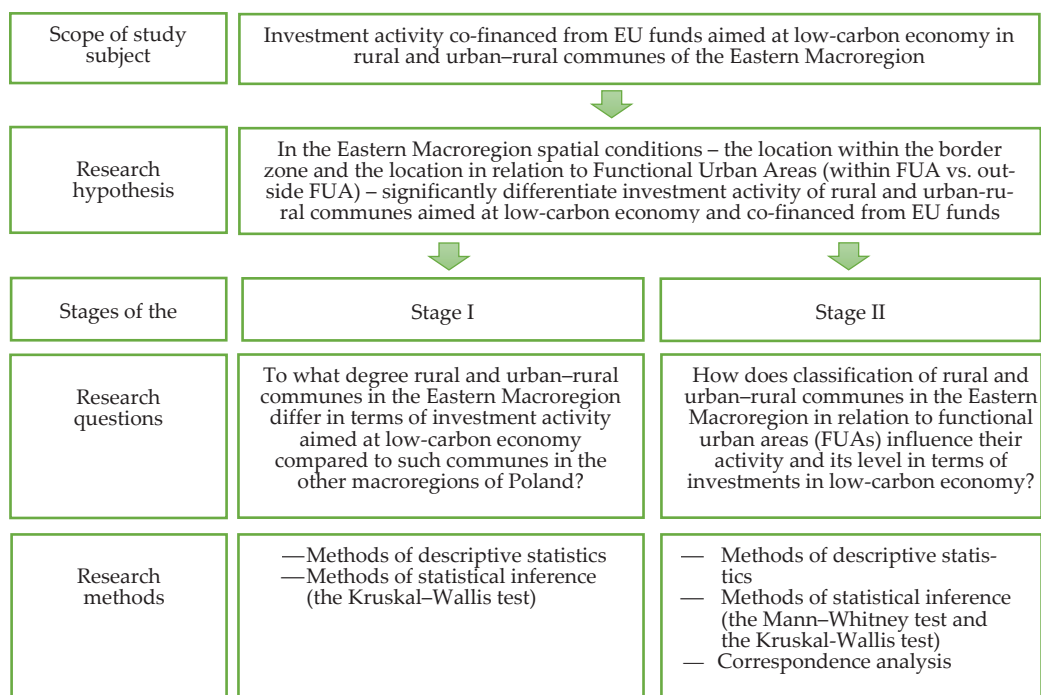


Figure 1. Stages of the study assessing investment activity of rural and urban–rural communes in the Eastern Macroregion aimed at low-carbon economy and co-financed from EU funds. Source: the author’ study.

The second stage of the study consisted of the assessment of the investment activity of rural and urban–rural communes in the Eastern Macroregion. Both the activity and the level of investments co-financed by EU funds aimed at the low-carbon economy were evaluated in terms of these parameters per capita and per unit area (km²) of communes according to delimitation types. In this part of the study methods of descriptive statistics as well as statistical inference were used. To ensure the appropriate selection of statistical methods, the study was preceded by verification of the distribution of the dependent variable within the analyzed groups. Both graphical analysis (histograms) and the Shapiro–Wilk normality test were applied to assess the shape of the distribution. Due to its high power and accuracy, the Shapiro–Wilk test is recommended for samples of this size [93]. In cases where the assumption of normal distribution was not met, non-parametric tests were used, such as the Mann–Whitney test for comparisons of two independent samples and the Kruskal–Wallis test for comparisons of several independent samples [91,92].

The results of the tests served as a starting point for further exploration of structural relationships. In order to investigate dependencies between the types of rural and urban–rural communes in the Eastern Macroregion following the Delimitation of Rural Areas and the level of their investments in the low-carbon economy, correspondence analysis was applied. It is a method of exploratory data analysis for qualitative data [94]. It is a statistical approach facilitating graphical display for the structure of dependencies between categorical data in a two-dimensional space. The correspondence analysis does not have to meet assumptions of normal distribution or homogeneity of variance, which distinguishes it from many classical parametric methods [95].

Relations between categories of two variables were the object of analysis here. The first variable was the type of rural and urban–rural communes in Eastern Poland according to the Delimitation of Rural Areas (agglomeration vs. non-agglomeration, differentiated in terms of their population density). The other variable was the level of investments in the low-carbon economy per capita and per unit area (km²). The quantitative variable was categorized into four classes based on the quartiles of its distribution, representing different levels of capital expenditure: none or low (values below or equal to the bottom quartile), mean lower (above the lower quartile and lower or equal to the median), mean higher (above the median and below or equal to the upper quartile), and high (values exceeding the upper quartile). This approach limits the influence of extreme observations and allows complex relationships to be presented in the form of an interpretable correspondence map. This method does not replace quantitative analysis but rather complements it, allowing for a graphical representation of relationships and similarities between categories in a two-dimensional space. The choice of correspondence analysis was justified by the need to identify patterns of associations between the type of local government unit and the categories of investment levels, while maintaining the ability to present the results synthetically within a factorial space [94].

This study has several limitations that should be considered when interpreting the results. First, the analysis is limited to projects co-financed from European Union funds. As a result, investments financed exclusively from national or local sources are not included, which may lead to an underestimation of the total scale of low-carbon investment activity in communes. Nevertheless, the use of EU-funded projects ensures data availability, consistency, and spatial comparability. Second, the identification of projects related to the low-carbon economy is based on their classification in official program databases. Due to the multi-purpose character of many public investments, some projects may generate only indirect climate effects, while others may include components that are not strictly related to emission reduction. This introduces a degree of uncertainty in assigning projects to the low-carbon category. Third, various types of low-carbon investments—such as

energy efficiency, renewable energy sources, transport, and municipal infrastructure—were analyzed jointly, despite differences in their cost structures, implementation scales, and financing mechanisms. Therefore, the results reflect overall investment activity rather than sector-specific patterns.

4. Results

4.1. Border Areas in Transition Towards Low-Carbon Economy: Investment Activity of Rural and Urban–Rural Communes in the Eastern Macroregion Compared to the Other Regions of Poland

In view of the considerable spatial diversification of Poland [23], including, among other things, differences in the income potential of local government units, structure and demographic trends (depopulation and population aging), transportation and market accessibility (duration of travel to provincial centers and network density), economic structure (share of agriculture and share of SMEs), technological potential, and conditions for development of renewable energy sources (insolation, wind, biomass and grid connectivity), it is justified to conduct the analysis at the macroregional scale. In the case of the Eastern Macroregion, it is additionally advisable to refer to the above-mentioned DRA [24], which distinguishes agglomeration and non-agglomeration communes of high and low population density, making it possible to precisely identify its peripheral character and its impact on the scale and intensity of low-carbon investments. In the peripheral regions of Eastern Poland rural and urban–rural communes predominate in the structure of local government units, while at the same time they face challenges typical of such peripheries, such as scattered settlement patterns, lower population density, population aging, less developed entrepreneurship, and limited income potential [23]. These conditions may influence both the number and value of projects aimed at the low-carbon economy implemented by local government entities.

Investments of communes aimed at the low-carbon economy (including renewable energy sources) constitute a major channel for the implementation of EU climate and energy goals at the local level. In EU financial frameworks, i.e., in the years 2007–2013 and 2014–2020, financing came primarily from the European Regional Development Fund and the Cohesion Fund (e.g., regional operational programs) and territorial cooperation programs (e.g., Interreg). According to the results of research conducted by Standar et al. [22], communes in Poland within the two most recent financial frameworks were the primary beneficiaries, utilizing approximately half the number and value of national projects aimed at the development of the low-carbon economy.

Between both these financial frameworks, a significant change occurred both in the scale and level of maturity of the discussed actions. While the years 2007–2013 may be defined as the initial stage, the years 2014–2020 marked a definite popularization of the discussed investments as well as a considerable expansion of their range among communes. As indicated by data presented in Figure 2, the level of participation increased, understood as the percentage of communes which implemented at least one project related to the development of the low-carbon economy. This index may be treated as a measure of the diffusion of public policy, referring to the local government units entering the program, while at the same time it supplements indexes showing the intensity of the investigated phenomenon. On the national scale, the participation index increased from 18% in the years 2007–2013 to 68% in the period 2014–2020, which confirms the transition from the pilot phase to the stage of extensive implementation. In this respect, the Eastern Macroregion was distinguished by the greatest activity in both these financial frameworks, as in 2007–2013 the percentage of communes implementing these projects already amounted to 43%, while in the years 2014–2020 it reached 83%. Within the second discussed financial framework, comparable values were recorded in the Southern (80%) and Central Macroregions (78%),

while they were lower in the Northern (70%), South-Western (59%), Mazowiecki (55%) and North-Western Macroregions (46%). The greatest increments in the values of the index were recorded in regions with low initial levels; i.e., in the Central (+68%), Northern (+59%), and Southern Macroregions (+57%). The range between the macroregions decreased markedly (from approximately 1–43% to 46–83%), which indicates convergence in the level of investment activity aimed at the development of the low-carbon economy, with the Eastern Macroregion maintaining the leading position (Figure 2).

Percentage of all communes in the macroregion (%)

Percentage of rural and urban-rural communes in the macroregion (%)

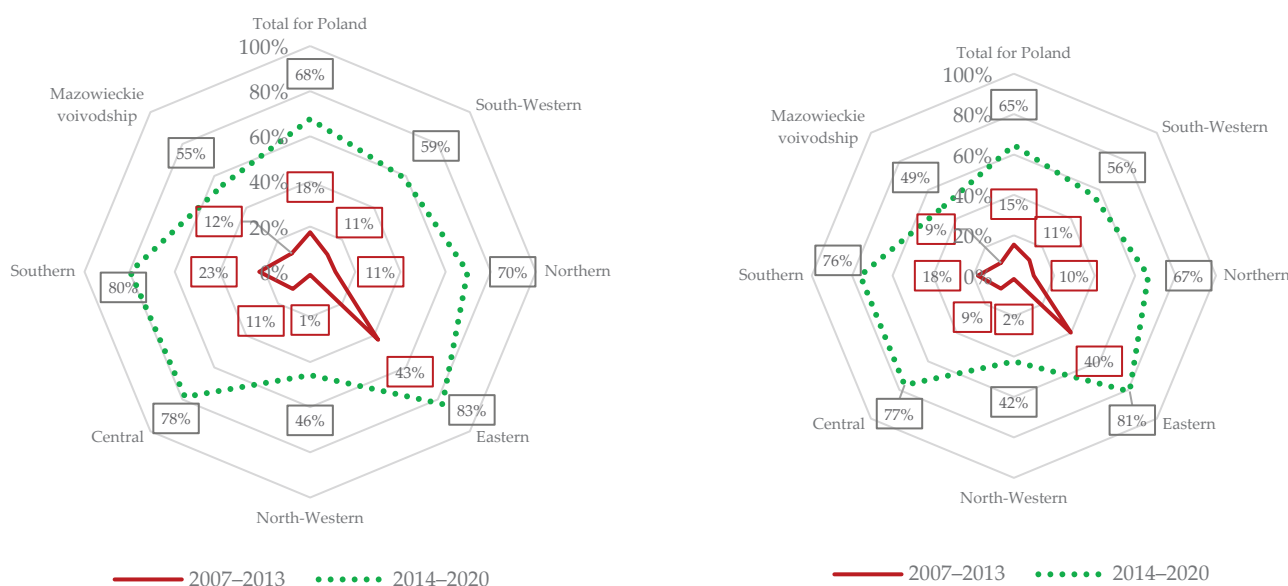


Figure 2. Percentages of communes (total, rural and urban-rural) implementing investments co-financed by EU funds and aimed at the low-carbon economy in terms of macroregions in Poland in financial frameworks of 2007–2013 and 2014–2020. Source: Author’s study based on data from the Ministry of Development Funds and Regional Policy [88,89].

An analogous pattern was observed in the group of rural and urban-rural communes. On the national scale the percentage of entities, which implemented at least one project increased from 15% in the years 2007–2013 to 65% in the period 2014–2020 (i.e., by 49%), which confirms significant popularization of investments aimed at the development of the low-carbon economy outside large cities. The Eastern Macroregion maintained its leading position in both financial frameworks, recording an increase from 40% to 81% (i.e., +41%), although the increase was slightly lower than in the regions starting from relatively low initial levels, such as the Central (+68%), Southern (+58%), or Northern Macroregions (+57%). The difference between the macroregions in terms of the share of rural and urban-rural communes acquiring and implementing projects co-financed by EU funds and aimed at the low-carbon economy decreased markedly. This means that the level of participation of these communes in individual parts of Poland was increasingly similar. At the same time, the Eastern Macroregion maintained its leading position, while the North-Western Macroregion and the Mazowiecki Voivodship were below average in the second of the investigated financial frameworks (Figure 2).

In both analyzed financial frameworks, communes were allocated acquired funds primarily to thermal upgrade of public buildings, street lighting, local heating systems, development of renewable energy systems, sustainable mobility, and supplementary mea-

asures (such as energy management or education) [88,89]. In the years 2014–2020 compared to 2007–2013, the number of communes implementing similar projects increased considerably, with the projects having greater budgets (Figure 2, Table 1). As shown by the results from the data provided in Table 1, in both investigated financial frameworks, Polish communes jointly completed approximately 4.9 thousand projects aimed at the low-carbon economy, acquiring for this purpose almost PLN 40 billion (EUR 9.5 billion). A significant majority of these enterprises was conducted in the years 2014–2020 (over 85%). Among them rural and urban–rural communes accounted for approximately 3.5 thousand investment projects (over 70% of projects), with a total value exceeding PLN 11.5 billion (EUR 2.7 billion) (approximately 30% of the total; Table 1).

Table 1. The number and value of investment projects in communes aimed at the low-carbon economy and co-financed from EU funds in macroregions of Poland in the years 2007–2013 and 2014–2020.

Macroregion	The Number of Projects			Value of Projects (in PLN Millions)		
	2007–2013	2014–2020	Total	2007–2013	2014–2020	Total
Total for communes						
South-Western	62	279	341	118.0	2609.0	2727.0
Northern	67	647	714	210.7	5197.3	5407.9
Eastern	321	1048	1369	751.9	5973.3	6725.1
North-Western	8	435	443	11.5	4813.1	4825.6
Central	37	479	516	122.2	3597.7	3719.9
Southern	128	1007	1135	445.1	6859.1	7304.2
Mazowieckie Voivodship	55	304	359	159.2	8872.9	9032.1
Total for Poland	678	4199	4877	1818.5	37,922.3	39,740.8
Rural and urban–rural communes						
South-Western	27	191	218	65.0	734.9	799.9
Northern	43	462	505	90.5	1062.5	1152.9
Eastern	257	871	1128	581.6	2681.3	3262.8
North-Western	8	296	304	11.5	1240.2	1251.7
Central	29	410	439	101.6	1426.1	1527.7
Southern	72	541	613	137.2	2267.9	2405.2
Mazowieckie Voivodship	39	237	276	113.9	990.6	1104.4
Total for Poland	475	3008	3483	1101.2	10,403.4	11,504.7

Source: Author's study based on data from the Ministry of Development Funds and Regional Policy [88,89].

It needs to be stressed that in the years 2014–2020, compared to the previous financial framework, the frameworks for the implementation of low-carbon measures were significantly standardized. Among other things, ex ante and ex post energy audits became commonly applied procedures, a set of universal indexes to monitor effects was introduced, while the application procedure was standardized. These changes also included local government units, which promoted the execution of routine packages of measures, such as thermal upgrades to multiple structures, modernization of lighting systems, and installation of local renewable energy sources, all resulting in a greater scale of implemented projects and increased stability of unit costs, as well as more predictable energy and emission levels [96].

Table 1 presents the distribution of the number of projects and the value of acquired funds in the macroregions, both jointly for all communes and separately for rural and urban–rural communes. This approach makes it possible to identify the unique character of the Eastern Macroregion compared to the other parts of Poland in relation to the analyzed

phenomenon. In the further stages of this analysis, these compilations were supplemented with data converted to unit measures (per capita and per km²).

In the Eastern Macroregion, communes completed almost 1.4 thousand projects (i.e., over ¼ of their total number in the country), the value of which exceeded PLN 6.7 billion (EUR 1.6 billion) (i.e., almost 17% of their total value in Poland). Between the two financial frameworks, a marked increase in activity was observed: the number of projects went up from 321 to 1048 (over 3-fold), while their value increased from PLN 0.75 billion to as much as PLN 5.97 billion (from EUR 0.17 billion to EUR 1.4 billion) (almost 8-fold). In both financial frameworks the Eastern Macroregion ranked first in Poland in terms of the number of acquired projects, whereas in terms of their value it ranked third, after the Mazowieckie Voivodship and the Southern Macroregion (Table 1).

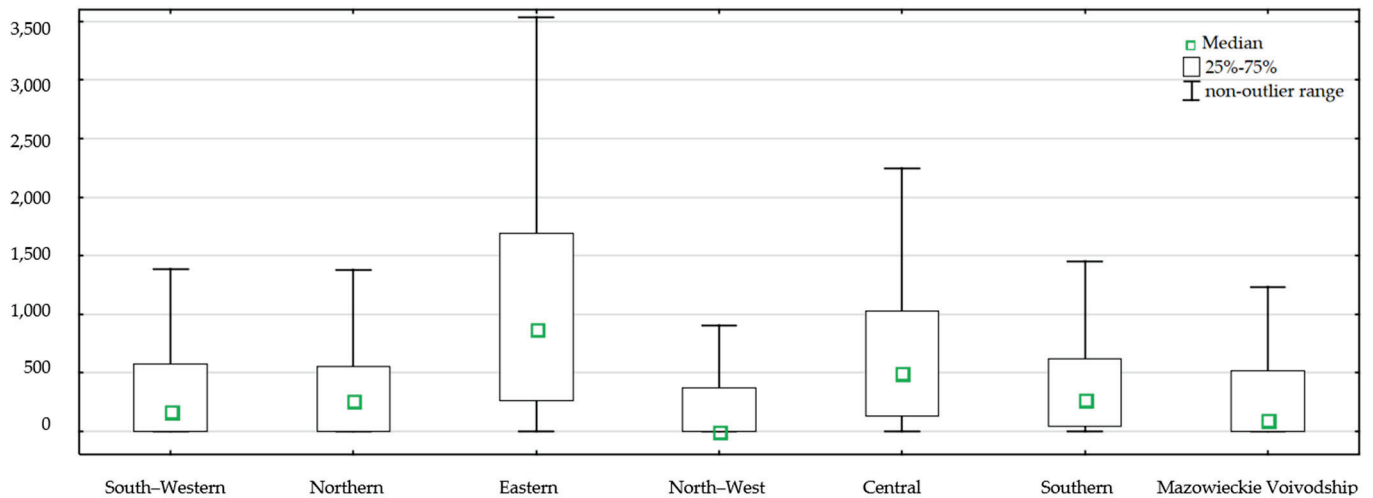
The importance of the Eastern Macroregion was even more evident in the group of rural and urban–rural communes. These units implemented over 1.1 thousand projects (over 80% of all such enterprises in the macroregion) valued at approximately PLN 3.3 billion (EUR 0.8 billion) (almost a half of their total value). In both financial frameworks rural and urban–rural communes of the Eastern Macroregion maintained the leading position on the national scale, both in terms of the number of projects and the value of acquired funds. During the analyzed period, almost every third project in this category of communes co-financed by EU funds was implemented in the Eastern Macroregion—they accounted for approximately 32% of their total number and over 28% of the value of such investments (Table 1).

Summing up, the unique character of local government activity in the Eastern Macroregion needs to be stressed here, as projects completed by rural and urban–rural communes accounted for over 80% all enterprises, at the national level slightly over 70%. In terms of the financial value, the share of this group reached almost 50%, with less than 30% at the national scale. These data indicate that investments co-financed by EU funds and aimed at the low-carbon economy in the peripheral regions of Eastern Poland were predominantly rural, which justifies the need for further in-depth analysis of this category of communes.

Figure 3 shows the average value of projects aimed at the low-carbon economy completed in the years 2007–2020 by all communes jointly and by rural and urban–rural communes in the macroregions of Poland. Statistical analysis conducted using the Kruskal–Wallis test confirmed that differences in medians for acquired funds per capita and per 1 km² between the macroregions are statistically significant ($p < 0.05$). The highest value was recorded in the Eastern Macroregion. The median of funds acquired by urban–rural communes in that macroregion amounted to over PLN 870 per capita (EUR 207 per capita) and over PLN 39 thousand/km² (EUR 9.3 thousand per km²), whereas on average on the national scale these values were PLN 275 (EUR 65.5 per capita) and slightly below PLN 17 thousand/km² (EUR 4.1 thousand per km²). This means that the intensity of investment activity in urban–rural communes of the Eastern Macroregion was over 3-fold higher per capita and over 2-fold higher per 1 km² compared to the national mean. When interpreting these results, it needs to be stressed that the high values per unit area indicate that the advantage of the Eastern Macroregion does not result solely from demographic factors (i.e., the smaller population size), but also reflects greater accumulation of outlays in spatial terms. Relatively high medians per 1 km² were also recorded in the Southern Macroregion (almost PLN 38 thousand/km², i.e., EUR 9.1 thousand per km²) and the Central Macroregion (approximately PLN 31.5 thousand/km², i.e., EUR 7.5 thousand per km²), although this was at lower values per capita (amounting to PLN 265 and PLN 502 per capita, i.e., EUR 63 and 120 per capita). This indicates a different combination of demographic and spatial conditions, as a more compact settlement structure promotes high outlays per unit area, but it is not reflected proportionally in the intensity of investment activity per capita.

In turn, the Northern and South-Western Macroregions ranked below the mean in both categories of these indexes.

Investment in the low-carbon economy per capita (in PLN, Kruskal–Wallis test = 325.3; $p < 0.001$)



Investments in low-carbon economy per unit area (in PLN per 1 km², Kruskal–Wallis test = 292.3; $p < 0.001$)

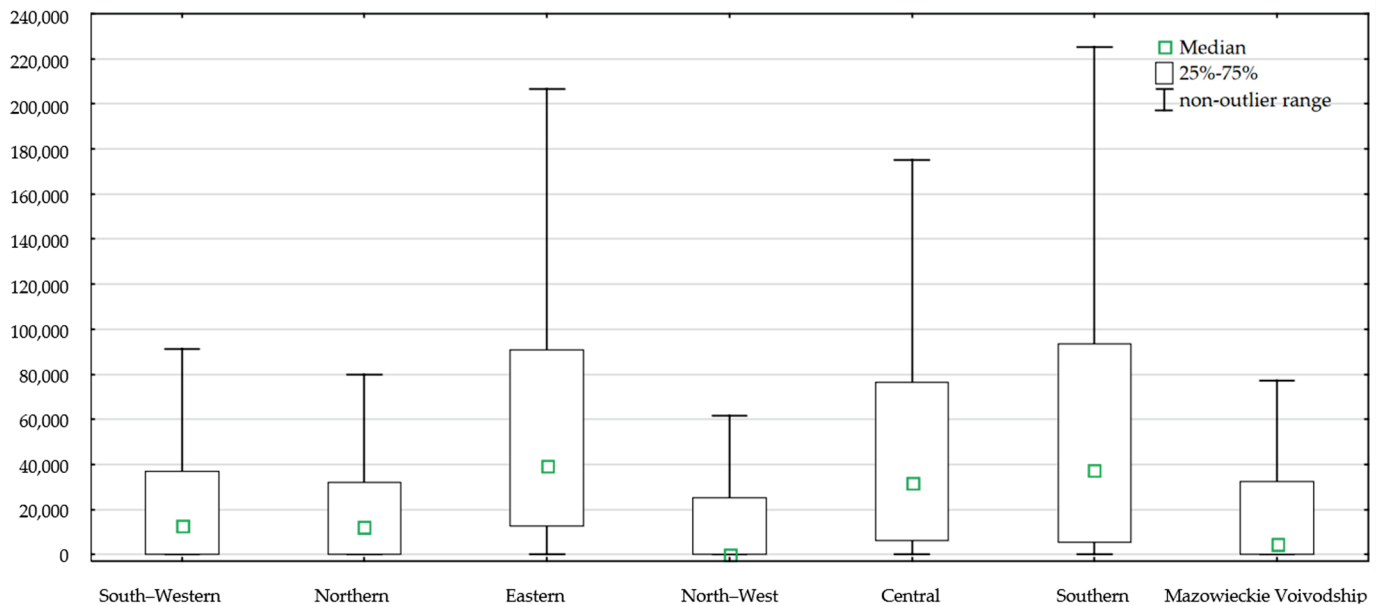


Figure 3. Box-plots illustrating values of acquired projects co-financed by EU funds and aimed at low-carbon economy per capita (in PLN) and per unit area (PLN per 1 km²) in rural and urban–rural communes depending on the macroregions, and totals in financial frameworks of 2007–2013 and 2014–2020. Source: Author’s study based on data from the Ministry of Development Funds and Regional Policy and Statistics Poland [88,89].

4.2. Between Functional Urban Areas and Peripheries: Investment Activity of Rural and Urban–Rural Communes in the Eastern Macroregion

In the Eastern Macroregion, the activity of communes to acquire EU funds for enterprises aimed at the low-carbon economy constituted a significant mechanism for the implementation of climate and energy policies at the local level. However, the scale of this activity is far from uniform—it varies depending on the type of rural and urban–rural communes, classified according to delimitation typology. This distinction into agglomeration and non-agglomeration communes and into units with high and low population densities makes it possible to separate the impact of location in relation to Functional Urban Areas

(FUAs) from the influence of the internal settlement structure, determining unit costs and the character of potential investments.

In the Eastern Macroregion, a definite majority of rural and urban–rural communes are non-agglomeration communes (approximately 83%). In this group, proportions of communes with low (52%) and high population density (48%) are comparable. This structure differs from the national figures, where units with a high population density (55% of the total) predominate among non-agglomeration communes. Agglomeration units in the Eastern Macroregion account for less than 17% of all rural and urban–rural communes, which is 2% less than the national mean, while units with a low population density predominate there [24].

In the next part of the analysis, the popularity of low-carbon measures was assessed in rural and urban–rural communes of the Eastern Macroregion, assuming as a measure the percentage of communes which acquired at least one project within a given financial framework. A comparison of the years 2007–2013 and 2014–2020 makes it possible to identify the transition from the pilot phase to the stage of common participation, whereas the joint presentation for the entire period of 2007–2020 makes it possible to assess stability and range of participation within a longer timeframe.

In the years 2007–2013, the investment activity of rural and urban–rural communes in the Eastern Macroregion was moderate and markedly varied—from 33% in non-agglomeration communes with low population density to almost 47% in agglomeration communes with high population density. However, in the succeeding financial framework (2014–2020), a definite increase in that activity was recorded. The highest level was found for agglomeration communes with low population density (over 86%), while it was lowest in non-agglomeration communes with low population density (78%). The dynamics of change were most evident in the groups of communes with low population density, both in agglomeration (an increase by over 47%) and non-agglomeration communes (by almost 49%). The increase in investment activity among communes with high population density was smaller, although it was still considerable (by over 33% in agglomeration communes and by almost 32% in non-agglomeration ones) (Figure 4).

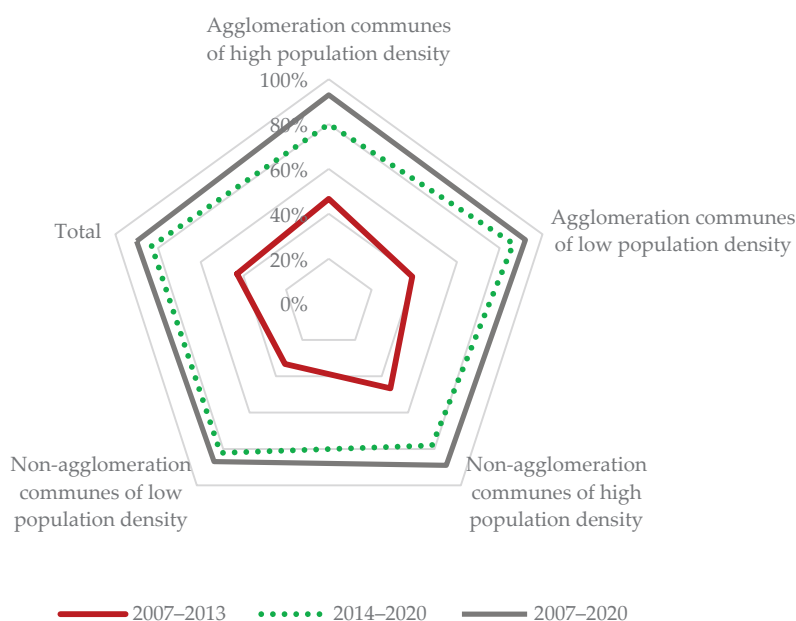


Figure 4. Investment activity of rural and urban–rural communes according to the typology of the Delimitation of Rural Areas in acquisition of low-carbon projects co-financed by EU funds in the Eastern Macroregion in the years 2007–2013 and 2014–2020 (%). Source: Author’s study based on data from the Ministry of Development Funds and Regional Policy and Statistics Poland [24,88,89].

When investigated jointly for the years 2007–2020, the participation of rural and urban–rural communes in low-carbon projects was almost universal, as it reached 93% in agglomeration communes of high population density, 92% in agglomeration communes of low population density, 89% in non-agglomeration ones with high population density, and 87% in non-agglomeration communes of low population density (Figure 4). This shows convergence between types specified in the Delimitation of Rural Areas and transition from selective implementation (2007–2013) to the extensive popularity of the discussed actions (2014–2020). The greatest dynamics of change were observed in communes with low population density, which suggests that the accumulation of project activity promoted acquisition of expertise on the part of local organizations and diffusion of good practice in the entire macroregion. At the same time, it needs to be stated that there is a certain group of communes (from 7% to 13%, depending on their type), which in both financial frameworks implemented no projects aimed at the development of the low-carbon economy. It is these communes that should be a priority target group for interventions in the current financial framework of 2021–2027.

In the years 2014–2020, there was a marked popularization and increase in the scale of actions undertaken by rural and urban–rural communes in the Eastern Macroregion. Overall, they completed over 1.1 thousand projects worth approximately PLN 3.3 billion (EUR 0.8 billion), of which the second investigated financial framework accounts for over 77% of the number and more than 82% of the value. The average value of a project increased from approximately PLN 2.3 million (EUR 0.6 million) in the years 2007–2013 to approximately PLN 3.1 million (EUR 0.7 million) in the years 2014–2020, which indicates the increased financial scale of this activity (Table 2).

Table 2. Projects aimed at low-carbon economy co-financed from EU funds completed by rural and urban–rural communes in the Eastern Macroregion in terms of their types in the Delimitation of Rural Areas (DRA) and location in FUAs in the years 2007–2013 and 2014–2020.

List	The Number of Projects			Value Projects (in PLN Million)		
	2007–2013	2014–2020	2007–2020	2007–2013	2014–2020	2007–2020
Types of communes according to the DRA						
Agglomeration communes of high population density	11	33	44	24.9	241.7	266.6
Agglomeration communes of low population density	27	176	203	59.6	429.0	488.6
Non-agglomeration communes of high population density	122	307	429	292.1	1140.8	1432.8
Non-agglomeration communes of low population density	97	355	452	205.0	869.8	1074.8
Types of communes in relation to FUA						
Agglomeration communes	38	209	247	84.5	670.7	755.2
Non-agglomeration communes	219	662	881	497.0	2010.6	2507.6
Total	257	871	1128	581.6	2681.2	3262.8

Source: Author's study based on data from the Ministry of Development Funds and Regional Policy and Statistics Poland [24,88,89].

In terms of their types according to the Delimitation of Rural Areas, the greatest share in the number and value of projects was found for non-agglomeration communes, which completed a total of 881 projects worth over PLN 2.5 billion (EUR 0.6 billion). However, it needs to be remembered that they constitute approximately 83% all rural and urban–rural communes in the Eastern Macroregion (half of them with low and half with high population density), while agglomeration communes account for less than 17%, being predominantly entities with low population density. Thus, the predominance of communes located outside FUAs in the joint presentations of data is partly the effect of population structure. In this respect, agglomeration communes with high population density are exceptions to the trend, since despite the relatively low number of projects (44) they acquired a total of PLN 266.6 million (EUR 63.5 million), which is equivalent to a unit value above the average (approximately PLN 6.1 million, i.e., EUR 1.5 million). This indicates the implementation of more capital-intensive, integrated projects, such as the thermal upgrade of many buildings or systemic modernization of lighting, taking advantage of the economies of density.

Analysis of the division into communes located within FUAs and those outside these areas confirms the dominance of entities outside FUAs, which accounted for over 78% of the total number and almost 77% of the value of the projects in the region. However, this advantage decreased in the second of the investigated financial frameworks. In the years 2007–2013, the ratio of the number of projects implemented outside FUAs to those within FUAs was approximately 5:1 (219/38; 497/84.5 PLN million), while in the years 2014–2020 it dropped to 3:1 (662/209; 2010.6/670.7 PLN million) (Table 2).

In the Eastern Macroregion, in the group of rural and urban–rural communes, the median for the value of acquired projects aimed at the low-carbon economy per capita in the first financial framework (2007–2013) amounted to PLN 0 in all types of communes classified according to the Delimitation of Rural Areas (Table 3). This means that at least a half of communes in each category did not acquire any projects for this type of activity within this period, which is consistent with the early period of formation of the support system and the limited availability of stable, predictable, and standardized financing mechanisms for investments made by local government units concerning energy efficiency and renewable energy sources.

In the second investigated financial framework (2014–2020), a definite popularization of these measures was observed and medians for the values of acquired projects aimed at the development of the low-carbon economy per capita significantly increased, particularly in the group of communes with low population density, including both agglomeration and non-agglomeration communes. The fact that even within FUAs, the median for the value of investments in the low-carbon economy per capita was higher in the group of communes with low rather than high population density indicates that the diversification is caused not only by the location of these territorial units in relation to urban cores, but also by the character of the settlement structure itself.

As previously mentioned, among rural and urban–rural communes, the highest average amount of funds acquired in low-carbon projects co-financed by EU funds per capita was recorded in territorial units of low population density. In agglomeration communes of this type, this amounted to almost PLN 925 per capita (EUR 220 per capita), while in non-agglomeration communes it was over PLN 901 (EUR 215 per capita). Furthermore, in the latter group, the greatest diversification was observed between the quartiles, which shows strong differentiation of individual investment trajectories. Slightly lower values were recorded in non-agglomeration communes of high population density (approximately PLN 872 per capita, i.e., EUR 208 per capita), while markedly the lowest values were in agglomeration communes with high population density (PLN 276 per capita, i.e., EUR 66 per capita) (Figure 5).

Table 3. Median values of low-carbon projects co-financed from EU funds per capita and per unit area in rural and urban–rural communes of the Eastern Macroregion, by type according to DRA typology and FUA affiliation in the years 2007–2013 and 2014–2020.

List	Investment in Low-Carbon Economy per Capita (in PLN)			Investments in Low-Carbon Economy per Unit Area (in PLN Thousand Per 1 km ²)		
	2007–2013	2014–2020	2007–2020	2007–2013	2014–2020	2007–2020
Types of communes according to the DRA						
Agglomeration communes of high population density	0.0	250.3	276.3	0.0	40.0	51.7
Agglomeration communes of low population density	0.0	682.9	924.5	0.0	38.8	50.8
Non-agglomeration communes of high population density	0.0	610.4	871.9	0.0	42.3	56.5
Non-agglomeration communes of low population density	0.0	640.0	901.2	0.0	18.3	24.4
Types of communes in relation to FUA						
Agglomeration communes	0.0	619.7	752.7	0.0	39.9	51.2
Non-agglomeration communes	0.0	640.0	877.9	0.0	27.4	35.3
Total	0.0	636.8	871.9	0.0	28.6	39.1

Source: Author's study based on data from the Ministry of Development Funds and Regional Policy and Statistics Poland [24,87–89].

This system suggests that in less populated parts of the macroregion, typical modernization packages (e.g., thermal upgrades of public buildings, modernization of street lighting using LED systems, and microinstallation of renewable energy sources) generated relatively stronger effects per capita. It was different for agglomeration communes with high population density, where the median was markedly lower. This resulted both from the higher population denominator, and a different investment profile, in which a significant role was played by competition for funds other than low-carbon projects.

Figure 5 presents a total median for the value of low-carbon projects acquired by rural and urban–rural communes in the Eastern Macroregion expressed per unit area (1 km²), depending on the division into delimitation types. In the entire macroregion, the median amounted to almost PLN 46 thousand/km² (EUR 11 thousand per km²). The highest value was recorded in non-agglomeration communes with high population density (PLN 56.5 thousand/km², i.e., EUR 13.5 thousand per km²), which was slightly higher than in agglomeration communes of high population density (PLN 51.7 thousand/km², i.e., EUR 12.3 thousand per km²) and agglomeration communes of low population density (PLN 50.8 thousand/km², i.e., EUR 12 thousand per km²). Differences between these two types of agglomeration communes were slight (1–2%), whereas the advantage of non-agglomeration communes with high population density and agglomeration communes reached approximately 10%.

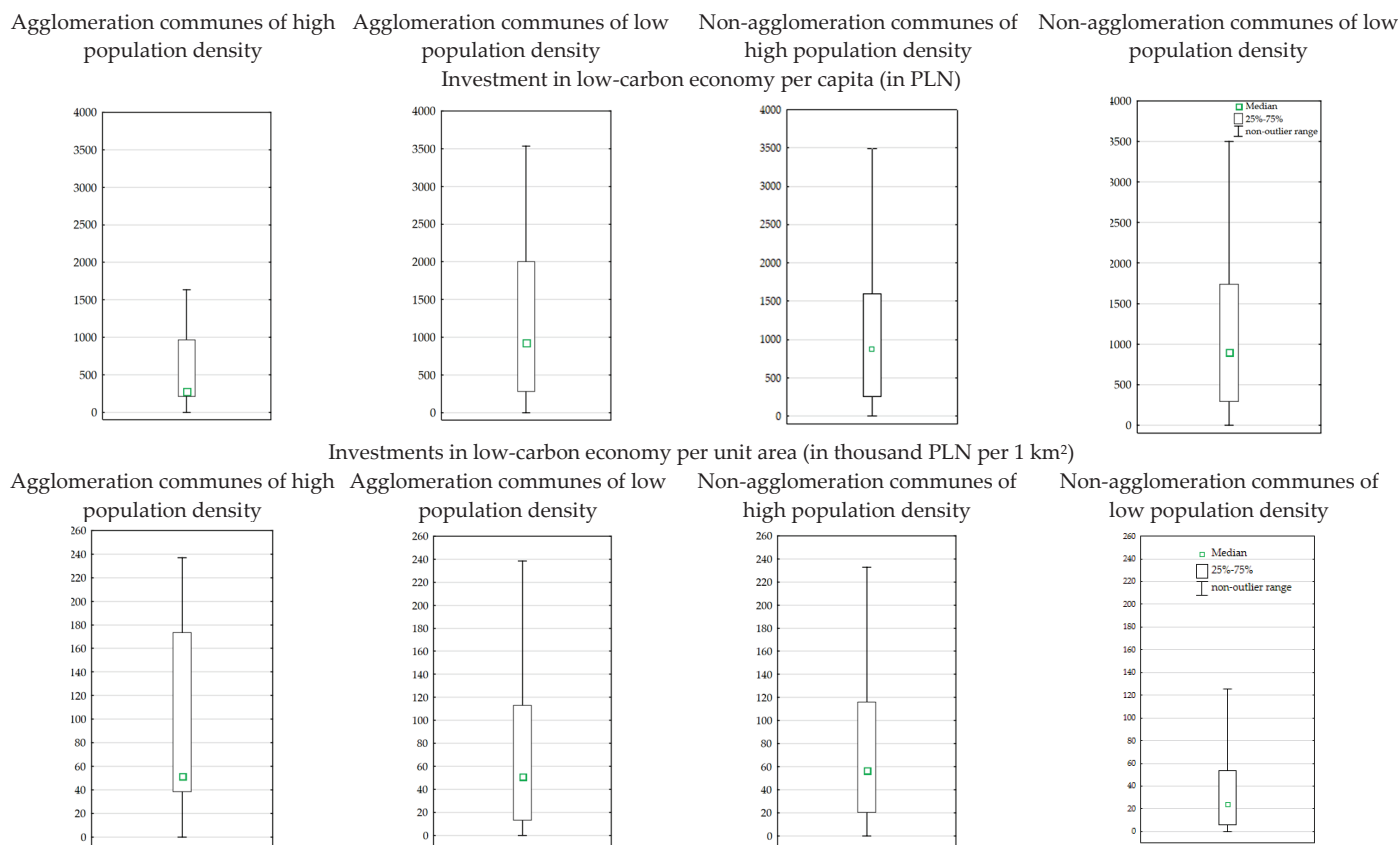


Figure 5. Value of low-carbon projects co-financed from EU funds per capita and per unit area (km^2) in types of rural and urban–rural communes classified according to the Delimitation of Rural Areas in the Eastern Macroregion of Poland, showing totals in the years 2007–2020 (box-plots). Source: Author’s study based on data from the Ministry of Development Funds and Regional Policy and Statistics Poland [24,87–89].

In the group of agglomeration communes of high population density, nevertheless, a marked interquartile range was observed, showing high heterogeneity in terms of the intensity of investment activity aimed at the low-carbon economy. This diversification may have resulted from several factors. Firstly, it may be influenced by the effect of area and the share of urbanized area. In smaller communes with a denser settlement and building structure the same amounts manifested in higher values per 1 km^2 , while in larger communes, they were distributed over a larger area. Secondly, from different profiles of the investment portfolio, communes implementing grid investment projects (e.g., modernization of street lighting systems and thermal upgrade packages for multiple buildings) attained greater intensity of spatial outlays compared to communes in which single point projects predominated. Thirdly, a significant role could have been played by differences in institutional and fiscal potential, access to territorial instruments (cross-border cooperation), and technological conditions (e.g., grid connectivity and standard of municipal infrastructure assets), which directly determined the scale and type of feasible measures.

The lowest level of investments aimed at the low-carbon economy per unit area was recorded in non-agglomeration communes of low population density (PLN 24.4 thousand/ km^2 , i.e., EUR 5.8 thousand per km^2), which constituted approximately half of the value acquired in the other three types of rural and urban–rural communes. This distribution is consistent with the logic of the spatial index, i.e., in territorial units of large area, frequently characterized by a high share of forested areas and protected areas, outlays are distributed more uniformly and

are more markedly scattered, while their lower urbanization rate additionally limits intensity in terms of value per 1 km².

The relatively high investment activity observed in peripheral communes should be interpreted in the context of their structural constraints. Limited fiscal capacity, dispersed settlement patterns, and ageing energy infrastructure increase the sensitivity of these areas to energy costs and external supply risks. Under such conditions, EU co-financing becomes a crucial enabling factor, allowing peripheral local governments to overcome investment barriers and actively participate in low-carbon transition, despite long-term development disadvantages.

Recorded research results constituted the basis for an in-depth intraregional analysis. Mann–Whitney tests confirmed that the significant differences in the level of investment activity aimed at the low-carbon economy between communes located within and those outside FUAs were observed when converting the value of acquired projects into respective figures per unit area (km²). Overall, for the entire period of analysis (2007–2020) no significant differences were found in the level of investment per capita between communes located within an FUA and those outside FUAs (median: PLN 752.7 vs. 877.9/person; $U = 13,288$, $p = 0.74$). This indicates that when expressed in values per capita the investment activity aimed at the low-carbon economy was comparable regardless of the communes' location in relation to Functional Urban Areas. Furthermore, the division into types of communes according to the Delimitation of Rural Areas did not differentiate statistically significantly the level of investments in the low-carbon economy per capita. Despite marked differences in medians (e.g., a lower value in agglomeration communes of high population density), considerable dispersion, including the recorded zero values, leads to lack of significance at typical α levels (Table 4).

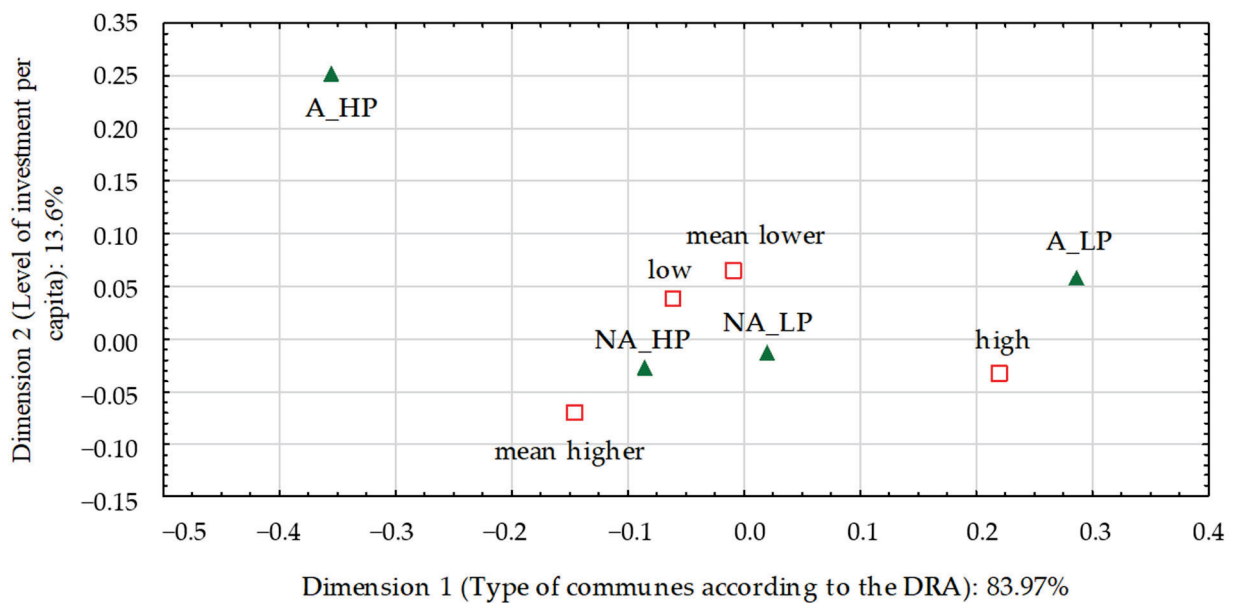
Table 4. Results of non-parametric tests for dependencies between the types of rural and urban-rural communes (FUA and DOW) and the level of low-carbon investments co-financed by EU funds per capita and per unit area (km²) in the Eastern Macroregion of Poland, showing totals in the years 2007–2020.

List	Value of Investments per Capita (in PLN)			Value of Investments per 1 km ² (in Thousand PLN)		
	Median	Mann–Whitney test	p	Median	Mann–Whitney test	p
Classification of communes depending on FUA location						
Agglomeration communes	752.7	13,288	0.74	51.2	18,789	0.02
Non-agglomeration communes	877.9			35.3		
Classification of communes according to DRA						
Agglomeration communes of high population density	276.3	4.4	0.22	51.7	38.87	0.00
Agglomeration communes of low population density	924.5			50.8		
Non-agglomeration communes of high population density	871.9			56.5		
Non-agglomeration communes of low population density	901.2			24.4		

Source: Author's study based on data from the Ministry of Development Funds and Regional Policy and Statistics Poland [24,87–89].

A different situation is found for investments in the low-carbon economy in rural and urban–rural communes of the Eastern Macroregion per unit area (km²). Communes located within FUAs attained higher spatial intensity of outlays than communes located outside FUAs (PLN 51.2 thousand vs. 35.3 thousand/km²; $U = 18,789, p = 0.02$). Statistically significant differences were also found between types of communes distinguished according to the Delimitation of Rural Areas ($H = 38.87, p < 0.001$). The lowest median was recorded in non-agglomeration communes of low population density (PLN 24.4 thousand/km²), the highest in non-agglomeration communes of high population density (PLN 56.5 thousand/km²), while the types of agglomeration communes received intermediate ranking positions.

In the next stage of the study, correspondence analysis was applied in order to identify dependencies between the types of rural and urban–rural communes according to the Delimitation of Rural Areas in the Eastern Macroregion, and the level of investment activity aimed at the low-carbon economy. This analysis treats the system of categories as points in space and makes it possible to assess both the existence of a relationship (the χ^2 test) and the geometry of relationships (factorial coordinates, \cos^2 , and representation quality) (Figures 6 and 7 and Tables 5 and 6).

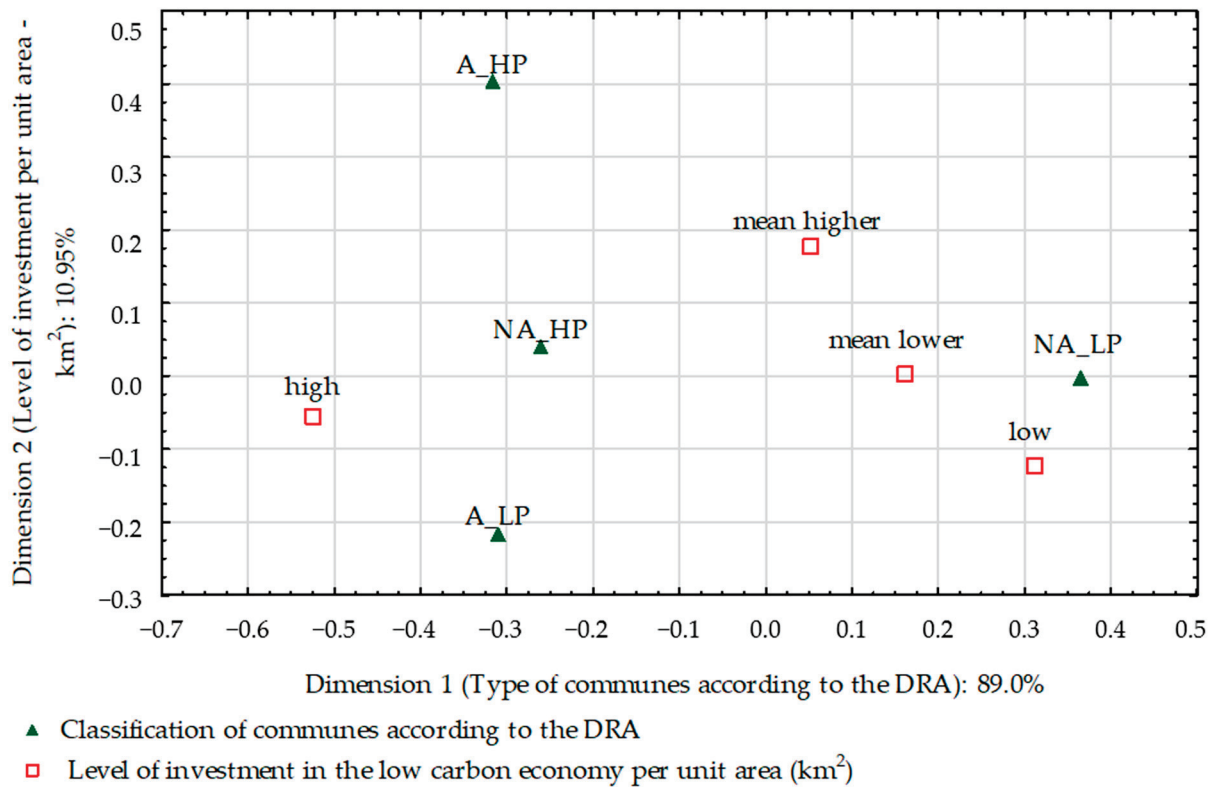


- ▲ Classification of communes according to the DRA
- Level of investment in the low-carbon economy per capita

Statistical results: $\chi^2 = 9.63, p = 0.38$

Legend: A_HP—agglomeration communes of high population density; A_LP—agglomeration communes of low population density; NA_HP—non-agglomeration communes of high population density; NA_LP—non-agglomeration communes of low population density.

Figure 6. A correspondence map presenting dependencies between the types of rural and urban–rural communes in the Eastern Macroregion (according to the DRA classification, Dimension 1) and the level of investments co-financed from EU funds and aimed at the low-carbon economy per capita (Dimension 2) in the years 2007–2020 Source: Author’s study based on data from the Ministry of Development Funds and Regional Policy and Statistics Poland [24,87–89].



Statistical results: $\chi^2 = 50.0$; $p < 0.001$

Legend: A_HP—agglomeration communes of high population density; A_LP—agglomeration communes of low population density; NA_HP—non-agglomeration communes of high population density; NA_LP—non-agglomeration communes of low population density.

Figure 7. A correspondence map presenting the dependence between the type of rural and urban-rural communes (according to the DRA classification, Dimension 1) in the Eastern Macroregion and the level of investments co-financed from EU funds and aimed at the low-carbon economy per unit area (km²) (Dimension 2) in the years 2007–2020. Source: Author’s study based on data from the Ministry of Development Funds and Regional Policy and Statistics Poland [24,87–89].

In the first case, when the value of investments was calculated per capita and then categorized (absence or low, mean lower, mean higher, or high level), no statistically significant relationship was found between the type of communes and the level of their investment activity aimed at the low-carbon economy ($\chi^2 = 9.63$; $p = 0.38$). Although the distribution of points suggests a weak trend along Dimension 1, the category high (a positive coordinate) is located closer to agglomeration communes of low density (A_LP: 0.29), while mean higher (a negative coordinate) is closer to agglomeration communes of high population density (A_HP: -0.35). Non-agglomeration communes are located closer to the center (NA_HP: -0.09; NA_LP: 0.02). However, as there is a lack of significance in Chi-squared tests, these relationships need to be treated as weak and non-correlated. The high quality of representation for some categories in Dimension 1 (e.g., high, mean higher, A_LP, and A_HP) needs to be stressed, which means that this dimension properly orders the data in the geometrical sense, but is not reflected in a statistically significant dependence between the variables. The lack of statistical significance for the dependencies between the investigated phenomena is consistent with the earlier results of non-parametric tests for the index of investment in the low-carbon economy per capita (lack of differences between inside an FUA vs. outside FUA, and between the delimitation classes), which suggests that the figures calculated per capita equalize diversification between the types of communes.

Table 5. Factorial coordinates and representation quality indexes for variables including types of rural and urban–rural communes (DRA) in the Eastern Macroregion and levels of low-carbon investments per capita co-financed by EU funds in the years 2007–2020.

List	Coordinates		Quality of Representation	Cos ²	
	Dimension 1	Dimension 2		Dimension 1	Dimension 2
Type of communes according to the DRA					
Agglomeration communes of high population density	−0.35	0.25	0.99	0.66	0.33
Agglomeration communes of low population density	0.29	0.06	1.00	0.60	0.04
Non-agglomeration communes of high population density	−0.09	−0.03	0.95	0.16	0.08
Non-agglomeration communes of low population density	0.02	−0.01	0.45	0.01	0.15
Level of investments per capita					
Low	−0.06	0.04	0.82	0.58	0.24
Mean lower	−0.01	0.06	0.84	0.02	0.82
Mean higher	−0.15	−0.07	1.00	0.81	0.19
High	0.22	−0.03	1.00	0.98	0.02

Source: Author's study based on data from the Ministry of Development Funds and Regional Policy and Statistics Poland [24,87–89].

Table 6. Factorial coordinates and representation quality indexes for variables covering types of rural and urban–rural communes (according to the DRA) in the Eastern Macroregion and the level of investments co-financed by EU funds and aimed at the low-carbon economy per unit area (km²) in the years 2007–2020.

List	Coordinates		Quality of Representation	Cos ²	
	Dimension 1	Dimension 2		Dimension 1	Dimension 2
Type of communes according to the DRA					
Agglomeration communes of high population density	−0.32	0.40	0.997	0.38	0.62
Agglomeration communes of low population density	−0.31	−0.22	0.999	0.67	0.33
Non-agglomeration communes of high population density	−0.26	0.04	0.999	0.98	0.02
Non-agglomeration communes of low population density	0.37	−0.00	1.000	1.00	0.00
Level of investments per unit area (km ²)					
Low	0.31	−0.12	0.999	0.86	0.14
Mean lower	0.16	0.00	0.993	0.99	0.00
Mean higher	0.05	0.18	0.999	0.08	0.92
High	−0.52	−0.6	1.000	0.99	0.01

Source: Author's study based on data from the Ministry of Development Funds and Regional Policy and Statistics Poland [24,87–89].

In turn, the arrangement of points in the correspondence map (Figure 7) indicates a clear pattern of correspondence between the types of rural and urban–rural communes classified according to the Delimitation of Rural Areas and the level of investments in the low-carbon economy per unit area (km²) in the Eastern Macroregion ($\chi^2 = 50.0$; $p < 0.001$). Dimension 1 (the principal axis of correspondence) orders categories from lower values of investment on the positive side—where the levels low and mean lower are found, as well as non-agglomeration communes of low population density (NA_LP: $x = 0.37$)—to higher values on the negative side, with the level high ($x = -0.52$) and the types of communes with higher population density more strongly linked with FUAs: non-agglomeration com-

munnes with a high population density (NA_HP: $x = -0.26$) and agglomeration communes (A_LP: $x = -0.31$; A_HP: $x = -0.32$). This means that territorial units of considerable area and scattered settlement patterns (NA_LP) are relatively more often linked with lesser intensity of investment in the low-carbon economy per 1 km², while communes with greater population density, both non-agglomeration and agglomeration types, are associated with higher levels of the discussed investment activity index. Dimension 2 provides, first of all, intragroup differentiation among the agglomeration groups: A_HP ($y = 0.40$) is closer to the profile mean higher ($y = 0.18$), while A_LP ($y = -0.22$) is closer to high ($y = -0.60$), which may be interpreted as a different manner of spatial concentration of projects in agglomeration communes of varied population density. These results are consistent with the earlier non-parametric tests of the investment activity index calculated per unit area (per 1 km²) and they support the conclusion that settlement structure and linkages with FUAs are correlated with the intensity of investment activity aimed at the low-carbon economy in spatial terms, while in terms of data presented per capita, differences between the delimitation classes were not confirmed statistically.

5. Conclusions

The empirical studies conducted made it possible to assess the level, diversification, and dynamics of changes in investment activity connected to the development of the low-carbon economy co-financed by EU funds in Polish communes, focusing on rural and urban–rural communes in the Eastern Macroregion. The results of these analyses clearly confirm that in the two completed financial frameworks, the policy to support low-carbon projects in Poland shifted from the pilot stage to the phase of extensive popularization. The share of communes which implemented at least one such project increased from 18% in the years 2007–2013 up to 68% in the financial framework 2014–2020, which marked the transition from selective implementation to common implementation of low-carbon measures. This process is promoted by the standardization of implementation procedures, such as the obligation to conduct *ex ante* and *ex post* energy audits, application of uniform indicators, and standardization of documentation, which facilitated the replication of routine investment packages such as thermal upgrades of multiple buildings, modernization of street lighting, and local renewable energy systems. As a consequence, these measures have led to more predictable unit costs and stable energy generation and GHG emission levels.

In both investigated financial frameworks, the Eastern Macroregion was distinguished by the greatest participation of communes on a national scale, both in absolute numbers and among rural and urban–rural communes. In that macroregion, a total of 1.4 thousand projects were implemented, accounting for almost $\frac{1}{4}$ of all projects in Poland, confirming the key role of this macroregion in the implementation of local climate and energy policies. A particularly characteristic aspect was connected with the markedly rural profile of this investment activity. Over 80% of projects in the investigated macroregion were implemented by rural and urban–rural communes, which accounted for almost 50% of the total value (compared to less than 30% on the national scale). This means that the advantage of the Eastern Macroregion did not result solely from its demographic structure, but also from the greater scale and accumulations of these projects. An increase in the average value of a project from approximately PLN 2.3 million (EUR 0.6 million) to PLN 3.1 million (EUR 0.7 million) indicates the transition to more complex and capital-intensive investments, despite the fact that in terms of the total value of projects the region ranked third in Poland.

From the perspective of energy security, the analyzed low-carbon investments play a dual role. On the one hand, improvements in energy efficiency and the deployment of renewable energy sources in rural and urban–rural communes reduce dependence on

external energy supplies and increased local generation capacity, which enhances the reliability of energy provision in peripheral areas. On the other hand, the diversification of energy sources and the modernization of local infrastructure mitigate exposure to energy price shocks and contribute to the long-term affordability and stability of energy services for households and local enterprises. In this sense, the high absorption of EU funds in the Eastern Macroregion strengthens not only low-carbon transition, but also the multidimensional energy security of structurally weaker territories.

It needs to be stressed that high investment activity of communes in the Eastern Macroregion was also supported by the dedicated financial instruments allocated to this part of the country. Within the Operational Program Eastern Poland 2014–2020, that region was provided with an additional amount of structural funds allocated not only to support competitiveness and innovation, but also sustainable energy transition. However, it needs to be stressed that these programs were to the greatest extent used by large cities serving the function of subregional growth poles, implementing projects aimed at the development of sustainable municipal transport and low-carbon mobility. Rural and urban–rural communes, despite limited access to such instruments, showed high activity in acquiring funds within the regional operational programs, which confirms their increasing institutional and operational capacity in the implementation of climate and energy policies.

In terms of research methodology, a particularly significant role is played by the sensitivity of formulated conclusions in relation to the selection of a point of reference or benchmark. When presenting the funds acquired for low-carbon investments per capita no statistically significant differences were found between rural and urban–rural communes located within Functional Urban Areas (FUAs) and those outside these areas, which was similar to the relationship between the types of communes classified according to the delimitation methodology. However, a different picture is obtained when analyzing the intensity of allocated outlays per unit area, as communes located within an FUA and those with greater population density (both agglomeration and non-agglomeration communes) reached significantly higher values of investments per 1 km², while non-agglomeration communes of low population density recorded the lowest levels of this activity. This means that in communes with greater building development density and technological infrastructure, identical investment outlays are reflected in higher intensity in spatial terms, whereas in scattered rural structures this effect was diffused.

Within the Eastern Macroregion, progress in institutional learning could be observed along with the diffusion of good practice, particularly in communes with low population density, where the growth dynamics for the increase in commune participation was greatest. At the same time, a group of communes was identified (from 7% to 13% depending on the type), which in both financial frameworks implemented no projects aimed at the development of the low-carbon economy. These communes, most frequently non-agglomeration communes with low population density and limited income potential, should become a priority for measures in the current financial framework 2021–2027. In turn, in agglomeration communes of high population density, a relatively lower number of projects was recorded, while there was a higher unit value of investments, which indicates implementation of more integrated projects utilizing economies of scale.

High absorption of EU funds in the Eastern Macroregion shows that the institutional solutions used in the years 2014–2020, such as standardization of procedures, common monitoring indexes, and routine investment packages, made it considerably easier for communes to acquire EU funds and implement projects. It would be advisable to maintain and develop similar mechanisms in successive program periods, particularly in relation to peripheral areas, where stability and predictability of support instruments are of key importance for the effectiveness of implemented projects.

In terms of public policies, the recorded results indicate the need for a dual strategy. Firstly, continuation of support for non-agglomeration communes of low population density through umbrella projects (i.e., joint initiatives of local government bodies facilitating implementation of numerous small investments, e.g., renewable energy installations, within one program), joint commissioning, and development of institutional potential. Secondly, it is important to provide further support for agglomeration communes in the execution of more capital-intensive systemic projects. In broader terms, the results of this study undermine the stereotype of Eastern Poland as an area with development deficits. High investment activity aimed at the low-carbon economy on the part of rural and urban–rural communes in that region shows that peripheral regions of Poland may serve as leaders in local energy transition.

Analyses conducted to date concerning the development of the low-carbon economy in Poland focused primarily on urban and metropolitan centers, leading to the marginalization of rural and peripheral regions. This study fills this research gap, showing the Eastern Macroregion as a region of active adaptation to climate policy, in which communes of rural and urban–rural character predominate. The application of two measures for investment intensity, i.e., per capita and per 1 km², made it possible to separate demographic and spatial effects. This confirms that the assessment of local energy transition and its implications for energy security is highly sensitive to the choice of reference unit, and that spatial concentration of investment may be a more informative indicator than per capita figures in sparsely populated peripheral regions.

The results of empirical studies have made it possible partly to positively verify the research hypothesis, according to which, spatial conditions in the Eastern Macroregion, including location in the border zone as well as location in relation to Functional Urban Areas (within an FUA vs. outside an FUA), significantly diversify the investment activity of rural and urban–rural communes related to the low-carbon economy and co-financed by EU funds. However, this differentiation is manifested primarily in spatial terms (value of investments per 1 km²), where communes located within an FUA and those with greater population density attained significantly higher levels of investment compared to non-agglomeration communes with low population density. In terms of respective figures per capita, this dependence was not statistically significant, which indicates that the effect of the settlement structure and location is manifested only after the spatial concentration of the population and infrastructure have been considered.

It was finally confirmed that spatial factors—both in terms of location in relation to urban cores and location in the border zone—play a significant role in modifying the intensity and character of low-carbon investments co-financed by EU funds. However, their impact is not manifested directly on the volume of funds acquired per capita, but rather on the spatial concentration of investment projects, dependent on settlement density and urbanization rate. This means that transition towards the low-carbon economy in the Eastern Macroregion varies in spatial terms, but it does not directly reflect the gradient of peripherality. On the contrary, it confirms the capacity of communes with a diverse development potential to adapt and effectively implement climate policies utilizing EU funds.

In the context of the EU financial perspective 2021–2027, the results of this study suggest that support instruments addressed to rural and peripheral communes should take into account the differentiated spatial conditions identified in the analysis. The high effectiveness of low-carbon investments observed in the Eastern Macroregion, particularly in rural and urban–rural communes, indicates the importance of continuing support for projects related to energy efficiency, renewable energy sources, and local infrastructure. The obtained results also show that umbrella projects and joint initiatives from local governments may constitute an effective formula for reducing organizational and financial

barriers in communes of low population density. The experience of the Eastern Macroregion may therefore be used as a reference point for other peripheral regions, provided that regional institutional and settlement conditions are taken into account.

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Abbreviations

The following abbreviations are used in this manuscript:

DRA	Delimitation of Rural Areas
FUA	Functional Urban Areas
EU	European Union
RES	renewable energy sources
GHG	greenhouse gas emissions
A_HP	agglomeration communes of high population density
A_LP	agglomeration communes of low population density
NA_HP	non-agglomeration communes of high population density
NA_LP	non-agglomeration communes of low population density

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Article

The European Charter for Sustainable Tourism (ECST) as a Tool for Development in Rural Areas: The Case of Vesuvius National Park (Italy)

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Abstract

The study investigates how agriculture can serve as a driver of sustainable tourism and local development within the Vesuvius National Park under the European Charter for Sustainable Tourism (ECST) framework. Based on 14 semi-structured interviews with farmers, tourism operators, cultural institutions, and producer consortia, the findings reveal that agriculture plays a central role not only as a productive sector but also as a custodian of biodiversity, identity, and territorial resilience. Stakeholders emphasised the economic and symbolic value of traditional crops, highlighting how farm-based experiences, product certifications, and civil-society networks strengthen community cohesion and diversify visitor flows. Nevertheless, tourism remains predominantly concentrated in the vicinity of the volcano's crater, thereby excluding the park's other trails, limiting the positive impacts on rural and peripheral areas. Practical implications point to the need for improved mobility infrastructure, cross-sector coordination, and targeted incentives to link agrotourism circuits with regional branding and EU sustainability policies. Overall, the study shows that integrating agriculture into tourism governance can foster more inclusive, resilient, and territorially embedded forms of rural development in protected areas.

Keywords: agricultural heritage; agritourism; rural development; climate-resilient farming; sustainable tourism; natural protected areas; participatory governance; biodiversity conservation; cultural landscape; agroecology

1. Introduction

In recent decades, sustainable tourism has increasingly emerged as both a policy imperative and a practical framework for reconciling economic development with the preservation of environmental and cultural heritage [1,2]. In Europe, this evolution has been catalysed by the European Charter for Sustainable Tourism in Protected Areas (ECST), established by the EUROPARC Federation in 1995 and conceived as a voluntary governance and certification tool for protected areas willing to commit to collaborative, strategically planned tourism development [3]. The ECST, structured in three phases—covering the accreditation of sustainable destinations (Phase I), the engagement of local partners (Phase II), and the inclusion of tour operators (Phase III)—requires the active participation of stakeholders from public authorities, the tourism sector, civil society, and local communities in order to co-produce strategies and action plans that balance environmental protection, socio-cultural integrity, and economic viability [4,5].

The combination of sustainable agriculture and tourism in protected natural areas can become a tool for biodiversity conservation and local development [6,7], triggering

collaborative processes that lead to greater community involvement and a strengthening local identity [8]. In this regard, the Charter framework explicitly recognises sustainable rural agriculture as both a cultural asset and a cornerstone for diversifying tourism products, stabilising rural populations, and conserving landscapes. Other experiences in Italy show the interaction between tourism and agriculture in the ECST context, as in the cases of the Colli Euganei Regional Park and the Tuscan Archipelago National Park. In the first case, the ECST is a useful operational tool for the agricultural and tourism sectors, with agriculture becoming a central element in the park, which sees the Charter as a valuable platform for promoting tourism [9]. In the second case, on the other hand, agriculture plays a more identity and heritage-based role, providing a backdrop for the tourist products of the Tuscan islands, while the ECST Forum acts as a meeting place for stakeholders, creating governance networks [10]. Although in peri-urban Mediterranean protected areas such as Vesuvius National Park, where high visitor numbers meet fragile ecosystems and complex socio-economic conditions, the real test lies in adaptive, inclusive management that can channel tourism demand into regenerative pathways.

Within this framework, the Vesuvius National Park, Italy, represents a compelling and complex case study, since agriculture–tourism integration has been reinforced through cross-sector initiatives that valorise local foodways, develop agrotourism circuits, and position agrifood producers as key actors in delivering sustainability outcomes. Literature from comparable ECST-certified areas confirms that participatory governance and cross-sector linkages are critical to overcoming barriers like institutional fragmentation, uneven private-sector engagement, and insufficient long-term monitoring [11,12].

Despite the growing attention to sustainable tourism governance in protected areas, limited research has analysed how the ECST framework operates in highly anthropised Mediterranean contexts where agriculture, tourism, and urban pressures coexist. This study addresses this gap by examining how agriculture functions not only as an economic activity but also as a governance lever within the ECST framework. In doing so, it contributes to the literature on sustainable rural development and agritourism by linking protected area management with community-based agricultural practices.

2. Materials and Methods

2.1. Study Site

Established in 1995, the Vesuvius National Park covers approximately 8500 hectares encompassing not only the slopes of one of the most known active volcanoes in the world, Mount Vesuvius, but also the older Mount Somma caldera, hosting rich biodiversity and endemic species adapted to volcanic environments. The park is a legally designated natural protected area but also a UNESCO Man and the Biosphere (MAB) Reserve, recognised as a model territory where biodiversity conservation is integrated with the sustainable use of resources, and it is also part of the EU Natura 2000 Network, which safeguards habitats and species of European interest through rigorous conservation measures [13]. Its landscapes combine Mediterranean forests, volcanic slopes, archaeological sites, and traditional rural settlements, interwoven with the metropolitan periphery of Naples. This juxtaposition generates both opportunities and tensions: the park embodies what may be considered a “threshold territory,” economically peripheral yet symbolically central, facing simultaneous pressures from mass tourism, urban sprawl, environmental risks, and the need for rural regeneration.

The area’s agricultural heritage is a core component of its cultural identity and economic resilience and independence, since the time of the Romans [14]. Volcanic soils and centuries-old practices yield products of exceptional quality, many certified with Protected Designation of Origin (DOP) or Controlled Designation of Origin (DOC) labels. These

include *Lacryma Christi* and other Vesuvio DOC wines safeguarded by the *Consorzio Tutela Vini Vesuvio* DOP (Pomigliano, Italy); the *Pomodorigino del Piennolo del Vesuvio* DOP (Vesuvius Cherry Tomatoes), protected by its dedicated Consortium (Sant'Anastasia, Italy); and the *Albicocca del Vesuvio* (Vesuvius Apricot), a Slow Food Presidium (that operates in several municipalities in the Vesuvius area) encompassing numerous native cultivars. Other emblematic crops include the *Pisello Centogiorni* (Centogiorni Peas), cherries, figs, pears, walnuts, hazelnuts, and the renowned *San Marzano* tomatoes. Such produce is not merely of gastronomic interest but functions as a keystone for place-based tourism experiences, linking local farms, gastronomy, and cultural events to broader narratives of identity, landscape conservation, and sustainable livelihoods [15]. To further safeguard this heritage, the Vesuvius National Park Authority has recognized the need to establish its own Environmental Sustainability Label, which local agricultural enterprises may join on a voluntary basis. This initiative is intended to further strengthen the connection and collaboration between the park's administration and local producers, thereby protecting the territory's image, production processes, and agricultural traditions, that are all part of the tangible and intangible heritage of the area.

The park also hosts an exceptional network of rural sites that embody local history: the medieval *Borgo of Casamale* in Somma Vesuviana, historic farmsteads such as *Masseria Casa Bianca* in Boscotrecase, *Villa Regina* in Boscoreale with its Roman-era winemaking facilities, the *Museo della Civiltà Contadina* in Somma Vesuviana, and the Vesuvian *Miglio d'Oro* villas. Together with archaeological sites like Herculaneum and Boscoreale and an 11-trail network totalling 54 km and ranging from the high-demand *Gran Cono* crater path to agricultural itineraries like *Vallone della Profica Paliata*, these elements form a multi-layered tourism offering that spans natural, cultural, and experiential domains through the agricultural heritage of the area.

2.2. Research Design

The study followed a qualitative and exploratory design. Semi-structured interviews were selected as the main tool of investigation because they offered the flexibility to explore participants' experiences and subjective interpretations while still maintaining comparability across cases. The overall objective was to map how key stakeholders perceived the role of agriculture in sustainable tourism development in the park, with a focus on identifying opportunities, strengths, weaknesses, and risks connected to agricultural activities. In adopting this design, the study sought not only to describe the current dynamics but also to contribute to cumulative knowledge by using methods that can be replicated and compared across different contexts.

2.3. Recruitment of Participants

Participant recruitment followed a purposive sampling strategy complemented by a limited snowball technique. Initially, key informants were intentionally selected based on their direct involvement in agriculture–tourism governance within the park authority, producer consortia, and civil-society organisations. Access to this wide range of stakeholders was facilitated by the Forum, the participatory body established under the ECST framework, which provided a valuable entry point to networks of accredited participants. The purposive logic allowed for the inclusion of individuals holding diverse institutional roles and knowledge domains, thereby ensuring theoretical representativeness rather than statistical generalisability [16,17]. Subsequently, a controlled snowball process was employed to identify additional actors through the professional and organisational networks of initial respondents. This combined approach is consistent with qualitative research conducted in

complex governance contexts, where relational linkages are crucial for accessing relevant expertise while maintaining diversity and information power [18].

Beyond their institutional affiliation, participants represented different degrees of experience and involvement. Farmers were selected from small to medium-scale holdings and included individuals with multigenerational family farms as well as entrepreneurs engaged in organic and niche production. Representatives of producer consortia brought in-depth knowledge of product certification processes and territorial branding. Cultural operators included museum directors and festival organizers with long-standing involvement in heritage valorisation. Civil society actors and NGOs contributed perspectives grounded in advocacy and community mobilisation, while representatives of the park authority and local administrations offered insights into governance and planning. This heterogeneity ensured that the sample captured not only organisational roles but also varied professional trajectories, knowledge domains, and levels of direct interaction with agricultural and tourism practices.

To ensure the adequacy of the sample, the recruitment process was guided by the principle of theoretical saturation [19,20]. After the eleventh interview, no new themes or conceptual categories emerged, and subsequent interviews served primarily to refine and validate existing ones. The final number of 14 participants was therefore deemed sufficient to reach saturation, given the high degree of expertise and heterogeneity among respondents (Table 1). This aligns with the methodological literature suggesting that saturation is typically reached between 12 and 20 interviews in qualitative research of this scope, especially when participants are highly knowledgeable and strategically positioned within the field under study [21].

Table 1. Profile of interviewed stakeholders.

Number	Institution	Role	Age Group	Gender
1	Farm	Farmer	41–50	M
2	Social Media Agency	CEO	41–50	M
3	Local Wine Consortium	President	51–60	F
4	Non-Profit Organization	President	31–40	F
5	Non-Profit Organization	President	51–60	M
6	Local Food Consortium	President	61–70	F
7	Museum	Director	61–70	M
8	Sustainable Agriculture Consulting Agency	Coordinator	51–60	M
9	Sport Association	Founder	61–70	M
10	Association of Local Hoteliers	President	51–60	F
11	Local Festival	Founder	61–70	M
12	Non-Profit Organization	Representative	61–70	M
13	Farm	Farmer	41–50	M
14	National Park	Government Official	51–60	F

Source: authors' elaboration.

A balance was intentionally maintained between different actor groups—farmers, consortia leaders, cultural and tourism operators, representatives of NGOs and civil society, and public officials—so that each major governance dimension of the ECST framework was included. This distribution allowed the research to capture the full spectrum of per-

spectives across production, institutional, and community levels, enhancing both depth and interpretative validity without compromising analytical coherence.

2.4. Data Collection

Data collection took place in April 2025 and combined face-to-face and online interviews, depending on participants' availability and preferences. Conducting the interviews in spring was a deliberate methodological choice. April represents a transitional period in the Vesuvius National Park: while not yet characterised by the mass tourism flows typical of the summer and early autumn months, it is already a time when local actors are engaged in preparing activities and strategies for the upcoming high season. This timing facilitated access to participants who were less constrained by peak-season workloads, while also allowing the research to capture expectations, perceived challenges, and anticipated opportunities at the outset of the tourist cycle. In this way, the dataset reflects both retrospective assessments of past seasons and prospective orientations for the forthcoming ones, situating stakeholder perspectives within the seasonal dynamics of tourism in the park.

Each conversation lasted between 30 and 50 min, allowing sufficient time to address the main themes while also giving space for spontaneous reflections. An interview guide was developed to provide a common structure across interviews. It began with questions about the participant's professional role and involvement in the park's governance, then moved to sustainable tourism. A third section explored strengths, opportunities, weaknesses, and risks of agriculture–tourism integration, and a final part encouraged participants to propose recommendations for future strategies within the ECST framework. While the guide ensured that all interviews addressed comparable topics, the semi-structured format also gave the interviewer the flexibility to probe further or adapt questions to the specific expertise of the participant. This balance of structure and openness was particularly useful for capturing both expected and unexpected insights [22].

All interviews were audio-recorded with explicit consent from participants and later transcribed verbatim in Italian. Translations into English were produced for the purpose of analysis and publication, with particular care taken to preserve the nuances of meaning. Field notes were also taken during and immediately after each interview to record contextual observations such as non-verbal cues, emotional tone, and situational elements that might help interpret the data.

2.5. Data Analysis

The interview transcripts were analysed using a thematic approach. The process began with repeated readings of the material, which allowed the researchers to become deeply familiar with the content. This immersion stage was followed by systematic coding of significant passages. Coding was carried out inductively, with NVivo software (version 14) used to organise and retrieve segments of text.

To ensure interpretive validity, the analytical process followed a constant comparison logic in which emerging codes were repeatedly checked against the raw data and against each other. Two researchers independently reviewed a subset of transcripts and discussed discrepancies until consensus was reached, ensuring intersubjective agreement. In addition, an audit trail was maintained throughout the process, documenting coding decisions and the evolution of categories.

The transformation of codes into themes occurred through iterative clustering: conceptually related codes were grouped into higher-order categories, which were then refined through team discussions and visual mapping in NVivo. This process allowed the researchers to identify five overarching themes (1. centrality of agriculture in the park's socio-economic system; 2. agriculture as cultural heritage and economic resource; 3. civil

society and community networks; 4. the crater-only experience; 5. governance and local management) that captured both the breadth and depth of stakeholder perspectives, while maintaining a close link between empirical evidence and theoretical interpretation.

2.6. Ethical Considerations

The study received formal approval from the Institutional Review Board of the Osservatorio Universitario sul Turismo (ethical approval code: A052025) of the University of Naples Federico II. All participants were provided with an information sheet detailing the objectives of the research, the voluntary nature of participation, and the measures adopted to safeguard confidentiality. Written informed consent was obtained before the start of each interview.

To protect anonymity, personal identifiers were systematically removed from transcripts and replaced with pseudonyms. In addition to pseudonymisation, further precautions were applied to ensure that individual participants could not be re-identified. Direct references to names, institutions, or other unique attributes were substituted with generic descriptors, and potentially revealing contextual details were generalised when necessary. The correspondence between pseudonyms and real identities was stored separately on encrypted and password-protected files accessible only to the research team, making the anonymisation process effectively irreversible.

Data files, including audio recordings and transcripts, were archived on secure, password-protected devices, and will be retained exclusively for research purposes. These procedures complied with the requirements of the General Data Protection Regulation (GDPR), which also granted participants the right to withdraw their data at any point before analysis. The ethical protocol therefore ensured that the study respected participants' autonomy, privacy, and rights throughout the entire research process, while aligning with international standards for the responsible management of qualitative research data.

2.7. Limitations of the Study

Although the chosen methodology allowed for rich and nuanced insights, certain limitations must be acknowledged. Semi-structured interviews, by their very nature, do not provide statistically generalisable findings. The use of a combined purposive–snowball strategy may also have introduced a bias toward more visible or institutionally connected stakeholders, leaving more marginal voices under-represented. In addition, the translation of transcripts from Italian to English could have entailed minor shifts in meaning, despite the careful cross-checking conducted by the research team.

A further limitation concerns the timing of data collection. All interviews were conducted in April 2025, a period that precedes the high tourist season in the Vesuvius National Park. While this facilitated access to participants and enabled the capture of expectations and strategic planning for the upcoming season, it may also have introduced a temporal bias. Interviews conducted in a pre-seasonal context are more likely to reflect anticipatory perspectives rather than the operational realities experienced during peak months. Consequently, dynamics such as visitor management challenges, income variability, or environmental pressures may have been underrepresented or interpreted through a prospective lens.

Future research could address this limitation by adopting a longitudinal design that combines data collection before, during, and after the tourist season. Such an approach would allow for the observation of how stakeholder perceptions evolve over time and reveal cyclical patterns influencing the agriculture–tourism relationship in protected areas.

Overall, the present findings should therefore be viewed as a pre-seasonal snapshot, providing valuable but temporally situated insights into the park's socio-ecological dynamics.

3. Results

The results emerging from the thematic analysis are organised into five interconnected themes that collectively represent the socio-ecological dynamics of the Vesuvius National Park.

Table 2 summarises the hierarchy and interconnections among the main themes, illustrating how agriculture functions as the central axis linking tourism development, community engagement, and governance processes within the ECST framework.

Table 2. Conceptual relationships between identified themes.

Main Theme	Description	Interconnections
1. Agriculture as the Backbone	Agriculture acts as the structural and symbolic foundation of the park's economy, culture, and landscape.	Serves as the central node connecting tourism, community networks, and governance decisions.
2. Cultural Heritage and Biodiversity	Traditional practices and native crops represent both identity and ecological assets.	Strengthens tourism attractiveness through authenticity; informs conservation policies.
3. Economic Valorisation and Tourism Diversification	Integration of agricultural production into tourism circuits creates new income sources and experiences.	Relies on governance coordination and community participation for sustainability.
4. Civil Society and Community Networks	NGOs and associations promote sustainable consumption, environmental education, and food heritage.	Act as mediators between producers, visitors, and institutional actors.
5. Governance and Local Management	The ECST Forum fosters multi-stakeholder collaboration and adaptive management.	Provides the institutional framework that connects and stabilises all other themes.

Source: authors' elaboration.

3.1. Centrality of Agriculture in the Park's Socio-Economic System

The analysis revealed a strong consensus around the idea that agriculture is not a peripheral activity within the park's socio-economic system, but rather the structural backbone upon which sustainable tourism strategies could be built, and around which the governance framework of ECST holds the greatest potential to deliver long-term benefits. This centrality emerged consistently across all sectors, whether farmers, hospitality operators, cultural institution managers, environmental NGOs, or producer consortia, and was strongly linked to both tangible and intangible heritage values.

Interviewees frequently referred to iconic Vesuvian products—such as *Lacryma Christi* wines, the *Pomodoro del Piennolo*, or the apricot varieties safeguarded by Slow Food Presidia—not only as goods of exceptional quality but also as emblems of local identity and living symbols of resilience. These products, embedded in the volcanic terroir, were described as “ambassadors” of the territory, capable of attracting visitors, sustaining rural employment, and strengthening the park's reputation beyond national borders.

Several participants also emphasised the socio-economic dimension of agriculture, noting that it represents one of the few sectors able to anchor populations to rural areas and counter processes of outmigration and urban sprawl. Far from being a residual practice, farming was portrayed as a form of active land stewardship, indispensable to maintaining the mosaic of landscapes that visitors associate with the Vesuvian cultural identity. In this sense, stakeholders insisted that agriculture should be seen as a strategic ally of conservation and tourism development, rather than as a potential competitor for land use.

This perception situates farming at the core of territorial branding strategies, where agricultural landscapes and products are leveraged not only for their economic contribution but also for their symbolic and experiential value. Without actively managed rural areas, many respondents argued, sustainable tourism in the park would remain incomplete and unbalanced, unable to differentiate itself from standardised urban tourism in the metropolitan area of Naples.

3.2. Agriculture as Cultural Heritage and Economic Resource

The findings highlight that agriculture in the Vesuvius National Park represents both a repository of cultural and ecological heritage and a vital economic resource. Stakeholders consistently described local farming practices as expressions of identity and continuity, deeply rooted in the volcanic landscape. The protection of native species and the persistence of traditional cultivation methods are seen not merely as productive activities but as acts of cultural preservation and intangible heritage conservation. As noted by a grower of Vesuvian apricots (Interview n. 13), the 23 autochthonous varieties once emblematic of Campania's agricultural excellence are increasingly threatened by rising temperatures and recurrent fires, while commercial chains tend to favour uniform, standardized imported products. He affirmed:

“Engaging with a global economy is a real challenge for farmers coming from rural areas like those of the Vesuvius National Park. Beyond the material and logistical difficulties, climate-related problems such as climate change and its effects make it increasingly hard to farm locally. The crop varieties produced here are of national importance, yet many of these small farms are hard to reach. Still, they strive to revitalize a territory that has often been neglected over the years. What we see is also a cultural crisis, caused by the depopulation of rural areas. Small-scale organic farming is struggling to survive. There is an immense heritage here, but managing it is extremely difficult, even at the political level.”

This statement encapsulates a wider sentiment among respondents: agriculture acts as a living archive of knowledge and practices that sustain biodiversity and maintain the distinctive cultural landscape of the volcano's slopes. The ongoing process to obtain Protected Geographical Indication (PGI) status for Vesuvian apricots was frequently cited as an example of how heritage conservation and economic valorisation can converge. The same farmer added:

“Applying for and obtaining the PGI certification for apricots, as well as for other local products, is essential to protect local varieties while preserving the values of our territory.”

Building on this interdependence between identity and productivity, interviewees also described agriculture as a key driver of economic diversification and tourism attractiveness. Integrating agricultural activities into tourism circuits was seen as a way to ensure the viability of small-scale farms while offering visitors meaningful experiences linked to the park's ecological and cultural narratives. Producers engaged in beekeeping, viticulture, and organic cultivation framed their work as part of a sustainable economy that combines environmental care with market opportunities. As one farmer and beekeeper explained (Interview n. 1):

“Apiculture contributes to sustainable land use while producing local honey varieties appreciated in both domestic and tourism markets.”

Similarly, the President of a local wine consortium (Interview n. 3) highlighted how collective initiatives strengthen the bond between agricultural production, community identity, and tourism promotion:

“The activities we promote are the result of a collective effort of active listening and participation, with the aim of connecting producers and local communities while building a bridge between agricultural tradition and innovation that unites nature with culture. Through events dedicated to showcasing local wine production, we disseminate our products starting from the municipalities within the park and reaching major Italian destinations, to enhance and promote the local food and wine heritage.”

Such examples show how economic valorisation reinforces rather than dilutes cultural significance. Local products are not only market commodities but also “ambassador products” that embody the park’s identity, transforming farming into a form of experiential tourism and environmental stewardship.

In this sense, the economic and cultural dimensions of agriculture are inseparable. The preservation of biodiversity sustains product quality and authenticity, while tourism provides the visibility and income necessary to maintain small-scale production. Agriculture thus emerges as both a symbolic and material foundation for sustainable tourism: a system where cultivation, heritage, and hospitality coexist in a mutually reinforcing cycle.

3.3. Civil Society and Community Networks

The role of civil society initiatives and thematic networks emerged as another pillar of the agriculture-centred vision. One of the most widespread local environmental non-profit organisations was noted for its annual national festival dedicated to environmental culture and sustainability, as well as for campaigns promoting agricultural products from protected areas. Such activities aim to link producers with tourism promotion strategies, while at the same time reinforcing regional food heritage. The President of this organisation (Interview n. 4) emphasised:

“The initiatives are designed to highlight the territory and its unique products, while also creating a network between producers and consumers. The goal is to support local excellence, make it known throughout the country, and promote local agriculture.”

Beyond the activities of individual associations, many interviewees underlined how collective action by civil society helps to create a “territorial narrative” in which agriculture is presented as a common good rather than a private activity. Local NGOs, cultural associations, and volunteer groups were seen as critical in mobilising communities, ensuring intergenerational transmission of farming knowledge, and engaging residents and visitors in co-creating sustainable practices. Community gardens and social agriculture projects were repeatedly cited as examples of initiatives that not only preserve biodiversity but also strengthen social cohesion, educational opportunities, and inclusive participation for marginalised groups.

These initiatives resonate with the principles of the Environmental Quality Label promoted by the Vesuvius National Park, which requires commitment to environmental responsibility, efficient resource use, and the valorisation of local products as part of quality standards for tourism. Civil society thus plays a bridging role: on the one hand it supports producers in enhancing the value of their goods, and on the other hand it mediates between institutions and local communities, making participatory governance tangible.

Furthermore, several stakeholders highlighted the importance of informal networks that extend beyond the park’s boundaries, linking Vesuvian actors with broader regional or national movements for sustainable agriculture and food sovereignty. Such connections amplify visibility and create synergies that would be difficult to achieve through isolated initiatives. The capacity of civil society to combine advocacy, cultural promotion, and grassroots mobilisation therefore emerged as an essential driver for integrating agriculture and tourism in a way that is socially embedded, culturally meaningful, and environmentally responsible.

3.4. The “Crater-Only” Experience

The perspectives of hospitality and cultural operators confirmed both the opportunities and the challenges of integrating agriculture into the visitor economy. The President of a local hoteliers’ association stressed that while some visitors are receptive to rural itineraries, the dominant market segment remains focused on a “crater-only” experience. Visiting the Vesuvius crater alone in fact limits the enjoyment of the park to a restricted area, excluding the other trails that are representative of the peculiar characteristics of the territory. She explained (Interview n. 10):

“For years now, we have been organising tourist packages that include visits to agricultural trails to promote and enhance the territory. However, these are not always appreciated by tourists, who often want their visits to be limited only to the Vesuvio crater. This narrow focus causes them to miss the opportunity to truly discover the territory and its lesser-known sites.”

This testimony points to a misalignment between the existing tourism demand and the broader supply of cultural and agricultural experiences. Cultural institutions echoed similar concerns but also saw opportunities. The Director of a Museum (Interview n. 7) advocated for the creation of inter-museum networks that would connect archaeological sites with rural traditions and farming landscapes:

“A network of museums in the territory is an effective response to enhancing even the museums connected to farming traditions. Working together in a network means creating connections between different cultural sites and institutions, initiating a participatory process, and fostering partnerships to support the immense tangible and intangible heritage.”

Sport-tourism initiatives provided another example of diversification. A founder of a local sport association (Interview n. 9) described how trail-running competitions, ranging from 20 to 75 km, traverse agricultural and volcanic landscapes, allowing participants to engage physically with vineyards, orchards, and historic trails. These events create powerful narratives that contrast with massified, mono-site tourism and show the potential for agriculture-based routes to disperse visitor flows.

The persistence of a “crater-only” tourism model also reflects structural governance gaps, particularly in the provision of mobility infrastructures and the coordination of itineraries across municipalities. Stakeholders frequently linked these shortcomings to the absence of integrated policies capable of redistributing flows and ensuring that agricultural and cultural sites are adequately connected and promoted.

3.5. Governance and Local Management

From a governance perspective, the ECST Forum emerged as the institutional arena capable of reconciling the multiplicity of interests identified in the interviews. Stakeholders agreed that placing agriculture at the heart of tourism planning provides a cross-cutting lever that diversifies the economic base, stabilises rural populations, strengthens destination identity, and ensures that revenues remain embedded in the local economy. As stated by an interviewee (interview n. 14):

“The Vesuvius National Park has always faced two major challenges: upholding legality and ensuring environmental sustainability. Thanks to a strong network of local stakeholders who choose to collaborate, it is possible to address both—especially with the support of agricultural communities. The park cannot be a sanctuary of biodiversity as in other contexts, the nature of this territory demands a broader vision. Here, agriculture not only supports the preservation of the land, biodiversity, and ecosystems but also sustains local culture and traditions, also through tourism experiences.”

At the same time, respondents were candid about existing barriers. Public transport limitations restrict access to rural areas, while visitor flows continue to be overly concentrated around the crater, producing recurring overcapacity between April and October. Agriculture-based itineraries, rural heritage routes, and dispersed visitor circuits were consistently mentioned as strategies to alleviate pressure on the volcano summit and to distribute benefits more evenly. Yet, as several stakeholders noted, such strategies are only viable if agricultural landscapes are actively managed, valorised, and viewed as tourism assets. Some participants also highlighted that while the ECST Forum provides a valuable local platform, its effectiveness depends on the alignment with regional planning instruments and European sustainability frameworks. Without such vertical coordination, local initiatives risk remaining fragmented or symbolic.

4. Discussion

The findings of this study reinforce the idea that agriculture is not a peripheral economic activity within the Vesuvius National Park but a structural pillar of sustainable tourism and territorial governance. This resonates strongly with the broader literature on rural multifunctionality and ecosystem service provisioning in peri-urban protected areas [23–25]. By placing agriculture at the core of the park’s sustainable tourism strategies, stakeholders articulated a vision of farming that goes beyond its productive role, recognising it as a custodian of biodiversity, a transmitter of cultural traditions, a source of identity, and a differentiating factor for tourism in a fragile volcanic environment. Such a vision underscores how the park exemplifies the hybrid socio-ecological character of Mediterranean protected landscapes, where human activity and conservation are intertwined rather than opposed [26,27]. The effort to obtain PGI certification for Vesuvian apricots exemplifies how heritage conservation, economic value, and territorial branding can converge, strengthening resilience against homogenising market forces [28].

At the same time, the findings also expose several conflicts that are likely to recur in other Mediterranean and peri-urban protected areas. Stakeholders frequently mentioned spatial competition between agricultural land and tourism infrastructure, particularly in municipalities where urban expansion and visitor facilities exert pressure on limited rural spaces. Rising land prices, driven by tourism investment and real-estate speculation, were perceived as a direct threat to the continuity of small-scale farming. Moreover, climate-related risks—such as wildfires, drought, and soil degradation—were identified as critical stressors that simultaneously affect agricultural viability and tourism safety. These tensions suggest that the coexistence of agriculture and tourism cannot be taken for granted but must be continuously negotiated through adaptive spatial planning, transparent land-use regulation, and participatory monitoring mechanisms.

The valorisation of agricultural landscapes as “living archives” supports the idea that protected areas are not static natural reserves but dynamic socio-ecological systems where conservation is achieved through active human stewardship. In this context, farmers in the Vesuvius Park emerge as strategic partners in conservation and tourism governance, able to transform traditional practices into experiential and educational tourism products which diversify and decentralise the offering in a context monopolised by cultural tourism linked to the two archaeological parks in the area (Herculaneum and Pompeii) and visits to the *Gran Cono*, the summit area of the volcano, which has been heavily touristified over the last decade [29].

The results also highlight the role of sustainable tourism in enabling small-scale agriculture to resist structural pressures. Farmers stressed that climate change, market globalisation, and demographic decline undermine the viability of traditional agriculture, yet tourism provides an alternative channel to maintain livelihoods, reinforcing the value of

tourism as an alternative food network through activities such as visits to production sites and direct sales [30]. This finding is in line with studies on the economic and ecological benefits of multifunctional farming systems [31,32]. In particular, the alignment between niche agricultural activities and experiential tourism was evident in examples such as apiculture, where beekeeping simultaneously sustains biodiversity and provides marketable products for tourism. Similarly, viticulture, supported by promotional fairs and events, transforms Vesuvian wines into “ambassador products” that embody both agricultural prestige and territorial identity. This integration describes the dual role of agriculture in resisting the homogenisation of global food systems while anchoring economic benefits locally [33,34]. By connecting agricultural products to visitor experiences, the park leverages agriculture not only as a sector under threat but as a cross-sectoral resource capable of generating resilience and reinforcing place branding.

Civil society initiatives emerged in the findings as essential actors in operationalising the values of the ECST. Organisations such as environmental NGOs and local groups carry out programmes that promote food heritage, biodiversity, and sustainable farming. These activities exemplify how ECST principles are translated into practice through campaigns, festivals, and educational projects, which reinforce the Environmental Quality Label as a mechanism to codify eco-responsible practices [35].

According to data, while some visitors are receptive to rural itineraries that link vineyards, orchards, and cultural sites, as mentioned above, the majority remain focused on a “crater-only” experience. This pattern risks degrading over-visited areas while leaving broader cultural landscapes underexplored [36–38]. Accordingly, it is important to design integrated tourism products capable of shifting demand beyond the crater. The proposal for inter-museum networks that link archaeological heritage with agricultural traditions illustrates how tourism products can be diversified to include both tangible and intangible heritage [39]. Similarly, sport–tourism events such as trail-running competitions show how visitor flows can be channelled through agricultural zones, offering immersive experiences that combine physical endurance with cultural discovery [40,41].

It is important to note that findings also reveal several tensions and divergences that warrant critical reflection. Most previous ECST-related studies emphasise rural remoteness and ecological preservation as key assets for sustainable development [42–44], whereas the Vesuvius case illustrates how high anthropisation, urban pressure, and environmental risks require adaptive governance models that the current ECST guidelines only partially address. Moreover, the data suggest that agriculture in peri-urban protected areas operates not merely as a cultural or economic function, but as an interface sector that mediates between conservation, tourism, and local identity. This hybrid role challenges traditional dichotomies between “production” and “protection” often found in the literature on rural development [45]. In addition, while participatory governance is typically portrayed as a stabilising factor [46], local stakeholders indicated that civic participation can also be uneven and fragile, depending on institutional continuity and the availability of incentives. Accordingly, the Vesuvian experience underscores the need for a more context-sensitive and adaptive ECST framework that explicitly accounts for peri-urban complexity, infrastructural constraints, and socio-ecological volatility. In this sense, the ECST Forum was consistently identified as the institutional platform capable of integrating agricultural stakeholders into sustainable tourism strategies, stressing the importance of participatory governance in enabling adaptive co-management. The Forum’s collaborative design allows heterogeneous actors—from farmers to NGOs, from municipal officials to consortia leaders—to share resources, resolve conflicts, and build consensus on strategic priorities. By embedding agriculture within governance frameworks, the Forum enhances resilience through stabilising rural populations, embedding economic benefits locally, and reinforcing

authentic destination identity. Yet, operational challenges remain. In particular, infrastructural deficits—especially in public transport—hinder the dispersion of visitor flows to rural areas. Furthermore, the risk of bureaucratisation may weaken stakeholder engagement if participatory processes become symbolic rather than substantive. The findings on seasonality and flow concentration also underline that the integration of agriculture into tourism cannot be reduced to isolated projects but requires structured policy interventions across scales. Transport accessibility, marketing strategies, and certification systems emerge from the data not only as operational needs but as governance challenges demanding coordinated action [29,47].

Beyond confirming the relevance of the ECST as a governance tool, the interviews also revealed several original insights that could inform the future evolution of the Charter framework. First, stakeholders consistently viewed agriculture not as a sectoral component but as a cross-cutting governance lever that strengthens local identity, biodiversity management, and economic diversification. This suggests the need to recognise agri-food systems more explicitly within ECST strategic guidelines, particularly for Mediterranean protected areas where rural and urban dynamics intersect. Second, the study highlights the value of informal civic and producer networks as complementary to the formal ECST Forum. Their ability to sustain participation beyond project cycles shows how bottom-up engagement can enhance the resilience and legitimacy of Charter processes. Third, participants emphasised the importance of context-sensitive application of ECST principles, arguing that peri-urban parks require more flexible mobility and visitor-management models than those envisaged in rural or alpine contexts. These contributions, grounded in empirical stakeholder evidence, extend the practical validity of the ECST by aligning its governance approach with emerging socio-ecological challenges in complex protected landscapes.

Beyond these local challenges, the results have broader implications for other Mediterranean and peri-urban protected areas where ecological fragility and social complexity intersect. The Vesuvian experience shows that integrating agriculture into sustainable tourism strategies can strengthen resilience, but only when governance frameworks explicitly recognise hybrid socio-ecological systems rather than idealised rural models. Lessons from this case may thus inform the implementation of the ECST in similar contexts by emphasising the importance of flexible planning tools, cross-sector coordination, and climate-adaptive management. In this regard, the park serves as a laboratory for reinterpreting the ECST principles under conditions of high urban pressure and environmental vulnerability, offering transferable insights for other territories seeking to balance conservation, production, and tourism development.

5. Conclusions

This study contributes to the theoretical conceptualisation of sustainable tourism governance by showing that agriculture can function as a cross-cutting driver of resilience in peri-urban protected areas. It expands the literature on the ECST by highlighting the hybrid socio-ecological nature of Mediterranean landscapes, where conservation and production coexist rather than compete. The Vesuvius National Park exemplifies how the inclusion of agriculture within ECST governance models transforms it from a sectoral activity into a mechanism for place-making, biodiversity stewardship, and socio-cultural continuity. By emphasising these interconnections, the research reframes the ECST not only as a certification system but as a dynamic platform for integrating ecological, cultural, and economic objectives in complex territorial contexts.

Nevertheless, operational challenges persist. Visitor flows are highly concentrated around the crater, while infrastructural deficits, especially in public transport, limit access to rural itineraries.

Within this framework, policy implications emerge at multiple scales and should be addressed in terms of both urgency and responsibility. At the local level, the immediate priority lies in improving accessibility and visitor dispersion within the park. Investments in public transport and digital mobility solutions are essential, and their implementation should be coordinated by the park authority in partnership with municipalities and local transport agencies. At the same time, producer consortia and tourism operators must be actively involved to ensure that improved infrastructure translates into effective agricultural itineraries and diversified visitor experiences.

At the regional level, priority should be given to integrating the park's agricultural-tourism strategy into broader territorial development plans. This requires the Campania Region to mobilise resources for rural regeneration, support quality labelling and foster multi-actor governance platforms. Regional agencies can also play a key role in facilitating partnerships between agricultural networks and cultural institutions, thereby ensuring that tourism circuits include both tangible and intangible heritage.

At the European level, policy measures should focus on consolidating and scaling quality certification systems such as PGI and the Environmental Quality Label, aligning them with the EU's Farm to Fork strategy and rural development programmes [48]. The European Commission and the EUROPARC Federation can thus provide frameworks that reinforce local branding while embedding the park within transnational sustainability networks.

Overall, the policy challenge is not only operational but also strategic: it requires prioritising actions that strengthen participatory governance and secure long-term resilience. Without clear attribution of responsibilities across scales and actors, operational interventions risk remaining fragmented or symbolic rather than transformative.

Future action should therefore focus on strengthening networks between agricultural producers, tourism operators, civil society, and public authorities to enhance innovation and resilience. Encouraging young generations to engage in farming through training, incentives, and partnerships with schools and universities could also help counter demographic decline in the sector. Finally, climate adaptation measures, including wildfire risk management and the protection of crop diversity, must be prioritised to secure the ecological foundations upon which both agriculture and tourism depend.

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Article

Addressing Hunger and Poverty Eradication: Recursive Dynamic CGE Modelling Analysis Using South Africa as a Case

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Abstract

This study evaluates growth and income distribution targets needed to alleviate poverty and eradicate hunger, and assesses strategies to achieve these goals in rural areas in South Africa. Most development policy studies concentrate on growth, inequality, and poverty reduction, while explicit SDG-related applications receive less attention, especially in Africa. To fill this gap, we apply a framework that combines a recursive dynamic CGE model with a microeconomic simulation model in a top-down and bottom-up fashion. We explore two scenarios: a business-as-usual simulation and an agricultural growth simulation that tests investment, export enhancement, productivity improvements, and social assistance extension. The agriculture policy includes targeted social assistance. Halving poverty and eradicating extreme hunger requires 2.7% annual economic growth and 3.6% agricultural growth from 2018 to 2030. In the business-as-usual scenario, poverty is expected to rise from 55.2% in 2015 to 56.1% by 2030, with 24% still below the food poverty line. The agricultural growth scenario can advance hunger and poverty goals if individual consumption increases by 2.6% annually. Achieving SDG targets for hunger and poverty demands interventions beyond agricultural policy. South Africa can achieve its hunger and poverty SDG goals through a combination of agricultural investments, social assistance, and labour policies.

Keywords: CGE models; microsimulation; labour markets; policy simulation; sustainable development goals; rural development; income inequality; hunger; poverty; South Africa

1. Introduction

Economic development has traditionally been associated with structural transformation. Agriculture has played a pivotal role in this discourse, with the progression from agriculture to manufacturing and services constituting a persistent theme. This has incited a continuous debate regarding the prioritisation of sources of economic growth for developmental purposes: some argue for accelerating the industrialisation process [1–3], while others advocate for agriculture-led growth, citing its strong linkages to poverty alleviation [4,5]. The experience of the Green Revolution offered an alternative perspective, suggesting that modern science and technology could enable agriculture to function as a dynamic engine of growth and development. Nevertheless, the optimism surrounding the sector's potential was mitigated by the suboptimal performance of numerous agricultural development initiatives, particularly in sub-Saharan Africa, alongside the transition to export-oriented manufacturing growth in the economies of East Asian nations [6]. More recently, the Sustainable Development Goals of the United Nations (SDGs or Global Goals)

have shifted the focus from the growth–agricultural productivity nexus to reforming the agricultural sector with the objective of enhancing job creation and food (as well as nutritional security), thus reducing high levels of poverty in developing countries. More specifically, as shown in Box 1, the first two SDGs specifically target to reduce poverty and eradicate hunger.

Box 1. Goals 1 and 2 of the SDGs.

SUSTAINABLE DEVELOPMENT GOALS 1 and 2

GOAL 1.1 TARGETS

“By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions.”

GOAL 2.1 TARGETS

“By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round.”

<http://www.undp.org/content/undp/en/home/sustainable-development-goals.html> (accessed on 15 May 2025)

This approach is based on the assumption that agricultural activities are the main source of income and economic livelihoods for the majority of poor people in developing countries. Thus, strategies to achieve “pro-poor” or “shared growth” would be more effective if policies and investments targeted growing labour-intensive sectors such as agriculture, where the poor are active participants and important stakeholders. Agriculture is fundamentally related to various sectors, with extensive research supporting its crucial role in enhancing yields, driving economic expansion, creating employment, and mitigating poverty [5–8]. Although most of these development policy studies focus on growth, inequality, and poverty reduction, applications that are explicit to SDG targets receive much less attention, particularly in Africa.

Within the general equilibrium tradition, computable general equilibrium (CGE) models have emerged as a useful and viable way to study changes related to the attainment of the SDGs, utilizing data from national accounts to depict economic flows. Lofgren and Diaz-Bonilla [9] extended a CGE model to connect income, labour, and education, asserting that more public investment is needed to meet Ethiopia’s Millennium Development Goals (MDGs), while Maisonnave et al. [10] used a CGE model to show the complexities of trade-offs between attaining MDG goals and their financing in South Africa. The World Bank’s MAMS model, made for MDG policy studies by 2015, includes several applications to the SDGs in the developing world [11]. Other uses of CGE models for SDG matters in Africa include studies by Balma et al. [12] for Burkina Faso, Fofana et al. [13] for South Africa, and Karim et al. [14] and Aarich et al. [15] focussing on Morocco, as well as analyses by Roson [16] and Yeshineh and Woldeyes [17] concentrating on Ethiopia. Although these studies have provided a coherent and systematic integration of macro-micro-pathways to help align with the objectives of the SDGs, less attention has been given to evaluating the targets for growth and income (or expenditure) distribution required for attaining the SDGs.

This study aims to address these gaps and has two main goals: first, to assess the growth and income (or spending) distribution targets that are required to achieve the goals to alleviate poverty and eradicate hunger, and second, to pinpoint and evaluate strategies that facilitate the achievement of poverty reduction and hunger elimination targets in rural regions. The latter is through agriculture interventions, since agriculture is a major activity in rural areas (South Africa lacks an official definition of rural areas; most government departments, including Statistics South Africa, define rural areas as “the sparsely populated

areas in which people farm or depend on natural resources, including the villages and small towns that are dispersed through these areas. In addition, they include the large settlements in the former homelands, created by the apartheid removals, which depend for their survival on migratory labour and remittances.” (Rural Development Framework of 1997). This is the definition used in the rest of this study. By rural development, we shall take it to mean economic growth that reduces poverty and eliminates hunger in those rural areas.). The study develops and applies a dynamic macro-micro modelling framework that combines a recursive dynamic CGE model with a microeconomic simulation model in a top-down and bottom-up fashion. The economic modelling methodology helps to define and quantify the milestones to be reached to achieve the SDGs. Furthermore, the analysis contributes to the identification and selection of priority areas for public and private investments to achieve the SDGs and targets.

The macro-micro modelling is applied to a case study of South Africa, which is an interesting case test to focus, on for several reasons. Along with the other 193 Member States of the United Nations, South Africa has committed to meet the SDGs by tackling significant issues such as poverty, inequality, and unemployment. Despite being an upper middle-income country, South Africa has the world’s highest income inequality and high poverty rates, particularly affecting rural areas. Stagnant economic growth over the past two decades, increasing public debt, energy crises, and global disruptions, such as climate change [18], the COVID-19 pandemic [19], and conflicts in Ukraine and Russia [20] have exacerbated poverty, inequality, and unemployment. Therefore, achieving “zero hunger” and eliminating poverty, which are key SDGs, will require reviving economic growth and transformative changes in the rural and agricultural sectors of South Africa. Indeed, South Africa’s 2030 National Development Plan Vision, the country’s blueprint for development, makes clear the importance of rural development. Additionally, this focus and commitment to rural development and agriculture has been recognised in the Medium Term Development Plan (2025–2030), which includes medium-term strategies to ensure food security and commitment to rural development. Although these initiatives and pronouncements are commendable, the specific impact of agriculture on economic development and the achievement of the SDGs is still underexplored. In particular, identifying policy actions that have the potential to advance progress requires an evidence-based approach. The models are used to perform ex ante assessments of the likely impacts of policy actions on South Africa’s key development goals over the period 2015–2030. Assessing the impacts of milestones and actions helps create policies to meet SDG goals of eradicating poverty and hunger. Although certain particulars of the model pertain directly to South Africa, the analysis is also applicable to other developing and middle-income nations (see, for example, [21], which applies a similar approach to ten African countries, while [22,23] use a similar approach with an agriculture-rural focus for Senegal.

The subsequent structure of the paper is as follows. Section 2 develops the methodology used to quantitatively assess the SDG milestones, and includes an overview of the South African economy based on the used household and macroeconomic data. Section 3 presents the scenarios and results, with an extended discussion of the results. Section 4 gives an extended discussion of the findings, putting into context and pointing to caveats and fruitful areas for future research. Section 5 concludes the paper and points out caveats and policy directions.

2. Methodology and Data

2.1. Conceptual Framework

Recent studies have developed frameworks to study SDGs, highlighting their connections and interdependencies (see [24,25] for reviews). Model types are key in forming

sustainable development policies. Input–output models describe national economies but are limited for long-term scenarios, due to their static nature [26,27]. Macro-econometric models, which have the advantage of being dynamic and which rely on extensive historical data, also have restricted utility for long-term analysis [28,29]. System dynamics models work well for scenario analysis, but pose challenges in setting boundaries and feedback loops [30,31]. Bottom-up optimization and simulation models, with their focused scope and detailed exploration of technologies and alternatives, are beneficial for sector-based planning; nevertheless, they typically lack feedback loops with other sectors in the broader economy [27,29]. Multi-agent models, though promising for sustainable development [32], are experimental and have few applications [33]. Hybrid and integrated assessment models combine different modelling approaches, addressing some shortcomings of the categories mentioned above and offering a more adaptable and customized approach [24,27,34], but they struggle to adequately address issues of poverty and inequality. Dynamic CGE models are advantageous for scenario analysis, utilising a consistent theoretical framework and sectoral feedbacks; however, their theoretical bases may hinder their suitability for modelling sustainable development transitions [35,36].

The approach used in this study involves using macro–micro economic simulation models to facilitate the identification and prioritization of effective and efficient policies and investment areas to reduce hunger and poverty, in line with the SDG Agenda. As the name implies, the models combine a macro (CGE) model and a micro (MS) model to address hunger and poverty development goals and targets. Figure 1 summarises in schematic fashion the economic modelling framework, which is in three main iterative yet consistent steps, discussed in the rest of this section, which include data collection and collation, modelling and analysis.

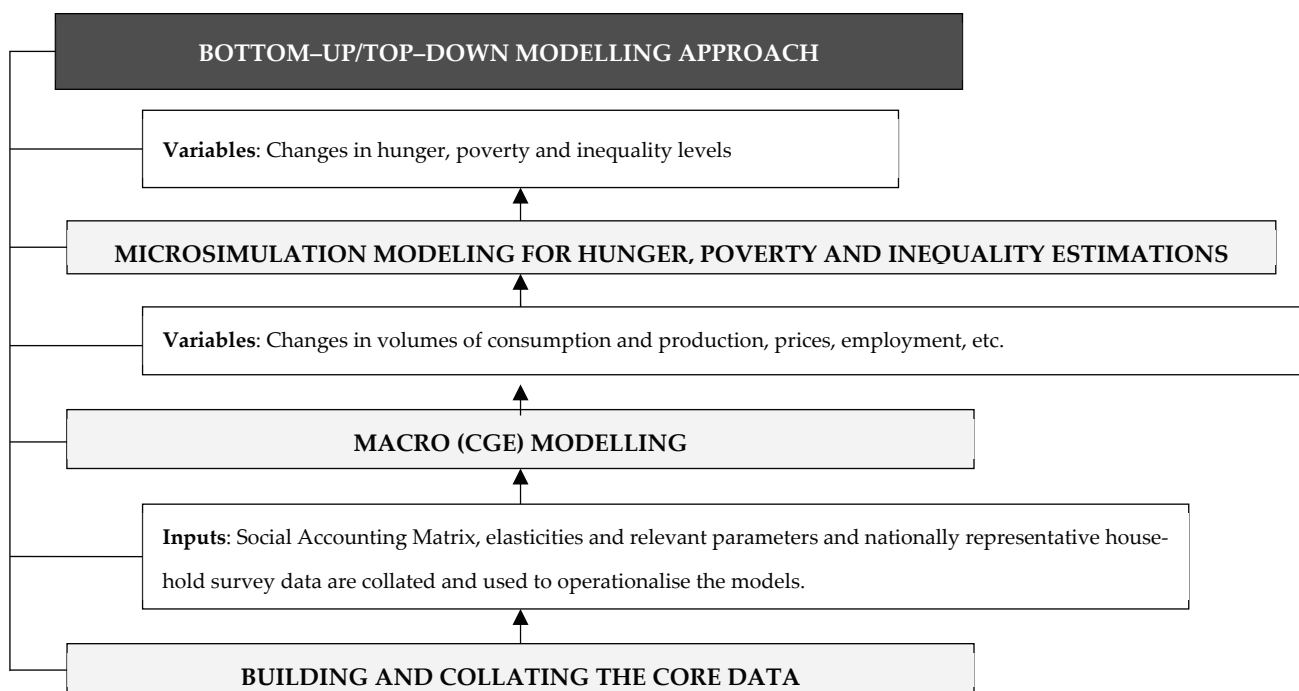


Figure 1. Economic Modelling Steps. Source: Authors’ compilations.

As shown in Figure 1, a layered micro–macro model for setting the priorities for hunger and poverty reduction is used. Starting with the data collection and its collation, the micro and macro models are interlinked in a top-down fashion. The micro model follows the specifications of [13] and builds on the non-parametric income distribution microsimulation modelling to assess the income (or expenditure) growth targets and their

distribution across the population, in order to achieve the nationwide poverty reduction SDG goals. At the same time, because the model distinguishes rural from urban areas, this assessment also contributes to the setting of rural poverty reduction goals. These income or expenditure growth targets are then imposed on the macro model to generate, in turn, the growth and investments targets for the entire economy, and the rural sectors specifically. In so doing, the macro model also contributes to setting productivity growth and external trade growth targets. A major advantage of the layered approach in this study is its ability to project economic development to 2030, and to accommodate a disaggregated production sector structure and multiple individuals at the micro level.

We outline the empirical approach in the rest of this section in three steps. We begin with an outline of the micro-economic simulation model and its analysis. This is followed by a discussion of the CGE model, before concluding with a brief discussion of the underlying data.

2.2. The Micro Model

The micromodel allows for the direct evaluation of poverty and inequality levels, with individual-level assessments grounded in microdata. Poverty levels are linked to income or consumption expenditure levels and their distribution throughout the population, as suggested by Ravallion [37,38]. Our study is innovative in employing a nonparametric microsimulation model to evaluate the target aggregate consumption expenditure (growth) and its distribution necessary to meet the SDG targets on poverty and hunger.

Microsimulation models can be distinguished by various characteristics. The key aspects include the incorporation of agents' behaviours, the time frame of their decision-making processes, and the inclusion of general equilibrium effects, as noted by Bourguignon and Spadaro [39] and Spadaro [40]. Two categories of such models can be distinguished—behavioural and accounting. Accounting approaches assess what are often referred to as 'morning-after effects' or the direct first-order effects of interventions [40]. On the other hand, behavioural models seek to uncover second-order effects of interventions, and often rely on mathematical modelling of underlying economic decision processes of individuals. The Lucas critique [41], which points out issues of structural dependence caused by selected parameters within structural modelling, is frequently regarded as a significant challenge. To mitigate these issues, reweighting techniques are recommended (see, for instance, Meagher [42], Devarajan and Go [43], Agénor et al. [44], Ferreira and Horridge [45], Buddelmeyer et al. [46], and Hérault [47]).

This paper uses an SDG micro-model with a non-parametric framework. The approach consists in adjusting the probability distribution of (per capita) income or expenditure consumption to create coherence and consistency with aggregate data. Changes in individual income or consumption expenditure are translated into changes in consumption behaviour occurring within the population through adjustments in the probability distribution of income or consumption expenditure, in response to a (macro) shock or change in aggregate data. Thus, individuals implicitly adjust their behaviour in response to a (macro) shock. The model minimizes the Kullback–Leibler cross-entropy measure of the distance between the posterior (w) and the prior (v) probability distributions of income or consumption expenditure (i), that is

$$\text{Min } \Omega = \sum_i w_i \cdot \ln \frac{w_i}{v_i} \quad (1)$$

with a specified posterior probability distribution of income or consumption expenditure

$$\sum_i w_i = 1 \quad (2)$$

which is consistent with the following aggregate data or attributes:

- Population growth and urbanization, where θ is the urbanization ratio, and u the rural population share ($u \subset i$):

$$\sum_u w_u = \theta \tag{3}$$

- Mean per capita consumption expenditure (Y_g) by group g , i.e., national and rural; $y_{i,g}$ individual (i) consumption expenditure

$$\bar{Y}_g = \sum_i w_i \cdot \bar{y}_{i,g} \tag{4}$$

- Poverty headcount ratio (P_z) by poverty line (z), i.e., national, food, and international; $p_{i,z}$ individual (i) poverty status according to the poverty line (z):

$$\bar{P}_z = \sum_i w_i \cdot \bar{p}_{i,z} \cdot i(\bar{y}_i < z) \tag{5}$$

The first-order condition derivatives μ , α , β and μ are Lagrangian parameters associated with constraints related to the posterior probability distribution, population growth and urbanisation, mean consumption expenditures, and poverty headcount ratios, respectively, as follows:

$$\log w_i - \log \bar{v}_i + 1 - \mu - \alpha - \beta_g \cdot \bar{y}_{i,g} - \mu_z \cdot \bar{p}_{i,z} = 0 \tag{6}$$

We make use of the of Foster–Greer–Thorbecke (FGT) [48] family of poverty measures. There are three measures, the Poverty Headcount Index (P_0), the Poverty Gap Index (P_1) and the Poverty Severity Index (P_2). (P_0) measures the proportion of the population that is poor. However, it does not say anything about the extent of poverty. (P_1) then shows the extent of poverty by measuring how far the poor are from the poverty line. In order to understand the inequality among the poor, the square of the poverty gap, (P_2), is used. The formulae are shown below:

$$P_0 = \frac{1}{N} \cdot \sum_{i=1}^N I(y_i < z) \tag{7}$$

$$P_1 = \frac{1}{N} \cdot \sum_{i=1}^N \frac{(z - y_i) \cdot I(y_i < z)}{z} \tag{8}$$

$$P_2 = \frac{1}{N} \cdot \sum_{i=1}^N \left[\frac{(z - y_i) \cdot I(y_i < z)}{z} \right]^2 \tag{9}$$

where N is total population, y_i is expenditure of individual i and z is the poverty line.

The poverty line (z) measures the minimum expenditure requirement to fulfil basic food and non-food needs. Although there is no international standard for measuring hunger, the standard approach is to compare the number of calories eaten by a person to the number of calories needed (i.e., 2100 calories per person per day). To construct the poverty line, it is necessary to specify a consumption package considered adequate for basic food and non-food consumption needs and then estimate the cost of that package. In general, a number of poverty lines are constructed. The extreme poverty line, also known as the food poverty line, measures the minimum amount of money needed to purchase a food package to meet basic food needs for a given country. The standard poverty line adds to the food poverty line, and includes the basic non-food items to measure the minimum amount of money to satisfy the basic food and non-food needs in a given country. Finally, the empirical strategy for the microsimulation applies the Kullback–Leibler minimum divergence cross-entropy (CE) method in two distinct phases. Initially, the sample weights assigned to households in the Income and Expenditure Survey [49] are converted into a prior probability distribution. Subsequently, the Kullback–Leibler minimum divergence cross-entropy (CE) is employed to derive a posterior probability distribution aligning

with household income, categorized by sources such as labour, capital, and transfers, as observed in the CGE model post-shock via the Bourguignon method [50]. This approach ensures that the distribution of consumption expenditures among the population aligns properly (Figure 2). Additionally, compliance with Engel’s law is essential, particularly regarding the increasing share of income spent on food, reflecting the income inequality prevalent in South Africa (Figure 3).

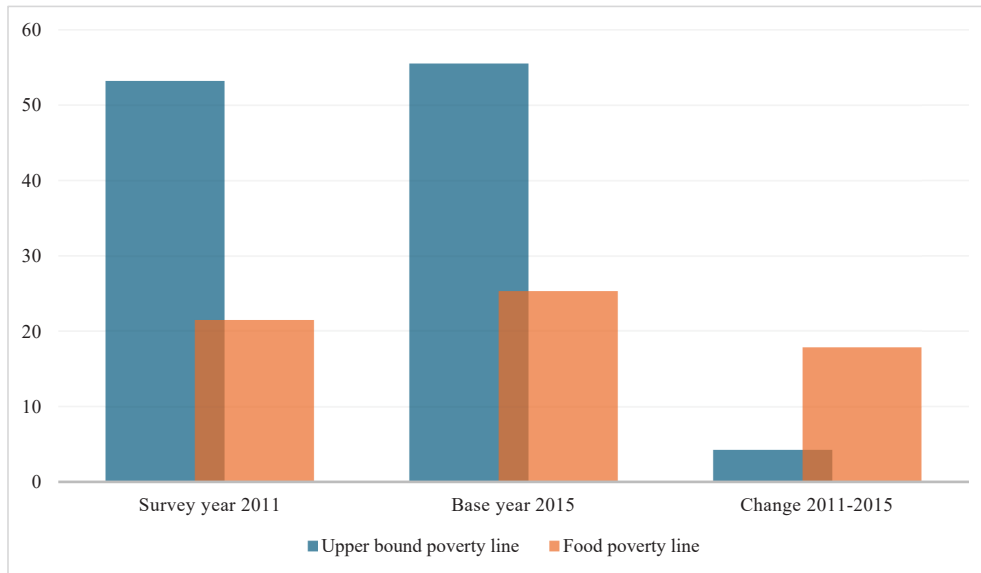


Figure 2. Hunger and Poverty Goals and Targets (%). Source: Computations by the authors using Statistics South Africa [51]. Note: in 2015, the poverty line for overall living expenses was set at ZAR 992, while the threshold for food-related poverty was at ZAR 441 per person, each month.

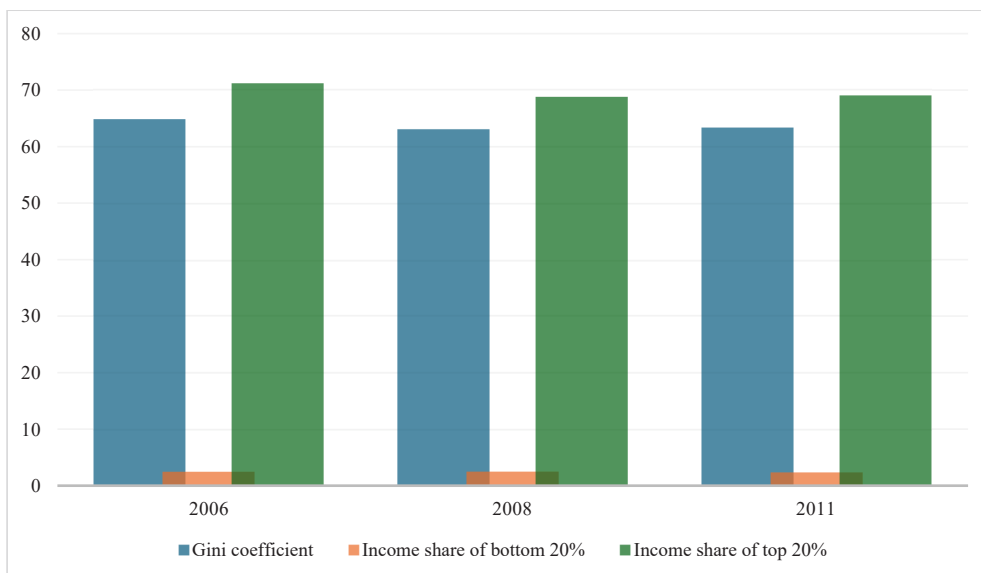


Figure 3. Income inequality trend, 2006–2011. Source: Author computations based on World Bank [52].

2.3. The Macro Model

The macro model utilised in our study is a dual economy CGE model for the economy. (The term ‘dual economy’ refers to the existence of traditional and modern sectors within one economy (Lewis [53]). Lewis two-sector model assumptions are that (a) the traditional sector is agriculture and (b) the modern sector is industry.) The model approach is based on

the Walrasian approach concerning small open economies. Producers, aiming to maximize their profits, and consumers, striving to maximize their utility, respond to changes in relative prices by adjusting the quantities they supply and demand, ensuring simultaneous market equilibrium. The economy adopts global market prices for exports and imports. The CGE model’s typical features stem from the dynamic CGE model proposed by the Partnership for Economic Policy (PEP), as described by Decaluwe et al. [54]. The PEP model is customised to fit South African realities and data. The CGE model is presented in this section in four major blocks: supply block (production and trade), demand block (income, savings and demand), and macroeconomic block (macroeconomic constraints and closure rules). While the spotlight is on the main mechanisms of the model, the full specification of the equations and definition of parameters, variables, and sets of the model can be provided, upon request, from the authors.

2.3.1. Production, Trade and Labour Markets

Inventory and warehouse management practices have a significant influence. In terms of production, it is assumed that the production technology exhibits constant returns to scale, represented through nested constant elasticity of substitution (CES) functions (Leontief and Cobb–Douglas functional forms are two specific cases of CES function implying zero and one elasticity of substitution, respectively). The aggregate output XST_j is postulated as a Leontief function dependent on value-added VA_j and intermediate consumption CI_j (Equations (1) and (2)). Employing a Leontief function implies that production activities require a fixed volume of value added and a fixed amount of intermediate consumption, with no substitution possible between them.

$$VA_j = v_j XST_j \tag{10}$$

$$CI_j = io_j XST_j \tag{11}$$

Equation (3) describes the activities’ j value added (VA_j) as a CES function that integrates the composite labour demand (LDC_j) and capital demand (KD_j). Equation (4) outlines the activities’ behaviour in maximizing profit (or minimizing cost) by stating that the ratio of LDC_j to KD_j is equivalent to the inverse ratio of their respective factor prices (R_j to WC_j). Activities, j , continue to employ labour and capital until their marginal products match their factor prices, which are the rental rate for capital R_j or the wage rate for labour WC_j .

$$VA_j = B_j^{VA} \left[\beta_j^{VA} LDC_j^{-\rho_j^{VA}} + (1 - \beta_j^{VA}) KD_j^{\rho_j^{VA}} \right]^{-\frac{1}{\rho_j^{VA}}} \tag{12}$$

$$LDC_j = \left[\frac{\beta_j^{VA}}{1 - \beta_j^{VA}} \frac{R_j}{WC_j} \right]^{\sigma_j^{VA}} KD_j \tag{13}$$

Equations (5) and (6) describe the overall demand for labour within each activity, j . In the Constant Elasticity of Substitution (CES) framework, Equation (5) accounts for the constraints on substituting between the various labour types, l . Meanwhile, Equation (4) posits that labour is hired in a cost-effective manner by equating the ratio between a particular labour type and composite labour (marginal product) to the inverse ratio of that labour type’s wage rate and the composite labour wage rate, as dictated by the first-order condition.

$$LDC_j = B_j^{LD} \left[\sum_l \beta_{l,j}^{LD} LD_{l,j}^{-\rho_j^{LD}} \right]^{-\frac{1}{\rho_j^{LD}}} \tag{14}$$

$$LD_{l,j} = \left[\frac{\beta_{l,j}^{LD} WC_j}{W_l} \right]^{\sigma_j^{LD}} \left(B_j^{LD} \right)^{\sigma_j^{LD}-1} LDC_j \tag{15}$$

Equation (6), known as the Leontief equation, extracts the aggregate composite activities of intermediate consumptions (CI_j) from the activity of intermediate consumption ($DI_{i,j}$) for each specific commodity i . The input–output coefficients (aij) externally specify the complementary proportions of $DI_{i,j}$.

$$DI_{i,j} = aij_{i,j} CI_j \tag{16}$$

2.3.2. Demand Block

The demand block outlines the income, saving, and consumption behaviour of institutions. Here, a household’s total income is the sum of earnings from skilled and unskilled labour, capital returns, and indexed transfer income. The disposable income of households is derived by subtracting income tax and indexed out-transfers from their gross income. A fixed portion of this disposable income is allocated to savings. For firms, income is calculated by adding their portion of capital income to their in-transfers. Once firms pay government taxes and make real-term fixed out-transfers to other agents, what remains becomes their savings. The government receives income from direct taxes on household and firm incomes, as well as export taxes, import tariffs, indirect taxes on imported and domestic goods, production taxes, a share of capital incomes, and indexed transfer receipts, which include dividends, concession sales, and foreign aid. Government savings are derived by deducting consumption and indexed transfer payments from total government income. It is important to note that while government spending is set in real terms, nominal expenditures are variable and depend on price changes.

An extended linear expenditure system (ELES) is utilized to represent demand by illustrating both consumption and labour supply behaviours. This model distinguishes between non-discretionary components, related to autonomous consumption of goods and leisure—which are not influenced by income changes—and a discretionary component tied to induced consumption, which is income-dependent. Autonomous consumption is influenced by factors outside of income, such as social policies, and remains constant, unlike induced consumption, which varies with disposable income.

A unitary household h utility is modelled by an extended Stone–Geary utility function defined over (i) market products and l leisure time (\downarrow). C and θ represent the total and subsistence levels of consumption of market products, respectively. \downarrow and γ are the total and minimum levels of leisure time by household members. Leisure time is a normal good. For simplicity sake, here the subscripts h , i and l are ignored. α and β are the marginal budget shares that determine the allocation of household supernumerary income between market products and individual leisure times, with $\alpha + \beta = 1$.

$$(C - \theta)^\alpha \cdot (\downarrow - \gamma)^\beta \tag{17}$$

The household faces budget and time constraints:

$$Y = R + w \cdot L = p \cdot C \tag{18}$$

$$\bar{T} = L + \downarrow + \gamma \tag{19}$$

Y is the gross income net of saving, p the commodity market price, w the wage rate, and L the time supplies to market. The full income Y^F constraint below is obtained from the above equations:

$$Y^F = R + w \cdot \bar{T}L = p \cdot C + w \cdot (\downarrow + \gamma) \tag{20}$$

The following demand and supply function is derived from utility maximization under the full income constraint:

$$C = \bar{\theta} + \frac{\alpha \cdot (Y - p \cdot \bar{\theta})}{p \cdot (1 - \beta)} \quad (21)$$

$$L = \bar{H} - \frac{\beta \cdot (Y - p \cdot \bar{\theta})}{p \cdot (1 - \beta)} \quad (22)$$

The maximum time available for work and leisure \bar{H} is computed as follows:

$$\bar{H} = \bar{T} - \bar{\gamma} \quad (23)$$

Both poor and non-poor households display a non-discretionary component related to autonomous consumption of product ($\bar{\theta}$) and leisure (\bar{H}) and a discretionary component that fluctuates with income and prices. First, changes in consumption and labour supply of poor households resulting from the SDG Push interventions are transmitted from the micro model to the macro model through the non-discretionary consumptions of products and leisure. Second, both poor and non-poor households are affected by the feedback effects of initial shocks through their exposure to markets (e.g., income and price effects). The non-discretionary component of the demand for products and leisure time from household members are calibrated using the Frisch parameter.

The Frisch parameter measures the income elasticity of the marginal utility of income, which declines as income increases, and is expressed as follows:

$$Frisch = - \frac{Y}{Y - p \cdot \bar{\theta}} \quad (24)$$

The denominator refers to the supernumerary income, which is the leftover income after the consumer fulfils all basic subsistence requirements. This supernumerary income impacts how much is spent on discretionary activities, like purchasing products and enjoying leisure, with portions α and β allotted to these categories. When the supernumerary income is smaller, the absolute value of the Frisch parameter increases, while the discretionary spending on total consumption and leisure decreases. Hence, a higher Frisch parameter is assigned to lower-income households to emphasize the essential consumption of products and leisure. Conversely, wealthier households receive a lower Frisch parameter to focus more on discretionary spending. The overall household consumption is modelled through a multi-tiered nested Cobb–Douglas function that merges market goods with leisure. On a first level, essential goods form final consumption via a Cobb–Douglas function, while on a broader scale, food and non-food items, along with leisure, are incorporated into final consumption using a Linear Expenditure System (LES) function.

2.3.3. Trade

Within the model, South Africa engages in international trade by importing goods and services while making payments for transfers and capital income. Simultaneously, the nation exports products and receives transfers from other countries. To represent these interactions, we adopt the small-country assumption and incorporate the traditional Armington approach, which postulates that there are well-behaved preferences within a weakly separable product category that comprises similar, but not identical, products (Armington [55]). These products are distinguished by their origin, and a CES (Constant Elasticity of Substitution) is assumed for products within the same category. Similarly, on the export front, the behaviour is modelled via a constant elasticity of transformation (CET) function, reflecting the variations in commodities sold across different markets. We

consider world market prices as exogenous, while the domestic prices are dictated by local supply-and-demand equilibrium. This indicates that South Africa acts as a price taker in global markets; hence, to enhance its market share globally, it must increase its competitiveness.

2.3.4. Unemployment

The modelling of labour markets is enriched by empirical data from South Africa, as demonstrated by Kingdon and Knight [56,57]. The labour market segments—unskilled, low-skilled, medium-skilled, and skilled—operate under the assumption of imperfect market conditions. This scenario is examined using the wage curve model proposed by Blanchflower and Oswald [58]. The wage curve captures the relationship between the unemployment rate (u_l) and the real wage rate ($\frac{w_l}{p}$) for a given labour category l . The relationship is expressed as follows:

$$u_l = \left(\frac{w_l}{p} \right)^\eta \quad (25)$$

where w_l is the wage rate for labour category l ; p , the average economywide price level; and η , the elasticity of the real wage rate with respect to the changes in the unemployment rate.

In contrast, the high-skilled labour market is presumed to function according to a competitive market clearance pattern, suggesting complete employment. Workers in every skill category are considered to have full mobility among various industries within the nine provinces and the two settlement types (urban and rural). Regarding rural–urban migration and remittances, the model incorporates an exogenous framework for the movement of labour between rural and urban zones and between provinces, specific to each skill category. Additionally, the proportions of labour income allocated to the origin and destination locations as internal remittances are exogenously determined. As labour relocates from one area to another, remittances flow in the reverse path. This external framework implies that a mix of economic and non-economic factors shape urban–rural migration and remittance flows. The model also examines the sensitivity of internal remittance rates.

2.3.5. Macroeconomic Constraints, Closure Rules and Dynamics

All commodity markets, including capital and skilled labour markets, follow the neoclassical market-clearing price system, in which simultaneously determined producer and consumer prices vary only by given tax/subsidy and margins rates. Each market is cleared when composite supply equals demand (final household consumption, final government consumption, intermediate demand, demand for fixed capital formation, and change in stock). Unskilled workers' unemployment rates clear the supplies and demands in the unskilled labour market. Total investment, i.e., the fixed capital formation and the changes in stocks, is equal to the savings of domestic institutions—household, firm, and government—plus the foreign saving or current account balance converted to the local currency, using the exchange rate. Capital markets and skilled labour markets are cleared. Regarding closure rules, we posit that the nominal exchange rate serves as the numeraire in our model. We then apply the small-country hypothesis, wherein South Africa acts as price taker and international prices are predetermined. Furthermore, we assume that the current account balance and the government's expenditure on goods and services, alongside all tax rates (which include direct, indirect, import, and producer taxes), remain constant. To construct the model's reference trajectory over time, it is presumed that the stock of capital increases between periods, due to new sector investments. The distribution of new private investment adheres to the accumulation equation of Jung and Thorbecke [59]. Based on the model's dynamic framework, derived from [59], both producers and consumers are

short-sighted, making decisions to maximize utility and profits within a single period. The transition across periods is governed by the savings and capital accumulation. A typical capital accumulation equation is employed, where savings add to the current capital stock after accounting for depreciation. In this framework, sectors vie for investment, with the allocation of new capital being dictated by the sector-specific costs, returns on capital, and past investment trends.

2.4. The Data and Model Calibration and Implementation

The South African CGE model is implemented using the modified Social Accounting Matrix (SAM) for 2023, building upon the 2015 SAM crafted by van Seventer et al. [60] and further elaborated in van Seventer and Davies [61]. We make several modifications to the SAM to convert it towards an agriculture-focused SAM (Ag-SAM). This Ag-SAM is constructed utilizing the Supply and Use Table (SUT) and the income and expenditure surveys, along with the labour force surveys. Since the data to build the Ag-SAM were derived from various sources and different time periods, the initially constructed SAM contained inconsistencies. We employed the RAS method and the GAMS programme, as outlined in Lemelin et al. [62], to reconcile this information and achieve a balanced SAM. The program minimizes alterations to the original data using multiple optimization techniques, such as cross-entropy and least squares. To update the SAM, we use the adaptation proposed in Robinson et al., [63] which uses prior information (the original balanced SAM) and recent macroeconomic conditions, to estimate a new SAM through cross entropy.

The resulting Ag-SAM includes thirty industries or activities, featuring a disaggregated “Agriculture, forestry, and fishing” and thirty commodities, including a staple for “Agriculture, forestry and fishing”. Ninety labour categories derived from nine provinces (respectively, Western Cape, Eastern Cape, Northern Cape, Free State, KwaZulu-Natal, North West, Gauteng, Mpumalanga, and Limpopo), two settlement types (urban and rural), and five levels of skill category (skill categories (5): based on the highest education level achieved, i.e., Unskilled: no schooling and less than Grade 1, Lower-skilled: grade 2 to 7, Medium-skilled: Grade 12, Skilled: certificate and diploma, High-skilled: degree and postgraduate diploma) using education attainment, are incorporated. There is a single capital factor account and four tax accounts: taxes on production, production subsidies, taxes and duties on products, and current taxes on income and wealth, twenty-one institutional accounts, comprising 18 household segments, and two capital accounts: fixed capital formation and changes in inventory levels. The result is the final balanced Ag-SAM.

The model’s reliability has been validated through sensitivity analysis, examining different closures and parameter choices (see Fofana et al. [13] and Mabugu et al. [64]. Additionally, ref. [13] assessed multiple data series to find that the model’s outcomes are somewhat influenced by the selected series. The MS model is applied using the household survey from the 2017 National Income Dynamics Study and from [49,51].

We end with a brief discussion of key features of the South African economy at the benchmark level of the economy (2015) painted by the SAM. According to the Ag-SAM, and summarised in Table 1, which reflects the composition of the South African economy’s sectors, the service sector accounts for approximately 70.2% of GDP, making it the largest sector, while the agricultural and industrial sectors contribute 2.3% and 17.5%, respectively. These sectors are significant in both exports and imports.

The study modifies the South African SAM framework to categorise the labour force into 90 segments by worker and market characteristics, province, settlement type, and skill level. As previously argued in [56,57], in the Ag-SAM in Table 2, high-skilled labour is associated with lower unemployment while unskilled labour faces higher unemployment.

Furthermore, unemployment is more common in rural areas (Table 2). Table 3 shows that households mainly rely on low-skilled labour income (Table 3).

Table 1. Distribution of the South African economy across key sectors, 2015, %.

Sector	Share of GDP	Value-Added Share	Export Share	Import Share
Agricultural	2.3	2.3	2.5	1.3
Industrial	27.5	28	84.6	84.5
Mining	5.9	6	28.1	11.1
Construction	3.4	3.6	0.04	0.03
Other Industry	18.2	18.4	56.5	73.4
Sum	100	100	100	100

Source: Computations by the authors using the South Africa Social Accounting Matrix ([60,61]).

Table 2. Unemployment rates by skill category in South Africa.

Category	Urban	Rural	All
Unskilled	29.0	29.5	29.3
Low-skilled	36.5	42.5	38.5
Medium-skilled	28.0	42.7	30.6
Skilled	15.1	31.6	17.9
High-skilled (degree or postgraduate diploma)	5.6	8.7	5.8
Total	28.3	40.2	31.4

Source: Computations of the authors using South Africa SAM Social Accounting Matrix ([60,61]). Note: The unemployment figures also account for discouraged job seekers.

Table 3. Labour earnings distribution (percentages).

Level of Education	Western Cape		Eastern Cape		Northern Cape		Free State		KwaZulu-Natal	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Unskilled	1.3	7.5	1.7	7.5	3.4	10.1	2.8	3.5	1.7	7.5
Low-skilled	40.8	60.7	47.8	67.4	41.8	65.3	44.4	68.1	37.7	58.5
Medium-skilled	36.9	23.9	32.3	16.2	36.6	13.8	32.6	16.8	41.4	24.9
Skilled	9.2	3.8	10.2	5.9	8.7	6.4	11.0	6.8	10.5	6.8
High-skilled	11.8	4.0	8.1	3.0	9.5	4.5	9.2	4.8	8.6	2.3
Total	100	100	100	100	100	100	100	100	100	100

Source: Based on computations using South Africa SAM Social Accounting Matrix ([60,61]). Note: the unemployment figures also account for discouraged job seekers.

3. Simulations and Results

Establishing simulation scenarios is an essential phase, because they help with increasing modelling accuracy and also aid in the meaningful comparison and interpretation of the results. These scenarios are chosen to help address South Africa's dual development objectives as outlined earlier in the study objectives: firstly, to evaluate the targets for growth and income (or expenditure) distribution aimed at lowering poverty and eliminating hunger in South Africa as outlined by the SDGs, and secondly, to identify and evaluate an intervention strategy that supports achieving poverty reduction targets in rural areas.

Our implementation strategy is in three interrelated steps. First, it is customary to establish a Business-as-Usual (BAU) scenario, serving as a benchmark to evaluate proposed policy modifications. Essentially, the BAU scenario outlines a growth path that the economy would follow in the absence of any significant disruptions during a specified timeframe. For the current study, the BAU scenario is formulated by assuming that the economy will replicate its average growth performance from 2008 to 2023. This average annual growth is projected from 2024 to 2030, to construct the BAU. In addition, the BAU scenario factors in recent trends in per capita final-consumption expenditure, income inequality, and changes in rural and urban demographics and urbanisation patterns. Using data and models

discussed previously, the BAU is calibrated. All the model input data including parameters is reported in the Appendix. Second, we use the modelling to work out the milestones for growth and consumption necessary for poverty and hunger reduction. Third, we design a strategy informed by the modelling to eradicate hunger and reduce poverty. We call this the Sustainable Development Goal (SDG) scenario, as it aligns with demographic and rural–urbanisation targets, utilising the SDGs concerning poverty and hunger to assess changes in consumption growth and income inequality.

3.1. Milestones for SDG Poverty Reduction and Hunger Eradication Results

The simulations aim to determine the economic changes needed to meet specific targets, focusing on necessary income growth and distribution. Below are the poverty targets for South Africa and its rural regions. Table 4 highlights the poverty shifts required to achieve the SDGs by 2030. Simulating these economic adjustments involves assumptions about the economy’s path to 2030, as detailed in the BAU.

Table 4. Rural Poverty Status and Goals.

Poverty Headcount	Poverty Line	Base Year 2011	Reference Year 2017	Change 2011–2017	SDG Goals Year 2030	Change 2017–2030
South Africa	Upper/month	39.2	36.1	−7.9	18.1	−50.0
	Lower/month	14.4	12.7	−11.8	0.0	−100.0
	Food/month	8.3	7.2	−13.3	0.0	−100.0
Rural	Upper/month	60.7	53.3	−12.2	-	-
	Lower/month	24.8	20.0	−19.4	-	-
	Food/month	14.6	12.1	−17.1	-	-

Source: Computations based on model and [51].

To address the differences in rural and urban dynamics and explore rural strategies effectively, assumptions regarding the growth of population are key. According to calculations based on the United Nations data and reported in Table 5, the total population is expected to rise from 56.7 million in 2017 to 69.3 million by 2030, with an overall annual growth rate of 1.6%. Regionally, urban areas will grow by 2.3% annually, while rural areas expect a growth of only 0.1%. Urbanisation rates are projected to increase from 65.8% in 2017 to 71.5% by 2030, a 10.4% growth over the period, as shown in Table 5.

Table 5. Population Growth and Urbanisation, 2015–2030.

Year	Total Population	Percentage Population Growth Rate (%)	Urban Population, Total	Percentage Urban Population Growth Rate (%)	Rural Population, Total	Percentage Rural Population Growth Rate (%)	Annual Percentage of Population in Urban Areas (%)	Change in Annual Percentage of Population in Urban Areas (%)
2015	55,011,977	1.6	35,648,311	2.3	19,363,666	0.1	64.8	0.8
2016	55,864,680	1.6	36,477,842	2.3	19,386,839	0.1	65.3	0.8
2017	56,730,601	1.6	37,320,562	2.3	19,410,039	0.1	65.8	0.7
2018	57,609,944	1.6	38,176,676	2.3	19,433,268	0.1	66.3	0.7
2019	58,502,917	1.6	39,046,392	2.3	19,456,524	0.1	66.7	0.7
2020	59,409,731	1.6	39,929,923	2.3	19,479,808	0.1	67.2	0.7
2021	60,330,601	1.6	40,827,481	2.2	19,503,120	0.1	67.7	0.7
2022	61,265,745	1.6	41,739,285	2.2	19,526,460	0.1	68.1	0.7
2023	62,215,384	1.6	42,665,556	2.2	19,549,828	0.1	68.6	0.7
2024	63,179,743	1.6	43,606,519	2.2	19,573,224	0.1	69.0	0.6
2025	64,159,049	1.6	44,562,402	2.2	19,596,648	0.1	69.5	0.6
2026	65,153,535	1.6	45,533,436	2.2	19,620,099	0.1	69.9	0.6
2027	66,163,436	1.6	46,519,857	2.2	19,643,579	0.1	70.3	0.6
2028	67,188,991	1.6	47,521,904	2.2	19,667,087	0.1	70.7	0.6
2029	68,230,442	1.6	48,539,819	2.1	19,690,623	0.1	71.1	0.6
2030	69,288,037	1.6	49,573,849	2.1	19,714,188	0.1	71.5	0.6
All	-	26.0	-	39.1	-	1.8	-	10.4

Source: Computations based on United Nations [65].

Table 6 provides the necessary expenditure growth targets for poverty calculation. Between 2017 and 2030, the per capita consumption expenditure must rise by 34.5%,

averaging 2.0% annually. The overall consumption expenditure should grow at an annual average rate of 3.6%. These metrics support the calculation of target inequality rates using the Gini and Theil indices. (The Gini index measures overall income inequality, but is not perfectly decomposable (with zero residue), so the Theil index (which is perfectly decomposable) is used for measuring income inequality within rural groups.) The Gini coefficient is expected to decrease by 21.6%, and the Theil index by 41.5%, within the same timeframe. These national targets, designed to halve poverty and eliminate hunger by 2030, are detailed in the upper section of Table 6.

Table 6. National Poverty Reduction Goals and Targets.

Variables	Reference Year 2015	Halving Poverty and Eliminating Extreme Poverty	
	Value	Value	Variation
Poverty measures			
Headcount ratio, extreme poverty	0.127	0.001	−99.2%
Headcount ratio, international poverty	0.072	0.000	−100.0%
Headcount ratio, standard poverty	0.361	0.151	−58.2%
Inequality measures			
Gini coefficient	0.658	0.516	−21.6%
Theil Index	0.896	0.524	−41.5%
Household final consumption expenditure			
Per capita growth rate, 10-year period	30,758	41,370	34.5%
Per capita growth rate, annual average	-	-	2.0%
Global growth rate, annual average	-	-	3.577%

Source: Authors' computations based on model simulation results.

To gain a more detailed understanding of the results, an intermediate sectoral output table is created. Table 7 presents the GDP data divided by sector, including agriculture, industry, and manufacturing. The model is performing as expected: from 2023 to 2030, all sectors are predicted to grow, with economic growth rates projected to rise from 1.65% in 2024 to 2.05% in agriculture, 0.5% to 0.7% in industry, 0.9% to 1.3% in manufacturing, and 2% in services. The mechanism is a decline in domestic prices due to lower producer prices and trade margins, which boosts consumption and stimulates domestic demand. This results in increased production in most sectors, such as agriculture (which sees the highest increase) and related activities, manufacturing (due to its connections with agro-industry sectors like food and beverages), and service sectors, as shown in Table 7.

Table 7. Percentage change in total domestic production in different sectors.

	2024	2025	2026	2027	2028	2029	2030
All	1.65%	1.69%	1.75%	1.81%	1.88%	1.96%	2.05%
Agriculture	2.59%	2.60%	2.63%	2.69%	2.76%	2.84%	2.92%
Industry	0.46%	0.55%	0.58%	0.60%	0.62%	0.64%	0.66%
Manufacturing	0.87%	1.00%	1.08%	1.13%	1.18%	1.22%	1.27%
Services	2.08%	2.10%	2.16%	2.23%	2.32%	2.41%	2.51%

Source: Authors' computations based on model simulation results.

In Table 8, the micro-simulated projections for rural areas illustrate the ambitious targets of eradicating hunger and halving poverty. To achieve these objectives, a significant reduction of 48.2% in rural headcount poverty is essential. Concurrently, there must be a substantial enhancement of 42.8% in the final household consumption expenditure for rural populations.

Table 8. Rural Poverty Results.

Variables	Reference	Halving Poverty and Eliminating Extreme Poverty	
		Simulation	Variation
Poverty measures			
Headcount ratio, extreme poverty	0.200	0.003	−98.5%
Headcount ratio, international poverty	0.121	0.002	−98.3%
Headcount ratio, standard poverty	0.533	0.276	−48.2%
Household final consumption expenditure			
Per capita growth rate, 10-year period	5017	7165	42.8%
Per capita growth rate, annual average	-	-	2.4%
Total growth rate, annual average	-	-	2.5%
Inequality, Theil Index	0.654	0.433	−33.8%

Source: Authors' computations based on model simulation results.

Finally, discussion turns to the ramifications on needed consumption required for the fulfilment of the hunger and poverty SDG targets. Illustrated in Table 9 are the projected outcomes vis-à-vis the target trajectory for per capita required-consumption escalation. The findings delineate a requisite per capita alimentary-consumption augmentation rate of 17.5% across the entire analytical temporal span, necessitating an annual mean growth of 2.7%.

Table 9. Food Consumption Growth.

Variables	Reference Year	Halving Poverty and Eliminating Extreme Poverty	
	2015	Value	Variation
Per capita growth rate, period 2018–2030	985	1158	17.5%
Per capita growth rate, annual average	-	-	1.1%
National aggregate growth rate, annual average	-	-	2.7%

Source: Authors' computations based on model simulation results.

The increase in household consumption expenditure requirement per province is given in Table 10. The increase required tends to be higher in the rural provinces than in the urban ones, which is quite intuitive. In the rural provinces, the annual average growth targets change by more than 3%. In terms of poverty reduction, the resulting numbers of persons impacted are given in Table 11.

Table 10. Rise in household consumption spending by province and area.

Region	Area	Inclusive Growth Scenario	
		Period 2018–2030	Annual Average
Western Cape	Urban	37.1%	2.5%
Eastern Cape	Urban	33.1%	2.2%
Northern Cape	Urban	42.8%	2.8%
Free State	Urban	38.0%	2.5%
Kwazulu-Natal	Urban	42.6%	2.8%
North West	Urban	44.9%	2.9%
Gauteng	Urban	25.0%	1.7%
Mpumalanga	Urban	38.2%	2.5%
Limpopo	Urban	49.8%	3.2%
Western Cape	Rural	47.8%	3.0%
Eastern Cape	Rural	52.4%	3.3%
Northern Cape	Rural	65.6%	4.0%
Free State	Rural	13.1%	1.0%
Kwazulu-Natal	Rural	31.1%	2.1%
North West	Rural	33.6%	2.3%

Table 10. *Cont.*

Region	Area	Inclusive Growth Scenario	
		Period 2018–2030	Annual Average
Gauteng	Rural	13.0%	0.9%
Mpumalanga	Rural	60.3%	3.7%
Limpopo	Rural	51.7%	3.3%

Source: Authors computations' based on model simulation results.

Table 11. Poverty reduction by province and area, number of persons.

Province	Area	Extreme Poverty	Standard Poverty
National	All	6,589,574	11,049,010
Gauteng	Urban	1,433,492	2,403,595
Kwazulu-Natal	Rural	729,243	1,222,752
Kwazulu-Natal	Urban	667,726	1,119,604
Limpopo	Rural	663,416	1,112,377
Western Cape	Urban	644,776	1,081,122
Eastern Cape	Rural	518,232	868,941
Eastern Cape	Urban	385,378	646,179
Free State	Urban	309,051	518,199
North West	Rural	280,863	470,935
Mpumalanga	Rural	235,205	394,378
Mpumalanga	Urban	207,806	348,436
North West	Urban	200,979	336,990
Northern Cape	Urban	106,146	177,979
Limpopo	Urban	93,927	157,492
Free State	Rural	51,263	85,955
Western Cape	Rural	42,859	71,863
Gauteng	Rural	9751	16,350
Northern Cape	Rural	9461	15,863

Source: Authors' computations based on model simulation results.

3.2. Strategic Options for Inclusive Growth—SDG Scenario Results

Next, the micro targets are imposed onto the macro model, to inform on household consumption. The prerequisites for meeting the SDGs in 2030 are that (a) household final consumption expenditure, and average annual growth from 2018 to 2030, is 3.6%; and (b) rural household final consumption expenditure, and average annual growth for 2018 to 2030, is 2.5%. The targets for reduction in rural income inequality, through regional income growth targets, are given in Table 12.

The objective is now to use the results to develop step-by-step strategies that enable either the entire nation, or just rural regions, to achieve their specified SDG targets. Initially, a baseline scenario that represents the continuation of current practices is evaluated against these targets. Following this, various agricultural growth scenarios incorporating three policy tools are examined. These tools focus on investment, export enhancement, and productivity improvement strategies, all guided by the country's National Development Plan 2030 and other agriculture strategy programs. The next phase involves independently evaluating these policy instruments. For each strategy, three distinct agriculture-focused tests are conducted:

- Investment Growth Strategy
 - ✓ Domestic Private Investments increase.
 - ✓ Foreign Investments increase.
- Export Growth Strategy
 - ✓ Agri-food Export Volumes increase.
 - ✓ Agri-food Export Prices increase.
- Productivity Growth Strategy
 - ✓ Food and Beverage Productivity and Production increase.
 - ✓ Agricultural Productivity and Production increase.

Table 12. Regional rural inequality targets.

Province	Area	Period 2018–2025	Annual Average
Western Cape	Rural	47.8%	3.0%
Eastern Cape	Rural	52.4%	3.3%
Northern Cape	Rural	65.6%	4.0%
Free State	Rural	13.1%	1.0%
Kwazulu-Natal	Rural	31.1%	2.1%
North West	Rural	33.6%	2.3%
Gauteng	Rural	13.0%	0.9%
Mpumalanga	Rural	60.3%	3.7%
Limpopo	Rural	51.7%	3.3%

Source: Authors' computations based on model simulation results.

In the third step, we amalgamate effective approaches aimed at rural development. From this blend of simulations, we extract the ultimate strategy mix for rural development in South Africa, to achieve the SDGs. Tables 13 and 14 exhibit the results of the reference scenario, or business-as-usual scenario. These results indicate that without any change, and if the economy continues its current trajectory, national targets remain unmet. Similarly, neither aggregate rural targets nor regional rural targets are achieved in six of the nine provinces. This suggests that for South Africa to fulfil the SDG targets, it must alter its present course and implement particular strategies.

Table 13. Household Consumption Change, Reference Scenario (%).

Period	South Africa	Rural
2018	2.851	2.565
2019	2.803	2.533
2020	2.756	2.499
2021	2.711	2.465
2022	2.665	2.429
2023	2.621	2.392
2024	2.576	2.354
2025	2.532	2.316
2026	2.489	2.277
2027	2.445	2.238
2028	2.402	2.199
2029	2.358	2.159
2030	2.314	2.119
Average	2.579	2.350
Target	3.577	2.527

Source: Authors' computations based on model simulation results.

Table 14. Change in Rural Household Consumption by Province (%).

Period	Western Cape	Eastern Cape	Northern Cape	Free State Rural	KwaZulu-Natal	North West Rural	Gauteng	Mpumalanga	Limpopo
2018	1.897	1.489	13.188	5.228	2.061	2.367	9.242	3.621	2.827
2019	1.929	1.508	11.565	5.006	2.048	2.325	8.473	3.547	2.782
2020	1.959	1.522	10.294	4.801	2.032	2.285	7.824	3.475	2.737
2021	1.986	1.531	9.271	4.609	2.014	2.246	7.267	3.403	2.691
2022	2.011	1.536	8.432	4.431	1.993	2.208	6.784	3.332	2.645
2023	2.034	1.537	7.730	4.264	1.970	2.171	6.362	3.262	2.598
2024	2.056	1.534	7.134	4.107	1.944	2.136	5.989	3.193	2.551
2025	2.075	1.529	6.623	3.961	1.917	2.101	5.657	3.125	2.504
2026	2.094	1.520	6.178	3.823	1.888	2.067	5.359	3.058	2.457
2027	2.110	1.510	5.788	3.693	1.857	2.033	5.091	2.992	2.409
2028	2.125	1.497	5.442	3.571	1.825	2.000	4.847	2.927	2.362
2029	2.140	1.483	5.134	3.456	1.792	1.968	4.624	2.863	2.315
2030	2.152	1.468	4.857	3.347	1.757	1.937	4.419	2.800	2.268
Average	2.044	1.513	7.789	4.175	1.931	2.142	6.293	3.199	2.550
Target	3.049	3.296	3.956	0.950	2.107	2.254	0.944	3.694	3.255

Source: Authors' computations based on model simulation results.

The second set of simulations thus assesses the effectiveness of different policy instruments with regard to rural income growth and distribution. We successively implement a series of tests through one-percent increase in domestic private investments, foreign

investments, agri-food export volumes, agri-food export prices, food and beverage productivity and production, and agricultural productivity and production. The results of the tests are quite varied. Some strategies have positive effects on rural development, and thus have a chance to contribute to attaining the SDG targets 1.1 and 2.1. The other three, domestic private investment, agriculture export volumes and agriculture export prices, do not contribute to reaching the targets.

Now that we have a clear understanding of the simulations that support rural development (defined as above), we integrate them into a comprehensive rural development strategy package. This package comprises three key policies: foreign private investments, enhanced productivity and production in the food and beverage sector, and increased agricultural productivity and production. Our goal is to determine the necessary levels of these elements to achieve the hunger and poverty SDGs. The simulation results indicate that the economy requires a 10.5% annual growth rate in foreign investment, a 2.5% average annual growth in agricultural productivity, and a 3.5% average annual increase in agri-food commodity exports, to reach the SDG targets (Table 15). Under these conditions, both national and aggregate rural targets are met, with most regional rural targets achieved as well, except for the provinces Western Cape and Eastern Cape, which fall short, as shown in Table 16.

Table 15. Household Final Consumption Change, Reference Scenario (%).

Period	South Africa	Rural
2018	3.404	3.126
2019	3.415	3.137
2020	3.432	3.154
2021	3.455	3.175
2022	3.483	3.202
2023	3.519	3.233
2024	3.561	3.271
2025	3.611	3.314
2026	3.669	3.364
2027	3.734	3.420
2028	3.808	3.484
2029	3.891	3.554
2030	3.982	3.632
Average	3.613	3.313
Target	3.577	2.527

Source: Authors' computations based on model simulation results.

Table 16. Rural Household Final Consumption Change by Province, Reference (%).

Period	Western Cape	Eastern Cape	Northern Cape	Free State Rural	KwaZulu-Natal	North West Rural	Gauteng	Mpumalanga	Limpopo
2018	2.380	1.992	13.902	6.591	2.641	2.856	10.166	4.184	3.350
2019	2.400	2.033	12.416	6.361	2.673	2.868	9.427	4.161	3.359
2020	2.423	2.076	11.262	6.162	2.709	2.883	8.830	4.145	3.373
2021	2.448	2.120	10.345	5.990	2.749	2.901	8.342	4.137	3.392
2022	2.477	2.168	9.606	5.843	2.794	2.924	7.943	4.137	3.417
2023	2.510	2.218	9.003	5.719	2.844	2.951	7.614	4.143	3.447
2024	2.548	2.271	8.506	5.616	2.900	2.982	7.344	4.158	3.482
2025	2.592	2.328	8.095	5.533	2.961	3.019	7.123	4.180	3.524
2026	2.641	2.389	7.754	5.468	3.029	3.060	6.944	4.210	3.573
2027	2.697	2.456	7.470	5.419	3.104	3.108	6.801	4.248	3.628
2028	2.760	2.527	7.236	5.386	3.185	3.162	6.689	4.294	3.690
2029	2.830	2.604	7.043	5.368	3.275	3.222	6.603	4.349	3.759
2030	2.909	2.687	6.885	5.363	3.371	3.289	6.541	4.411	3.835
Average	2.586	2.297	9.173	5.755	2.941	3.017	7.715	4.212	3.525
Target	3.049	3.296	3.956	0.950	2.107	2.254	0.944	3.694	3.255

Source: Authors' computations based on model simulation results.

We now seek to determine the necessary growth rates for both the agricultural sector and the broader economy, to achieve the desired income and expenditure benchmarks aimed at halving poverty and eradicating extreme poverty and hunger. Simulation results indicate that the economy should expand at an average annual rate of 2.7%, while the

agriculture sector needs to advance at a robust 3.6% from 2018 to 2030, as illustrated in Table 17.

Table 17. Economic Growth, Rural Development Scenario (%).

Period	Economywide	Agriculture
2018	2.9	3.0
2019	2.9	3.2
2020	2.8	3.3
2021	2.8	3.4
2022	2.8	3.5
2023	2.8	3.6
2024	2.7	3.7
2025	2.7	3.7
2026	2.7	3.8
2027	2.7	3.8
2028	2.7	3.9
2029	2.6	3.9
2030	2.6	3.9
Average	2.7	3.6

Source: Authors' computations based on model simulation results.

Based on these results, policy makers in South Africa have multiple pathways available to achieve economic growth objectives, including those recently suggested by the IMF [66], OECD [67] and World Bank [68]). This study now extends these to examine the necessary investment levels to facilitate the targeted growth. According to the simulation outcomes, in order to reach the aforementioned growth objectives, the nation's average annual investment growth must be 3.6%, with the agriculture sector requiring a growth rate of 2.2% between 2018 and 2030 (Table 18).

Despite the effort, the annual growth and expenditure increase is insufficient to raise everyone above the monthly income threshold by 2030, to eradicate hunger. One way that this shortfall could be covered is through extending the country's social assistance coverage. According to the modelling, the required expansion of social assistance programs is large, aiming to envelop 10% of the population—approximately 7 million individuals—as outlined in Table 19. The anticipated reduction of the Gini index to 0.513 by 2030, 0.673 in 2015, underscores the criticality of income growth strategies in combating hunger. However, it becomes clear that income redistribution emerges not just as a vital, but as the keystone, element in a strategic overhaul aimed at diminishing inequality and extinguishing hunger. The primary focus of the social assistance policy should be on reaching these 7 million poor people. According to the results of our model in Table 19, these people are spread over the urban–rural divide and across the nine provinces, although predominantly in rural areas. Table 19 shows social assistance efforts are targeting six key provinces to support rural and urban poor: rural Limpopo, both rural and urban KwaZulu-Natal, rural and urban Eastern Cape, and urban Gauteng. In view of the fact that South Africa's debt-to-GDP ratio has been rising over the past 15 years, it is crucial to explore various funding sources, rather than simply expanding the fiscal deficit. Maintaining the continuity of social assistance requires it to be self-financing and not contribute to further debt. In the short term, such a policy will need to be supported by a mix of budget cuts elsewhere, elevated taxes, and increased borrowing. While this task is crucial, it falls outside the purview of our research. Readers interested in the impacts of these financing strategies should refer to [13,20], who have carried out financing options of social grant extension in South Africa.

Table 18. Investment Growth, Rural Development Scenario (%).

Period	Economywide	Agriculture
2018	4.0	1.3
2019	3.9	1.5
2020	3.9	1.7
2021	3.8	1.9
2022	3.7	2.0
2023	3.7	2.2
2024	3.6	2.3
2025	3.6	2.4
2026	3.5	2.5
2027	3.5	2.6
2028	3.4	2.7
2029	3.4	2.7
2030	3.3	2.7
Average	3.6	2.2

Source: Authors' computations based on model simulation results.

Table 19. Number of assisted persons, SDG Scenario.

Provinces	Urban	Rural	All
Western Cape	253,771	64,100	317,871
Eastern Cape	491,462	894,376	1,385,838
Northern Cape	119,063	10,347	129,410
Free State	281,061	69,460	350,521
Kwazulu-Natal	524,597	1,357,482	1,882,079
North West	181,638	386,901	568,539
Gauteng	614,971	3,259	618,230
Mpumalanga	162,578	333,409	495,987
Limpopo	66,614	1,120,113	1,186,727
South Africa	2,695,755	4,239,447	6,935,202

Source: Authors' computations based on model simulation results.

We next explore the relationship between spending increases and the employment and wage outlooks by skill level in regions targeted by the SDGs. In other words, we want to find out what the modelling can suggest in terms of using labour markets to tackle the social problems (see the IMF [66], OECD [67] and World Bank [68]). Unlike in the IMF [66], OECD [67] and World Bank [68], which are based on a national approach of labour markets and other structural interventions needed to unlock growth, wage expectations are assessed and compared across five skill categories in this study. The rationale is straightforward—the poor are predominantly found in the rural areas in South Africa, so any big contributions towards meeting hunger and poverty SDGs need to focus on addressing poor people in rural areas. Our results in Table 20 show that job and income prospects for skilled and high-skilled individuals are better than for other skill levels in all SDG-focused regions, with the exception of rural Northern Cape. Thus, a focus on upskilling labour in rural areas will increase their prospects of landing a decent job.

Table 20. Annual wage rate change (%) under Sustainable Development Goals scenario.

Areas in Rural to Focus On	Unskilled	Lower-Skilled	Medium-Skilled	Skilled	High-Skilled
Eastern Cape	6.1	6.2	6.1	7.4	7.4
Northern Cape	14.2	15.5	16.5	14.7	17.8
KwaZulu-Natal	2.5	2.7	2.8	4.0	4.4
Mpumalanga	4.2	3.8	4.2	5.5	6.3
Limpopo	3.6	3.9	3.8	4.7	5.5

Source: Computations of the authors using model results and Statistics South Africa [49].

In regions identified for achieving SDGs, households primarily depend on employment within unskilled, low-skilled, and medium-skilled labour sectors (Table 21). Con-

sequently, the initiation and broadening of comprehensive skill development programs within these SDG-centric areas possess substantial potential to mitigate widespread income-inequality gaps.

Table 21. Income distribution by production factor category in rural areas (percentages).

Region	Unskilled, Low-Skilled, and Medium-Skilled Labour	Skilled and Highly Skilled Labour	Capital and Transfers	Total
Western Cape	59	34	7	100
Eastern Cape	54	31	15	100
Northern Cape	46	45	9	100
Free State	33	23	44	100
KwaZulu-Natal	55	28	17	100
North-West	56	17	26	100
Gauteng	40	45	15	100
Mpumalanga	60	29	11	100
Limpopo	58	32	9	100

Source: Computations of the authors using model results and Statistics South Africa [49].

Summing up, rural South Africa hosts the highest poverty and hunger rates, positioning itself to significantly address hunger and extreme poverty through agricultural output and job creation. This issue is crucial for development. The analysis identifies milestones, intervention areas, and outcomes at national, provincial, and regional (urban vs. rural) levels. The main policy focus should be on social assistance, labour market improvements, agricultural productivity, and rural skill development.

4. Discussion

As the deadline for the SDGs approaches, could South Africa potentially capitalise on this opportunity, using agriculture? South Africa is confronted with pronounced income inequality and poverty, predominantly in rural locales. In the face of such challenges, this paper presents a novel framework combining micro- and macro-level models to identify steps for South Africa and similar nations to halve poverty and eradicate hunger by 2030. From an analytical perspective, the study's innovation lies in employing a nonparametric microsimulation model to evaluate income growth and distribution targets needed to meet the SDG goals on hunger and poverty. The simulations develop strategies to help quantify milestones and achieve SDG targets on hunger and poverty. Beginning with a business-as-usual simulation, various agricultural growth strategies involving investment, export enhancement, and productivity improvements in and for agriculture are tested. This market-orientated agriculture policy intervention is complemented with a targeted social-assistance extension.

Milestones show that to halve poverty and eradicate extreme hunger, the economy must grow by 2.7% annually, and the agricultural sector by 3.6%, from 2018 to 2030. Market-orientated policy increases investments to achieve the economic growth and private consumption goals set by milestone assessments. According to the BAU simulation, the poverty headcount index is projected to rise from 55.2% in 2015 to 56.1% by 2030. This increase is exacerbated by population growth, making it unlikely that the target to halve poverty by 2030 will be achieved in the BAU scenario. Similarly, hunger will continue, with 24% of people below the food poverty line by 2030 under BAU. Conversely, the country can make inroads into the hunger and poverty goals if the individual consumption expenditure grows by an average of 2.6% annually. To reach the consumption expenditure growth target, a reduction in income inequality is essential, potentially through expanding social assistance to cover 10% of the population, thus working towards eradicating hunger by 2030. These findings, taken together, advocate for strategic interventions targeting agricultural expansion in rural areas such as Eastern Cape, Limpopo, Mpumalanga, KwaZulu-Natal

and Northern Cape. In this way, South Africa can get on track with its key development agenda under mixed economic and social policies. Long-term development of skills for impoverished households, especially in rural areas, will increase employment and income opportunities necessary for attaining the SDGs.

The paper centres on the national focus with a distinct rural sector bias and on agriculture, which is predominant in these locales. It is, therefore, worthwhile in the discussion to explore how agriculture contributes to pro-poor growth within South Africa. The country's history of unequal land distribution starkly contrasts with other developing countries where agricultural productivity growth could directly elevate income for impoverished smallholders. In South Africa, farming tends to be more capital intensive compared to many developing nations, which means that even significant growth in commercial farming is unlikely to result in substantial job creation for farmworkers. Additionally, the agricultural GDP contribution, roughly at 2%, is small, suggesting that even rapid growth in agriculture might result in limited economic impact. Given these imposing factors, questions about the relevance and generalization of insights from our numerical analysis are valid; however, we affirm their relevance when correctly interpreted. The principal message to be drawn is the existence of a multiplicative propagation effect stemming from investments in agriculture, as opposed to exact magnitudes of the numbers in the results. Notably, these secondary equilibrium effects are substantial, particularly in a nation where agriculture comprises a minor fraction of GDP. The results hinge on two pivotal, yet resilient, assumptions affirmed by other studies on South Africa: firstly, that productivity improvements in agriculture will mainly aid poorer consumers, through reduced food prices (refer to [69–71]). Secondly, that rural zones are populous, with impoverished individuals; most of South Africa's poor dwell in rural, rather than urban, settings [72,73]. Thus, advancements in agriculture are likely beneficial predominantly to the poor. Despite agriculture's modest GDP portion, its influence on livelihoods is noteworthy, contributing 15% to 20% of employment opportunities, underscoring its crucial role as an employer, especially for the economically disadvantaged (see [71]). Moreover, subsistence farming serves as a cornerstone for the poor in South Africa, making up 20% and 8% of jobs in the lowest and next-lowest income levels, respectively (see [70,71]).

The usual modelling caveats apply to this work. The results are sensitive to assumptions made and accuracy of the data used. Ultimately, our findings' robustness hinges on the model's underlying assumptions. Firstly, the assumptions concerning the substitution elasticities between domestic and foreign good composites, as well as between skilled and unskilled workers, impact commodity and factor demands following shocks. The values used for these elasticities can result in either an overestimation or underestimation of the distributional effects. Secondly, the assumption of an endogenous labour supply that adjusts to income and price variations makes our conclusions sensitive to the selected income elasticities. As these values are sourced from previous studies performed using econometric techniques where available, they might exaggerate or diminish labour market results. Thirdly, the portrayal of domestic production and unpaid care work relies on assumptions about minimum consumption needs and time allocation. If these assumptions are inadequately specified, they can cause underestimation or overestimation of consumption and distributive effects. Fourthly, household behaviour, namely consumption choices, is modelled using an LES (Linear Expenditure System) function, which might not entirely reflect real-world realities. While these simplifications are necessary, and commonly used in applied modelling to operationalise the models, they may restrict the reliability of some micro-level results. To mitigate these limitations, sensitivity analyses were conducted on key parameters, and the results were evaluated for stability under different assumptions [13,64]. This research could be further extended by incorporating (i) more SDGs into

the models, (ii) applying the modelling to a larger number of developing countries and (iii) the interlinkages between trade and climate change (Pérez-Peña et al., [74]). More broadly, we have assumed the government can effectively implement policy interventions and strategies suggested by the modelling. Future work should assess actual implementation, considering challenges such as coordination, policy harmonisation, effectiveness, budget adequacy, funding access, monitoring, evaluation, and sustainability of reforms. Understanding these issues is crucial for enhancing policy effectiveness and reducing poverty and hunger. Finally, a thorough analysis of rural and national development linkages requires comprehensive econometric studies on rural–urban and intersectoral factor mobility and production and consumption elasticities, possibly using panel data and advanced methods such as IV and SUR. This analysis is beyond this paper’s scope, due to data quality issues and the need for results that fit into a CGE framework.

5. Conclusions

The results illustrated above have been generated through a recursive dynamic CGE model, which is coupled with a household microsimulation model. The combination of these two modelling approaches enables the simultaneous assessment, in a model-consistent way, of the macroeconomic and distributional (poverty and inequality) effects of policy interventions. The findings, taken together, advocate for strategic interventions targeting agricultural expansion in rural areas, to get the country on track with its key development agenda pertaining to hunger and poverty SDGs.

The work makes three important contributions to the literature. First, the issue of rural development is studied from a perspective of sustainable development goals, including a recursive dynamic analysis of macro and micro variables, to determine milestones for achieving sustainable development goals. The second notable contribution arises from the potentially novel approach of placing the examination of quantified milestones within a general equilibrium framework specific to an African nation. This allows for the evaluation of how investments driven by the agriculture sector might facilitate the achievement of the SDGs related to hunger and poverty in South Africa. The third contribution highlights the importance of a combined policy approach to addressing hunger and poverty. Thus, South Africa is likely to get on track with its key hunger and poverty SDG agenda under a mixed policy strategy of agricultural investments, social assistance, and labour policies. This is important because, while from the literature on growth–poverty links it is evident that the structure of growth matters, it is clear that unless agricultural growth is combined with social assistance and skilling programmes in South Africa, hunger and poverty will not be eradicated.

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Article

From Local Product to Destination Identity: Leveraging Cave-Aged Cheese for Sustainable Rural Tourism Development

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Abstract: This study investigates how local gastronomic products with strong cultural and heritage value can contribute to destination identity and sustainable rural tourism development. Focusing on cave-aged cheeses, it emphasizes the case of Roquefort-sur-Soulzon (France), where traditional cheese-making and natural cave-aging have been successfully integrated into tourism experiences that reflect terroir, authenticity, and rural heritage. To explore tourist motivations, a survey of 416 visitors was conducted. Factor analysis and Structural Equation Modeling (SEM) were used to identify the main drivers behind cheese-related tourism. The analysis revealed three key motivational factors: Traditional Gastronomy, linked to interest in regional food practices; Cheese Experience, emphasizing the unique appeal of Roquefort cheese; and Heritage Tourism, reflecting a desire to connect with rural identity and sustainable traditions. These results support the hypothesis that culturally significant local food products can serve as central elements in shaping place identity and attracting visitors through immersive, heritage-based experiences. The study concludes that food heritage can be a powerful tool for rural development, offering economic, cultural, and experiential value. It also identifies similar opportunities in Serbian regions such as Pirot and Sokobanja, where traditional kačkavalj cheese and natural cave environments present strong potential for tourism growth rooted in local identity.

Keywords: gastronomic tourism; heritage-based experiences; sustainable rural development; destination identity; cave-aged cheese

1. Introduction

In an increasingly globalized world, the distinctiveness of local products has emerged as a vital component in shaping the identity of destinations [1]. Local products, often defined as goods that are produced within a specific geographical region and reflect the cultural heritage of their surroundings, play a critical role in not only fostering a sense of place but also in enhancing the economic viability of communities [2]. These products often serve as tangible representations of the traditions, customs, and values of the people, thus contributing to a broader narrative that defines a region's identity [3]. From the renowned wines of Bordeaux [4] to the artisanal cheeses of Switzerland [5], local products have not only encapsulated the essence of their origins but have also become powerful symbols that attract tourism and build community pride [6].

The significance of local products in shaping destination identity cannot be overstated [7]. Local products are characterized by their unique attributes, which often stem from traditional methods of production, local ingredients, or historical significance associated with the region [8]. According to Antolini et al. [9], the rich Italian cuisine relies

heavily on local ingredients and methods that vary from region to region, underpinning the identity of places such as Emilia-Romagna or Campania. Historically, local products have been pivotal in the development of regional identities; they often tell stories of the land and its people, weaving narratives that have been passed down through generations [10–13]. Regions such as Champagne in France [14] or the Basque Country in Spain [15] have successfully aligned their identities with their local products—champagne and pintxos, respectively—creating a sense of pride among locals and recognition among tourists [16]. These products serve not only as commodities but as cultural artifacts that embody the spirit, heritage, and authenticity of their locales [17].

As local products evolve, they often undergo a transformation into cultural symbols that embody the traditions and customs of a destination [18]. Festivals and events dedicated to local products play a crucial role in this process, acting as platforms for promotion and celebration [19–23]. According to Varela [24], the annual Pizzafest in Naples showcases the city's iconic pizza, drawing both locals and tourists alike to partake in a celebration of culinary heritage. Such events not only elevate the status of local products but also engage the community, reinforcing cultural ties [25,26]. According to He et al. [27], local products often reflect the unique practices and values of the region, serving as a reminder of the collective identity of its people. Successful branding strategies have further solidified this transformation; consider the case of Vermont's maple syrup, which has become an emblem of New England's agricultural identity [28,29]. Through clever marketing and storytelling, local products can transcend their utilitarian purposes, becoming cherished symbols of cultural pride that resonate with both residents and visitors [30].

Cave-aged cheese, as a traditional and regionally distinctive food, serves as a compelling example of how culinary heritage can support sustainable rural tourism and contribute to the revitalization of local economies [31]. The significance of cave-aged cheese in rural tourism is underscored by its rich historical context and unique characteristics [32]. Traditionally, cave-aged cheese production dates back hundreds of years, often originating in regions where natural caves provided the ideal microclimate for fermentation and aging [33]. The unique characteristics of cave-aged cheese, such as its distinctive flavors and textures, arise from the specific microorganisms present in the cave environments, which cannot be replicated in commercial cheese production [34]. This authenticity is a major draw for tourists seeking unique culinary experiences [35]. According to Sgroi [36], local culinary traditions, such as cheese-making workshops and tasting tours, actively engage visitors and enhance their understanding of regional culture. This connection between food and place not only attracts tourists but encourages them to immerse themselves in the local way of life, fostering a sustainable tourism model that benefits rural communities economically and socially.

Among such destinations, Roquefort-sur-Soulzon in southern France stands as a globally recognized model, where the production and aging of Roquefort cheese in natural caves have not only preserved a centuries-old tradition but also generated sustainable tourism that intertwines sensory experience, heritage valorization, and local economic revitalization [37]. According to Jolly et al. [38], the famous Roquefort cheese, aged in the caves of southern France, has been produced since the Roman era, establishing a deep-rooted connection between local culture and culinary heritage. Attracting approximately 200,000 visitors annually, this small village demonstrates how a niche product, deeply embedded in local identity, can serve as a cornerstone for destination branding and rural sustainability. While France's Roquefort cheese has become an internationally recognized symbol of rural identity and economic vitality—supported by strong geographical indication (GI) protection and integrated agri-tourism—Serbia's cave-aged *Kačkavalj*, particularly from the village of Staničenje near Pirot, remains largely forgotten.

This research draws on the example of Roquefort-sur-Soulzon to explore the broader relationship between traditional cheese-making, cultural authenticity, and tourist motivation. By examining the motivations, experiences, and perceptions of 416 visitors through a quantitative methodology grounded in positivist epistemology, the study seeks to validate the hypothesis that local gastronomic products with strong heritage value—like cave-aged cheeses—can act as catalysts for sustainable rural tourism and destination identity formation. The novelty and applied relevance of this research lie in its comparative and visionary potential. While Roquefort-sur-Soulzon serves as an established benchmark, this study proposes a transfer of knowledge and practice to Staničenje, a village near Pirot in southeastern Serbia. Nestled in the shadow of the Stara Planina mountains, Staničenje holds a lesser known but historically significant legacy in cheese maturation. From the mid-20th century, the natural cave in this village functioned as a low-energy, ecologically sustainable maturation chamber for Pirot kačkavalj cheese—exported globally and revered for its unique flavor, enhanced by the cave’s naturally regulated microclimate. Unlike modern industrial cheese production, the Staničenje cave exemplifies a form of rural heritage practice that is both environmentally and economically sustainable yet underutilized in Serbia’s current tourism and development frameworks. Moreover, the research identifies *Sokobanja*, a prominent spa and wellness destination, as another untapped opportunity. Known for its karstic geological features, Sokobanja has numerous caves that could potentially be adapted for cheese aging—opening a path for the development of a geographically specific product such as *Sokobanja kačkavalj*. Integrating cheese production with wellness tourism would create a unique tourism blend: nature, health, and gastronomy, thus broadening the destination’s appeal while fostering local pride and sustainable livelihoods.

This leads to the central hypothesis of this study H: Local gastronomic products with strong cultural and heritage value—such as cave-aged cheeses like Roquefort or Pirot kačkavalj cheese—can serve as central elements in shaping destination identity and motivating sustainable rural tourism development through authentic, multisensory, and heritage-based experiences. By applying insights from the case of Roquefort-sur-Soulzon, this study aims to establish a replicable model for revitalizing similar destinations through cheese heritage tourism. It highlights the potential of multisensory, place-based experiences to foster emotional engagement, cultural learning, and sustainable travel behaviors—while contributing to rural economic resilience.

The findings reveal three principal components, namely Traditional Gastronomy, Cheese Experience, and Heritage Tourism, which justified 84.781% total variance on tourist motivations. Major gastronomy tradition offers substantial motivation for tourists through true, meaningful, and multi-sensorial experience which involves feelings toward cultural heritage and local identity. There is anticipation of taste, smell, and visual appeal which will spice up the desire to explore and consume the place through the local cuisine; the traditional dishes are symbols of place and craftsmanship. This is the sort of duality that Roquefort cheese has. It is not only a culinary attraction but also an emblem of heritage that enhances tourist involvement through experiential learning, through educational interactions, and through emotional resonance, ultimately anchoring the relationship of food, culture, and place. This study does not only advance theoretical insights in gastronomic and heritage tourism but also fulfills a strategic objective to inspire heritage-based rural revitalization in places like Pirot and Sokobanja by reactivating their authentic resources that have been overlooked for quite a long time—natural caves for cheese ripening, traditions of making artisan cheese, and identities for culinary traditions.

Despite growing recognition of local gastronomic products as drivers of rural tourism and destination identity, there remains a lack of empirical research specifically linking cave-aged cheese heritage with sustainable rural tourism development. While prominent

cases like Roquefort-sur-Soulzon are well documented, less attention has been paid to comparable but underutilized contexts in Eastern Europe, particularly Serbia. Existing literature often overlooks the integration of natural cave environments as authentic, low-impact maturation spaces with tourism potential. Moreover, few studies have quantitatively investigated the specific tourist motivations tied to these unique heritage food products, leaving a gap in understanding how such culinary traditions can be strategically mobilized to foster sustainable destination branding and economic resilience in lesser-known rural areas. This study addresses these gaps by offering a novel, comparative analysis of cave-aged cheese tourism, combining a well-established model from Roquefort-sur-Soulzon with an emerging Serbian context. By applying quantitative methods grounded in positivist epistemology—specifically factor analysis and Structural Equation Modeling (SEM)—this research empirically identifies key motivational factors behind cheese-related tourism. It contributes to the broader fields of gastronomic and heritage tourism by demonstrating how multisensory, authentic culinary experiences rooted in cultural heritage and place identity can serve as catalysts for sustainable rural development. The study advances theoretical understanding of food heritage as a multidimensional construct that bridges culture, economy, and tourism, while offering practical insights for rural revitalization initiatives in Serbia and similar regions.

The paper is organized as follows: Section 2 provides a comprehensive literature review on local gastronomic products, heritage tourism, and sustainable rural development, with a particular focus on cave-aged cheeses. Section 3 details the materials and methods, including the survey design and the quantitative approach used to analyze tourist motivations. Section 4 presents the results of the factor analysis and Structural Equation Modeling (SEM), identifying the key motivational components. Section 5 offers a detailed discussion of the findings, structured into six subsections: Section 5.1 examines Traditional Gastronomy as a multisensory and motivational driver (H1 & H2); Section 5.2 explores Roquefort cheese as a central experiential anchor (H3 & H4); Section 5.3 discusses cultural and rural authenticity as catalysts for immersive experiences (H5 & H6); Section 5.4 analyzes interactions between identified factors in rural cheese tourism; Section 5.5 interprets the findings in light of existing literature; and Section 5.6 outlines practical implications for rural tourism development. Finally, Section 6 concludes the study by summarizing key insights, outlining limitations, and suggesting directions for future research. The Appendix A includes the full survey questionnaire used in this study.

2. Literature Review

The cultural significance and culinary heritage of traditional gastronomy are deeply rooted in the stories and practices that have evolved over centuries. Each regional dish is more than just a culinary experience; it is a narrative that reflects the diverse cultural backgrounds and historical contexts from which it originates [35]. Understanding the origins and evolution of these dishes not only enhances our appreciation of their cultural and historical significance but also highlights how culinary practices have adapted over time, influenced by geographical, social, and environmental factors [39]. This exploration into traditional cuisine reveals the intricate connections between food, culture, and history, offering insights into a region's past and its evolution, which in turn informs its present identity [40]. Culinary traditions, passed down through generations, serve as a testament to the enduring nature of cultural heritage, underscoring the importance of documenting and preserving these practices to ensure their survival in an ever-changing world [41–43]. The preservation of regional dishes and their cooking techniques not only celebrates the culinary heritage of various ethnic groups but also plays a crucial role in maintaining cultural identity and promoting understanding across different communities [44]. Therefore, it is

essential for stakeholders, including local communities and policymakers, to collaborate to protect and promote the culinary heritage, ensuring that these rich traditions continue to thrive and enrich our global cultural landscape [45].

The art and science of cheese crafting are intricately intertwined, showcasing a balance between tradition and innovation that is crucial in creating distinct flavor profiles. The journey of understanding these flavors is a sensory exploration that involves both artistic interpretation and scientific understanding. Each cheese is a narrative of its origins, influenced by factors such as the type of milk used and the cheesemaking methods, all of which contribute to its unique character [46]. The process of aging further refines the cheese, allowing the development of rich and complex flavors that are essential to its identity [47]. This intricate interplay of elements not only enhances the sensory experience but also connects enthusiasts to the cultural and historical aspects of cheesemaking [48]. By engaging in cheese tastings, individuals can develop a refined palate, enabling them to recognize and appreciate the nuanced characteristics of different cheese styles [49]. Ultimately, the appreciation of cheese is not just about taste but also about understanding the cultural significance and the artistic expression embodied in each artisanal creation [50].

Tourists are attracted by opportunities for immersive experiences, such as guided visits to natural caves used for aging cheese, tasting local products, and engaging with producers who embody generational knowledge [51]. This form of tourism provides a symbolic escape from modernity while enabling a reconnection with sustainable and traditional ways of life [52]. Comparable motivations have been identified in other heritage-rich rural areas. According to Poggi et al. [53], in Tuscany's Val d'Orcia, tourists are drawn by its UNESCO-protected cultural landscape, historic hilltop towns, and traditional agricultural practices. Similarly, in the Spanish region of La Rioja, visitors seek out wine tourism experiences that combine rural aesthetics, local gastronomy, and deep-rooted cultural narratives [54]. In both cases, as in Roquefort-sur-Soulzon, travelers are motivated not only by scenic beauty but by a desire to connect with local identity, sustainability values, and living traditions [55].

According to Karoui et al. [56], in Gruyères, Switzerland, visitors are attracted by the picturesque Alpine setting and the opportunity to witness traditional Gruyère cheese-making in artisanal fromageries. The destination offers immersive visitor experiences, including cheese museums, tasting sessions, and educational workshops, all framed within a strong sense of heritage and regional pride. According to Mauricio et al. [57], the Parmigiano Reggiano region in Emilia-Romagna, Italy, draws culinary tourists eager to observe the aging process in large cheese warehouses and learn about centuries-old methods preserved by local consortia. These destinations, like Roquefort-sur-Soulzon, appeal to travelers who value authenticity, craftsmanship, and sustainable food heritage [58]. In this context, cave-aged cheese transcends its role as a gastronomic product and becomes a symbolic asset through which destination identity is constructed and communicated. The sensory uniqueness, production setting, and cultural narratives embedded in the cheese contribute directly to place branding, allowing destinations such as Roquefort-sur-Soulzon to distinguish themselves within competitive rural tourism markets [59].

In each of these cases, the combination of rural atmosphere, gastronomic tradition, and cultural storytelling forms a compelling tourism proposition [60]. Visitors are not merely consuming products but participating in a cultural ritual, making such destinations ideal for those motivated by immersive heritage experiences [61]. These dynamics can be interpreted through the lens of experiential tourism theory, where visitors seek not only consumption but active participation and emotional connection with place [62]. The concept of cultural capital is also relevant, as local products like Roquefort cheese carry symbolic value that enriches both personal experience and community identity. Roquefort-sur-Soulzon thus

exemplifies how cheese tourism can serve as a vehicle for rural cultural revitalization, sustainability awareness, and experiential travel [60]. These parallels highlight a broader trend in rural tourism, where authenticity, heritage, and immersive learning form the core of the visitor experience [63]. Consequently, Roquefort-sur-Soulzon stands as a representative case of how rural destinations can leverage cultural capital and sustainability to attract meaning-seeking tourists.

3. Materials and Methods

The total number of valid respondents in the survey was 416. Roquefort-sur-Soulzon, renowned for its iconic blue cheese matured in natural caves, attracts a significant number of tourists annually. Estimates suggest that the village receives approximately 200,000 visitors each year. As stated by Ahmed [64], for a tourist population of 200,000, with a confidence level of 95% and a margin of error of 5%, the optimal sample size is determined to be 384 respondents. Therefore, the sample from Roquefort-sur-Soulzon that took part in the study is both valid and reliable.

The gender distribution was relatively balanced, with a slight predominance of male participants (52.2%) over females (47.8%). This gender ratio suggests a nearly equal representation, allowing for a reasonably gender-neutral interpretation of the survey results. In terms of age structure, the sample was predominantly composed of middle-aged and older adults. The largest age group was between 45 and 54 years (40.1%), followed by the 55 to 64 age category (28.8%), and respondents over 65 years of age (16.3%). Younger age groups were less represented, with only 2.4% in the 18–24 range and 5.5% in the 25–34 bracket. This distribution indicates that the study largely reflects the attitudes and behaviors of more mature tourist segments, which may influence the findings, particularly in the context of cultural and gastronomic tourism where older demographics are often more engaged. Educational attainment among respondents was predominantly at the secondary level. A total of 66.3% had completed high school, while 27.2% held a college or faculty degree. Only 2.9% had attained a postgraduate (Master or Ph.D.) level of education, and a small minority (3.6%) reported having completed only elementary education. The dominance of respondents with high school and tertiary education levels suggests a population with moderate to strong educational backgrounds, suitable for analyzing perceptions related to food heritage, tourism, and sustainability. Overall, the demographic profile suggests that the sample is composed mainly of older, moderately to well-educated individuals, with a balanced gender distribution—an important consideration for interpreting motivations and preferences related to cheese heritage tourism.

This study adopts a positivist epistemological approach, aiming to objectively investigate the relationships between tourist motivations, gastronomic experiences, and perceptions of cultural and heritage values in rural cheese-producing destinations. Rooted in a deductive research paradigm, the study tests theoretical assumptions through empirical observation, using statistical analysis to confirm or refute hypotheses regarding the role of local gastronomic products—such as Roquefort or Kačkavalj cheese—in sustainable rural tourism development and destination identity formation. A quantitative research design was employed, involving the development and administration of a structured questionnaire. The instrument was based on previously validated constructs in tourism and gastronomic motivation research and adapted to fit the specific context of cheese heritage. The questionnaire used in this study was developed based on previously validated constructs from studies on food tourism, rural tourism, and tourist motivation. The items were adapted to fit the specific context of Roquefort-sur-Soulzon, a destination known for its cheese heritage and rural character. The constructs—such as cultural heritage motivation, gastronomic interest, hedonism, authenticity seeking, sustainability orientation, and trend

sensitivity—were informed by prior research, including works by Björk and Kauppinen-Räsänen [65], Kivela and Crofts [66], Kim et al. [67], Sims [68], and Getz and Robinson [69]. These studies provided the foundation for operationalizing motivational dimensions relevant to food-based and rural tourism experiences. Items were slightly modified in wording to ensure contextual relevance while retaining their original conceptual intent. The majority of respondents in the survey conducted in Roquefort-sur-Soulzon were international tourists, accounting for 52.4% of the total sample, while domestic visitors from France constituted 47.6% ($n = 198$ out of 416). The international segment was composed primarily of tourists from Germany (12.5%), followed by the United Kingdom (8.7%), Spain (8.7%), the Netherlands (7.7%), Belgium (6.7%), the United States (4.8%), and Japan (3.4%). This international diversity underscores the transnational appeal of Roquefort-sur-Soulzon as a gastronomic and cultural destination. Regarding travel distance, while exact kilometer measurements were not captured in the questionnaire, the geographic spread of the visitors indicates a combination of medium- and long-haul tourism, with European tourists primarily originating from neighboring or proximate countries, and a smaller proportion of long-distance travelers from North America and Asia. The presence of such varied origin points suggests that Roquefort-sur-Soulzon is perceived not merely as a regional attraction, but as a destination of international interest, particularly in the context of food heritage tourism. In terms of visit motivation, the results from the motivational scale and subsequent factor analysis clearly indicate that cheese-related experiences were a primary driver for the visit rather than a complementary activity. The second extracted factor—labelled Cheese Experience—demonstrated strong loadings on items such as Cheese Heritage (0.910), Culinary Exploration (0.836), and Cheese Indulgence (0.779). These findings reveal a specific and focused interest among tourists in engaging with Roquefort cheese both as a product and as a cultural-symbolic object. High agreement scores on statements like “The opportunity to taste authentic, local cheese motivated me to visit Roquefort-sur-Soulzon” and “Learning about the history of Roquefort cheese was a major reason for my visit” confirm the centrality of cheese to the travel motivation. These results support the conclusion that cheese tourism in Roquefort-sur-Soulzon functions as a core tourism motivator, rather than a secondary or peripheral interest. The integration of culinary and heritage experiences contributes to the destination’s attractiveness, particularly for tourists seeking authentic, localized, and educational food-related experiences.

Items were measured using a five-point Likert scale, capturing degrees of agreement with statements related to traditional gastronomy, cheese-specific experiences, and heritage tourism values. The research was conducted during the summer months of 2024, when the number of visits to these caves is the highest. Data were collected on-site in Roquefort-sur-Soulzon, a rural destination recognized for its strong integration of gastronomic and heritage tourism. The primary site for survey administration was the Société Caves, the most prominent cheese-aging facility in the village, which attracts over 200,000 visitors annually. The data collection was conducted using a convenience sampling approach, targeting visitors at key tourist touchpoints such as cheese producers (Roquefort Gabriel Coulet and Papillon) offering guided tours and tastings, as well as along the hiking trails of the Parc Naturel Régional des Grands Causses. This approach was chosen to capture a diverse range of visitor profiles and motivations within the practical constraints of the fieldwork setting.

This methodological framework enables a structured examination of the central hypothesis H: that local gastronomic products with strong cultural and heritage value—such as cave-aged cheeses like Roquefort or Pirot kashkaval cheese—can serve as central elements in shaping destination identity and motivating sustainable rural tourism development through authentic, multisensory, and heritage-based experiences.

Bearing in mind that this research should set a model according to which similar destinations could be developed all over the world, it was necessary to set several key sub-hypotheses.

H1. *The multisensory experience of consuming traditional gastronomy (taste, smell, sight, touch) enhances tourists' emotional and hedonic satisfaction, leading to a stronger desire to engage in food-related activities during their visit.*

H2. *Tourists are more motivated to consume traditional gastronomy when it is perceived as an authentic representation of local heritage, which enhances their desire to understand the destination's cultural identity.*

To test these sub-hypotheses, the authors asked two conceptual questions: *How does the availability of traditional gastronomy lead to tourist motivation? and Why does traditional gastronomy motivate tourists to explore and consume on-site?*

H3. *The heritage and cultural significance of Roquefort cheese motivate tourists to prioritize it as a key experiential activity during their visit, as they seek to engage with both the product and its historical narrative.*

H4. *Tourists are more motivated to engage with Roquefort cheese when the product's heritage and artisanal status evoke emotional and intellectual curiosity, enhancing their desire to learn about its production and history.*

To test these sub-hypotheses, the authors asked two conceptual questions: *How does the availability and heritage of Roquefort cheese lead to desire to taste, learn about, and enjoy Roquefort cheese as a central component of the travel experience? and Why does the availability and heritage of Roquefort cheese produce this effect (Tourists' desire to taste, learn about, and enjoy Roquefort cheese as a central component of their travel experience)?*

H5. *Tourists are more likely to engage in authentic cultural experiences (e.g., attending local festivals, participating in traditional food preparation) when they perceive these experiences as opportunities for self-discovery and personal connection to local identity.*

H6. *The perceived contrast between rural and culturally rich environments and urbanized, globalized settings increases tourists' desire for immersive cultural experiences, providing emotional resonance and a sense of escape from their daily routines.*

To test these sub-hypotheses, the authors asked two conceptual questions: *How does cultural and rural authenticity lead to immersive heritage experiences? and Why does cultural and rural authenticity trigger desire for meaningful and immersive heritage experiences?*

The subsequent task involved the application of factor analysis, which distinguished three distinct factors: Traditional Gastronomy, Cheese Experience and Heritage Tourism. Tourists were presented with a collection of 35 variables (Appendix A) that required responses on a five-point Likert scale: 1—Strongly Disagree, 2—Disagree, 3—Neutral, 4—Agree, and 5—Strongly Agree. The equation:

$$X_i = \lambda_1 F_1 + \lambda_2 F_2 + \lambda_3 F_3 + \varepsilon_i$$

represents a common factor model, frequently applied in factor analysis to explain the variance in an observed variable (X_i) as a linear combination of multiple latent factors and a residual error term. In this context, the observed variable X_i (e.g., an individual survey

item measuring tourist motivations or preferences) is modeled as being influenced by three latent constructs: $F1$: Traditional Gastronomy, $F2$: Cheese Experience, and $F3$: Heritage Tourism. Each of these latent factors (F) captures the shared variance among a set of observed indicators that reflect a common underlying dimension of tourist experience. The coefficients λ_1 , λ_2 , and λ_3 are referred to as factor loadings; they quantify the strength and direction of the relationship between the latent factors and the observed variable. Higher loading values suggest a stronger association between the factor and the observed indicator. The term ϵ_i denotes the unique variance of the observed variable—including measurement error and any variance not accounted for by the latent factors. It ensures that the model distinguishes between shared (common) variance and specific variance inherent to the indicator. The purpose of this model is to reduce dimensionality and to uncover the underlying structure of observed tourist responses. This type of modeling is instrumental in tourism research, as it allows researchers to identify and validate key motivational dimensions influencing tourist behavior. By using factor analysis, one can empirically group related motivations and better understand how different experiential components—such as gastronomy, cheese production, and cultural heritage—interact in shaping tourism demand.

After the extraction of latent constructs through Exploratory Factor Analysis (EFA), the study advanced to the application of Structural Equation Modeling (SEM). This analytical step is essential for providing a robust framework to test the theoretical model, allowing for simultaneous estimation of multiple interrelated dependence relationships.

$$Y = \beta X + \zeta Y$$

where Y represent tourists' motivation to engage in cultural and gastronomic activities, β the effect of perceived authenticity on motivational engagement, X perceived authenticity of traditional gastronomy (e.g., heritage value of Roquefort cheese) and ζY as unobserved factors affecting motivation (e.g., personal preferences, prior experiences, or other external influences). One of the key advantages of SEM lies in its ability to model complex causal pathways between observed and latent variables, incorporating both measurement and structural components. In the context of this research, the factors derived—Traditional Gastronomy, Cheese Experience, and Heritage Tourism—are hypothesized to be interconnected constructs that jointly influence tourists' emotional satisfaction and behavioral intentions, such as their willingness to revisit the destination. SEM enables the examination of these relationships within a comprehensive framework, offering insights not only into the direct effects of each factor on outcome variables, but also into potential mediating or moderating effects that may exist among them. By applying SEM, the study seeks to validate the proposed hypotheses and assess the overall fit of the conceptual model, thereby contributing to the theoretical and practical understanding of how gastronomic heritage influences sustainable rural tourism behavior.

Roquefort-sur-Soulzon as a Model Destination for Cheese Heritage Tourism

Roquefort-sur-Soulzon, a village located in the Aveyron department of southern France's Massif Central region, represents a paradigmatic case of how a local gastronomic product can anchor a sustainable rural tourism model [70]. As the sole authorized maturing zone for the world-renowned Roquefort cheese, this commune holds a distinguished status protected by the Appellation d'Origine Protégée (AOP) designation. The natural caves of Combalou Mountain provide the unique microclimatic conditions essential for the maturation of Roquefort cheese, thereby linking the product inextricably with its geographic and cultural terroir [71]. The village has strategically leveraged this cheese heritage to develop a multi-dimensional tourism offering that integrates sensory experience,

heritage interpretation, and local economic support. A central component of this strategy is the cave tours and cheese museums operated by major producers such as Société, Papillon, and Gabriel Coulet [71]. These guided visits offer tourists insights into the natural geology of the Combalou caves, the artisanal cheese-aging process, and the historical narratives surrounding Roquefort production. The dramatic and naturally ventilated caves serve not only as production spaces but also as immersive heritage sites that reinforce the authenticity and specificity of the product. Tasting experiences and on-site retail further enhance the tourist encounter, offering visitors the opportunity to sample a variety of Roquefort cheeses paired with regional wines or culinary products. These experiences culminate in direct purchases from producers, fostering short food supply chains and reinforcing the role of local food systems in rural tourism economies. Roquefort-sur-Soulzon plays an integral role in broader agri-tourism and gastronomic networks, such as the “Route des Fromages AOP” in the Occitanie region [72]. These routes combine cheese-focused tourism with farm visits, artisan food workshops, and dining experiences in local establishments that feature Roquefort-based cuisine. Through these regional collaborations, Roquefort is positioned not only as a singular destination but as a node within a broader cultural landscape of French food heritage [73].

The cultural significance of Roquefort is also celebrated through festivals and local events, which include fairs, workshops, culinary demonstrations, and storytelling performances that underscore cheese as a marker of local identity. These activities contribute to community engagement and deepen the visitor’s understanding of the cultural context surrounding the product. The destination places a strong emphasis on education around the AOP system and the concept of terroir [71]. By elucidating the strict geographic and methodological requirements that define Roquefort production, local stakeholders use tourism as a vehicle for promoting food authenticity, heritage conservation, and consumer awareness of geographic indications (GI). This educational dimension reinforces the unique relationship between place, production, and cultural value. As a case study, Roquefort-sur-Soulzon exemplifies how a local gastronomic product can function as a catalyst for sustainable rural tourism, one that interweaves sensory pleasure, cultural depth, and local development. The village stands as a benchmark for other rural destinations—such as Pirot or Sokobanja (Serbia), where cheese production and cave-based natural heritage also exist—demonstrating how place-based food identity can be transformed into an immersive and resilient tourism offering.

4. Results

To explore the underlying motivational dimensions driving visitation to Roquefort-sur-Soulzon—a destination renowned for its cheese heritage—an exploratory factor analysis (EFA) was conducted. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy was 0.754, indicating an acceptable level of shared variance among variables, while Bartlett’s Test of Sphericity yielded a highly significant result ($\chi^2 = 4152.815$, $df = 45$, $p < 0.001$), confirming the data’s suitability for factor analysis (Table 1).

Table 1. KMO and Bartlett’s Test.

Kaiser–Meyer–Olkin Measure of Sampling Adequacy.	0.754	
Bartlett’s Test of Sphericity	Approx. Chi-Square	4152.815
	df	45
	Sig.	0.000

Source: Table created by the authors.

Three distinct factors were extracted based on eigenvalues greater than 1, cumulatively accounting for 84.781% of the total variance (Table 2).

Table 2. Total Variance Explained.

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.522	45.222	45.222	2.033	20.334	20.334	3.368	33.676	33.676
2	2.067	20.674	65.896	3.121	31.213	51.547	2.720	27.198	60.874
3	1.888	18.885	84.781	2.875	28.748	80.295	1.942	19.421	80.295
4	0.557	5.569	90.350						
5	0.363	3.631	93.981						
6	0.225	2.251	96.232						
7	0.149	1.490	97.722						
8	0.112	1.115	98.837						
9	0.076	0.763	99.600						
10	0.040	0.400	100.000						

These factors reflect coherent thematic groupings related to gastronomy, sensory experience and heritage, as follows (Table 3):

- **Traditional Gastronomy (Factor 1):** This factor captures tourists' appreciation for regional and traditional food practices. It comprises high loadings from items such as: Food Heritage and Local Tasting. These results indicate that visitors are strongly motivated by the opportunity to engage with authentic local culinary practices, with a particular emphasis on cheese tasting and traditional food systems. Tourists' exposure to traditional food production and local tasting opportunities leads to a heightened appreciation for regional gastronomy. The strong association with Food Heritage and Local Tasting indicates that engagement with authentic culinary practices results in the motivation to travel to destinations known for their traditional food systems. The cause—availability of traditional gastronomy—leads to the effect—motivation to explore and consume regional products on-site.
- **Cheese Experience (Factor 2):** The second factor is centered on the specific experiential appeal of Roquefort cheese. It is defined by the following items: Cheese Heritage, Authentic Tasting, Culinary Exploration, Cheese Indulgence. This dimension highlights the destination's strong identity as a gastronomic attraction, with visitors motivated by opportunities to taste, explore, and indulge in Roquefort cheese as a key part of their travel experience. The prominence of Roquefort cheese as a culturally and gastronomically significant product causes tourists to associate the destination with a unique culinary identity. High loadings for Cheese Heritage, Authentic Tasting, Culinary Exploration, and Cheese Indulgence demonstrate that this product-centric experience stimulates curiosity, sensory exploration, and indulgence, thereby driving travel motivation. The cause—availability and heritage of Roquefort cheese—produces the effect—desire to taste, learn about, and enjoy cheese as a central component of the travel experience.
- **Heritage Tourism (Factor 3):** This factor reflects a broader cultural and heritage-oriented motivation for visiting Roquefort-sur-Soulzon. Items with strong loadings include Cultural Heritage, Cultural Immersion, Rural Escape, and Sustainable Traditions. These variables indicate that many tourists seek meaningful connections with the destination's rural and cultural identity, including traditional lifestyles, sustainability values, and immersive experiences in a tranquil setting. The presence of cultural

heritage elements and a rural environment leads tourists to seek immersion in local traditions and values. The factor includes Cultural Heritage, Cultural Immersion, Rural Escape, and Sustainable Traditions, showing that when tourists perceive a destination as rich in heritage and aligned with sustainability, it leads to the motivation to connect more deeply with place identity and to engage in culturally oriented travel behavior. The cause—cultural and rural authenticity—results in the effect—search for meaningful and immersive heritage experiences.

Table 3. Factor Loadings for Tourist Motivations Related to Gastronomy, Heritage, and Cheese Experiences.

	Factor(s)		
	Traditional Gastronomy	Cheese Experience	Heritage Tourism
Cultural Heritage	−0.225	0.203	0.756
Cheese Heritage	−0.134	0.910	0.312
Food Heritage	0.999	0.003	0.013
Cultural Immersion	−0.098	−0.087	0.987
Authentic Tasting	−0.078	0.807	0.224
Culinary Exploration	−0.120	0.836	0.388
Local Tasting	0.952	−0.059	0.063
Cheese Indulgence	−0.126	0.779	0.409
Rural Escape	−0.114	−0.147	0.779
Sustainable Traditions	0.009	0.129	0.707

To ensure interpretability, individual questionnaire items were grouped under the three extracted factors based on their highest loadings and conceptual coherence: Factor 1: Traditional Gastronomy—This dimension captures tourists’ motivation to explore the destination through local food practices. It includes items such as Food Heritage (loading = 0.999), Local Tasting (0.952), and Sustainable Traditions (0.707). These items reflect interest in traditional, sustainable, and locally rooted culinary experiences that go beyond mere consumption to include ethical and cultural considerations. Factor 2: Cheese Experience—This factor represents a specific attraction to the Roquefort cheese itself, emphasizing experiential and sensory engagement. It includes items such as Cheese Heritage (0.910), Authentic Tasting (0.807), Culinary Exploration (0.836), and Cheese Indulgence (0.779). These reflect tourists’ desire to engage with the production, taste, and historical context of Roquefort cheese as a core part of their visit. Factor 3: Heritage Tourism—This dimension encompasses broader cultural motivations for travel, linked to a desire for immersion in local identity and rural escape. Items loading strongly here include Cultural Immersion (0.987), Cultural Heritage (0.756), and Rural Escape (0.779), which represent motivations to understand the culture, environment, and heritage of the region in a deeper, more meaningful way. The high loadings (all ≥ 0.70) indicate strong internal consistency and validate the conceptual grouping of questionnaire items under each motivational factor.

The presented Structural Equation Model (SEM) examines the complex interrelations between three latent constructs—Traditional Gastronomy (F1), Cheese Experience (F2), and Heritage Tourism (F3)—in the context of rural gastronomic tourism, using Roquefort-sur-Soulzon as the case study (Figure 1). The model tests how these latent variables influence tourist motivation and behavior, especially in relation to consuming and experiencing locally significant products such as Roquefort cheese. Factor 1: Traditional Gastronomy

(F1) is conceptualized as a core motivational dimension reflecting tourists' appreciation for destinations with a strong gastronomic identity. It is operationalized through two indicators: Food Heritage (FH), which measures the value tourists place on traditional food production methods, and Local Tasting (LT), which captures the importance of sampling local cheese during their stay. The factor loadings for FH (1.00) and LT (1.17) indicate a strong alignment with the latent variable, confirming that traditional gastronomy is a key experiential component of the destination's identity.

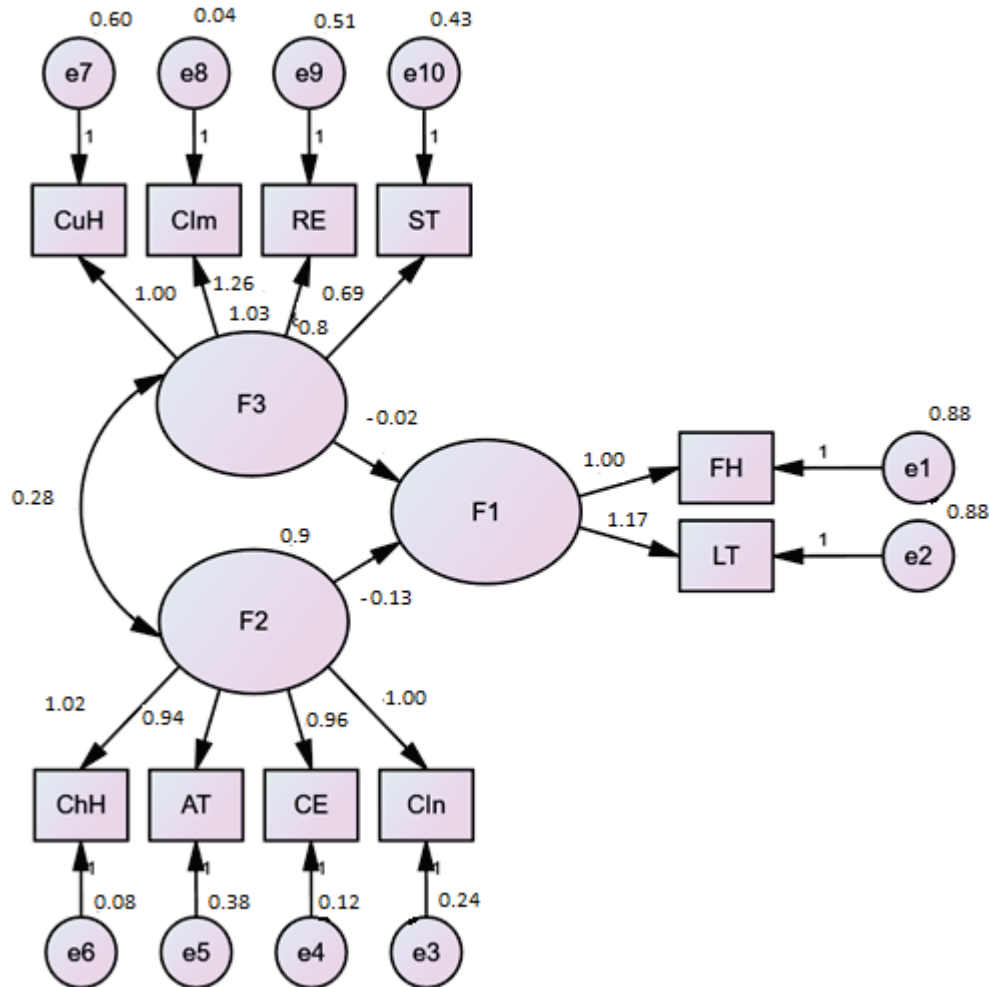


Figure 1. Structural Equation Modeling (SEM). Source: Prepared by the authors (2025).

Factor 2: Cheese Experience (F2) represents the experiential and emotional engagement with the iconic product—Roquefort cheese. It includes four observed variables: Cheese Heritage (ChH), Authentic Tasting (AT), Culinary Exploration (CE), and Cheese Indulgence (CIn). High standardized loadings (ranging from 0.94 to 1.02) suggest that this factor effectively captures the depth of tourist interaction with cheese as a cultural, sensory, and learning experience. This construct reflects tourists' desires to engage with the product both hedonically and intellectually.

Factor 3: Heritage Tourism (F3) captures broader motivational dimensions tied to the cultural and rural context of the destination. It includes Cultural Heritage (CuH), Cultural Immersion (Clm), Rural Escape (RE), and Sustainable Traditions (ST). These variables represent tourists' motivations to connect with local customs, escape from urban routines, and support sustainable practices. The factor loadings range from 0.69 to 1.26, indicating a heterogeneous yet coherent construct that connects cultural identity with the appeal of rural, tradition-based tourism. In the structural equation model (SEM), the labels e1–e10

represent the error terms associated with each observed variable, which are survey items grouped under the latent constructs (Traditional Gastronomy, Cheese Experience, Heritage Tourism). These error terms account for the variance in the observed variables that is not explained by the latent factors.

The results of the exploratory factor analysis (EFA) and structural equation modeling (SEM) provide empirical support for several of the proposed hypotheses: H1: “The multisensory experience of consuming traditional gastronomy (taste, smell, sight, touch) enhances tourists’ emotional and hedonic satisfaction, leading to a stronger desire to engage in food-related activities during their visit”. → Supported by the strong factor loadings of Food Heritage (0.999) and Local Tasting (0.952) within the Traditional Gastronomy factor. These findings indicate that sensory and hedonic elements of food consumption significantly contribute to tourists’ motivation; H2: “Tourists are more motivated to consume traditional gastronomy when it is perceived as an authentic representation of local heritage, which enhances their desire to understand the destination’s cultural identity”. → Confirmed through the significant contribution of Authentic Tasting (0.807) and Culinary Exploration (0.836) under the Cheese Experience factor, highlighting the role of authenticity in shaping gastronomic motivation; H3: “The heritage and cultural significance of Roquefort cheese motivate tourists to prioritize it as a key experiential activity during their visit, as they seek to engage with both the product and its historical narrative”. → Empirical support is evident from Cheese Heritage (0.910) and Cheese Indulgence (0.779) loading strongly on the Cheese Experience factor, indicating that the cultural narrative surrounding Roquefort cheese is a key experiential driver; H4: “Tourists are more motivated to engage with Roquefort cheese when the product’s heritage and artisanal status evoke emotional and intellectual curiosity, enhancing their desire to learn about its production and history”. → Supported by the inclusion of Culinary Exploration and Authentic Tasting, which represent affective and cognitive dimensions of curiosity, and their high loadings within the Cheese Experience factor; H5: “Tourists are more likely to engage in authentic cultural experiences (e.g., attending local festivals, participating in traditional food preparation) when they perceive these experiences as opportunities for self-discovery and personal connection to local identity”. → Supported by high factor loadings of Cultural Immersion (0.987) and Cultural Heritage (0.756) on the Heritage Tourism factor, demonstrating that visitors are drawn to cultural identity and meaning; H6: “The perceived contrast between rural and culturally rich environments and urbanized, globalized settings increases tourists’ desire for immersive cultural experiences, providing emotional resonance and a sense of escape from their daily routines”. → Strongly supported by Rural Escape (0.779) and Sustainable Traditions (0.707), confirming that the rural character of Roquefort-sur-Soulzon provides an emotional and experiential counterpoint to tourists’ everyday urban lives. The SEM model further confirms the structural relationships among the three latent factors and their contribution to the overarching motivational framework, reinforcing the multidimensional nature of tourist engagement with food, culture, and heritage. All of the model fitting indicators indicates an acceptable fit. A RMSEA value of 0.060 (between 0.050 and 0.080) indicates a good fit. Higher values (>0.90) of CFI (0.968), TLI (0.948) and GFI (0.930) indicates a good fit.

The standardized regression weights (Table 4) from a Structural Equation Modeling (SEM) analysis reveals the complex relationships between three latent constructs that capture different dimensions of tourist motivation in the context of cheese-centered rural tourism: Traditional Gastronomy (F1), Cheese Experience (F2), and Heritage Tourism (F3). A key finding from the model is the strong and negative relationship between F2 (Cheese Experience) and F1 (Traditional Gastronomy), with a standardized regression weight of -0.959 . This negative coefficient suggests a counterintuitive dynamic: while one might

expect deeper involvement in cheese-related experiences to reinforce appreciation for traditional gastronomy, the data indicate that visitors who are highly motivated by cheese-specific experiences may differentiate these from broader traditional food values. This may reflect a form of experiential specialization, whereby tourists are particularly drawn to the unique, immersive, and sensory attributes of Roquefort cheese and its production, and therefore engage with it as a standalone gastronomic attraction rather than as part of a broader culinary heritage framework. In contrast, the path from F3 (Heritage Tourism) to F1 (Traditional Gastronomy) is weak and negative (-0.112), suggesting that general heritage tourism motivations—such as interest in local culture, rural escape, and sustainability—have little explanatory power in shaping tourists' perceptions of traditional food culture in this specific context. This implies that while tourists value the cultural and historical context of Roquefort-sur-Soulzon, this appreciation does not necessarily extend to a broader engagement with traditional gastronomy unless it is explicitly tied to the cheese experience.

Table 4. Standardized Regression Weights: (Group number 1—Default model).

			Estimate
F1	<---	F2	−0.959
F1	<---	F3	−0.112
Food Heritage	<---	F1	0.136
Local Tasting	<---	F1	0.159
Cheese Indulgence	<---	F2	0.892
Culinary Exploration	<---	F2	0.936
Authentic Tasting	<---	F2	0.826
Cheese Heritage	<---	F2	0.961
Cultural Heritage	<---	F3	0.764
Cultural Immersion	<---	F3	0.986
Rural Escape	<---	F3	0.801
Sustainable Traditions	<---	F3	0.694

Factor F1: Traditional Gastronomy is defined by two observed variables: Food Heritage (0.136) and Local Tasting (0.159). These loadings are relatively low, indicating that this construct is not strongly defined in the current model. The low factor loadings suggest that visitors do not view traditional food heritage or tasting experiences as major stand-alone components of their tourism motivation, unless these are tied specifically to the cheese-related context (captured under F2). This may also imply the need for stronger interpretative frameworks at the destination level to better connect local gastronomy with cultural storytelling and tradition.

Factor F2: Cheese Experience, by contrast, emerges as a robust and highly coherent construct, with very high factor loadings: Cheese Indulgence (0.892), Culinary Exploration (0.936), Authentic Tasting (0.826) and Cheese Heritage (0.961). This indicates that visitors to Roquefort-sur-Soulzon are highly motivated by a comprehensive and authentic cheese-related experience, including its history, production methods, sensory qualities, and the opportunity for indulgence. These findings underscore the centrality of the cheese product as a destination identity marker, capable of attracting tourists who are not only food-oriented but also deeply engaged in culinary discovery. The extremely high loading on Cheese Heritage suggests that storytelling and educational components related to the origins and tradition of Roquefort cheese are particularly impactful.

Factor 3 F3: Heritage Tourism is also well-defined, though slightly less cohesive than F2. Its observed variables load strongly: Cultural Heritage (0.764), Cultural Immersion (0.986), Rural Escape (0.801) and Sustainable Traditions (0.694). The high loading on

Cultural Immersion indicates that experiencing the customs and lifestyle of the destination is of paramount importance. This supports the idea that Roquefort-sur-Soulzon is not merely seen as a site of production but as a living cultural landscape, where traditions, natural beauty, and rural charm play an integral role in the tourist experience. Furthermore, Rural Escape and Sustainable Traditions suggest that the destination appeals to values-driven tourists who seek peace, authenticity, and environmental or cultural sustainability.

5. Discussion

The results validate all six subhypotheses (Table 5), confirming the interconnected roles of traditional gastronomy, iconic food products like Roquefort cheese, and the authenticity of cultural and rural environments in motivating tourist behavior. Traditional gastronomy and cultural authenticity are not merely consumable features of a destination but serve as identity-building narratives through which tourists engage with place. The emotional and multisensory dimensions of food—particularly when tied to culturally significant items like Roquefort cheese—generate experiences that go beyond pleasure, entering the domains of meaning-making and identity expression. These findings enrich theoretical frameworks related to experiential tourism, cultural capital, and heritage consumption, particularly within rural tourism contexts.

Table 5. Summary Table.

Hypothesis	Supported By	Key Variables	Confirmed?
H1	Factor 1	Food Heritage and Local Tasting	Yes
H2	Factor 1	Food Heritage and Local Tasting	Yes
H3	Factor 2	Cheese Heritage, Authentic Tasting, Culinary Exploration and Cheese Indulgence	Yes
H4	Factor 2	Cheese Heritage, Authentic Tasting, Culinary Exploration and Cheese Indulgence	Yes
H5	Factor 3	Cultural Heritage, Cultural Immersion and Sustainable Traditions	Yes
H6	Factor 3	Cultural Heritage, Cultural Immersion, Rural Escape and Sustainable Traditions	Yes

5.1. Traditional Gastronomy as a Multisensory and Motivational Driver (H1 & H2)

The availability of traditional gastronomy acts as a powerful trigger for tourist motivation, providing opportunities for authentic, multisensory, and emotionally rewarding experiences. This directly addresses the first key research question: *How does the availability of traditional gastronomy lead to tourist motivation?* Findings show that sensory stimulation—particularly anticipation of taste, smell, and visual appeal—plays a key role in attracting tourists. The symbolic role of traditional food as a cultural signal reinforces the sense of authenticity and uniqueness of place. Tourists are drawn not only by the flavor itself but also by what the food represents: cultural heritage, craftsmanship, and a sense of place. When tourists are aware that a destination offers traditional cuisine, sensory anticipation is activated—sight, taste, smell, and even imagined texture come into play. This pre-travel activation is supported by promotional narratives, word-of-mouth, and media representations that imbue traditional foods with emotional and cultural significance. The presence of traditional dishes on-site transforms abstract interest into tangible action, reinforcing the motivation to explore and consume locally. These dynamics align with the notion that food acts as a pre-consumption attractor, where the promise of authenticity and multisensory pleasure becomes a travel motivator in itself. Additionally, the symbolic value of gastronomy

omy as a marker of identity supports the cultural dimension of motivation—tourists seek not just flavor but connection to place, heritage, and local life. This supports H1, confirming that the multisensory appeal of gastronomy significantly enhances emotional and hedonic satisfaction, which in turn motivates deeper engagement.

While initial motivations are shaped by sensory anticipation and symbolic associations, it is equally important to examine the underlying emotional and cultural dynamics that drive tourists toward direct, on-site engagement with local cuisine. This deeper perspective brings into focus a more nuanced layer of gastronomic tourism: *Why does traditional gastronomy motivate tourists to explore and consume on-site?* This question unpacks the deeper psychological and cultural motives behind tourist behavior. The findings highlight tourists' desire for authenticity, immersive sensory experiences, and emotional gratification. Food becomes a medium through which visitors perform identity, express values like sustainability and cultural appreciation, and access local narratives. Tourists are not merely drawn by flavor but by the embodied cultural experience that tasting provides. Food tourism becomes a form of lifestyle expression: engaging with slow, traditional food practices acts as a personal statement of values—authenticity, sustainability, and cultural curiosity. Consumption on-site allows tourists to integrate the destination's story into their own identity narratives, creating a sense of emotional and performative participation. Moreover, the hedonic and multisensory pleasure derived from local foods is intensified through narrative framing—stories of origin, craft, and tradition deepen the experience and embed it within the cultural landscape of the destination. Thus, gastronomy becomes a mechanism through which tourists simultaneously experience pleasure, meaning, and self-affirmation. These insights confirm H2, affirming that traditional gastronomy, when perceived as authentically linked to local heritage, becomes a compelling reason for tourists to seek out direct, on-site experiences.

Traditional gastronomy emerges as a strong motivational factor by offering tourists the opportunity for authentic, emotionally resonant, and multisensory experiences. This directly addresses the first research question: How does the availability of traditional gastronomy lead to tourist motivation? The data reveal that sensory anticipation—especially related to taste, smell, and visual appeal—significantly shapes travel intent. Traditional food operates as both a physical pleasure and a symbolic representation of cultural heritage, craftsmanship, and a sense of place. Tourists are not only drawn to the sensory qualities of traditional cuisine but also to its deeper meanings. Promotional materials, word-of-mouth, and media portrayals imbue these foods with emotional and cultural value even before travel begins. On-site experiences transform abstract interest into concrete engagement, as tourists actively seek out local dishes to explore and consume. This supports H1, affirming that the multisensory and emotional dimensions of traditional food enhance hedonic satisfaction and stimulate stronger tourist motivation. Going further, it is essential to ask: *Why does traditional gastronomy motivate tourists to explore and consume on-site?* Beyond anticipation, the desire for authenticity and emotional connection becomes central. Food becomes a cultural gateway through which tourists perform personal identity, express values such as sustainability and curiosity, and participate in local narratives. The act of eating local food becomes a statement about one's lifestyle and preferences, reinforcing a sense of belonging and emotional immersion. Narratives surrounding origin, craft, and tradition further deepen these experiences. Therefore, H2 is confirmed—when gastronomy is perceived as genuinely linked to local heritage, it not only attracts tourists but also fosters deep emotional and cultural engagement.

5.2. Roquefort Cheese as a Central Experiential Anchor (H3 & H4)

Roquefort cheese functions not only as a food product but as a heritage symbol, anchoring the tourist experience and shaping travel behavior. This is directly tied to the question: *How does the availability and heritage of Roquefort cheese lead to desire to taste, learn about, and enjoy it as a central component of the travel experience?* Roquefort cheese represents a prime example of how a product becomes a destination anchor. The findings confirm H3 by showing that the intertwining of product and place (through PDO status, artisanal methods, and historical prestige) enhances its attractiveness far beyond culinary interest. The ability to witness traditional production, interact with local cheesemakers, and explore the aging caves contributes to a deep engagement that is at once educational, sensory, and emotional. Tourists are not just tasting cheese—they are participating in a heritage narrative, accessing layers of place identity through the product. Roquefort becomes a focal point of the visit, with tourists prioritizing experiences around it—be it tours, tastings, or workshops—thus transforming the cheese into both a symbolic and embodied experience. Roquefort's PDO status, deep-rooted traditions, and strong place identity contribute to its elevated value in the eyes of tourists. The possibility to visit cheese caves, observe artisanal processes, and interact with local producers offers immediate and multisensory access, enhancing tourists' desire to consume and learn. This confirms H3, showing that Roquefort is not just consumed but experienced as part of the region's cultural identity.

In addition to its role as a gastronomic attraction, Roquefort cheese emerges as a powerful symbol of place-based identity, offering tourists a gateway into the cultural fabric of the region. To understand the depth of its impact on travel motivation and behavior, it is necessary to explore the mechanisms through which its heritage and availability generate such strong appeal: *Why does the availability and heritage of Roquefort cheese produce this effect?* H4 is confirmed by the synthesis of various motivators: sensory pleasure, intellectual stimulation, and cultural value. Roquefort cheese becomes more than a product—it is an object of cultural consumption, embodying the values and identity of the region. The tourists' motivation is enhanced by pre-travel expectations shaped by place branding and cultural discourse. Upon arrival, these expectations are met and often exceeded through multisensory experiences and behind-the-scenes access to production. The result is not merely enjoyment but meaningful learning and cultural appreciation. The cheese functions as a gateway into the regional way of life, reinforcing the travel experience as one of discovery, respect, and identity construction. In this way, food heritage contributes to a layered tourism experience, satisfying a spectrum of motives—emotional, cognitive, symbolic, and experiential. Findings indicate that the cheese's emotional, cultural, and intellectual appeal drives motivation. Its story, historical relevance, and artisanal production evoke curiosity and emotional connection. Tourists experience this product as a gateway to understanding local culture, reinforcing its status as a central part of the journey. Expectations formed before travel further amplify this effect, as tourists arrive with a pre-defined interest in engaging with the product. Thus, H4 is confirmed: the availability and symbolic value of Roquefort cheese create strong emotional and cognitive engagement, shaping tourists' behavior and anchoring it in the local heritage context.

5.3. Cultural and Rural Authenticity as a Catalyst for Immersive Experiences (H5 & H6)

Cultural and rural authenticity acts as a stimulus for immersive tourism, fostering emotional, cultural, and intellectual engagement. This is especially relevant for the research question: *How does cultural and rural authenticity lead to immersive heritage experiences?* Tourists respond to the presence of authentic cultural markers—such as architecture, food practices, and festivals—by actively seeking participatory experiences. These include hands-on involvement in traditions, rather than passive observation. Authenticity func-

tions here not as a passive backdrop but as an active catalyst—a perceived invitation for deeper exploration. Tourists respond to the contextual cues of authenticity (e.g., architectural styles, artisanal practices, local narratives) by seeking engagement rather than observation. This authenticity is experiential and embodied: travelers are invited to attend festivals, join workshops, or share meals prepared with traditional methods. These opportunities offer emotional depth and cultural intimacy, transforming the tourist from observer to participant. Immersion in authentic settings satisfies the postmodern tourist's need for meaning-making, creating transformative experiences rooted in emotional resonance and social connection. The second factor from the data confirmed that authenticity enhances emotional resonance and psychological fulfillment. This finding supports H5, emphasizing that authentic experiences promote self-discovery and deeper connection with local identity.

Beyond observable behaviors and preferences, it is also essential to explore the underlying psychological motivations that drive tourists toward immersive encounters with authenticity. This deeper layer of analysis addresses a key dimension of experiential tourism: *Why does cultural and rural authenticity trigger desire for meaningful and immersive heritage experiences?* The psychological mechanisms revealed through the data indicate that authenticity fulfills a search for meaning, contrast, and transformation. Tourists often escape urban routines to find simplicity, emotional depth, and historical continuity in rural environments. The narrative power of cultural practices allows tourists to feel part of a story, elevating their engagement. In confirming H6, the analysis underscores the internal psychological processes that are activated when tourists perceive authenticity. These mechanisms include identity-seeking (e.g., connecting with a purer, more rooted way of life), escapism (from the globalized, fast-paced world), and narrative immersion (the opportunity to “step into” a cultural story). The authentic environment functions like a stage upon which tourists project and perform their own desires for meaning, belonging, and discovery. The emotional and intellectual satisfaction derived from such engagement is profound, as it links leisure with personal growth and cultural capital acquisition. Rural spaces, in particular, act as psychological and symbolic counterpoints to urban life, reinforcing their appeal as meaningful and restorative destinations. These elements validate H6, illustrating how the contrast between rural authenticity and urban uniformity drives desire for transformative tourism experiences. Overall, the findings affirm that traditional gastronomy and cultural authenticity operate as more than static attractions—they are dynamic, multisensory, and symbolic resources that co-create meaning with tourists. This study thus contributes to a nuanced understanding of how emotional, sensory, and cultural factors intersect to shape contemporary rural tourism behavior and deepen place attachment.

5.4. Understanding Factor Interactions in Rural Cheese Tourism

The SEM reveals several important inter-factor relationships. Firstly, the structural model reveals a negative regression path from Cheese Experience (F2) to Traditional Gastronomy (F1) ($\beta = -0.13$). This inverse relationship may at first seem counterintuitive, as one might expect a positive association between specific and general gastronomic interests. However, a closer examination suggests a specialization effect: tourists who are highly motivated by cheese-related experiences (e.g., artisanal production, farm visits, curated tastings) may deliberately prioritize deep, niche engagements over broad culinary exploration. In this context, traditional gastronomy may be perceived as too generalized or commercialized, lacking the perceived authenticity or intimacy associated with localized cheese culture. This pattern could reflect a form of experiential segmentation, where tourists identify as “food specialists” (in this case, cheese connoisseurs or enthusiasts) rather than generalist food tourists. Such travelers might pursue immersive and educational

experiences tied to terroir, production methods, and artisanal heritage, which are distinct from the broader consumption-based experiences often marketed as traditional gastronomy. These findings align with literature emphasizing the rise of hyper-personalized and identity-driven tourism preferences, particularly in slow food and agri-tourism contexts.

Secondly, there is a moderate correlation between F2 and F3 (path coefficient = 0.28), confirming that cheese-related experiences are intertwined with broader heritage and rural tourism motivations. A weaker but notable connection exists between F3 and F1 (path coefficient = -0.02), pointing to the possibility that while heritage tourism complements traditional gastronomy, the motivational emphasis may vary between different tourist profiles. The model validates the theoretical assumption that products such as Roquefort cheese function not only as gastronomic commodities but also as carriers of destination identity.

The integration of cheese heritage, cultural authenticity, and sustainable rural values contributes to a cohesive tourism experience that appeals to both hedonic and learning-oriented motivations. This analysis supports the overarching hypothesis H that a local gastronomic product—like Roquefort or Kačkavalj cheese—can serve as a key driver for sustainable rural tourism development, enhancing the destination's identity and contributing to immersive, meaningful tourist experiences. The SEM results point to several strategic implications for sustainable rural tourism development centered around cave-aged cheese as a unique local product. The strong internal coherence of the Cheese Experience construct (F2) suggests that Roquefort cheese has significant potential as a destination brand anchor. It is more than just a product—it is an experience that blends education, taste, indulgence, and tradition. However, the disconnect between F2 and F1 warns against assuming that gastronomic tourism broadly defined (e.g., interest in all traditional foods) automatically overlaps with cheese tourism. This differentiation can be leveraged in marketing—for instance, by positioning Roquefort not only as a culinary highlight but as a gateway to a specific niche within gastronomic tourism.

The strong definition of Heritage Tourism (F3) points to the importance of embedding cheese tourism within a broader cultural narrative, one that includes immersive and sustainable experiences. Cheese caves, traditional methods, rural settings, and cultural performances can all contribute to reinforcing this holistic appeal. The SEM analysis underscores that cheese tourism represents a powerful and distinct motivational domain within rural tourism. While it intersects with traditional gastronomy and heritage tourism, it also stands on its own as a highly structured and motivationally potent experience. For destinations like Roquefort-sur-Soulzon, this presents a valuable opportunity to craft targeted offerings that not only celebrate the sensory and historical dimensions of cheese but also connect them with local identity, sustainability, and immersive rural charm.

While the findings provide meaningful insights into the motivational dynamics of rural cheese tourism, certain limitations must be acknowledged. First, the study was conducted in a single geographical location (Roquefort-sur-Soulzon), which may limit the generalizability of the results to other rural or gastronomic contexts. Second, the data collection took place during a specific season, potentially introducing a seasonal bias, as tourist motivations and behavior may vary across different times of the year. Third, although the sample size was sufficient for statistical analysis, the demographic profile of the respondents (e.g., age, nationality, education level) may have influenced the results in ways that are not fully representative of the broader tourist population. Future research should explore longitudinal and comparative approaches across multiple regions and seasons to validate and extend the findings. Additionally, qualitative insights from local producers and tourists could enrich the understanding of sensory, emotional, and identity-based dimensions of gastronomic tourism.

Building on the current findings, future research could benefit from replicating this study in other regions known for strong gastronomic or cheese-based identities—such as Tuscany (Italy), Asturias (Spain), or Šumadija (Serbia)—to test the robustness and transferability of the proposed model. A comparative cross-cultural approach would help identify both universal and region-specific motivational patterns. Additionally, longitudinal research could track how tourist motivations evolve over time, particularly in response to seasonal changes, sustainability trends, or destination branding efforts. Incorporating mixed methods—including in-depth interviews, ethnographic observation, and sensory ethnography—would provide richer insight into the emotional and symbolic dimensions of gastronomic engagement. Such approaches could further explore how tourists co-construct meaning through food-related experiences, and how this contributes to sustained place attachment and rural tourism development.

5.5. Interpretation of Findings in Light of Existing Literature

The findings of this study extend and nuance previous research on gastronomic and rural heritage tourism. Consistent with Lee et al. [74] and Lin et al. [75] the multisensory appeal of traditional food was confirmed as a key motivator for travel. The symbolic and emotional dimensions observed in this study also align with findings by Kaman and Yazicioğlu [76], who emphasized food as a cultural marker. Moreover, the identification of cheese heritage (e.g., Roquefort) as a distinct motivational construct reinforces insights by Sims [68] but goes further by highlighting the structural independence of niche cheese tourism from broader gastronomy. The confirmation of authenticity as a catalyst for immersive experiences is also in line with Hsu et al. [77] though this study contributes by unpacking the emotional and psychological mechanisms underpinning such engagement. Overall, the results validate and deepen prior theoretical frameworks while also offering new empirical evidence for how sensory, cultural, and symbolic dimensions of food interact in rural tourism contexts.

5.6. Practical Implications

The findings of this study carry valuable practical implications for rural tourism development, particularly in destinations aiming to leverage traditional food heritage as a driver of experiential tourism. The case of Roquefort-sur-Soulzon demonstrates how a singular product—cave-aged Roquefort cheese—can transcend its role as a food item and become a central element in shaping destination identity and tourist motivations. The structural equation model highlights the dominant influence of the cheese experience (F2) on visitors' engagement with the destination, indicating that activities such as cheese indulgence, culinary exploration, and learning about cheese heritage constitute the most impactful dimensions of the visitor experience. This insight is directly applicable to similar rural destinations such as Pirot and Sokobanja in Serbia, where kačkavalj cheese and natural cave environments represent untapped potential for niche tourism development. To replicate the success observed in Roquefort, these destinations should focus on developing an integrated cheese-centered experience. This includes the formalization of cheese routes, the establishment of interactive visitor centers, and the inclusion of cheese tastings within authentic rural settings.

Local producers should be positioned as cultural mediators, actively engaging with tourists through storytelling, workshops, and demonstrations, thus transforming traditional production processes into immersive tourist experiences. The Roquefort model shows that heritage tourism (F3) elements—such as cultural immersion, rural escape, and sustainable traditions—strongly complement the core gastronomic experience. These elements can be strategically reinforced in Pirot and Sokobanja through the development of

rural trails, eco-cultural interpretation, and culinary events that celebrate regional identity and foster deeper connections between visitors and local traditions. The existence of caves in these Serbian destinations also provides opportunities to creatively link natural assets with cheese production narratives, potentially framing caves as symbolic or functional components in the aging or presentation of cheese, thus enhancing authenticity.

However, the SEM results from Roquefort also suggest that traditional gastronomy (F1)—though thematically related—is not automatically activated by cheese-related motivations, as evidenced by its negative relationship with the core cheese experience factor. This underlines the need for careful curation and integration of gastronomic offerings. In practical terms, stakeholders in Pirot and Sokobanja should work to embed *kačkavalj* more prominently into local cuisine, restaurant menus, and food festivals, thus reinforcing its role as a symbol of place and culinary heritage. Finally, the broader implications for sustainable rural development are notable. Developing cheese-based tourism in destinations like Pirot and Sokobanja aligns with principles of community-based tourism, economic diversification, and territorial branding. By positioning local cheese production within a holistic tourism offering, these areas can foster rural revitalization, preserve cultural landscapes, and promote environmentally responsible visitation. The intersection of food heritage, cave tourism, and rural identity offers a unique pathway for destinations to build resilience, attract niche markets, and cultivate meaningful visitor experiences grounded in local authenticity.

6. Conclusions

The study conducted in Roquefort-sur-Soulzon, a village famous for its blue cheese, involved 416 valid respondents and aimed to explore the relationship between tourist motivations, gastronomic experiences, and perceptions of cultural heritage in rural cheese-producing areas. The demographic profile of participants indicated a balanced gender distribution, predominantly middle-aged and older adults with moderate to strong educational backgrounds. Utilizing a positivist approach and quantitative research design, the study employed factor analysis and structural equation modeling to test hypotheses regarding the influence of traditional gastronomy and heritage on tourist engagement and satisfaction, ultimately contributing to the understanding of sustainable rural tourism development. This study advances the theoretical understanding of how gastronomic heritage can shape destination identity and contribute to sustainable rural tourism development. Focusing on the case of Roquefort-sur-Soulzon, where traditional cheese-making and cave-aging practices have become emblematic of place-based cultural identity, the research illustrates how local food products can transcend their material value to function as powerful cultural symbols and experiential anchors. Through the identification of three distinct motivational factors—Traditional Gastronomy, Cheese Experience, and Heritage Tourism—the study demonstrates that tourist engagement with rural food destinations is both multifaceted and deeply rooted in the desire for authenticity, cultural immersion, and sensory fulfillment.

The Cheese Experience emerged as a central element, drawing visitors to Roquefort's iconic product, while Traditional Gastronomy and Heritage Tourism contextualized this experience within broader narratives of rural tradition and identity. The results suggest that while product appeal is crucial, its effectiveness in enriching tourist experiences depends significantly on the degree to which it is embedded in a coherent cultural and heritage framework. All six subhypotheses were validated using a positivist, quantitative approach through factor analysis and structural equation modeling, confirming the strong interconnections between food heritage, cultural authenticity, and visitor satisfaction. The study also reinforces the importance of emotionally resonant and transformative

experiences in rural tourism, shaped by symbolic associations and a sense of connection to place. This analysis supports the overarching hypothesis H that a local gastronomic product—like Roquefort or Kačkavalj cheese—can serve as a key driver for sustainable rural tourism development, enhancing the destination's identity and contributing to immersive, meaningful tourist experiences. As such, food heritage emerges not only as a tangible cultural asset but as a strategic medium through which tourists engage with the values, stories, and identities of rural communities.

To support the practical developments identified in this study, policymakers and tourism planners should prioritize the creation of multi-stakeholder strategies that actively involve local producers, tourism operators, and community members to ensure coordinated efforts and shared benefits. Investment in infrastructure is essential, including the development of visitor centers, clear signage, and improved accessibility to caves and rural sites, facilitating immersive cheese tourism experiences. It is also critical to encourage sustainable practices that safeguard the natural and cultural environment, such as preserving cave ecosystems and promoting environmentally friendly production methods. Targeted marketing campaigns should be developed to highlight the unique sensory, cultural, and heritage dimensions of cave-aged cheese tourism, aimed at both domestic and international audiences. Exploring opportunities to integrate cheese tourism with wellness and eco-tourism offerings—particularly in destinations like Pirot or Sokobanja—can help diversify and enrich the overall visitor experience. Looking ahead, future research should aim to deepen understanding of cheese heritage tourism by assessing its long-term socio-economic impacts on rural communities, including effects on employment and income diversification. Investigating how digital technologies, such as virtual reality and social media, can enhance visitor engagement and storytelling around cheese heritage is another promising avenue. Comparative studies across different regions and products would help identify transferable best practices as well as region-specific challenges. Finally, longitudinal research tracking changes in visitor perceptions and motivations over time will be essential to monitor the evolution and sustainability of cheese tourism development.

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Appendix A. Survey Questionnaire

Section A: Visitor Motivations

Please indicate your level of agreement with the following statements about your visit to Roquefort-sur-Soulzon, using the scale below: 1—Strongly Disagree, 2—Disagree, 3—Neither Agree nor Disagree, 4—Agree, 5—Strongly Agree.

Cultural Heritage and Tradition

- V1. I visited Roquefort-sur-Soulzon to experience the local cultural heritage.
- V2. Learning about the history of Roquefort cheese was a major reason for my visit.
- V3. I appreciate visiting destinations with strong traditional food production methods.
- V4. Experiencing the local customs and heritage of Roquefort-sur-Soulzon was important to me.
- V5. I was drawn to Roquefort-sur-Soulzon because of its historical significance in cheese-making.

Gastronomic and Culinary Interests

- V6. The opportunity to taste authentic, local cheese motivated me to visit Roquefort-sur-Soulzon.
- V7. I enjoy exploring culinary traditions when traveling, and Roquefort cheese was a big draw.
- V8. Sampling a variety of local cheeses during my visit was important to me.
- V9. I value food-based tourism experiences, and Roquefort fit that interest.
- V10. I visit destinations primarily for unique food experiences, such as Roquefort cheese.

Hedonism

- V11. I visited Roquefort-sur-Soulzon because I wanted to indulge in a unique sensory experience.
- V12. The idea of enjoying high-quality cheese and local delicacies appealed to my desire for pleasure.
- V13. My visit was motivated by the opportunity to experience the pleasures of tasting Roquefort cheese.
- V14. I enjoy visiting places that offer luxurious or indulgent experiences.
- V15. I wanted to enjoy a relaxing and enjoyable experience in a beautiful rural location.

Natural Environment and Cave Experience

- V16. The opportunity to visit the caves where Roquefort cheese is matured was a major attraction.
- V17. I am interested in experiencing natural environments, such as caves, while traveling.
- V18. The natural beauty of the area, including the caves, was a significant reason for my visit.
- V19. Visiting a destination that offers a combination of nature and food heritage is very appealing to me.
- V20. I enjoy exploring destinations where nature and food production are closely connected.

Rural and Authentic Experience

- V21. I prefer visiting small rural villages to experience authentic local life.
- V22. I was drawn to Roquefort-sur-Soulzon because of its rural charm and authenticity.
- V23. Experiencing life in a less touristy, more authentic rural setting motivated my visit.
- V24. I enjoy immersing myself in the local culture and lifestyle of rural destinations.
- V25. I sought an authentic experience, away from more commercialized tourist spots, in Roquefort-sur-Soulzon.

Sustainability and Support for Local Economy

- V26. It was important to me to support local businesses and producers during my visit.
- V27. I believe that sustainable tourism is essential for the development of rural areas like Roquefort-sur-Soulzon.
- V28. I enjoy visiting destinations that promote local traditions and sustainable practices.

- V29. My visit to Roquefort-sur-Soulzon was partly motivated by the desire to contribute to the local economy.
- V30. Supporting sustainable food production, like Roquefort cheese, was a key factor in my decision to visit.

Trend (Modern and Social Influence)

- V31. I visited Roquefort-sur-Soulzon because it is a popular destination among tourists.
- V32. Social media or influencers recommended Roquefort-sur-Soulzon as a must-visit location.
- V33. I wanted to visit Roquefort-sur-Soulzon because it is trending as a unique culinary destination.
- V34. Visiting Roquefort-sur-Soulzon was partly motivated by modern travel trends and recommendations.
- V35. I heard about Roquefort-sur-Soulzon through contemporary media and thought it would be a trendy place to visit.

Section B: Demographic Information

Please answer the following questions by selecting the option that best describes you:

1. **Gender**
 Male Female Other/Prefer not to say
2. **Age Group** Under 18 18–24 25–34 35–44 45–54 55–64 65 or older
3. **Educational Attainment** Primary school or less Secondary school/High school
 Vocational education Bachelor's degree Master's degree Doctorate/PhD
4. **Country of origin** _____.

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Article

Agricultural and Industrial Heritage as a Resource in Frontier Territories: The Border Between the Regions of Andalusia–Extremadura (Spain) and Alentejo (Portugal)

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Abstract: The border effect on heritage protection, shaped by historical and physical factors, contributes to the formation of socio-territorial systems, particularly in relation to productive landscapes. This study focuses on the Portuguese–Spanish border between Andalusia and Extremadura, a region where inter-regional dynamics mirror international tensions due to the coexistence of differing legislative frameworks. The area is characterized by shared agricultural and ecological systems and fragmented transport networks, which complicate territorial integration. Methodologically, the study involves a selection of seven municipalities based on demographic vulnerability and rural identity, followed by historical and spatial analysis using legal sources, historical dictionaries, and digital platforms for heritage mapping. One of the key components was the identification and documentation of historical mills linked to the Ardilla River and its tributaries, using a combination of official heritage databases and user-generated platforms like Wikiloc and local websites. The twenty-one mills found highlight a significant presence of unprotected yet generally well-preserved mills that exemplify the agricultural and industrial legacy of the region. These assets, often overlooked in formal inventories, underline the potential for cross-border heritage recognition and call for a rethinking of protection strategies through the lens of cultural landscapes and community engagement.

Keywords: border territories; productive heritage; mills; Portugal; Andalusia; Extremadura

1. Introduction

The economy of the Iberian Peninsula, both in Spain and Portugal, has been characterized by its rurality and by its agricultural and livestock activities, in which a large part of the population was occupied. However, with the changes of the second half of the twentieth century, the transformations have led to the rise of cities, leading to a problem of depopulation or aging in some areas. Moreover, in these places, there is less and less knowledge of rural areas and of the activities and heritage linked to them [1]. Although these areas hold important cultural and natural value, they are often overlooked by both planning policies and heritage laws. This is largely due to the undervaluation of such assets, which stems from the limited recognition given to agricultural activity [2], and for this reason, the decision was made to explore this topic from a perspective that moves away from the focus on case studies in major cities.

In addition, with the factors of the physical environment and the impact of the different civilizations that have marked its territory, a dynamic interchange of thousands of years has been fostered between the physical-environmental context and the social and economic

situations. These socio-economic conditions have allowed, throughout history, a certain distance of this rural territory from the generalized process alteration of the environment. This occurs mainly in a large portion of the Spanish and Portuguese states, which has allowed the identity to remain somewhat unchanged. Nevertheless, it faces great challenges, such as low population density and low degree of industrialization. The traditional land use systems, based on large landholdings, have also contributed to this, in addition to the low densification of roads [3]. This problem is significantly sensitive in border areas where different administrations converge and are usually far from the main cities.

The border is a spatial set whose military, economic, fiscal, or administrative characteristics vary according to space and time, which, if we speak in terms of identity, is presented as a whole as a result of geophysical issues and historical evolution. The regions have tried to resolve border conflicts by means of precise delimitation and collaboration agreements to ensure good inter-territorial relations [1].

The approach to heritage through its relationship with the territory is something recent, since previously, only the monument was protected in a unitary way; later, it was passed to the historical ensemble, later to the cultural and natural heritage, and finally, in the cultural landscape [4], which has its consequence in the European Landscape Convention of 2000 [5]. However, on many occasions, it has not been understood that the cultural landscape is something continuous and cannot be divided between administrations, which generates a border effect that hinders the protection of heritage linked to that territorial basis. This circumstance often refers to those that Spain has with other countries, such as France, Andorra, or Portugal, but in Spain, there is also the circumstance that, due to the transfer of competences to the Autonomous Communities, there is also a border effect between them.

It should not be forgotten that the border is a heterogeneous reality where numerous flows of different natures occur. Its real space does not usually correspond to that mapped on maps, plans, or drawings of its representations made by the agents working in this delimitation. The border is a zone and not a line, which is articulated around a set of central places on each side of the dividing line that interact with each other and develop their own dynamics [6]. Therefore, the study suggests making an effort to recognize these rural frontier spaces, in addition to promoting their recovery, in order to progress in the search for future sustainability and the internal restructuring of the territory. Furthermore, this issue could be in tune with the need to rebalance the territory in general, understanding that the population growth dynamics of the cities are not detrimental to the rest of the territory and, therefore, impact the rural area and are common in the present demographic imbalances. For this reason, it is imperative to safeguard these places through their appreciation by societies and cultures, given that they could be transformed into a vital resource [7]. It is important to consider that the suggestions that strengthen the position of heritage can contribute to strengthening territories with vulnerabilities, focusing on new sustainable opportunities, given that heritage is a resource for development [8].

The end result is reflected in the work area in what is currently perceived as a valuable legacy of formations and species of flora and fauna, and, consequently, of landscapes. These landscapes, with their structure and composition, are, in their origin, cultural landscapes. This is because, as in the historical and geographical context of the Mediterranean civilizations where the area to be worked on is located, they could not be understood through an exclusive study of any of the elements of the man–environment binomial.

Specifically, we have chosen to work with the agricultural heritage, legacy of rurality, and agricultural or livestock activities that have characterized the territories of the peninsula. This heritage has not been recognized until recently, and therefore, the definition of Agrarian Heritage is taken from the definition of the Baeza Charter on Agrarian Heritage

and is taken as a reference: “Agrarian Heritage is made up of the set of natural and cultural, tangible and intangible assets, generated or used by agricultural activity throughout history” [2]. Nevertheless, it is increasingly recognized, for example, by Unesco, such as the olive grove of Andalusia, which is under study for inclusion in the World Heritage List, or by the population itself, which asked the Junta de Andalucía to protect the Vega de Granada as a BIC, and this was not done [9]. However, despite their relevance and the significance of their cultural and natural values, they are not adequately treated either by planning instruments or by heritage legislation, due to the undervaluation of these assets, largely because of the little consideration given to agricultural activity [2]. To this must be added that despite this heritage recognition of agricultural assets, in most cases, their agricultural value is not taken into account, but rather other values such as artistic, historical or technical, which means that their protection is not adequate [9].

For this reason, it has been decided to work with an example of the assets of the productive legacy, the mills, that are located in the transboundary work zone and of low population density, which, as will be seen, are assets that are not protected, so they are in danger of destruction and loss of historical legacy, which is why it is important to identify and recognize them. Nevertheless, the protection of traditional mills in Europe has gained increasing attention within the broader field of rural and industrial heritage, particularly as awareness grows about the cultural, historical, and territorial values of these structures. However, despite their significance, many mills—both wind- and water-powered—remain under-protected and insufficiently documented, as some initiatives such as the European Heritage Label, the RE-USE Project (Interreg), or the ERIH network tend to focus on larger or more iconic sites, leaving smaller rural assets less visible. At the international level, The Faro Convention [10] underscores the societal value of cultural heritage and calls for community involvement in its preservation. Mills fit well within this vision, embodying local identity and traditional knowledge. Similarly, the TICCIH Charter [11] emphasizes the importance of industrial sites like mills as part of broader productive landscapes, while the widely respected Burra Charter [12] reinforces the protection of places with layered historical and cultural significance and supports the recognition of mills as both tangible and intangible heritage, deeply embedded in rural cultural landscapes.

The academic literature further contextualizes the value and perception of mills within heritage studies. Biel et al. [13] emphasize the challenge of integrating cultural heritage into sustainable development, stressing the need for adaptive reuse of rural assets. Strangleman [14] critiques the nostalgic framing of decaying industrial sites and calls for more meaningful representations that connect communities to their heritage in active ways. These approaches are highly relevant when considering how mills might be protected—not simply as static relics, but as dynamic elements of living landscapes.

At the national level, efforts vary widely. In the United Kingdom, the Society for the Protection of Ancient Buildings (SPAB) has established a dedicated Mills Section [15], producing regular inventories and engaging in restoration advocacy. The Netherlands, known for its iconic windmills, protects many such sites through national heritage listings and has succeeded in securing UNESCO recognition for ensembles like Kinderdijk [16].

In Spain and Portugal, the case study countries, the protection of mills remains fragmented. Though portals like the Guía Digital del Patrimonio Cultural de Andalucía and Portugal’s DGPC database provide some inventorying, there is still a lack of systemic recognition. The reliance on alternative data sources such as Google Maps, Wikiloc, and local village websites by researchers highlights the urgent need for formal protection and coordinated documentation efforts, particularly in cross-border basins such as the Guadiana.

Therefore, the approach has been adopted to address the challenges of properly understanding and protecting these agricultural assets within the framework of various legislations in a cross-border context. The ultimate aim, for future studies, is to explore ways of reactivating these areas through their historical legacy. While similar efforts have been made before, they have either not focused specifically on agricultural heritage [17], or have not considered the cross-border dimension [18], which is particularly significant, as legal boundaries are real, yet the landscapes and cultural assets they contain are continuous and do not conform to administrative limits.

Objectives

The article proposes to expose, through the inventory of the mills in the selected municipalities, the difficulty of their adequate understanding and protection by the different legislations in a cross-border context.

Its specific objectives include the following:

- To identify and examine legal frameworks and territorial disputes between countries and Spanish Autonomous Communities, in order to assess how these influence the protection and management of heritage assets in border areas.
- To analyze spatial data and territorial boundaries within the study area, with the aim of illustrating the disconnect between administrative borders and the continuity of cultural landscapes.
- To investigate the historical and current role of rural productive systems—particularly agricultural structures—as a basis for understanding their cultural and territorial significance.
- To compile, geolocate, and classify existing mills within the study area using fieldwork and archival data, in order to evaluate their distribution, typologies, and current condition.
- To develop informed protection strategies for the identified heritage assets, based on their cultural value, spatial patterns, and vulnerability within a cross-border context.

2. Materials and Methods

After a bibliographic review, and with the aim of exposing the difficulties that occur when protecting this agricultural heritage in a territory with different legislation and management, despite being a continuous landscape, we have sought to expose initially what the border means and what we understand by it, contextualizing its origin and definition and the inequalities that occur in terms of protection or management of natural or cultural heritage and the framework legislation of each administration in the area. As said, this circumstance refers to those that Spain has with Portugal; due to the transfer of competences to the Autonomous Communities, there is also a border effect between the Spanish regions, for instance, between Andalusia and Extremadura (Figure 1).

In particular, the border case study between Portugal, Extremadura, and Andalusia is sparsely populated and has major repopulation problems due to its peripheral position within the state, international, and regional economic systems. Moreover, they belong to the provinces and districts with the lowest levels of employment and income in Spain and Portugal and, in some cases, also in Europe. The presence of the regional and national boundary is also a problem due to the border effect caused by the transfer of competences and the development of the regional policy of the Autonomous Communities within the framework of the State of Autonomies [19]. All the problems and dysfunctions affecting these interstitial spaces are greater when the areas are economically underdeveloped, which especially affects the border area between Huelva, Badajoz, and Alentejo, where three different administrations converge (Figure 1). This area has always been a continuity solution between the Portuguese Baixo Alentejo and Sierra Morena, so that although it

was a common geoeconomic space, its development possibilities have been reduced and demographic depression has been accentuated. With all of the above, along with the historical, physical and economic factors, a situation of continuous demographic loss has been reached [20].



Figure 1. Map of the current Autonomous Communities, Regions and Districts, and the Provinces' limits on which the study centers, on both sides of the border between Spain and Portugal. Source: own elaboration based on both National Geographical Institutes' cartographies.

Subsequently, we have sought to define the territorial structure on which the heritage to be studied is based, including all those elements that make up the natural environment and those that were introduced by man, such as infrastructures. Next, the productive work that takes place in that area has been exposed, as an important part to understand in order to recognize the context in which the assets to be studied are built. Both the physical and the productive framework have been represented cartographically through the Geographic Information System QGIS with the bases of the Cartographic and Statistical Institutes of both countries, which has entailed certain difficulties since there is no cartographic base for the whole Iberian Peninsula, in spite of being recognized as a unitary element.

In order to better explain what we are looking for here, we have worked with a specific case study, which includes the area that includes the municipalities of Encinasola, Oliva de la Frontera, Jerez de los Caballeros, and Valencia del Mombuey on the Spanish side, and Moura, Barrancos, and Mourão on the Portuguese side (Figure 2). In addition to being cross-border at the international level, they are also cross-border between regions—such as Andalusia and Extremadura—and between Portuguese districts (those of Central Alentejo and Baixo Alentejo). However, the border effect is greater between Spanish Autonomous Communities, as we shall see later, due to the different regional legislations.

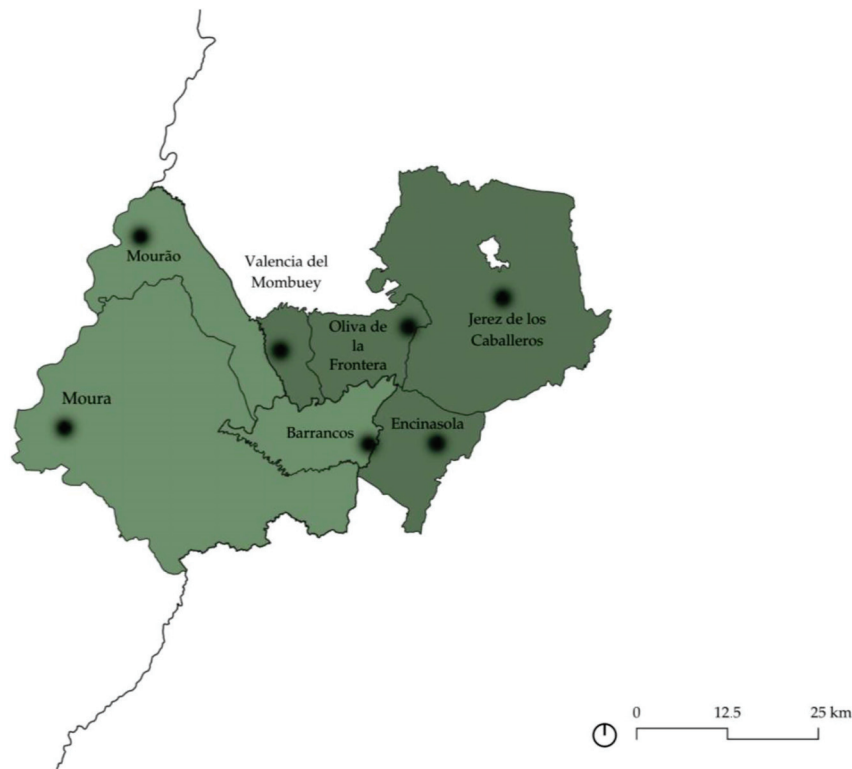


Figure 2. Map of municipalities on which the study is centered. Source: own elaboration based on both National Geographical Institutes' cartographies.

Precisely, this area is highly unstructured due to the low population density, the lack of medium-sized cities, the fragility of the rural population structure—which generates extensive unstructured rural areas—and the presence of a road system that favors external connections.

At present, a solution to this situation is being sought for rural areas through land use planning, which is very difficult in the specific area of work due to the intervention of several administrations, and therefore, they continue to have a depopulation process, especially in mountain areas and disadvantaged agriculture, among which is the territory of work. And that is precisely why this area of work has been chosen specifically because it includes not only conflicts between countries, but also between regions of the same country, but belonging to the same physical environment, such as the Guadiana River Basin. In addition, in a generic way, all the municipalities have a situation of population loss and aging, which makes them vulnerable, making it necessary to work in this type of nuclei to avoid their abandonment and consequent loss of identity.

Once the municipalities in which work was to be done had been decided, and after having explained the legal, physical, and productive framework, the relevance of recognizing the Agrarian Heritage was reinforced by reviewing what was said about those same municipalities in the two reference books of the time: the *Diccionario geográfico-estadístico-histórico de España y sus posesiones de ultramar*, by Pascual Madoz [21] and the *Diccionario geográfico-estadístico de España y Portugal*, by Sebastián Miñano y Bedoya [22]. In them, there is a brief description of the production and industry of the time, which allows us to identify how important these assets were for the time and compare it with the present in most cases, with the exception of the municipality of Barrancos, which does not appear in the corresponding document. Within the industrial section, in the case of Madoz's document, we recognize how many mills there were in each of the nuclei, highlighting how important these properties were for the economy of the time. At present, these assets are part of the productive legacy of the time and that is why it is decided to identify and recognize

them territorially in the different areas since their existence in this territorial set makes it a very successful example to expose the ways of life in the countryside and the changes experienced by our society in recent decades [23].

With this, we proposed a mapping of the immovable assets, such as the mills linked to the Ardilla River and its tributaries, within the framework of the Guadiana River Basin. It is understood that leaving aside how a sectorized protection does not help the understanding of a heritage system that could be recognised as a Cultural Landscape or as a Site of Ethnological Interest as a whole, since it is intrinsically linked to its territory. As the mills are neither protected nor inventoried at present, neither in Spain nor in Portugal, the locations have been obtained from the *Guia Digital* website of the Andalusian Institute of Historical Heritage (<https://guiadigital.iaph.es/>, accessed on 30 March 2025), the website of the Cultural Heritage of Portugal (<https://www.patrimoniocultural.gov.pt/instituicao/apresentacao/>, accessed on 28 March 2025). If the mills were not found there, they were identified from Google Maps, the websites of the villages, and Wikiloc—from the hiking routes shared by people. Moreover, additional information about the mills was sought; however, in some cases, it was not accessible. The sources consulted included online newspapers and personal websites, where the information was often shared by individuals rather than official institutions, in relation to the popular character of this type of heritage (Figure 3). It is therefore recognized that the study should be expanded and continued in the future, with other examples of productive heritage and with a deeper information of the study mills—such as fieldwork images.

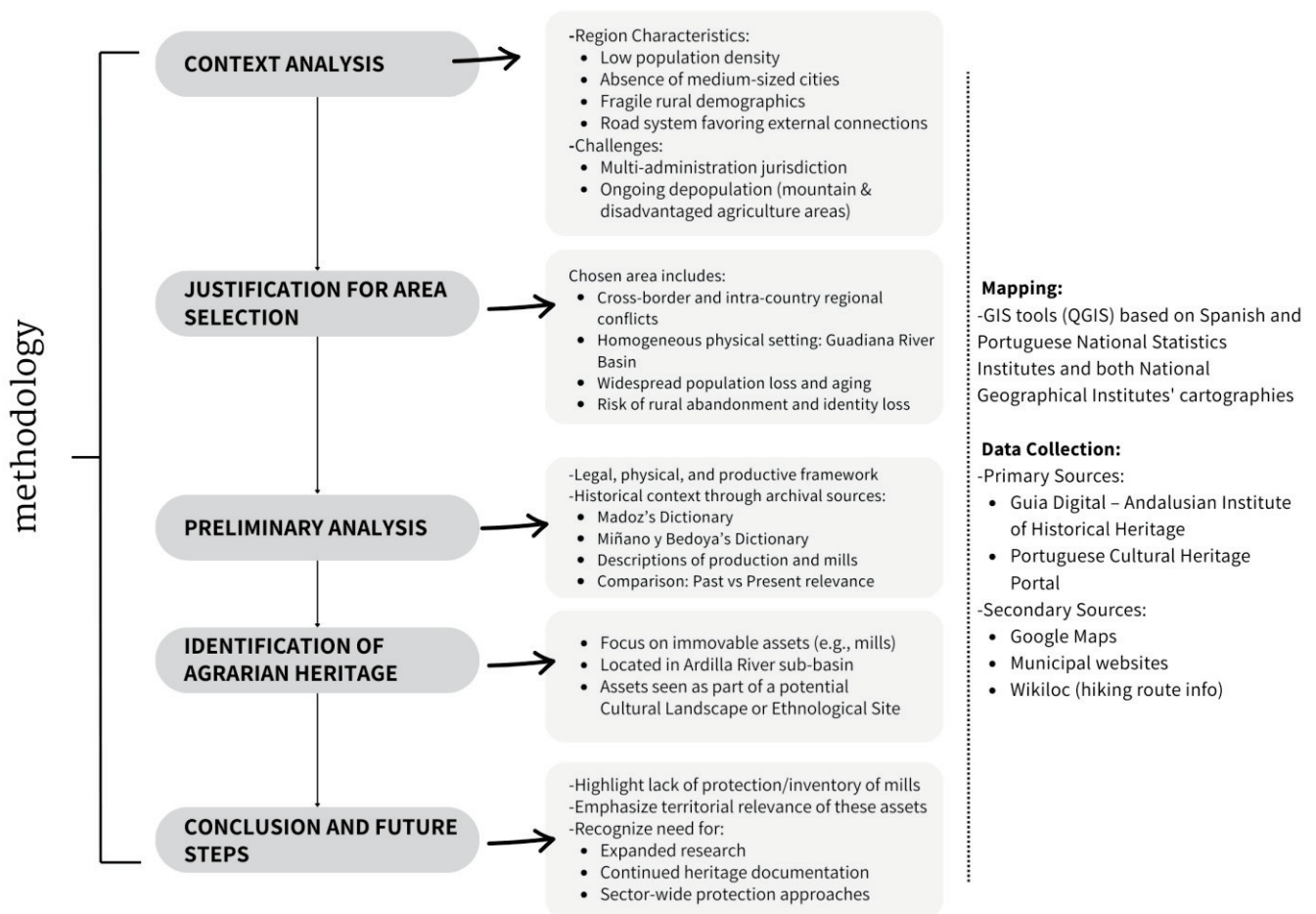


Figure 3. Diagram of the methodology used in the study. Source: own elaboration.

3. Results

3.1. Settlement Framework

The nuclei of study, in addition to being on the border, are municipalities with low population densities, which implies a general abandonment of the heritage in these places. The population densities in the work area have been quite low throughout history. The ongoing demographic decline stems from the historical processes of reconquest and repopulation, which have been shaped over time by the difficulties in establishing a productive zone in the region. In addition, the demographic problems have been pronounced during the 1950s, 1960s, and 1970s due to the great rural exodus that occurred throughout Spain. As a result of all of the above, the demographic structure has been affected, showing clear symptoms of an aging population, which is the first obstacle to its survival in the short-to-medium term [4]. In addition, the most depopulated rural areas tend to have the highest percentage of an aging population, due to the migration of young people to other towns or county seats, and fewer women, characterizing the rural environment [24].

The population structure follows a regressive pattern—as in the case of the states in general—but with a less youthful profile, which is a serious risk for the region. Therefore, demographic depression is one of the factors that define the study area (Table 1, Figure 4). This situation is due to the aforementioned physical and historical factors, which have been aggravated by the massive exodus to provincial capitals or developed cities between the 1950s and 1970s [19]. This problem does not occur in people of the same age or sex: it is the younger generation that emigrates, leaving the human potential unrenewed and the aging of the population, which in the short-to-medium term, will cause great problems of depopulation.

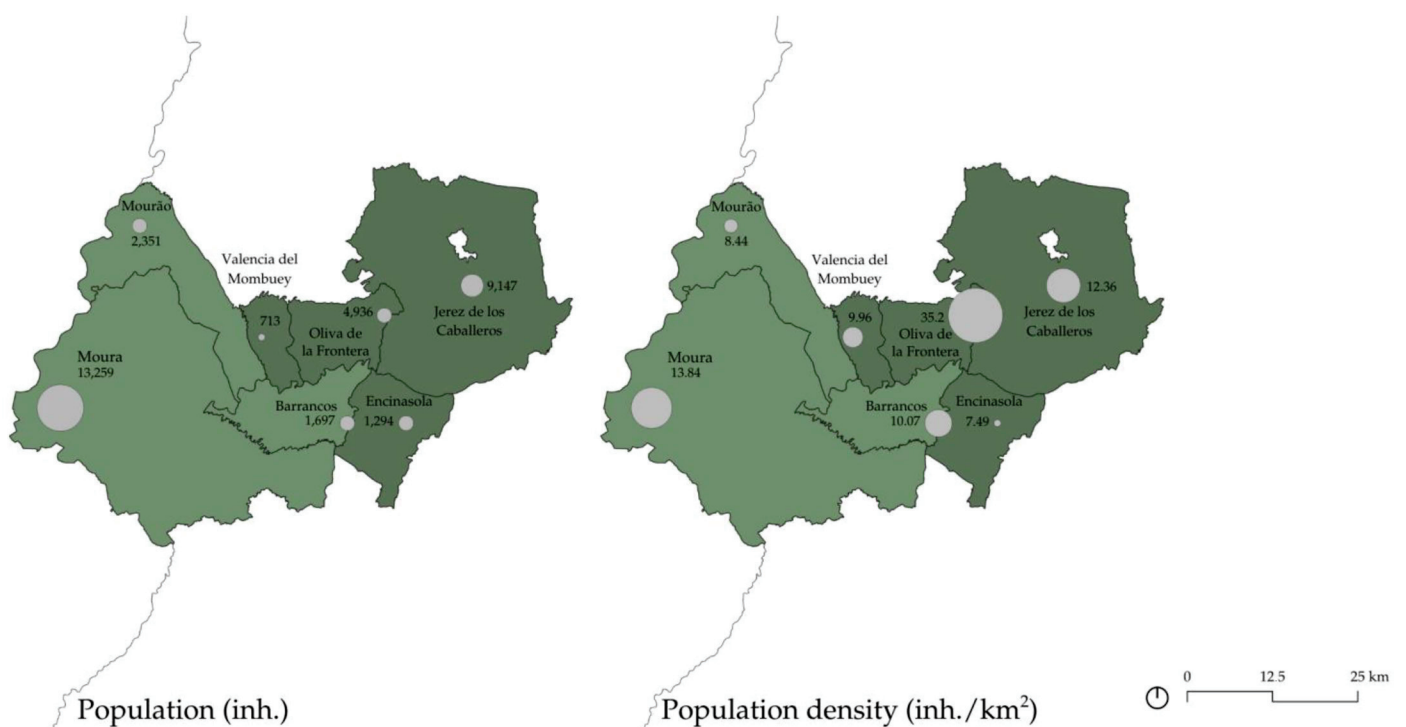


Figure 4. Map population and population density of the chosen municipalities. Source: own elaboration based on the information of the Spanish and Portuguese National Statistics Institutes and both National Geographical Institutes' cartographies.

Table 1. Table related to Figure 4, where the basic data of the municipalities are explained. Source: own elaboration based on the data of both the Spanish and Portuguese National Statistics Institutes.

Municipality	Country	Region	Province/ District	Surface (km ²)	Population (inh.)	Population Density (inh./km ²)
Encinasola	Spain	Andalucía	Huelva	178.12	1294	7.49
Jerez de los Caballeros	Spain	Extremadura	Badajoz	739.8	9147	12.36
Oliva de la Frontera	Spain	Extremadura	Badajoz	149.3	4936	35.2
Valencia del Mombuey	Spain	Extremadura	Badajoz	75	713	9.96
Moura	Portugal	Alentejo	Évora	957.73	13,259	13.84
Barrancos	Portugal	Alentejo	Beja	168.43	1697	10.07
Mourão	Portugal	Alentejo	Beja	278.54	2351	8.44
TOTAL Spain				402.42	6943	17.25
TOTAL Portugal				1404.7	17,307	12.3
TOTAL Work Zone				1807.12	24,250	13.41

inh./km² = inhabitants per square kilometer.

3.2. Legal Framework

Before proceeding to the exposition of all the elements that affect the border territory under study, it has been deemed necessary to make a reference to what is understood by the border and why it occurs in this context and the need to work on it, exposing the legal framework in which it is inserted.

Precisely, in Europe, the highest intensity of cross-border cooperation projects is located precisely between the borders of Spain and Portugal, and those of Austria and Germany, and those of Austria and Italy, with more than 300 projects in each INTERREG program [25]. Moreover, the Spanish–Portuguese border is the largest European border—1234 km—but it is considered one of the least prosperous, despite the fact that cooperation started as early as 1989–1993 [26]. Currently, the framework for cross-border cooperation with Portugal is the Treaty between the Kingdom of Spain and the Portuguese Republic [27] on Cross-border Cooperation between Territorial Entities and Bodies, signed in Valencia on 3 October 2002. As has already been seen, the two Spanish Autonomous Communities chosen for the development of the study are bordering the Portuguese country, and their cross-border cooperation is carried out within this framework. In addition, these regions have numerous tools and agreements to satisfy the cooperation between both sides of the Raya, despite the fact that the exclusive competences in international relations belong to the State. Nevertheless, the possibility is left for the Autonomous Communities to carry out external actions.

On the one hand, in the Directorate General for External Action of Extremadura, for example, there is the Cabinet of Cross-Border Initiatives, which has been working since 1993 to promote proposals that lead to the permeabilization of the border. Among others, there are heritage dissemination activities, such as publications related to historical heritage or the preparation of tourist-divulgative guides on popular festivals, routes along the Raya, the heritage cities of Évora and Mérida, gastronomy, etc. [28]. This has been thanks to certain tools of their own, to protocols accepted by both countries—such as the protocol between Alentejo, Centro Region, and Extremadura (1994)—and to funding coming from the European Union that allows border cooperation and the permeabilization of the territories. Also noteworthy is the Alentejo–Centro–Extremadura Euroregion (Figure 5), which seeks to focus on priority areas of cooperation [29].

In Andalusia, the General Secretariat for External Action of the Ministry of the Presidency is in charge of coordinating and providing general advice on the actions of the Regional Government of Andalusia abroad [30]: among others, for example, the development and updating of the agreements signed with the Algarve–Alentejo regions, promoting cross-border cooperation. Another of the fundamental precedents for institutional coop-

eration is the Alentejo–Algarve–Andalusia Euroregion (Figure 5)—institutionalized in May 2010—to promote a more advanced stage of cross-border cooperation, which aims to become a living space for participation [31].

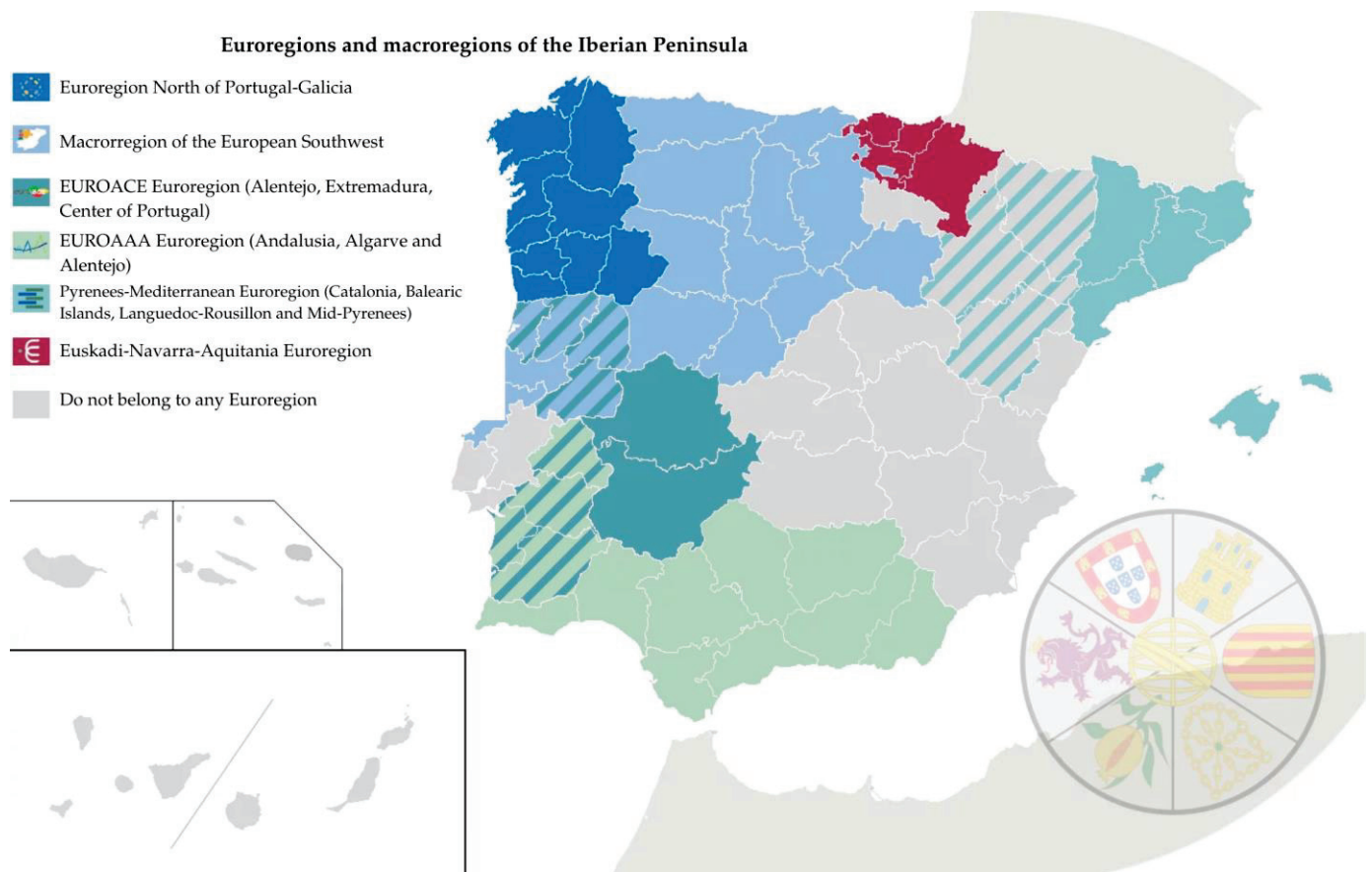


Figure 5. Map of the Euroregions and macroregions in the Iberian Peninsula. Source: <https://www.sociedadiberista.org/euroregiones-y-macrorregiones-en-la-peninsula-iberica/> (accessed on 17 March 2025).

What is proposed here is the study of the separation between the limits of both national and regional boundaries, since between them there are interactions between the central and peripheral forces of the border municipalities that do not always coincide with those used by the traditional groups that play an important role [6]. For example, the border between Spain and Portugal has been very variable throughout history, so that its current delimitation may not respond to the construction of what we recognize today as heritage, and the same happens between Autonomous Communities, specifically between Andalusia and Extremadura, whose dividing line has also fluctuated throughout history.

Precisely, in Spain, there is no interregional protection of cultural heritage, but it does happen with natural areas that can influence more than one Autonomous Community, as indicated in Article 149 of the Spanish Constitution: “The legislation, management, and concession of hydraulic resources and uses when the waters flow through more than one Autonomous Community, and the authorization of electrical installations when their use affects another Community or the transport of energy goes beyond its territorial scope” [32]. This happens, for example, in the case of the Ebro, which has the Ebro Hydrographic Confederation that depends on the Ministry for Ecological Transition and the Demographic Challenge, promoting actions and plans that depend on more than one Autonomous Community, such as the Ebro Hydrological Plan [33].

Therefore, it is noteworthy that there is no similar approach for cultural heritage, since the people who give meaning and participate in it live in the peripheral spaces, among which there is a sociological component that helps to maintain the status quo of the regions [6], which is necessary to understand in order to reach a territorial solution to the problems of depopulation and abandonment of these places. Before doing so, however, it is necessary to understand the legal framework of both countries in which the Autonomous Communities are constituted, whose basic institutional norms are the Statutes of Autonomy, which are made up of the identification of the community, its institutions of self-government, and the competencies assumed within the constitutional framework.

In Portugal, Law 107/2001, of 8 September 2001, on the Bases of the Policy and Rules for the Protection and Valorization of Cultural Heritage [34], is the law that currently protects heritage and establishes the bases for safeguarding and valorizing its cultural heritage, whose management is also under the responsibility of the Institute of Architectural and Archaeological Heritage Management, of national competence but in collaboration with the regions and municipalities. However, the law does not propose a classification of heritage protection figures, but differentiates between those of national interest, those of public interest, and those of municipal interest (Table 2). The difference with the Spanish case is that, in spite of the publication of the National Historical Heritage Law in 1985, the 1978 Constitution ceded the competencies in matters of heritage to the Autonomous Communities, in this case, Extremadura and Andalusia.

Table 2. Table of the protection figures of heritage on both sides of the frontier. Source: own elaboration based on the data of the Heritage Laws of Portugal, Extremadura, and Andalusia.

	Portugal	Spain	
		Extremadura	Andalusia
Law	Law 107/2001, of 8 September 2001, on the Bases of the Policy and Rules for the Protection and Valorization of Cultural Heritage.	Law 2/1999, of 29 March 1999, on the Historical and Cultural Heritage of Extremadura.	Law 1/1991, of 3 July 1991, on the Historical Heritage of Andalusia.
Figures	National Monument (MN: national monument) Property of public interest (IIP: Property of public interest, MIP: Monument of public interest, CIP: Complex of public interest, SIP: Site of public interest). Property of municipal interest (IM: Property of municipal interest, MIM: Monument of municipal interest, CIM: Complex of municipal interest, SIM: Site of municipal interest).	Historic Sites, Archaeological Protection Areas, Historic Gardens, Sites of Ethnological Interest, Monuments, Archaeological Park, Historic Site, Archaeological Zones, and Paleontological Zones.	Historic Site, Historic Gardens, Site of Ethnological Interest, Site of Industrial Interest, Monuments, Historic Site, Archaeological Areas, and Heritage Areas.

On the one hand, it should be noted that the Statute of Autonomy of the Autonomous Community of Extremadura states in its first article that “the vitality of its recent collective identity, the quality of its environment and its cultural heritage are differentiating elements of Extremadura and must guide the actions of the public authorities” [35]. In addition to this, the Extremadura region uses tools such as the Law of Historical and Cultural Heritage of Extremadura [36] and the Law of Nature Conservation and Natural Areas of Extremadura [37] for the protection of its cultural heritage environments, as we will see below. Specifically, the Extremadura Heritage Law classifies the properties to be protected in nine categories (Table 2).

For its part, the Statute of Autonomy of Andalusia was initially approved in 1981 (Organic Law 6/1981, of December 30), and subsequently amended in December 2006 (Organic Law 2/2007, of March 19), indicates in its article 10, 3.3° that one of the basic objectives of the Autonomous Community is “The strengthening of the awareness of identity and Andalusian culture through knowledge, research and dissemination of historical, anthropological and linguistic heritage” (2007, art. 10, 3.3°). The Junta de Andalucía, for this

purpose, has Law 14/2007, of 26 November, on the Historical Heritage of Andalusia [38], which repealed the previous Law 1/1991, of 3 July, on the Historical Heritage of Andalusia, and Law 2/1989, of 18 July [39], approving the Inventory of Protected Natural Spaces of Andalusia and establishing additional measures for their protection, for the protection of cultural heritage, which will be analyzed below. Specifically, in the current Andalusian heritage law, real estate is classified in eight different figures (Table 2).

As can be seen, the protection of heritage in each place is differentiated, which makes it very difficult to protect a legacy that could have similar characteristics on both sides of the border. In addition, it has become clear that there is also no willingness to collaborate in the protection of cultural heritage, but there is a willingness to protect natural heritage, mainly with Portugal, or in the case of water assets between Autonomous Communities, as in the Guadiana Hydrographic Confederation, despite being included in Article 247 of the Statute of Autonomy of Andalusia. For example, the heading “Interregional and cross-border cooperation”, provides that “The Regional Government of Andalusia will promote the formalization of interregional and cross-border conventions and agreements with neighboring regions and communities within the framework of the provisions of the Constitution, the Statutes of Autonomy and the applicable European regulations”, as it should do with the region of Extremadura.

Therefore, the heritage analysis of the border must aspire to the totality in order to articulate from it all the categories that help to understand all the variables that occur in it, such as the physical framework and the productive framework, in the case at hand. In order to grasp this totality, it is essential to understand the whole, without neglecting the fact that it is made up of fragments, and whose details help to expose the daily life of citizens [6]. This understanding must be interdisciplinary, since several materials are given in a specific area and a proposal is made to help develop a solid system in the border encompassing all its dynamics and explaining how its inhabitants live.

3.3. Physical Framework

The case study area is shaped by a distinctive physical environment that plays a crucial role in defining its territorial identity and unity [19]. The mountainous reliefs that dominate the landscape form a natural barrier, limiting communication between the municipalities located on the border, despite the presence of a few transversal roads. This region also includes a penillanura [40], a gently sloping plain, bordered by the Sierra Morena mountain range to the north. The Guadiana River basin (Figure 6) is integral to this landscape, with the river and its tributaries shaping the valleys within the region. Over time, these geological processes have resulted in the formation of a nearly ideal flat area, the penillanura, which gradually slopes toward the northwest, eventually descending towards the Guadiana River. This landscape has played a key role in the evolution of the region and continues to influence both natural and human systems [41].

Hydrologically, the area is significant due to the presence of the Ardilla River and its tributaries, which provide essential water resources for the region. The river has a limited flow and is affected by seasonal droughts, making irrigation a challenge, particularly in the warmer months [40]. Despite the region’s location within the Guadiana hydrographic basin, which includes several reservoirs for irrigation and hydroelectric production, there are ongoing concerns about water supply, particularly during dry periods. The scarcity of water in the region has led to calls for the construction of additional reservoirs and the formation of local water associations to address these challenges. Although these efforts have not yet extended into the study area, water scarcity remains a pressing concern for the local population [42].

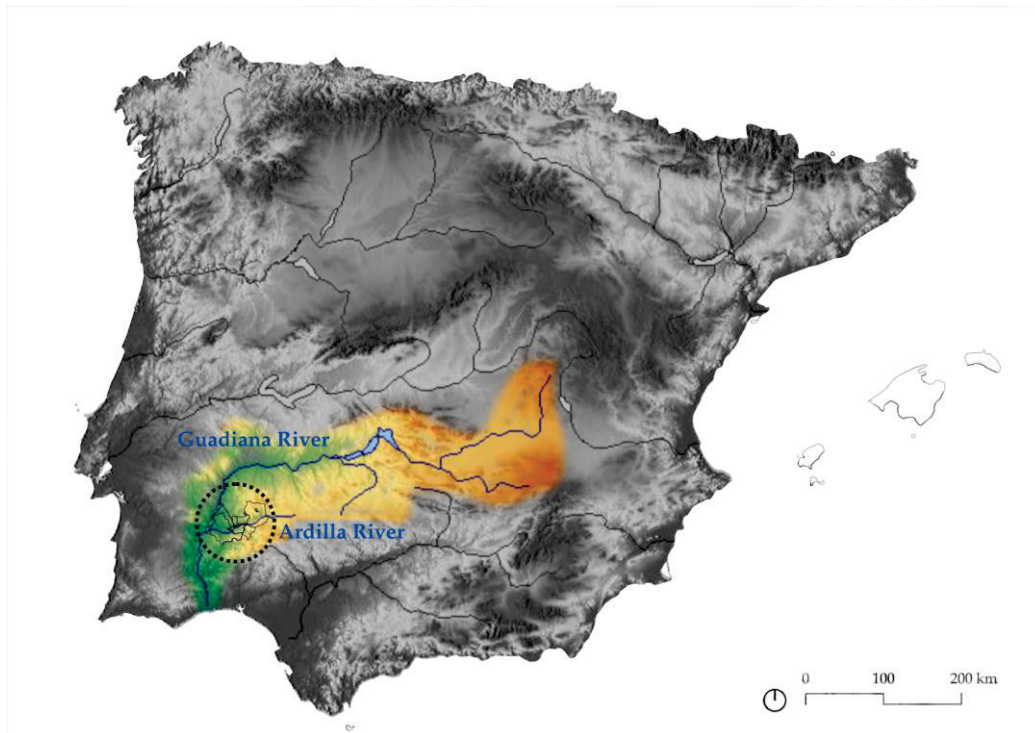


Figure 6. Map of Guadiana river basin in Spain and Portugal over the topographical base—greener colors mean a lower height, weather warmer colors imply a higher height. Source: own elaboration over the base of the map from <https://maps-for-free.com/> (accessed on 30 March 2025).

The climate of the area is Mediterranean, with a characteristic seasonal contrast and unpredictable cycles. The region experiences high levels of solar radiation, particularly in the non-winter months, which supports agricultural activity. However, the area's limited rainfall and high evaporation rates contribute to periods of drought, which impact crop yields and exacerbate water scarcity. The climate's variability presents challenges for maintaining consistent agricultural productivity and ensuring water availability for both consumption and irrigation [42].

In terms of vegetation, the region is primarily characterized by Mediterranean forests, interspersed with *dehesas*, or wooded grasslands. These landscapes have been significantly altered by human activity over the centuries, with the natural forests being cleared for agricultural purposes. The dominant vegetation types in the area include holm oak and cork oak, which are well adapted to the local climate. Agricultural practices, including olive cultivation and livestock farming, have further transformed the landscape, leading to changes in the local flora and fauna. The intensification of agriculture, particularly the expansion of pastureland, has reduced the diversity of wild mammals, with many species experiencing a decline due to the increased livestock population and the thinning of scrubland [3].

Another element that conditions the physical environment, but in this case is not natural, is the land communications system, which is recognized as being of great importance, since the land communications system is crucial for the region's economic development and connectivity, particularly between Spain and Portugal. However, the road network faces challenges due to poorly designed secondary roads, which hinder internal connectivity. There are a few key roads, such as the BA-102/EX-112 or the N386, which links Oliva de la Frontera, Valencia del Mombuey with Amareleja—belonging to the municipality of Moura—and the HU-9101, which becomes the N258, linking Encinasola and Barrancos. In addition, there is the EX-107 road linking Villanueva del Fresno with Mourão, which is out-

side the scope of this work, but, it was thought, necessary to mention. The deficiencies are particularly evident on the Spanish side of the border, where the road network's capacity and functionality are reduced, limiting the region's potential for economic integration and cross-border cooperation [19].

In conclusion, the region's physical environment (Figure 7), including its geography, hydrology, and climate, plays a pivotal role in shaping its agricultural and water management systems. While the Guadiana River and its tributaries provide essential water resources, the scarcity of water, combined with a Mediterranean climate and poor road infrastructure, poses significant challenges to the area's development. The natural landscape, marked by the *dehesas* and Mediterranean forests, has been reshaped by centuries of human activity, particularly agriculture and livestock farming. To ensure long-term sustainability, it is essential to address the region's water management challenges, improve its transport infrastructure, and enhance cross-border connectivity. A more efficient and integrated approach to water resources and infrastructure development is necessary to safeguard the region's agricultural heritage and promote its economic revitalization.

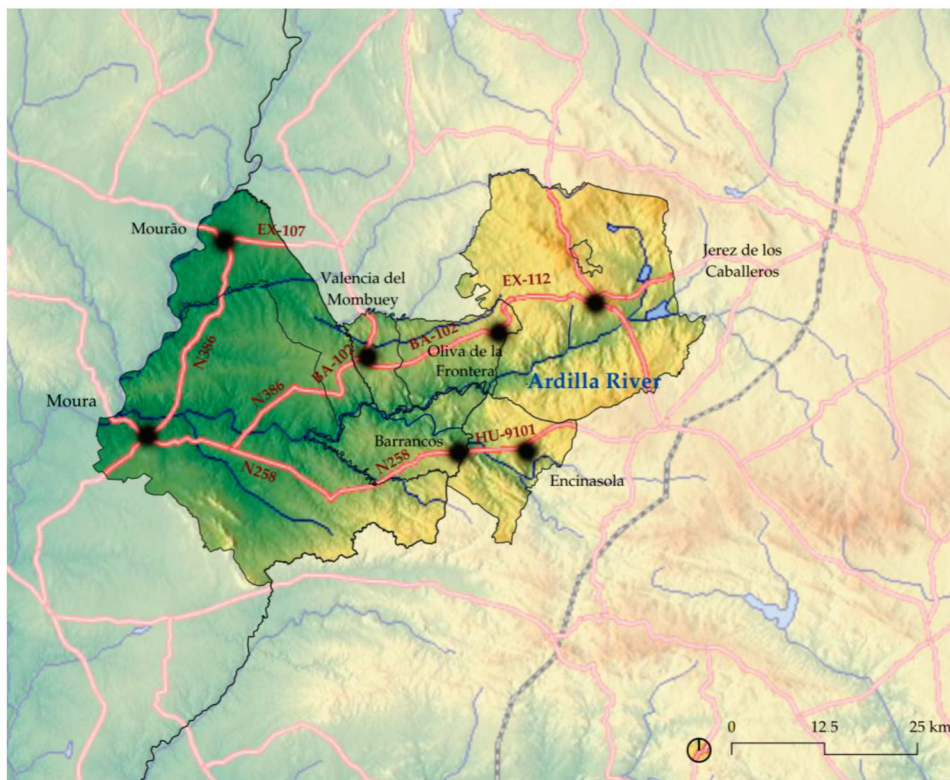


Figure 7. Map of the physical framework of the working area in which the base is the relief of the territory—from lower areas in green to red colors for the upper ones—and over it appear the hydrography (blue), the road network (red), and the cities of study (black dots). Source: own elaboration over the base of the map from <https://maps-for-free.com/> (accessed on 30 March 2025).

Embedded within this physical landscape is a rich cultural heritage that is intrinsically tied to the region's agricultural past. The mills located along the Ardilla River and its tributaries are a key feature of this heritage. These mills, which have served as central hubs for grain milling in the region, are an integral part of the area's agricultural infrastructure. The mills are not only functional artifacts but also reflect the historical way of life and the technological adaptations that local populations employed to work with the land and its resources [2]. They embody the interplay between human ingenuity and natural resources, making them an essential part of the region's cultural identity [43].

3.4. Production Framework

Dehesas, in general, are large areas of wooded pastureland, in which the degree of tree cover is variable, which have numerous uses and exploitation systems, of great socioeconomic, cultural, and environmental interest [44]. The physical environment in which the work area is located, which has just been analyzed, makes it difficult to intensify productive activities in these places. Therefore, livestock activity predominates alongside forestry and extensive agricultural exploitation [19]; however, this was not always the case.

After the Muslim domination, the settlers from the north of the peninsula began the process of pastureland deforestation, subjecting the territories to the origin of the current *dehesas*, and originating in the transfer by the Catholic Monarchs of grazing lands to military and religious orders and civilian communities. It is important to note that almost 40% of the pastureland in Spain is in Extremadura [44], of which the study area forms part. Until the 19th century, there were important extensions of communal lands, but since then, the territorial order has been altered by reducing them due to the disentailment processes and by the impact of mining, which modifies the structure of the city system. With this mining development, the livestock option was also reinforced in the region. In the second half of the 20th century, the agrarian model broke down, and pastures and Mediterranean forests were replaced to a large extent by timber reforestation—eucalyptus and conifers—changing the mountain landscape [45].

The development of agriculture, specifically, implies the radical substitution of the original vegetation cover, in addition to changing the cycles of matter and energy. By 1960, in many areas of the study regions, the active population was predominantly dedicated to the agricultural sector, and since then, the process of tertiarization has begun [45].

As for livestock, both in Roman times and in Al-Andalus, the primary activity of livestock is given, but not so much the agriculture that is reserved for the Guadalquivir Valley, and there are mostly pasture and forest districts. In the Christian era, livestock activity was characterized by the movement of livestock through a network of cattle trails between pastures and mountain areas. In the Modern Age, the transhumant livestock of the Mesta Real were confined to the Sierra Morena—intense in the working area—and other local enclaves. However, local livestock was more abundant, mainly sheep. In terms of land ownership and tenure regimes, the main models of farms in the Modern Age are configured. In the working area, there is a predominance of agricultural and livestock farms, with some estates, olive farms, mills, farmhouses, and wine presses. It is important to note that at this time, the main landowner of the lands in the working area was the Church. In pre-industrial times, there were some oil mills and many flour mills in the study area. This is because most of the manufacturing activity sectors are linked to the transformation of natural resources for local markets. The religious and civil disentailments of the 19th century also had an impact on the work zone. This was initially supposed to be a process of liberating the land market to boost agricultural productivity and redistribute land, but it functioned as a mechanism for financing the State. The disentailments favored the expansion of cultivated land to the detriment of forest and pastureland. Until the first third of the 20th century, industrial development was based on handicrafts for local consumption, linked to local natural resources such as mining and agro-industry. However, mining went into crisis, and the industrial base was centered on the agri-food sectors, but the post-war period and the first decades of Franco's dictatorship would lead to a major industrial crisis [45].

As for energy production, until the first half of the 19th century, it was based on animal, human, and water power. With the beginning of the industrial revolution, the energy model changed due to the presence of coal and electrification from the second half of the 19th century. After the First World War, large hydroelectric power plants and

electricity grids began to be installed in a large part of the territory. Specifically in the working area, the Sevillian network was developed between the two Communities, linking the power stations of Peñarroya-Pueblonuevo and Villanueva del Río y Minas. However, with the second technological revolution, based on petroleum, local energy sources are now in the background [45].

At present, the productive strategy of the *dehesa*, where the work area is located, are soils that generally do not have a large agricultural area and are therefore mainly oriented towards extensive livestock farming. However, agriculture and forestry and environmental uses are complementary, highlighting the multifunctional nature of the system. It is important to highlight, in this sense, that in addition to productive tasks, extensive livestock farming fulfills environmental responsibilities of great relevance, facilitating the spatial redistribution of the entire ecological system [35]. The performance of livestock represents production systems and landscapes as emblematic as *dehesas* or mountain pastures, which would not be feasible without the sustainable and logical management of extensive livestock. In this context, the territorial importance of the use of pastures by livestock exceeds its quantitative relevance compared to purely economic indicators; for this reason, integrated actions to promote this subsector acquire particular importance, given that they have a significant impact on various aspects that influence the territorial progress of rural areas in Andalusia—protection of nature and biodiversity, consolidation of the rural population, safeguarding of heritage values, etc.) [17].

In terms of agricultural uses, the Mediterranean climate and the poor soil mean that it is not possible to maintain sustainable and profitable agricultural crops on a large area of the pastures, so they resort to a rotational system in which they are not repeated on the same piece of land after a certain period of time. For this reason, the main forms of utilization for pastureland agricultural areas are cereals such as oats, barley, rye, and wheat. These crops contribute to the maintenance of the pastures, preventing them from being invaded by shrub species, while also feeding livestock or game. However, the current cereal surpluses lead to the abandonment of agricultural land, thus reducing the cultivated area and promoting the invasion by shrubs. Another frequent practice is the establishment of meadows. Other secondary uses of the *dehesa* are, among others, the hunting activity—of high economic profitability—the mycological sector, or the beekeeping sector [44].

As already mentioned, *dehesa* agriculture is related to the use of livestock, which is characterized by its extensive nature, supporting systems in which species capable of making efficient use of natural resources are used. This procedure has environmental advantages, but also helps to manage disadvantaged rural areas by increasing biological and landscape diversity, while maintaining decent socioeconomic conditions. Livestock can be considered as the main product of the *dehesa*, since it is a stabilization, perpetuation, and improvement tool. These are mostly of an extensive nature, dominated by autochthonous species, taking into account the limiting and ecological factors of the surrounding territory. These breeds allow an efficient use of natural resources, recognizing their importance in the management and sustainability of rural areas. This increases biological and landscape diversity and maintains sustainable production. The extensive production systems in place produce high quality products that are appreciated by consumers, but their low profitability makes it difficult to undertake technical improvements, and government aid is necessary for their maintenance [44].

In the working area, there are mainly cattle, sheep, and pigs, from which high-quality products are obtained, and the latter are fed by taking advantage of the production of acorns. Although cattle, sheep, and pigs are the three main livestock species in the *dehesas*, goats are important because they mainly provide meat and milk for cheeses. The species present in the working area are the Serrana and Retinta [44].

However, it is also important to highlight the role played by the *dehesa* as a tourist product, especially for its ornithology and natural assets, which provide economic complements to its own products, in which the equine livestock stands out; although it was once very important, nowadays, it is used as a leisure tool [44].

However, the situation in which the pasture systems find themselves (Figure 8), in general, are delicate, since they have low competitiveness, productivity, and profitability. However, with the incorporation of Spain into the European Union, and the application of the Common Agricultural Policy—which is the balance between agricultural production and the natural environment—it has undergone a series of reforms, largely to economically complement the situation of the sector.

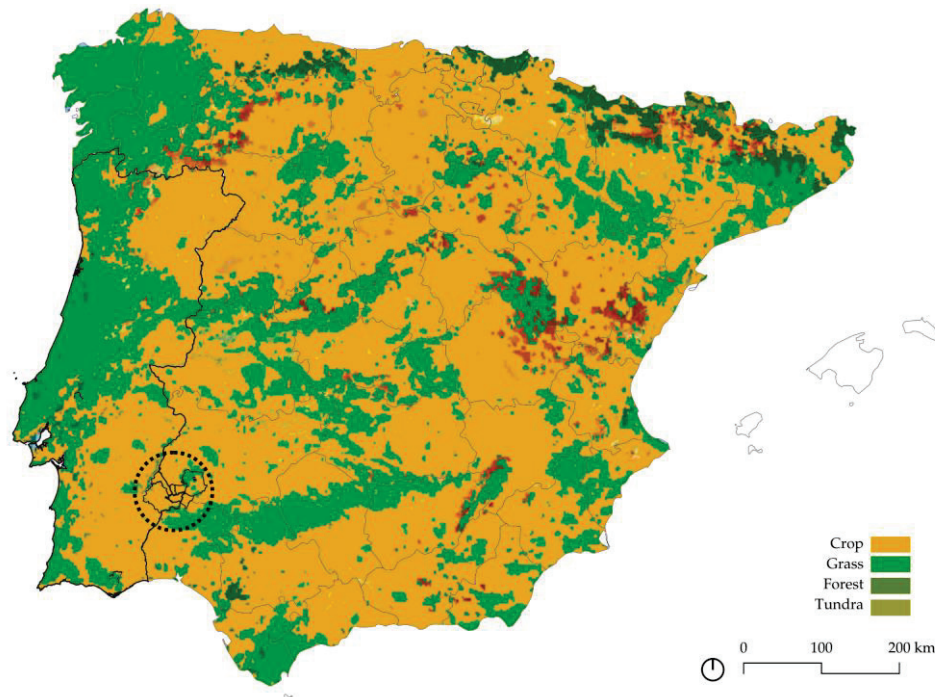


Figure 8. Map of the land use in the Iberian Peninsula, underlying the working area. Source: own elaboration over the base of the map from <https://maps-for-free.com/> (accessed on 28 March 2025).

3.5. Agricultural Heritage Framework

After reviewing the legal, physical, and productive framework, and observing the importance of the same in the area of work in particular, but in Spain and Portugal in general, throughout history, we will work with the heritage legacy in this rural area left by previous generations.

The rural heritage, composed of built elements and intangible manifestations [8], together with the territory interpreted in heritage terms, ensures that identity remains constant in the face of the standardizing pressures of globalization [4]. However, due to depopulation processes, a complicated process that includes, among other factors, low population density, the characteristics and values of these rural landscapes, protected by the society that inhabits them, are at risk of extinction [9]. To this must be added, as already mentioned, the added difficulty posed by the borders—both national and regional—when it comes to protecting assets that, despite being part of a common heritage system, are not protected jointly.

As previously mentioned, rural areas are home to a wide variety of heritage types, including both movable and immovable assets, as well as tangible and intangible elements. Within these, there are outstanding examples of immovable properties that represent important examples of productive heritage that allow us to identify historical processes

of implantation that have influenced not only demographic and urban transformations, but also the formation of its heritage and landscape [17]. In this case, we will use the agricultural, industrial, or ethnological heritage found in the municipalities under study, since it is essential to recognize the agricultural value, as a general value, but the one that should support it is the cultural value, which understands the agricultural practice as a social asset and understand its contribution to the inhabitants.

Precisely, in order to recognize the importance of the productive legacy in the study area, reference has been made to the historical documents that existed at the time, in which specific sections were made to recognize these activities in those municipalities. Specifically, in the following table, we observe what is described of each of the municipalities in the geographic–statistical dictionaries of Madoz [21] and Miñano and Bedoya [22], in relation to production and/or industry (Table 3).

Table 3. Table of the production and industry of the nineteenth century in each village. Source: own elaboration based on the data of *Diccionario geográfico-estadístico-histórico de España y sus posesiones de ultramar*, by Pascual Madoz [21] and the *Diccionario geográfico-estadístico de España y Portugal*, by Sebastián Miñano y Bedoya [22].

Municipality	Production	Industrial
Encinasola	wheat, barley and oats; the imported products are wine, oil and vegetables; there are sheep, goats, pigs and cattle, half of which are used for farming and hunting rabbits, partridges, hares, wild boars, and deer.	The general activity is agriculture; muleteering and women weaving linen and cloth for domestic use.
Jerez de los Caballeros	Wheat, barley, rye, oats, vegetables, fruits, wine, oil and acorns; sows, cattle, sheep, goats, working and pack horses, beehives, big and small game, abundant fish and tench fishing.	There are 7 leather tanning factories; 3 of wax and tallow candles; 8 of soft soap; 4 of pottery; 20 looms of canvas, tow and wool blankets; 9 oil mills; 2 presses; 40 flour mills, several tile and brick ovens, 13 stores, fair in the first 8 days of September, of esparto grass and cattle.
Oliva de la Frontera	wheat, barley, oats, chickpeas, beans, oil, oranges, fruits (melons and watermelons); sows, cattle, goats, sheep and horses; game of all kinds and fish from the river.	linen and wool looms, run by women; 20 flour mills; wheat is imported, and a modern concession fair is held on September 16 (sows and cattle).
Valencia del Mombuey	wheat, rye, barley, oats, chickpeas, beans, wine and acorns; sows, cattle, sheep and mares, and game of all kinds.	4 brandy factories, homemade linen looms, 4 flour mills, 4 bakeries, and the pig trade.
Moura	It abounds in grains, cattle, some wine, and a lot of oil. They have olive groves on the east and south and the rest is occupied by large oak and cork oak forests where they raise a lot of sow cattle; many beehives, abundant hunting.	-
Barrancos	-	-
Mourão	It produces many grains, oil, wine, cattle, beehives; hunting and fishing of the Guadiana River.	-

In general, there is a large production of grains, oil, and wine, as well as a variety of pomegranate trees. Specifically, for the concrete study of the patrimonial legacy, the work focuses specifically on the mills, which in the previous table are mentioned as existing in the 19th century, to observe if they are still preserved today (Table 4).

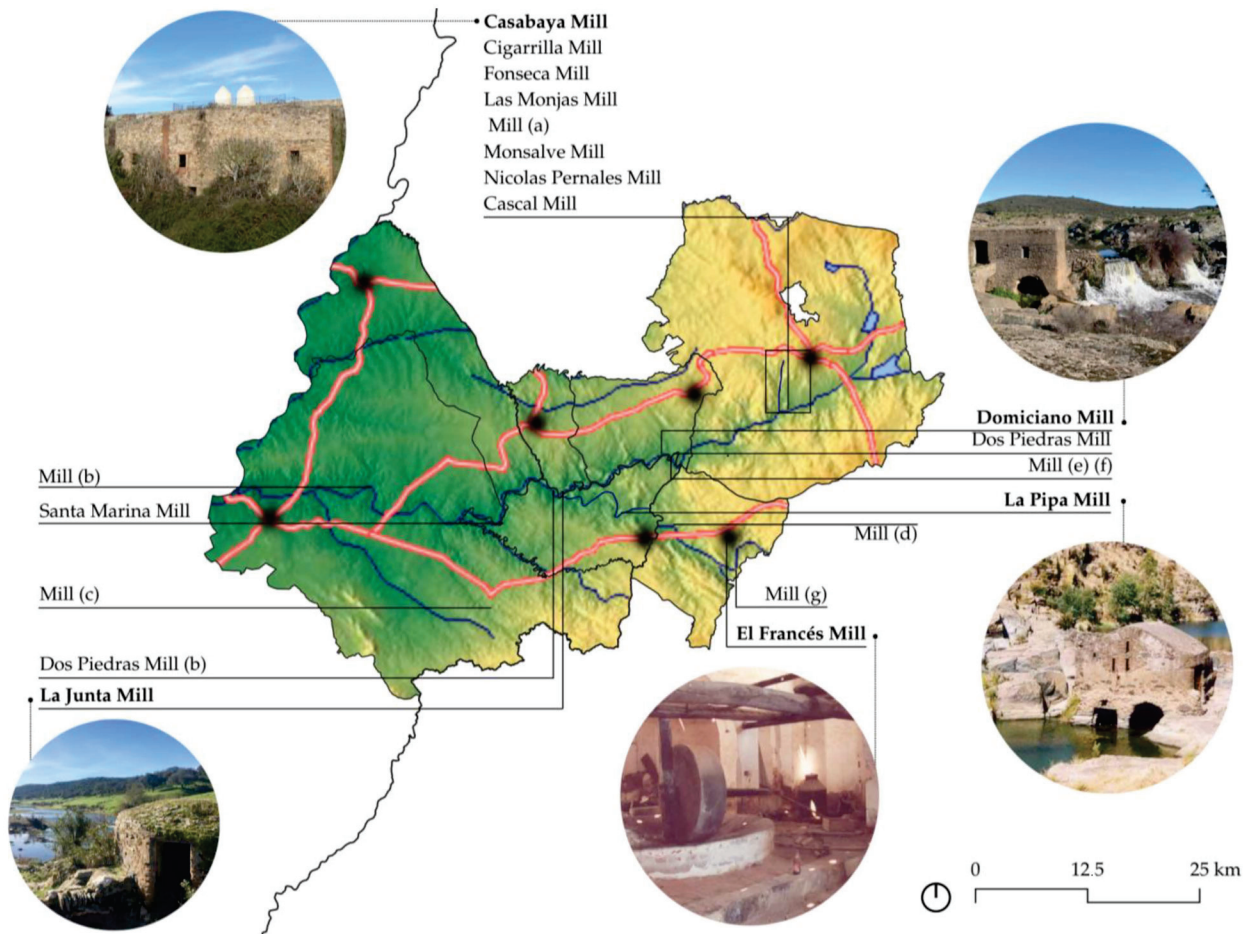


Figure 9. Map of mills in the study area over the base of the physical framework map, with pictures of some of the best examples of the mills. Source: own elaboration with the base from <https://maps-for-free.com/> (accessed on 30 March 2025) the data of the *Guia Digital* of the Andalusian Institute of Historical Heritage, the website of the Cultural Heritage of Portugal, Google Maps, the websites of the villages, and Wikiloc.

These are the structures that in their time served as mills, whose operation was based on facilitating, through a system that used a rotating wheel or a turbine, a mechanical process that served to grind cereals [43]. In this case, it is important, since they are goods that contributed to the economic development and cultural and social growth of particular times [18]. On the other hand, it would be important that the activity of this heritage does not cease, but in this case, the goods that are exhibited here today are not still in use, and therefore, the agricultural activity is relegated.

Once their location has been determined (Figure 9), it is necessary to understand them in strategic terms, as well as in the inherent characteristics of the region. It is crucial to consider heritage as a territorial resource to ensure its sustainability, as Unesco maintains [43]. Once the location in which the different pieces of mills are placed, it is observed that they accompany the course of the Ardilla River, from the Spanish side to the Portuguese side, and therefore, they are collected within the Guadiana Hydrographic Basin. In this sense, at present, there is no agreement that could unite all the municipalities involved in order to establish adequate protection for these pieces, which in no case are protected, nor properly identified.

Table 4. Table of the mills in each village related to Figure 9. Source: own elaboration based on the data of the *Guia Digital* of the Andalusian Institute of Historical Heritage, the website of the Cultural Heritage of Portugal, Google Maps, the websites of the villages, and Wikiloc.

Municipality	
Encinasola	French Mill Mill (d) Mill (g)
Jerez de los Caballeros	Casabaya Mill Cigarrilla Mill Fonseca Mill Las Monjas Mill Mill (a) Monsalve Mill Nicolas Pinales Mill Cascal Mill
Oliva de la Frontera	Domitian Mill Mill (e) Mill (f) Dos Piedras Mill (a)
Valencia del Mombuey	La Junta Mill Dos Piedras Mill (b)
Moura	Santa Marina Mill Mill (b) Mill (c)
Barrancos	La Pipa Mill
Mourão	-

Of the mills previously mentioned, information is available online for some, though not all, which represents a limitation of the study. For example, Mill La Junta owes its name to the confluence of the Ardilla and Murtigas rivers and is currently well preserved [46]. The El Francés Mill, dating back to the 18th century, functioned as an oil mill used for producing soap or oil, powered by beasts of burden. With the advent of new technologies, it fell into disuse [47]. A similar fate befell the Domiciano Mill, which remained operational until approximately 1960. This latter example consists of two adjoining naves, forming a double mill that is remarkably well preserved, including its original grinding stones [48]. These cases clearly demonstrate the presence of well-conserved examples of the area's agricultural and productive legacy—heritage assets that deserve further study and protection.

4. Discussion

Therefore, while European heritage policy frameworks and academic discourse increasingly emphasize the importance of traditional mills as elements of rural and industrial heritage, the situation on the ground—particularly in cross-border territories such as the Guadiana River Basin—reveals a striking gap between theory and practice.

As outlined in the broader European context, mills are increasingly acknowledged as cultural assets that embody the historical relationship between people, land, and production systems. Instruments such as the Faro Convention [10] and the TICCIH Charter [12] advocate for the recognition of these structures within heritage landscapes, emphasizing their value as both tangible artifacts and repositories of local memory. However, in the case of the transboundary rural zone between Spain and Portugal, these values are not being translated into protective measures or territorial recognition.

Despite the growing emphasis on vernacular and rural industrial heritage, the windmills scattered across this Iberian border region often remain absent from national invento-

ries, and in many cases, are not even locally identified. Unlike in the Netherlands or the UK—where projects like the Monumenten Inventarisatie Project (MIP) [16] or the SPAB Mills Section [15] ensure systematic documentation and restoration—Spain and Portugal’s approaches are fragmented and reactive, lacking binational coordination. The absence of integrated heritage strategies means these mills are rarely interpreted as part of a shared cross-border cultural landscape, even though their locations, typologies, and uses reveal clear historical continuities across both sides of the border.

Moreover, the lack of formal recognition has practical consequences. Without being listed in state databases such as Spain’s *Guía Digital del Patrimonio Cultural* or Portugal’s *DGPC*, these mills are excluded from conservation funding, protection statutes, and community-led revitalization initiatives. Researchers are thus forced to rely on non-official data sources—Google Maps, Wikiloc, and local knowledge—which, while valuable, underscore the absence of institutional stewardship.

This gap reflects the broader critique offered by scholars like Strangleman [14], who warns against a passive or nostalgic engagement with industrial ruins, and instead calls for active redefinition of heritage through community involvement and territorial meaning. In the case of the Spain–Portugal border region, such a redefinition is urgent: these mills are not isolated objects but integral to the identity and history of a fading rural fabric that spans both countries.

Therefore, what has been proposed here is to collect those assets that collect the values of traditional agrarian systems and that are within the definition of Agrarian Heritage of the Charter of Baeza, in order to make a proposal for its protection of territorial character, through some existing figure or some new proposals such as the Places of Agrarian Interest [2], but are not included in the heritage laws observed above. For this, and taking into account the study site where we are, it would be important that the land management instruments or management systems were of a territorial nature, at the supramunicipal and interadministrative level, for example, within the framework of the Guadiana Hydrographic Confederation, which could recognize the heritage associated with the main river and propose its protection.

To this end, The Guadiana River Basin itself offers a compelling case for applying the concept of Cultural Landscapes or Sites of Ethnological Interest to cross-border mill systems. The former is present in the current legislation of Andalusia and Extremadura, but not in the Portuguese legislation, which does not have a classification of protected assets. In the second case, as neither the Spanish nor the Portuguese legislation recognizes this figure, the European Landscape Convention [5] could be a tool to ensure the protection of the geological heritage of Extremadura and its maintenance. Yet, the current reliance on segmented national inventories obscures the broader landscape-based understanding that European conventions promote. This not only undermines heritage conservation but also weakens the potential for cultural tourism, sustainable development, and regional cooperation—objectives aligned with EU programs like Interreg and the European Heritage Label, which remain underutilized in this context.

In any case, the recognition of the agrarian heritage as a system would thus constitute a reference in territorial and urban planning and in the different processes of environmental evaluation of plans and projects. All the points identified should be considered in the studies of the physical environment and constitute an effective instrument for the preservation of the landscape in general.

In summary, while European policy and academic discourse provide a progressive vision for the protection of traditional mills, this vision is not yet realized in regions like the Iberian borderlands. Bridging this gap requires binational cooperation, community involvement, and a territorially integrated approach that moves beyond administrative

boundaries and recognizes mills as part of a shared cultural continuum, as has been done in the present study.

5. Conclusions

The socioeconomic opportunities of the area are largely determined by progressive aging, whereby the more active and dynamic population invests its human capital in areas with greater connectivity and business activity. In contrast, the aging population often shows little interest and initiative, adopting a passive attitude towards public or private opportunities or initiatives. The socioeconomic decline of this place is encouraged by the skeptical attitude of the inhabitants towards the present dynamics of the rural environment. Therefore, it is essential to innovate in agriculture and livestock in order to be able to compete with other areas or forms of production. This is achieved through the balanced transformation of the dry cereal crops of the *penillanura* and the appropriate use of the forest areas to cultivate alternative crops that are valued in the market. These efforts must take place within a cross-border framework, as the land forms a continuous and uninterrupted landscape, as shown throughout this study.

The scarcity of water and investment—challenges present throughout the region—suggests that the majority of farms rely on rainfed crops. This, combined with poor soil quality, negatively affects the production competitiveness. Nevertheless, agricultural activity has historically maintained environmental balance, harmonizing productive use with the natural environment, and doing so with minimal disruption to the ecological system's evolution. In this way, a balance has been struck between necessity and heritage—now increasingly at risk due to the ongoing reduction of the labor force in agriculture and livestock, as well as the irreversible loss of traditional land-use practices. These changes are causing shifts in soil use and altering the natural structure of the territory.

Although there is growing interest in protecting this type of heritage, there is currently no specific designation for agricultural heritage. While categories such as Place of Ethnological Interest or Cultural Landscape may be adapted, these apply only to the Spanish side. Moreover, any such protections would be granted individually, as there are no existing interregional agreements for protecting heritage as a system. As a result, their broader physical and cultural context is overlooked—despite its importance, as demonstrated in the study area.

This study has revealed the existence of a network of cross-border mills intrinsically linked to the Ardila River and its tributaries, which form part of the international Guadiana river basin. Their close connection to the landscape underscores the importance of recognizing and protecting these assets, as they represent a cultural legacy rooted in traditional practices that should be preserved over time. Nevertheless, researching the mills in this case has proven challenging, as many are not listed on official national or regional heritage registries. As a result, alternative sources—such as municipal websites and the trekking platform Wikiloc—had to be consulted, which imposes certain limitations on the study. Furthermore, while the mills have been identified, similar efforts should be extended to other elements of the area's agricultural heritage in order to build a comprehensive network of productive assets capable of revitalizing local activity. Similar border situations can also be found elsewhere in Spain, along other sections of the border with Portugal, as well as in the north with France, where this study could similarly be applied.

In conclusion, it is important to highlight the nature of the area as a bordering place with the territories of other Autonomous Communities and, in its westernmost zone, with Portugal. This emphasizes the need to consider elements such as the administration of shared agrarian and ecological systems, the articulation of transport networks, the linking of local productive systems, or the presence of centers and areas of functional

organization for the provision of services. These interconnected dynamics point to a structural framework for shaping the socioeconomic future of the region, grounded in its most valuable assets: environmental quality and traditional culture. Within this context, the protection and promotion of rural agricultural heritage emerge as fundamental pillars, with local communities playing a central role in safeguarding these practices and landscapes as part of a long-term, sustainable vision.

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Article

Landscape Character Assessment for Sustainable Rural Development in Border Insular Areas: A Case Study of Ano Mirabello, Crete

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Abstract: This article seeks to demonstrate the value of landscape character assessment in addressing the unique needs of remote areas, located at national insular borders, with lower levels of development and economic activity. The paper assesses and presents the predominant landscape character of a remote agricultural area in the north part of the island of Crete in Greece, the specific assets of various landscape character types with the main productive economic sectors, leading to a proposal for tourism development sustainable strategies. To achieve this, a landscape character assessment methodology was applied in combination with a literature review and landscape evaluation per each economic sector. The goals of a landscape strategy for the area were formulated to preserve and enhance the landscape character and uniqueness, as natural and cultural heritage, for the benefit of the island inhabitants. At the end, landscape strategies for the planning, management and protection of the specific area were proposed for its sustainable development.

Keywords: landscape character assessment; rural development; landscape strategies; planning; management; protection; border areas

1. Introduction

Rural areas are increasingly confronted with the demands of sustainable food production, climate change adaptation, nature restoration, and overall wellbeing. Among the primary challenges are the decline of farmland and green spaces due to land competition, the abandonment of traditional agricultural practices, and the intensification of farming, all of which pose significant obstacles to the future of rural landscapes.

Agriculture is vital not only as an economic factor but also as a key element of cultural identity and a long-standing connection to nature. The landscape, an important facet of agriculture's intangible values [1], holds particular importance for local communities, as it nurtures a sense of belonging, strengthens identity, and humanizes natural surroundings. According to the Lausanne Declaration, "Landscape plays a fundamental role in sustainable development by balancing environmental, social, cultural, and economic aspects. It is crucial for food and energy, addressing issues like climate change, biodiversity loss, air and water pollution, soil degradation, and land urbanization" [2]. Landscape serves as a key indicator for understanding climate change effects, projecting future scenarios, and developing adaptation strategies. Additionally, there is an increasing need for planning and management strategies that integrate landscape preservation (and heritage) with the responsible use of land resources [2].

Agricultural landscape is an expression of the bond between human society and the environment, embodying biodiversity and a coevolution process between man and nature. “Agricultural landscapes take over more than 10% of the earth’s land surface (1.5 billion ha), presenting a continuous field of interaction between man and nature, shaping the earth’s epidermis since antiquity” [3]. Throughout history, people devoted to agriculture contributed to the creation of what was then called “rural landscapes” and presently are regarded as examples of resilient landscapes towards climate change and a valuable resource not to be ignored or misused [4].

The initiatives set forth by the SDGs, the European Green Deal, and the Common Agricultural Policy (CAP) emphasize the critical role of agricultural landscapes as entities that should possess, or already do possess, the potential to drive the transition toward a socially and ecologically sustainable future for our planet. The 17 Sustainable Development Goals (SDGs), outlined in the United Nations 2030 Agenda for Sustainable Development adopted in 2015 [5], closely link agricultural landscapes to sustainability efforts. The Common Agricultural Policy (CAP), established in 1962, is a collaborative framework involving agriculture, society, and European farmers [6]. Its goals are not only to ensure a fair economic future for farmers but also to maintain the central role of agriculture in European society, with an increasing focus on environmental and climate objectives. Furthermore, the CAP aims to improve rural landscapes and promote local development through initiatives such as bio-economy, sustainable forestry, and eco-schemes. Several European policies, including the European Landscape Convention and the European Spatial Development Perspective, highlight the significance of landscapes in cultural, ecological, environmental, and social contexts, within regional planning, rural development programs, new governance models, and national and European spatial planning efforts. At the UN Climate Change Conference (UNFCCC) COP21 (2015), the Global Landscapes Forum underscored the importance of equitable and balanced landscapes in achieving food security, improving nutrition, advancing sustainable agriculture, addressing climate change and its impacts, supporting inclusive economic growth, and promoting sustainable consumption and production patterns.

On the other hand, in the monoculture of tourism, especially in islands, and more specifically the Greek islands, the environmental climatic challenges, and the socio-economic ones (e.g., financial crisis, refugee immigration), cause severe impact on social, economic, environmental services and require urgent actions and serious measures for their landscape restoration, protection and a place-based approach for their strategic management [7]. A 2002 European Parliament (EP) resolution (2002/2119(INI)) on structurally disadvantaged regions in the context of cohesion policy, stressed that the principle of solidarity should apply to regions with permanent geographical handicaps, such as island regions, since these areas suffer from structural disadvantages

To document human impacts on the natural environment and record the outcomes of land management and settlement, Landscape Character Assessment (LCA) methodologies were applied across Europe. The resulting maps illustrate variations in farming and development, reflecting the unique natural characteristics of each area. LCA informs land use and development decisions [8–10]. However, these assessments may vary significantly based on regional traditions, the specific objectives of mapping, landscape features, and the priorities of landscape planning and management [11,12]. Countries with a tradition of landscape research have composed reports on assessing landscape character [13,14], with the aim to contribute to the strategic and integrated management of their landscapes. In the Mediterranean, Landscape Character Assessment (LCA) is underdeveloped, particularly as a tool for landscape planning, with no efforts made for island landscape assessments [15]. Although Greece ratified the European Landscape Convention (ELC) in 2010 [16], landscape

policies, including LCA and Historic Landscape Characterizations (HLC) [17], remain underdeveloped for Greek landscape planning. Only a few sporadic initiatives have been undertaken, such as by governmental bodies (e.g., Special Frameworks of Spatial Planning and Sustainable Development) [18] or through South East European research projects (e.g., Medscapes Landscape Character Assessment (LCA), as applied in northern European countries, presents several challenges when implemented in the Eastern Mediterranean—particularly in Cyprus, Greece, Jordan, and Lebanon—due to limited primary data, linguistic differences (especially with Arabic), and varying perceptions of landscape features [19]. Quite recently (in 2024), the Landscape Observatory of Catalonia Spain produced maps of the unique agricultural landscapes and a wide range of landscape values are attributed to them, including natural, aesthetic, historical, social-use, symbolic and productive ones. Studies focusing on Mediterranean island landscapes highlight the importance of landscape character in developing strategies aimed at conserving and enhancing their unique identity and diversity, while also promoting sustainable development and land management [20]. The valuable role of landscape character assessment in supporting a multifunctional strategic framework for agricultural landscapes, such as olive groves, is also emphasized in many research studies [21].

Therefore, this study aims to take a step further by presenting a practical methodological framework specifically tailored to Mediterranean countries, where Landscape Character Assessment (LCA) remains underdeveloped. The ultimate goal is to raise awareness among people of all ages and backgrounds about the value of their landscape and to highlight the important role it can play in shaping planning and management strategies. The study focuses primarily on Greece, where the integration of LCA into landscape strategy formulation is still at an early stage and emphasizes the critical role of skilled professionals, such as landscape architects [22], as outlined in the European Landscape Convention, in transforming policy into actionable projects that inspire and engage local communities.

As such, this article seeks to demonstrate the value of landscape characterization in addressing the unique needs of remote areas located at national insular borders, which typically have lower levels of development and economic activity. Using a case study, the paper aims to assess and present the predominant agricultural character of a remote area in the northern part of Crete, Greece, and to propose a methodological framework for preserving its significant historical, cultural, and environmental heritage—an asset for sustainable tourism development strategies. The research will connect the specific assets of various landscape character types with the main productive economic sectors, and propose a direction towards specific strategies that will address the unique needs of remote areas and capture the existing lack of a holistic methodology based on a landscape approach specifically adjusted to Greece [23]. As such, the methodological approach will guide strategic management steps related to the values and characteristics of agricultural landscapes, fostering a connection between people and these landscapes, and preserving the agricultural landscape values especially of remote insular areas.

2. Materials and Methods

2.1. The Study Area

Ano Mirabello province is located at the northeastern part of Crete (Figure 1), within the Lasithi region, extending from the town of Milatos to Vrouchas and overlooking the Spinalonga harbor to the east. Ano Mirabello is under the jurisdiction of the municipality of Agios Nikolaos. The area covers a considerable portion of Mirabello Bay and is characterized by a mountainous landscape with a few villages situated along its slopes. The landscape is predominantly natural, though shaped by human intervention over the

centuries. It is marked by a diversity of terrain that alternates between steep rocky cliffs, small valleys, terraced hillsides, and coastal areas (Figure 2) [24].

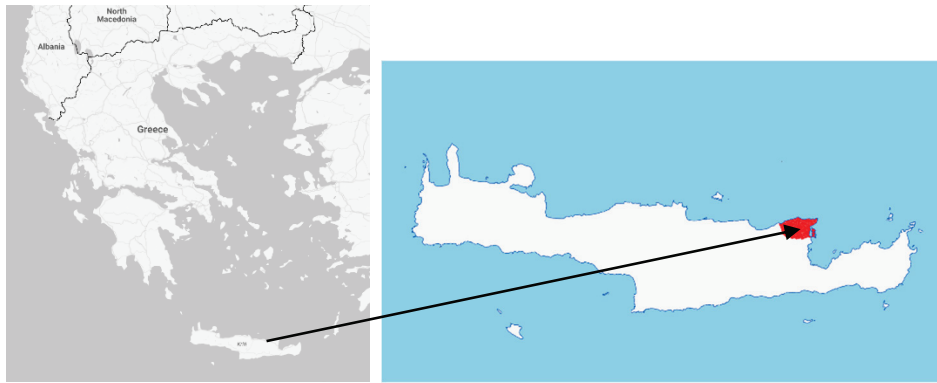


Figure 1. Location of the study area. Source: Eurostat, GISCO, 2020.



Figure 2. (a). A general overview of the landscape of Ano Mirabello. (b). Coastal landscape of the north part of Ano Mirabello. Source: author's archive.

It is one of the most tranquil and isolated parts of Crete, where the authentic character of the Cretan countryside is preserved. In the central and eastern parts of the area, there are small valleys where most of the villages are scattered. The majority of these areas are characterized by difficult access and a lack of recent significant human interventions.

Based on data from the Hellenic Statistical Authority (ELSTAT) from the 2021 Census, the population of Ano Mirabello is approximately 2784 residents. According to data from the 2011 ELSTAT Census, less than 10% of the local population is employed in the agricultural sector. In the mountainous regions, more than 50% of residents are retired, while those who are employed are primarily concentrated in the tourist zones, such as Elounda bay.

Wild nature can be found in several coastal and semi-mountainous landscapes of the region, which are important for birdlife [24,25].

The climate is Mediterranean, with hot, dry summers and mild, rainy winters. Average annual rainfall is around 340 mm, which sustains the vegetation but also contributes to water scarcity in the region during the summer months, being one of the driest locations in Crete. Strong north winds are common, especially during the winter [26]. The following graph (Figure 3) presents an estimate of the average annual temperature for the broader Agios Nikolaos region. The dashed blue line represents the linear trend related to climate change. An upward-sloping line from left to right indicates a warming trend, suggesting that Agios Nikolaos is experiencing rising temperatures due to climate change. A flat line suggests no significant change, while a downward slope points to a cooling trend over time.

The lower section of the graph displays the “warming stripes”, where each colored stripe corresponds to the average temperature of a specific year—blue indicates cooler years, and red indicates warmer ones.

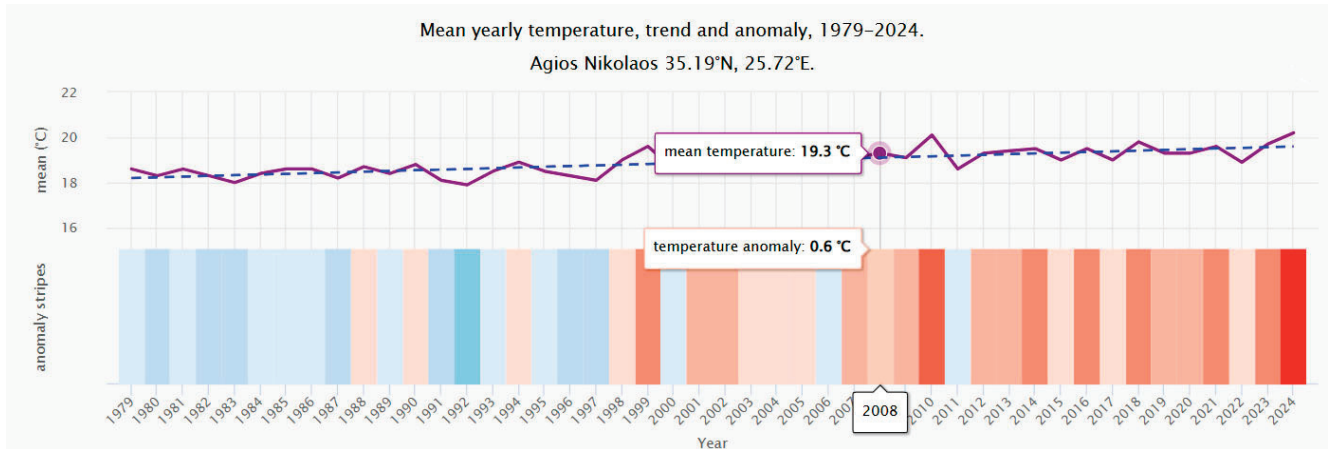


Figure 3. Yearly temperature change in Agios Nikolaos. Source: meteoblue.com.

The upper graph (Figure 4) presents an estimate of the average total precipitation for the broader Agios Nikolaos region. The dashed blue line indicates the linear trend associated with climate change. An upward-sloping line from left to right suggests a positive trend, meaning that precipitation levels are increasing over time, making the area wetter as a result of climate change. A flat line indicates no significant trend, while a downward slope signifies decreasing precipitation, implying drier conditions in Agios Nikolaos over time. The lower section of the graph displays what are known as precipitation stripes. Each colored stripe corresponds to the total precipitation recorded in a given year—green indicates wetter years, while brown represents drier ones.

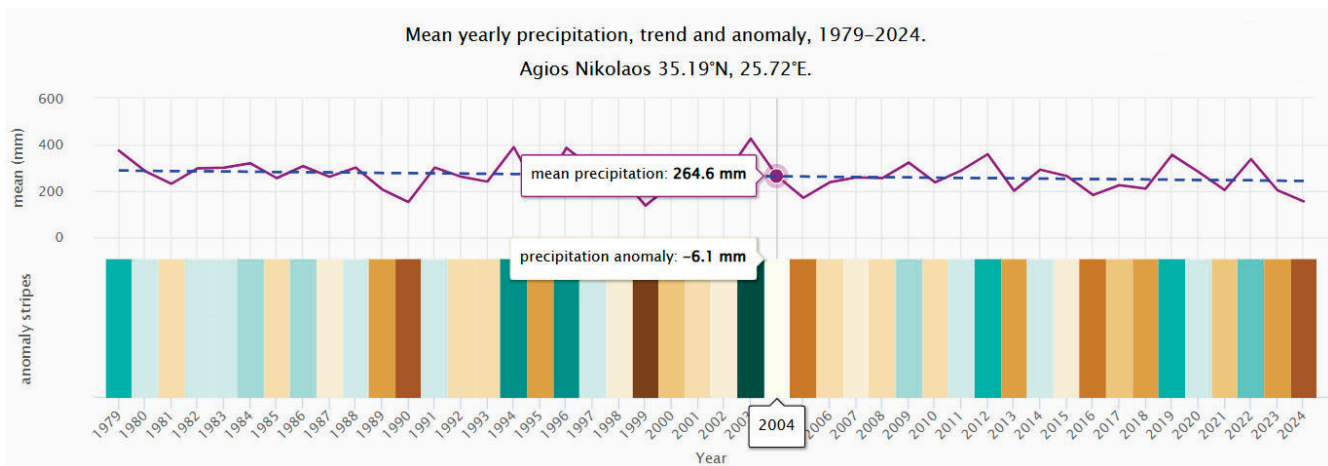


Figure 4. Yearly precipitation change—Agios Nikolaos. Source: meteoblue.com.

The region has a remarkable ecological profile, with various endemic plant species and a range of habitats that support unique wildlife. Ano Mirabello’s natural landscape (Figure 5) is ecologically significant, as it contains a variety of plant communities and ecosystems [27]. Three key factors have influenced the current form of vegetation in the area: the climate, intense grazing, and humans. The area belongs to the Mediterranean vegetation zone (*Quercetalia ilicis*). Two subzones of the Mediterranean zone are found within the study area: the *Oleo-Ceratonion* subzone in the coastal locations, and the *Quercion ilicis* subzone in the more mountainous areas [28,29].

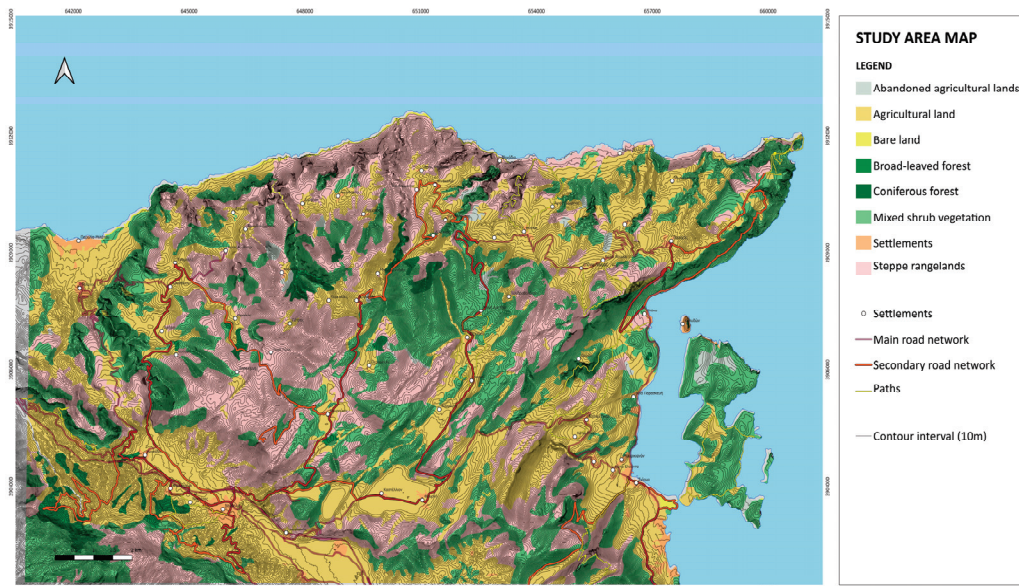


Figure 5. Study area map 2024. Source: author's production.

The history of Ano Mirabello dates to ancient times, with archaeological evidence suggesting that the area has been inhabited since the Minoan period. During the Venetian and Ottoman eras, it became a key agricultural hub, with terraced fields carved into the mountainside to maximize crop production. By the early 20th century, however, the abandonment of traditional farming practices began to take a toll, and the region's population began to decline. Nowadays, a lot of agricultural terraces are abandoned, and many of the crops have been replaced by olive groves (Figure 6) [25].



Figure 6. (a) Abandoned agricultural terraces. (b) Field patterns of annual crops in a mixture with olive groves. Source: author's archive.

Many mountainous areas have been abandoned by their inhabitants, who have relocated to urban centers and coastal regions. This development has significantly affected the relationship between humans and the land; domesticated animals are rarely seen, and grazing has declined. All of these changes mark the beginning of a new era for the region's "natural environment" [30].

In the last few decades, the tourism sector has developed rapidly, mainly along the coastal areas of the region and more specifically in Elounda, which has become one of the most popular destinations in the Mediterranean, renowned for its beaches. The mountain villages of Ano Mirabello, however, have not experienced similar development, having a few hotels and guesthouses, but to a limited extent [31].

The architectural character of the region is deeply rooted in traditional Cretan building techniques. Villages feature a unique blend of rural homes, farm structures, and small chapels. The layout of the settlements harmonizes with the natural terrain of the area and may feature linear, circular, or horseshoe-shaped characteristics. The final result blends naturally with the surrounding landscape, especially in cases of stone houses that “disappear” into the rocks [24]. Through continuous use and generational inheritance, these complexes underwent inevitable modifications that significantly altered their original characteristics. As a result, it is often difficult to identify the basic type of buildings, as the changes and adaptations over time have obscured their original form [25].

The architectural identity of Ano Mirabello is also characterized by the “metohia”, small agricultural settlements. The metohia were built scattered, mainly around the villages, to be used seasonally for agricultural activities, as they housed the villagers who worked on the estates of the region’s feudal lords.

The cultural landscape of the area, apart from the settlements and the metohia, is characterized by numerous dry-stone structures, such as windmills, retaining walls, dividing walls and cisterns (Figure 7) [32,33].



Figure 7. (a) Traditional cistern still in use. (b) A network of windmills. Source: author’s archive.

The open dry cisterns collect the scarce rainwater and supply the residents who remain in the area with water for both domestic use and the watering of animals and gardens [29,33]. Valuable landmarks are the windmills of the area, built from stone, typically horseshoe-shaped, and organized in clusters or standing alone. Most of them are in a state of ruin, although some have been restored. The quite specific structures such as Apanemidia (Figure 8a), are dry-stone vaulted or semi-vaulted shelters or windbreaks, to accommodate one or two individuals seeking protection from the strong winds in the northern part of Ano Mirabello. The area used to have a network of lookout posts mainly along the coastline, called Vigles, which today are in a ruined state. The region also boasts several significant monasteries and churches, such as the 16th-century Monastery of Aretiou [29] (Figure 8b).

Despite the natural beauty and cultural richness of Ano Mirabello, the area faces pressures from both urban development and tourism. The lack of a comprehensive planning system has led to sporadic and sometimes unsustainable growth, particularly around popular coastal areas. Illegal construction and unregulated tourism development continue to threaten the landscape and its ecological integrity.

Ano Mirabello was chosen as a case study due to its combination of (a) distinctive rural and coastal character, (b) valuable geological, natural, and cultural features, (c) abandonment of traditional agricultural practices with a clear impact on the landscape, (d) socio-economic pressures from tourism and urbanization, and (e) environmental challenges, such as climate-induced desertification and erosion. There is still an opportunity

for strategic development planning to protect and enhance the region’s unique landscape and cultural heritage.



Figure 8. (a) One type of Apanemidia. (b) The monastery of Aretiou. Source: author’s archive.

2.2. The Methodological Process

The following diagram presents the methodological steps taken to reach proposed strategies for each landscape character type (Figure 9).

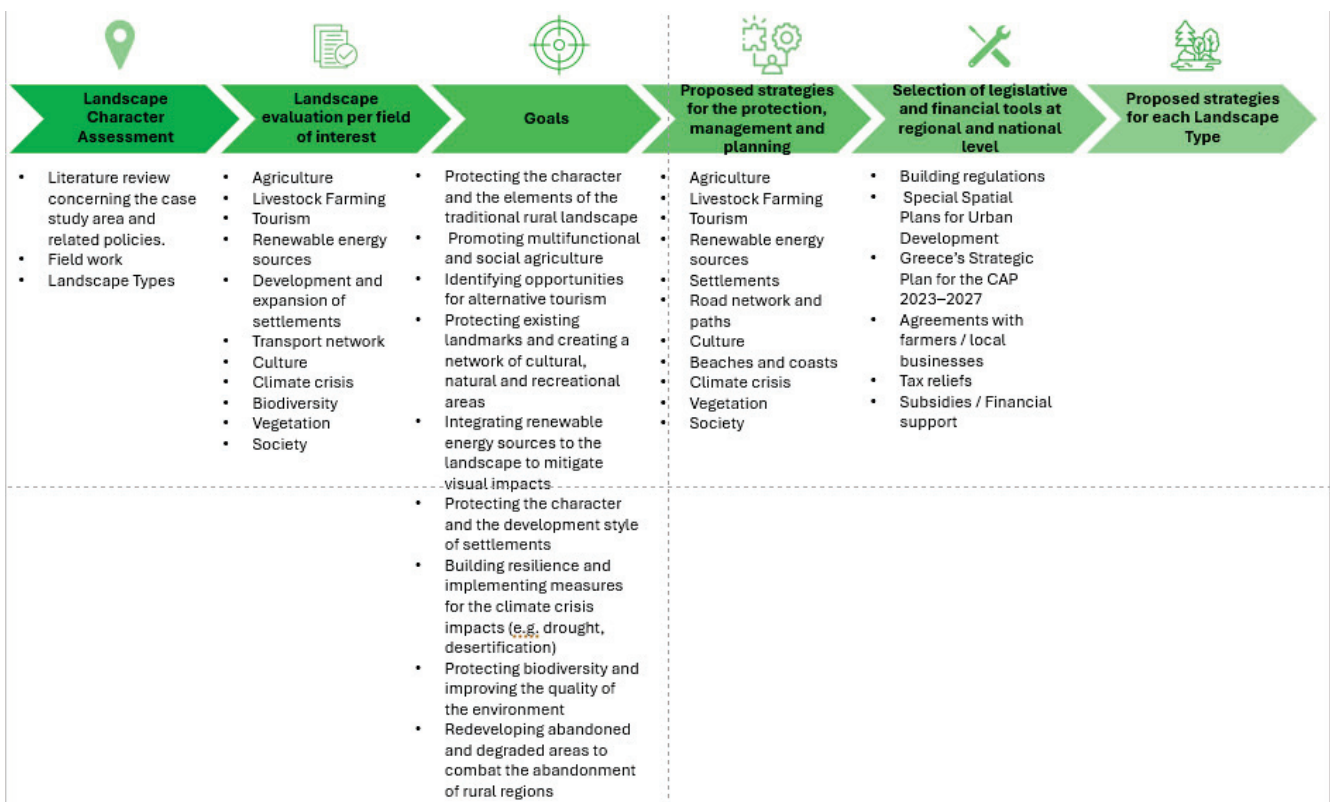


Figure 9. Diagrammatic process of methodology.

2.2.1. Application of Landscape Character Assessment

The first step was the application of Landscape Character Assessment methodology [34–37], with the necessary modifications imposed by constraints regarding data availability and resources.

- *Data pre-processing*

The collected data were primarily obtained from the publicly accessible website of the Decentralized Administration of Crete and the website of the Ministry of Environment

and Energy. Simultaneously, a comprehensive literature review and online research were carried out to gather essential information about the historical and natural environment of Ano Mirabello. This review encompassed data collection on various aspects such as geography, history, ecology, architecture, vegetation, and more, along with the acquisition of maps, technical reports, and photographs.

Primary data were sourced from the geoportal of the Decentralized Administration of Crete and other bibliographical references. Natural elements (topography, geology, soil, land cover, vegetation) were obtained in ArcGIS format from open-access data and scanned at 300 dpi. Cultural elements (archaeological sites, settlements, roads, paths, landmarks) and human activities (settlement expansion, tourism) were also scanned at 300 dpi. These maps were digitized in a GIS environment based on visual interpretation and georeferenced to the Greek natural grid EGSA 1987, with a minimum mapping unit of 1 km².

- Mapping procedure

The mapping process, executed in successive steps at a 1:25,000 scale, resulted in the initial landscape units by combining geomorphological data, land cover, soil, settlement locations, and the patterns of agricultural plots in the study area.

Step 1: The dominant landform type within each LDU was identified, informed by geological structure. The main data source was topographic contour maps (10 m or 20 m intervals), supported by Digital Elevation Models (DEMs), Google Earth imagery, and simplified geology and landform maps showing major rock types. Landforms were classified using general geographic and descriptive terms such as mountains, hills, uplands, and lowlands, based on average slope percentage. The first LDUs were formed based on the overlay of topographic contour and geology maps.

Step 2: Soil maps at a national scale 1:100,000 were used, providing a brief overview of indicative soil classes that cover the two essential parameters of soil drainage and fertility. Selective LDU subdivision occurred, unless it seemed really necessary; soil changes will normally show on the vegetation patterns of Step 3 (Landcover) allowing us to make the required subdivisions. However, we used this step to refine landform LDU boundaries, provided that the soil layer was more accurate than the geology.

Step 3: Landcover or vegetation maps from the Decentralized Administration of Crete and the website of the Ministry of Environment and Energy as well as satellite imagery (Google Earth) allowed us to interpret and refine the landcover of the area. An overlay of the provisional LDU boundaries (polygons derived from Steps 1 and 2) onto the landcover base map, helped us to subdivide and characterize the broad landcover categories.

Step 4: Settled areas are classified based on settlement spacing: closely spaced (1–2 km), moderately spaced (2–3 km), and sparsely spaced (over 3 km). Areas with no settlements are labeled as unsettled. Then, this classification was overlaid onto the LDUs from the land cover mapping. Each LDU was characterized by settlement density without further subdivision unless absolutely necessary.

Step 5: Field pattern maps were used based on the data given by OPEKEPE (the Greek Payment Authority of Common Agricultural Policy (C.A.P.)). Field pattern classes such as regular or semi-regular fields with mostly rectilinear boundaries, irregular fields with straight boundaries, sinuous boundaries (always irregular), terraces, wide, terraces, narrow, were used as auxiliary data for the characterization of the LDUs.

Step 6: Data related to archaeological areas, landmarks, road and path networks were added to the final LDUs map and helped in the final subdivision of the Landscape Division Units (LDUs).

- *Fieldwork*

The primary goal of the assessment field survey was to verify the information gathered during desktop mapping. The focus is on exploring the LDUs to understand their character and sense of place, taking representative photographs, reviewing and adjusting LDU boundaries, and determining whether any changes are needed, such as adding subdivisions or merging LDUs.

The field survey in the study area was conducted in two periods. The first took place in August 2023, in order to capture the overall landscape character of Ano Mirabello and was mostly as an exploratory visit. The second took place in March 2024 and contributed to the verification and optimization of the initial mapping results, as well as to a more accurate interpretation of the landscape's character. During the visit, standardized field recording forms were completed, photographs were taken to capture the overall character of the landscape, and specific elements discovered, as well as notable landmarks. In order to understand the LDUs and their character, we used three survey points. One from a distance to obtain an overall view, one from inside to have a direct view, and one at the perimeter for a "border" view. Given the limited financial resources and time constraints, we restricted our survey to roads accessible by car.

First, higher elevation viewpoints were selected to capture the overall character of the area. Then, we navigated through the LDU to understand the sense of place and record the landscape condition. Finally, we completed the field survey sheets and took photographs from selected viewpoints along the main roads. A high-resolution digital camera equipped with GPS was used to make it easier to reference specific locations later. Approximately 1,100 photographs were taken to document the key characteristics and features that contribute to the perceived character and sense of place. The photographs also served to record landscape condition and highlight any other aspects deemed noteworthy, such as particularly beautiful areas or degraded landscapes affected by infrastructure developments (e.g., photovoltaic panels, wind farms, etc.). A field survey sheet guided the collection of field data at each survey point. The survey sheet was tailored to the specific study and provided space for a written description, a checklist of landscape elements and their significance, a checklist of aesthetic and perceptual factors, and space for observations about the sensitivity and management needs of the landscape.

- *Landscape types*

The identification of Landscape Character Types (LCTs) was based on the merging of Landscape division units (LDUs) within the GIS database. LCTs were identified by grouping LDUs that shared dominant visual qualities and distinctive local features. This merging resulted in broader, more generalized LCTs that emphasized prevailing landscape characteristics. As a result, some detailed information was intentionally simplified or omitted for clarity and consistency, though it was still incorporated into the narrative descriptions of each type. The synthesis of all the above elements concluded with a landscape typology for the area of Ano Mirabello, whereby all the pressures and potential threats to the landscape were also identified per landscape type. The ultimate goal was to develop key principles (guidelines) for the management and design of each landscape type as well as for the protection and enhancement of the area's landscape's character and unique features.

2.2.2. Landscape Evaluation per Field of Interest

During the fieldwork and the literature review, the unique values of Ano Mirabello were highlighted, such as its rich biodiversity and traditional architectural structures, as well as the negative impacts resulting from human activities (e.g., careless planning of photovoltaic panels or wind farms) and other factors. The purpose of these observations

was to provide a comprehensive overview of the existing situation, identifying elements that require protection and promotion, as well as problems (as described in field survey sheets) that demand immediate action and strategic planning for sustainable development. From the literature review, regional action plans and relevant studies [31,38,39] were taken into consideration in order to identify the positive and negative aspects of planning per productive sector.

The sectors selected for our research were those that were most prominent in the area, such as agriculture, livestock, tourism, renewable energy, road network development, culture, climate change, society, settlement development, and more.

2.2.3. Goals

The goals of a landscape strategy for the area were formulated in order to preserve and enhance the landscape character and uniqueness, as natural and cultural heritage, for the benefit of the island inhabitants. They address the simple yet complex question: “What kind of landscape do we want for the future?” and reflect the expectations and desires of the citizens, as presented to us by the Regional Governor, the Mayor, Municipality officers, associations, and community representatives. These interviews took place during our field survey visits.

The Landscape Strategy aimed to serve as a foundation for ecological, economically, and culturally sustainable future development, while striving to achieve the following general landscape quality objectives:

- Well-preserved and thoughtfully designed landscapes, regardless of type (urban, agricultural, or natural) or character, which are developed through a place-based management model.
- Vibrant and dynamic landscapes capable of accommodating inevitable future spatial transformations without losing their identity and their calm, remote character.
- Heterogeneous landscapes that reflect the rich diversity of the Cretan landscape, taking into account all aesthetic, perceptual, economic, social, and environmental characteristics of the area, including flora, fauna, geological background, as well as historical and cultural elements of particular value.
- Organized and harmonious landscapes that avoid fragmentation and disruption, highlighting existing elements of particular aesthetic and ecological value.
- Unique landscapes that are far from being commonplace.
- Landscapes that maintain and enhance their references and values, both tangible and intangible (ecological, historical, aesthetic, social usage, productive, symbolic, and identity-related).
- Landscapes that always respect the heritage of the past.
- Landscapes that convey tranquility, free from discord, noise, and pollution from light or odors.
- Landscapes that can be enjoyed without jeopardizing their heritage and uniqueness.
- Landscapes that consider social diversity and contribute to the individual and collective well-being of the population, through a combination of educational and recreational opportunities in habitat protection areas and sites of particular geological significance.

The goals were mostly focused on protecting the character and elements of the traditional rural landscape, promoting multifunctional and socially sustainable agriculture, and identifying opportunities for alternative tourism. They also aimed to safeguard existing landmarks while establishing a network of cultural, natural, and recreational areas. Additionally, the integration of renewable energy sources into the landscape will be pursued to mitigate visual impacts. Efforts will be made to preserve the character and development

style of settlements, enhance resilience, and implement measures to address the impacts of the climate crisis, such as drought and desertification. The research also focused on protecting biodiversity, improving environmental quality, and redeveloping abandoned or degraded areas to combat the abandonment of rural regions.

At the end, strategies for achieving the above landscape quality objectives were developed by selecting general guidelines and actions applicable to the entire area. Subsequently, the unique character of each landscape was considered, incorporating place-based references to more accurately identify the locations covered by each strategy. The organisation and presentation of strategies were based on the Council of Europe Landscape Convention which promotes landscape protection, management and planning, the UN 17 Sustainable goals, and the guidelines, recommendations from the regional and local spatial plans

3. Results

3.1. Landscape Types

The analysis above identified 97 landscape units and 24 landscape types for the Ano Mirabello region. The naming of each landscape type was based primarily on the geomorphology and land cover, with a lesser influence from the presence of settlements (Figure 10).

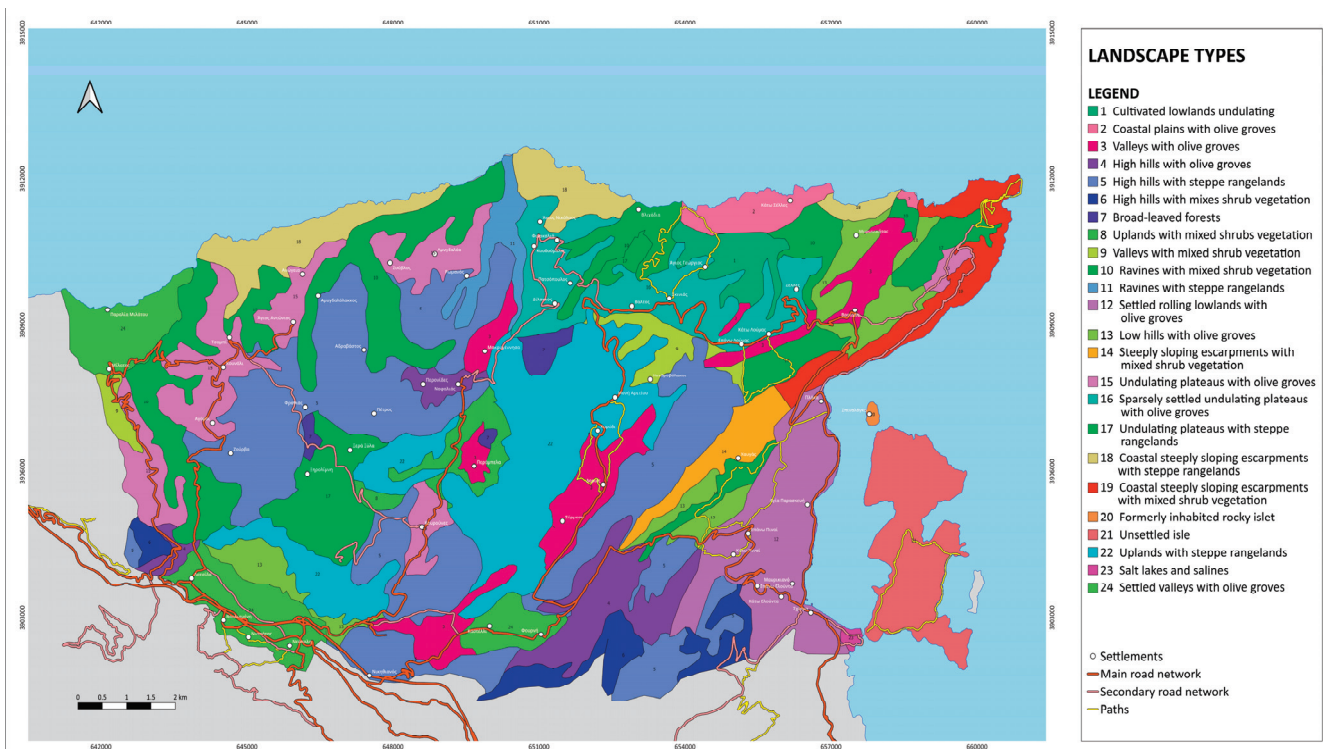


Figure 10. Map of landscape character types. Source: author's production.

The identification of landscape character types (LCTs) was primarily conducted based on field observation and experts' perception, by combining Landscape Division Units (LDUs) within the GIS database, followed by verification during fieldwork. Landscape character types were defined by grouping LDUs with similar visual characteristics and locally distinctive features. Therefore, LCTs could only be defined after a field survey, which incorporated the landscape's visual qualities into the mapping process [19].

This process led to the creation of more generalized LCTs, which focused on the most prominent characteristics, though some details were simplified or omitted for clarity and consistency. Landform and landcover were the most significant attributes contributing to

landscape character. It was thus decided that the combination of landform and landcover would be used as the basis to inform LCT definition. This meant that, for the purposes of the classification, some of the information that had been meticulously recorded during the previous stages of the characterization process were “lost” for reasons of uniformity and simplicity (for example, mixed LDU landcover characterizations might be concealed under a more generalized LCT definition focusing on the most dominant or characteristic use only).

Despite this, relevant information was still incorporated into the description of each type. The observer’s perception during the field survey was emphasized, making the field assessment crucial for interpreting the information in a comprehensive manner.

3.2. Assessment of the Situation in Ano Mirabello

The assessment of the current situation in Ano Mirabello, within the relevant field of interest, was based on the aforementioned work as well as regional and local spatial plans, and led to the following findings:

- *Agriculture*: The area is extensively cultivated with olive groves, providing a homogeneous and characteristic agricultural landscape. Unfortunately, most of the dry-stone terraces, which contributed to the preservation of traditional agricultural practices, landscape maintenance, its historical identity, and the region’s cultural heritage are abandoned. As such, the loss of unique features (hedgerows, dry stone constructions, and traditional field patterns), has led to the gradual disappearance of the character of traditional farmland. The appearance of large-scale intensive agricultural facilities becomes more intensive with visual intrusion to dominant locations [40], whereas many infrastructure elements (e.g., photovoltaic panels) have slowly been introduced without any planning.
- *Livestock farming*: Overgrazing is notable especially in deserted areas, where the loss of pastures, shrubland and forest areas is evident. The remaining livestock structures do not harmonize with the landscape (e.g., animal shelters) and require careful landscape design guidelines.
- *Tourism*: The area of Ano Mirabello is characterized by unbalanced tourism development. Massive tourism development is dominant along the east coastal areas in Elounda bay, attracting most international and national tourists, whereas the mainland and north coastal part remain undeveloped, limiting visitors’ opportunities to explore the region, its traditions, history, and environment. Therefore, the area faces a diversified tourism development, with a landscape decline and environmental degradation due to increased waste, traffic, and vehicle parking along Elounda bay and abandonment of its natural and cultural environment in the mainland.
- *Renewable energy sources*: Photovoltaic panels are quite visually intrusive, without proper planning and inappropriate selection of their size [41]. It shows that they are not in harmony with the landscape’s scale, leading to a loss of character. Similarly, the existing wind turbines are visually disruptive into the agricultural landscape, leading to the degradation of the landscape and ridge lines. However, their land cover is still limited and there is space for the appropriate development under specific guidelines.
- *Settlement*: The area is characterized by the abandonment of traditional villages, despite some scarce efforts for building restoration based on local architecture. On the other hand, the increase in settlement’s expansion along the east coastline is dominant, with diverse construction styles, housing layouts, non-local materials, and ornamental plants, leading to the loss of their unique character and relationship with the existing natural and historic landscape.

- *Cultural elements*: Most of the archaeological sites including metohia (traditional farm complexes) are neglected. Additionally, important cultural landscape elements such as the windmills, cisterns, and dry stone walls are abandoned and dysfunctional, requiring immediate restoration. There are also historical paths, which although currently lost, offer opportunities for revival and utilization as part of a hiking network, linking cultural and natural points of interest.
- *Natural elements*: The area hosts a variety of aromatic plants and endemic species, contributing to the uniqueness and ecological value of the landscape; however, the intensive development and subdevelopment of the area creates a risk of biodiversity loss and reduced income from products such as honey and medicinal and aromatic plants. In addition, rapid and drastic changes in land use and vegetation cover may distort the readability and character of the landscape. Additionally, the increase in development along the coastline will cause a decline of coastal ecosystems.

3.3. Proposed Strategies for Protection, Management and Planning

The main goal for the development of landscape strategies for Mediterranean island landscapes is the preservation and enhancement of their character and uniqueness, as a natural and cultural heritage for the benefit of the island inhabitants and as a foundation for ecologically, economically, and culturally sustainable future development, with the aim of achieving the general landscape quality objectives [20,42,43]. Based on this statement, the strategies were initially developed by selecting some general guidelines and actions for the entire area. Then, the research took into account the particular character of each landscape type. Through the detailed analysis of the natural and cultural characteristics of the area, a deeper understanding was achieved of the elements that constitute the unique landscape character of Ano Mirabello. Through the classification into landscape types, several challenges and opportunities were highlighted, contributing to the development of targeted strategies for the protection, management, and planning of the landscape of Ano Mirabello.

The proposed landscape strategies derived from a combination of the above results and the literature review of the national and local legislative planning frameworks (Figure 7). The strategies are categorized into three types, following the principles of the European Landscape Convention:

- Strategies aimed at protection: these include proposals for the preservation and maintenance of the features that differentiate the landscape of Ano Mirabello, justified by their cultural, environmental, and economic value, whether intrinsic or resulting from human intervention.
- Strategies aimed at management: these encompass proposals for guiding and harmonizing transformations driven by social, economic, and environmental activities.
- Strategies aimed at planning: these involve proposals related to the evaluation, restoration, and creation of landscapes.

A synopsis of specific design guidelines is analytically presented in the following table (Table 1).

The analysis of each landscape type revealed the guidelines that should be followed in a future local spatial plan for Ano Mirabello and specific strategies for the protection, management, and planning of each landscape type is analytically presented in the following table (Table 2).

Planning strategies emphasize the importance of integrating energy and infrastructure systems with agricultural and natural landscapes, utilizing local materials and indigenous plant species. The deployment of photovoltaic panels requires careful planning that respects local identity, guided by established landscape practices and methodologies [41], whereas

culture plays a vital role through the careful planning and preservation of a network of historical paths and landmarks.

The management strategies for most Landscape Character Types (LCTs) emphasize the concept of a multifunctional landscape. This approach prioritizes the preservation of native flora alongside the cultivation of olives and aromatic plants. Equally important is the conservation of drystone structures, which help prevent soil erosion and support biodiversity. Overall, the natural environment plays a central and guiding role in these strategies.

Most protection strategies prioritize the restoration of traditional agricultural elements and the maintenance of existing practices, as well as the preservation of cultural features related to water retention. These efforts aim not only to address climate challenges but also to conserve historically and architecturally significant structures (e.g., windmills) and protect the natural coastal landscape.

Table 1. Landscape strategies per economic sector for the area of Ano Mirabello.

	Protection	Management	Planning/Design
Agriculture	Preservation of small-scale farms.	Providing financial incentives to engage young people in the primary sector.	Integration of agricultural facilities (such as warehouses, machinery, etc.) into the landscape.
	Cultivation of resilient crop varieties.	Seeking solutions through agritourism (e.g., programs for learning and applying traditional agricultural practices).	Preservation of traditional dry-stone constructions and planting small trees and shrubs at field boundaries to ensure habitat continuity.
	Preservation of traditional agricultural practices.	Crop rotation to maintain soil fertility.	
Livestock farming	Implementation of rotational grazing systems in zones to address overgrazing.		Integration of livestock facilities into the landscape using vegetation and dry-stone constructions.
Tourism	Promotion of historical monuments.	Enhancing tourism in a manner consistent with the area's character.	Providing guidelines for the design of infrastructure and activities related to tourism.
	Promotion of harvest events.	Developing agritourism as a tool for managing local agricultural elements.	Utilization of aromatic plants that grow in the area, offering many opportunities for the tourism sector.
		Developing gastronomic tourism.	Designing cultural routes that connect the area's history and tradition.
Renewable energy sources	Conducting Environmental Impact Assessments before installing renewable energy systems.	Financial and technical support for the development of renewable energy sources.	Creation of multifunctional landscapes where renewable energy sources are integrated into other productive sectors
		Creating energy communities.	Proper spatial planning and sizing of photovoltaic installations.
Settlements			Preservation of the open, natural, and rural landscape character by limiting the development of wind turbines, especially on ridge lines.
			Guidelines regarding the architecture of new buildings and infrastructure.
			Adoption of policies guiding the proper restoration of existing traditional buildings.
Road network and paths	Restriction of vehicles in ecologically sensitive areas.	Creating a trail network connecting the area's landmarks.	Recognition and promotion of exemplary cases of new building construction.
			Concealing unsightly land uses visible from the main road network.

Table 1. Cont.

	Protection	Management	Planning/Design
Culture	Protection of archaeological sites, monasteries, horseshoe-shaped windmills, rainwater tanks, and dry-stone constructions.	Awareness programs on the architectural heritage of the region.	Appropriate landscape design of archaeological sites to improve accessibility, and harmonization with the landscape.
	Financial incentives for the restoration of cultural elements of the rural landscape.	Developing a management plan for the archaeological sites in the area.	
Beaches and coasts	Enhancement of vegetation along water corridors and coasts.	Improving the management of waste, sewage, and debris on the coasts.	Design and management of coastal access and parking areas.
Climate crises	Collaborations with universities to apply innovative solutions for protection.	Utilizing traditional water management practices (rainwater tanks, terraces).	
	Restoration of rainwater tanks for water storage.	Tree-planting programs to combat soil erosion.	
	Identification of vulnerable areas. Public awareness campaigns.		
Vegetation		Monitoring and reducing the spread of invasive species such as <i>Sarcopoterium spinosum</i>	Emphasizing the pronounced seasonal changes in vegetation through planning
		Preserving native vegetation in olive tree cultivations.	The proposed palette of plant species should include endemic species.
Society	Development of a culture among residents regarding land conservation and rural landscape preservation	Better management and utilization of the area's aromatic plants	
	Creation of cooperatives for economic development through local traditions and knowledge	Providing infrastructure to attract digital nomads	

Table 2. Landscape strategies for planning per each landscape type of Ano Mirabello.

Fields of Interest	Strategies for Planning	Landscape Types																								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Agriculture/ Livestock farming	Integrating photovoltaic panels into existing crops, creating multifunctional landscapes.																									
	Integration of agricultural infrastructures into the region's landscape through the use of plant material, dry-stone constructions, and appropriate siting.																									
	Integration of new crops, taking into account the existing field patterns and terrain of the area.																									
Tourism	Exploration of possibilities for planting small trees and shrubs at the edges and corners of fields to ensure continuity of natural habitats.																									
	Promotion of significant archaeological sites (<i>sunken city of Olous</i> , <i>Mosaic of the Early Christian Basilica of Poros Elounda</i>) and landmarks (Windmills of Poros Elounda, Chapel of Saint Luke) through appropriate development of the surrounding area and visitor information.																									
	Restoration of the Elounda estate complex to an information center for the region and coordinating actions for the development and promotion of the area.																									
	For better integration of tourist facilities into the landscape, it is proposed that planting designs do not follow strict linearity but rather more natural developments, contributing to the unification of different areas.																									

Table 2. Cont.

Fields of Interest	Strategies for Planning	Landscape Types																								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Renewable energy sources	Careful planning and selection of the size of the proposed photovoltaic panels, and concealing existing ones with appropriate planting.																									
	Conducting landscape studies for the proper placement of wind turbines, limiting their development to the ridgelines, and choosing locations where the visual impacts on significant views and the local residents will be minimal.																									
Settlements	The expansion and organization of settlements should follow the urban planning regulations and provisions of the area, without negatively intruding into the landscape.																									
	Every form of development should be designed and sited so that it integrates into the landscape, considering the views, relief, and natural character of the area, so as not to cause visual disturbance to the landscape and its distinctive features.																									
Road network and paths	Development of traditional settlements such as Finokalia, as an educational and research center for the region, based on the Finokalia Environmental Observatory.																									
	Creation and enhancement of pathways.																									

Table 2. Cont.

Fields of Interest	Strategies for Planning	Landscape Types																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Culture	Connecting the significant elements of the area to the broader network of cultural routes that will highlight the history and traditions of the region																								
	Creation of a network of walking routes and connection with the traces of trails dating back to the Venetian period.																								
	Creation of walking routes that will connect the natural, religious, cultural, and historical landmarks of the area.																								
	Connecting the area with the archaeological sites and landmarks located in Kolokytha through the existing walking routes, with appropriate signage.																								
Beaches and coasts	The coasts should have access, where feasible, through an organized and safe trail network that will create interesting hiking routes.																								
	Enhancement and completion of tree-lined avenues as landscape unification elements (eucalyptus trees between the settlements of Kastelli and Fournis, cypress trees at Monastery of Xera Xyla).																								
Natural Environment	Showcasing the natural wealth of the area through the creation of an organized and safe trail network.																								

4. Discussion

The purpose of this research is to highlight the value of the natural and cultural characteristics of a rural border landscape that is facing serious issues of deterioration and desertification. This will be achieved through a Landscape Character Assessment approach, demonstrating how such an approach can lead to planning guidelines for sustainable development. In comparison to previous similar studies, some of which were outlined in the introduction, this research specifically focuses on Mediterranean countries, where LCA remains in the early stages of application. Its aim is to foster greater public awareness of landscape value across all age groups and social backgrounds, and to promote the role of LCA in informing planning and management strategies. This specific methodology proves to be particularly useful for the Greek context, where the application of similar methodologies is lacking, especially in spatial and development planning.

The results allowed the researchers to capture the particular character of the area of Ano Mirabello of Crete. From the LCTs and analysis of the existing situation primary productive sectors, it became evident that specific natural elements, and local architecture with specific landmarks (chapels, archaeological sites, cisterns, windmills, etc.) are the most important cultural traits [44]. However, not preserving the traditional architectural character of the significant historical monuments and archaeological sites dating back to the Minoan era, along with the numerous distinctive windmills and old rural buildings (metohia), will imperil the island's historical continuity and unique identity. The area's natural beauty, including beaches and mountainous regions, is a strong draw for visitors. Preserving the natural condition of the landscape provides a unique experience for tourists seeking untouched and authentic places. On the other hand, more sites within the study area are expected to be affected by erosion due to the increased frequency and intensity of extreme weather events, such as torrential rains and strong winds, leading to soil loss and degradation of agricultural land, among other impacts, while some agricultural intensification actions have impacted on the area's natural resources, particularly the soil and water. A reduction in water reserves for irrigation and domestic use is also apparent. Due to the rapid increase in tourism development along the coastline, the villages in the mainland are not experiencing similar development and most of them are abandoned. This development has greatly impacted the connection between humans and the land; domesticated animals are seldom observed, and grazing activities have decreased. These shifts signal the start of a new chapter for the region's "natural environment".

While isolation and insularity present challenges, the remoteness and distance help preserve the traditional way of life and its remaining cultural significance [45]. However, the abandonment of agricultural land also diminishes the scenic and aesthetic appeal of island landscapes, which is vital for the tourism sector. This calls for the implementation of effective alternatives, such as agrotourism, to revitalize local economies in rural villages and inland communities [46].

The findings from the evaluation of the current situation in Ano Mirabello focused on development priorities, which became more specific, aligning well with the landscape strategies and being compatible with various landscape types. As younger members of local communities increasingly choose to work in sectors like tourism, there is a shortage of labor for managing agricultural land. This has led to a decline in small-scale farming and a shift from quality-focused to quantity-driven agricultural practices. Consequently, traditional methods and practices that define the area's identity are at risk of gradually disappearing. The decline in the permanent population in the mountainous areas of Ano Mirabello results in the weakening of the local economy and loss of connection to the region's history and roots.

The above results and Table 1 reveal and prioritize the development actions. A proposed solution could be the development of a complex, multifunctional agricultural system with higher added value. This would include the entire production cycle—from primary processing to the sale of products through short supply chains—enhanced by complementary activities such as social farming, and cultural initiatives (e.g., farm excursions, educational farms, agricultural museums). These integrated components could help compensate for potential losses in primary production while fostering more robust and sustainable regional development. The preservation of small-scale farms proved to be essential for maintaining the region’s agricultural heritage. It is also important to integrate agricultural facilities, such as warehouses and machinery, seamlessly into the landscape to minimize their visual impact. Cultivating resilient crop varieties [47] ensures sustainability and adaptability to environmental changes. Equally crucial is the preservation of traditional dry-stone constructions and the planting of small trees and shrubs at field boundaries to promote habitat continuity. Indigenous aromatic plants are a potential agritourism activity for the area around Ano Mirabello [48].

Efforts should also be made to promote historical monuments and celebrate local harvest events, fostering community engagement with the land’s cultural significance. The creation of multifunctional landscapes, where renewable energy sources are incorporated into other productive sectors, is another step toward sustainable development. Proper spatial planning and sizing photovoltaic installations will help balance energy production with the preservation of rural landscapes. Preserving native vegetation in olive tree cultivations is vital to maintaining biodiversity and ecological health. Additionally, fostering a culture of land conservation and rural landscape preservation among residents will help ensure the long-term sustainability of the region. Lastly, the creation of cooperatives can drive economic development by leveraging local traditions and knowledge, ensuring that these practices remain relevant and beneficial to future generations. Efforts to engage young people in the primary sector can be supported through financial incentives and the promotion of agritourism, such as programs focused on learning and applying traditional agricultural practices. Agritourism can also serve as a tool for managing local agricultural resources while providing financial and technical support for renewable energy development [49]. Creating energy communities and offering financial incentives for the restoration of cultural elements in rural landscapes further enhances local development. Collaborations with universities to apply innovative solutions for conservation, alongside public awareness campaigns, can strengthen these initiatives. Additionally, the creation of cooperatives based on local traditions and knowledge can drive economic development in rural areas.

The aim of any strategic plan in the context of tourism development would be to position the microregion as a cohesive destination, offering a comprehensive package of attractions that cater to diverse seasonal and thematic interests. This should ideally be implemented through destination management structures, thereby reinforcing the institutional framework necessary for effective coordination.

The landscape strategies for planning, management and protection for each landscape type as an outcome of the proposed framework of the LCA focus on visual/aesthetic and functional aspects. The above results of Tables 2–4 reveal and prioritize the development actions for each of the area’s landscape types. Protecting and conserving the environment is necessary for almost all landscape types. Most of the actions per landscape type were focused on sustainable planning, management and protection of agriculture, natural and cultural environment and settlements.

Table 3. Landscape strategies for management per each landscape type of Ano Mirabello.

Fields of Interest	Strategies for Management	Landscape Types																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Agriculture	Maintenance of indigenous vegetation in olive tree plantations for better integration into the landscape.																								
	Promotion of the cultivation of aromatic plants and strengthening of this sector to enhance the local economy.																								
	Provision of financial incentives to allow young farmers to engage in new crops, beyond olive cultivation.																								
Tourism	Development of gastronomic tourism combining wine tasting, cooking lessons, and visits to local farms.																								
	Development of a management plan for the archaeological sites located in the area, aiming to make some of them accessible to the public (<i>archaeological site of Drivo, Pinos tower, ancient Olous</i>).																								
Renewable energy sources	Management of visitor access to the island Kolokitha and parking areas, aiming to control disturbance levels, especially during the summer months.																								
	Utilization of the rooftops of hotels for the installation of photovoltaic panels to avoid increasing the energy burden on the wider area.																								
Settlements	Compose a maintenance plan for derelict traditional settlements																								
	Highlighting the existing trails and viewpoints along the route.																								
Road network and paths	Enhancement and improvement of existing walking routes to enable visitors to enjoy the religious and historical monuments.																								
	Highlighting the landscape of the salt lakes and integrating them into a wider network of salt pans in the Mediterranean and Europe, with the ultimate goal of protecting and preserving their historical memory.																								
Beaches and coasts	The installation of illegal constructions, which dominate the landscape and distort its coastal character, should be avoided.																								
	Waste and wastewater management in the area should be carried out through an organized plan.																								

Table 3. Cont.

Fields of Interest	Strategies for Management	Landscape Types																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Natural Environment	Maintenance of dry-stone structures to prevent soil erosion and enhance biodiversity.																								
	Promotion of research programs for the cultivation of experimental fields aimed at enhancing local meadows to limit the spread of <i>Sarcopoterium spinosum</i> .																								
	Maintenance of indigenous vegetation in olive tree plantations for enhancement of biodiversity and landscape connectivity.																								
	Controlled rotational grazing for the restoration of vegetation and eroded soil. Due to the sensitivity of this specific landscape type, it is important to implement a gradation in access and uses, with the aim of protecting its ecologically sensitive features and mitigating the adverse effects caused by human activities on the landscape. Systematic monitoring of soil and vegetation conditions to assess the impacts and take corrective measures.																								

Table 4. Landscape strategies for protection per each landscape type of Ano Mirabello.

Fields of Interest	Strategies for Protection	Landscape Types																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Agriculture	Restoration of dry-stone structures to preserve traditional agricultural practices.																								
	Protection of the boundaries of cultivated land bordering the settlement of Elounda and establishment of measures for the preservation of fields, which provide a historical continuity to the landscape and enhance local biodiversity.																								
Settlements	Avoidance of intensive olive cultivation to preserve the traditional field patterns and terrain of the area, which are adapted to the scale of Upper Mirabello.																								
	Preservation of the open, highly visible, and sparsely populated character of this specific Landscape Type. Any incompatible use (e.g., photovoltaic panels) should be discouraged so that the character of the landscape of this specific type, and more broadly, is maintained, taking into serious consideration the intense alteration the Elounda bay has undergone.																								

Table 4. Cont.

Fields of Interest	Strategies for Protection	Landscape Types																								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Culture	Restoration of rainwater collection tanks to promote the region's historical heritage and to strengthen water management.																									
	Restoration and highlighting of the horseshoe-shaped windmills of the area.																									
	Restoration and utilization of the <i>metochia</i> .																									
Beaches and coasts	Preservation of the character of the historical and natural landscape of Spinalonga as well as the surrounding coastlines through adherence to landscape protection provisions and urban planning regulations for the area.																									
	Preservation of the natural and wild character of the coastal steep slopes and shores, preventing any form of massive tourism development.																									
Natural Environment	Restoration of existing inactive quarries north of the settlement of Latsida.																									
	Protection of the wetland of the salt pan area with a specific management plan.																									
	Protection and management of broadleaf forests due to their uniqueness within the landscape.																									

Restoring buildings and promoting cultural preservation is a key focus for landscape areas that include settlements, isolated historical structures, and features like windmills and cisterns. In the case of limited financial resources, a proposed management plan would begin by protecting a selected number of the most valuable objects or parts of settlements. Preserving and maintaining the unique terraces and other natural elements of the rural landscape is crucial for supporting agricultural progress. Future development, whether in tourism, agriculture, or culture, should prioritize respecting the area's natural, cultural, and insular identity [50], while also educating visitors about the local environmental and cultural heritage. Furthermore, the outlined development priorities align with the specific landscape types, considering their capacity to accommodate future changes while preserving their authenticity. Consequently, the landscape types defined in this study can function as a reference for overseeing future development in remote areas, serving as essential territorial segments for implementing well-defined, regulated landscape strategies, initiatives, and projects [51].

Here, we revisit and address the main research question of this work, i.e., *“to which extent landscape character assessment and the proposed methodological process helped to address the unique needs of remote areas, located at national insular borders of Crete in Greece, with lower levels of development and economic activity, and to conclude to effective strategies for the sustainable development of the particular area”*.

The proposed methodology effectively identifies and evaluates landscape characteristics, and aligns with the objectives of the European Landscape Convention, namely the protection, management, and planning of landscapes [52]. This approach can serve as a valuable tool and example for the successful implementation of the Council of Europe Landscape Convention (E.L.C.), particularly in countries where Landscape Character Assessment (LCA) is still in the early stages of application. It demonstrates the importance of LCA in developing landscape strategies for the protection, management, and planning of insular areas.

Simultaneously, the proposed strategies are based on the UN 17 SDGs and present what landscape architects could do in order to implement these goals [53]. Landscape architects focus on transformation, innovation, and resilience to address food security and sovereignty. They prioritize ecological health and adapt education to tackle global environmental and community challenges. Their work helps connect communities and ecosystems, to sustainably protect and regenerate ecosystems, addressing social challenges while benefiting biodiversity and human well-being. It is precisely what the proposed strategies aim to achieve.

The LCA is particularly beneficial for regional and local spatial planning frameworks, as well as special spatial planning frameworks of islands and border areas. It should be applied early in the development planning process and in parallel with a policy program, rather than as an additional step at the end of the process [54].

In Greece, where landscape characterization and assessment efforts are often sporadic and fragmented, tools of this kind are essential for implementing the European Landscape Convention effectively [55–57]. These tools can also serve as critical “space regulators” within spatial planning processes, helping to integrate socio-economic and environmental transformations in a balanced and coordinated manner [57].

Future research will focus on adequate public participation methods and tools adjusted to the specificities of the border communities, in order to complement LCA tools and methods.

However, as noted in studies from the UK [58], one of the main limitations in applying LCA is the broad scale at which it is conducted and the absence of clear guidance. While character descriptions are considered especially useful, and an intermediate phase is

needed between the assessment and planning stages, where the LCA content can be further developed and specific issues explored in greater depth. This research aims to address this intermediate stage between the assessment and planning phases, and present the strong connections between LCA and landscape strategies. This research provides a comprehensive overview of the topic, and for management or planning related to specific areas such as ecological restoration or agricultural production, more detailed data are required to enhance the assessment and develop more targeted guidelines and strategies.

5. Conclusions

This research suggests different management strategies for different landscape types in a remote island area. The management of these landscapes should prioritize regeneration, blending recreational activities like agricultural tourism and harvesting with institutional revitalization, alongside synergistic development with coastal towns and resort areas, to create a new form of landscape.

This landscape research of Ano Mirabello is being conducted at a critical juncture, as landscapes across the Mediterranean are increasingly under pressure. This is largely due to rapid urbanization, rural abandonment, the climate crisis, technological advancements, tourism growth, economic challenges, and social inequalities, among other factors. In such a dynamic context, the importance of this study is clear. By thoroughly documenting the area's natural and cultural features, the article has provided a deeper understanding of the unique identity of the Ano Mirabello landscape. The region was classified into distinct landscape character types, which helped to identify both the challenges and opportunities faced by the area. This process has contributed to the development of targeted strategies aimed at the protection, management, and planning of the landscape. The proposed strategies, tailored by field of interest and landscape type, have been enhanced with examples of best practices to emphasize their value.

In relation to CAP 9 strategies, the proposed strategic steps will help towards a fair income to farmers, increase competitiveness and agricultural productivity in a sustainable way, contribute to climate change mitigation and adaptation, foster efficient management of natural resources, preserve landscapes and biodiversity, and protect food and health quality. The methodological approach to strategic steps for management and planning is related to the values and characteristics of agricultural landscapes, associating people with their landscape, enhancing the dialogue and agreement among key stakeholders. This tool facilitates a productive dialogue with locals to create a sustainable future plan for their area.

An essential next step in applying the study and its strategies is the active involvement of local citizens and stakeholders through participatory processes, such as workshops. This will help to identify the pressures on the landscape, the causes of these pressures, their environmental effects, potential future risks, and the preservation of unique cultural elements and traditions. In this way, the study can serve as a vital tool for planning and decision-making, guiding local authorities, designers, and landowners in implementing new policies that will safeguard the area and promote sustainable development. To create more comprehensive and integrated strategies, it is also important to conduct similar landscape studies in the wider region. This would provide a more holistic approach to landscape management across the entire region, considering its unique characteristics. Our findings suggest that Landscape Character Assessment (LCA) is a valuable tool for various sectors involved in landscape planning and management and leads to specific landscape strategies. The main contribution of this research is to offer a roadmap for managers and policymakers on how to utilize LCA, particularly in remote coastal and island areas like

the sensitive landscapes of the Mediterranean, to guide their development and manage pressures from various sectors.

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Article

Immigration and Local Endogenous Development in Rural Border Areas: A Comparative Study of Two Left-Behind Spanish Regions

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Abstract: Despite longstanding concerns about regional inequalities in both national and EU policy, the concept of ‘left-behindness’ has gained prominence in public and political discourse due to widening social and spatial disparities. A defining characteristic of left-behind areas is outmigration, ageing, and depopulation, yet the impact of incoming mobility remains underexplored. To bridge this gap, this article explores the role of international immigration in sustaining local economies in two left-behind border regions of Spain—Ribagorza (Huesca) and Sayago (Zamora). Grounded in the migration-development nexus, it argues that mobility can drive economic, social, and demographic revitalization, fostering sustainability and strengthening the social fabric of these rural communities. This research identified the case study areas based on their low local human development index, which integrates quantitative demographic, social, and economic indicators. It further examines migration dynamics through a qualitative approach, gathering insights via in-depth interviews. The paper analyses how the borderland conditions in those left-behind areas of Ribagorza and Sayago have influenced their demographic dynamics, with a particular focus on recent migration trends. It also examines the influence of local governance in shaping economic and social initiatives, such as entrepreneurship and immigration policies. The comparative analysis of Ribagorza and Sayago underscores the interplay between economy, migration, and local governance in shaping rural development in border left-behind areas. Ribagorza’s stronger governance structures, economic diversification, and higher immigrant integration have contributed to modest population stabilization. Sayago, despite its border advantages and cross-border labour exchanges, struggles with weaker governance, limited economic opportunities, and a rapidly ageing population.

Keywords: international migration; lifestyle entrepreneurs; Spain; local development; border; governance

1. Introduction

While regional inequalities have long been a focus of both national and EU policy, the concept of ‘left-behindness’ has gained prominence in public and political discourse amid growing social and spatial disparities. The economic literature and policy design are increasingly centred on understanding the local drivers of development within a new paradigm that has led to more localized interventions [1]. These efforts aim to harness economic potential and address left-behindness in alignment with the evolving concepts of “new ruralities” and mobility paradigms.

A key feature of left-behind areas is outmigration, ageing, and depopulation, which not only hamper local economies but also make their territory more socially vulnerable. As

younger generations leave for urban areas, these regions see a demographic shift toward an older population, which increases the demand for services, particularly health services, without a corresponding growth in the workforce to support them [2]. This emigration often further isolates ageing communities and limits opportunities for economic growth. This results in a Catch-22 situation in which the older population may not continue with their previous labour activities, while no new jobs are created because of the emigration of young people [3].

This is particularly acknowledged in European border regions, which are identified as some of the rural areas most affected by de-agrarianizing and depopulation [4,5]. These factors persist despite the European Union's longstanding focus on cross-border regions, as demonstrated by the early establishment of the Association of European Border Regions (AEBR) in 1971. This commitment is also evident in numerous cooperation initiatives, including the INTERREG programmes and the complementary LACE (Linkage Assistance and Cooperation for the European border regions), launched in 1990; the EURES Cross-Border Partnerships in 1994; and the most recent, the 2018 b-solutions project. Spain has been actively involved in these efforts since signing the European Framework Convention on cross-border cooperation in May 1981.

However, these initiatives have not always produced tangible results. Many border regions in Europe, especially those in distant rural areas, struggle to attract new residents, including farm labourers, lifestyle migrants, and remote workers looking for a quieter setting and more affordable housing [6,7]. Newcomers actively contribute to improving local amenities and connectivity, ultimately fostering a stronger sense of community [8]. In turn, their presence plays a crucial role in enhancing rural community resilience [9], both of which are essential in mitigating population decline and ageing. The point to stress here is that not all rural areas have the same capacity to attract new residents: while some struggle with weak labour markets and limited ability to integrate certain types of immigrants, others are better positioned to accommodate and benefit from their arrival [10]. It seems then that a demographic and spatial dichotomy has emerged between the more and the less developed rural areas in Spain (and across Europe) [11].

A growing body of research explores the experiences of various (mainly foreign-born) immigrant groups in rural settings, such as those working in farming and agri-food, tourism, caregiving, and lifestyle/amenity sectors [12,13]. Immigrants settling in rural areas face distinct challenges, including limited local knowledge and resources to support diversity, small population sizes that hinder the development of institutional infrastructure, and concerns among long-time residents that newcomers may disrupt traditional ways of life. Although immigrants have been recognized for filling essential roles in the rural labour market [14], their potential to drive economic growth through skills, training, networks, and entrepreneurship is only beginning to be fully appreciated [15,16].

From another perspective, the new mobilities paradigm [17] strongly affected scientific debates on migration, assuming that mobility is "normal". As a consequence, we must not consider migration as one single act but acknowledge ongoing negotiations of mobility and immobility [18]. Moreover, as Salazar suggests [19], "mobility and immobility are not mutually exclusive categories but, rather, two dynamic sides of the same coin" (p. 6). In fact, migration processes only constitute a relatively small part of spatial movements and blurring boundaries between residential mobilities and habitual/everyday mobilities are observable. In line with this, Milbourne and Kitchen introduced the term rural mobilities encompassing "movements into, out of, within and through rural places" (p. 385–386) [20].

Alongside demographic shifts, rural areas across Europe have undergone major economic transformations in recent decades. Rural regions can no longer be defined solely for agriculture [21,22], but as multifunctional areas, increasingly evolving into spaces for

consumption and leisure [11,23]. This functional shift has resulted in a diverse countryside where multiple stakeholders have legitimate interests in shaping its future [14,24]. This paradigm on “new ruralities” aligns with the discussion on the key role of international migration in rural areas, and the new mobilities paradigm.

Building on these premises, the contribution of the paper advances research on the role of international immigration in supporting local economies, promoting sustainability, and revitalizing the social fabric in two left-behind border regions. It offers diverse perspectives by comparing the economic structures and distinct population dynamics of Ribagorza, a *comarca* (like a county) in the Huesca province in the Spanish Pyrenees, and Sayago, located in Zamora province along the Spanish–Portuguese border (see Figure 1).

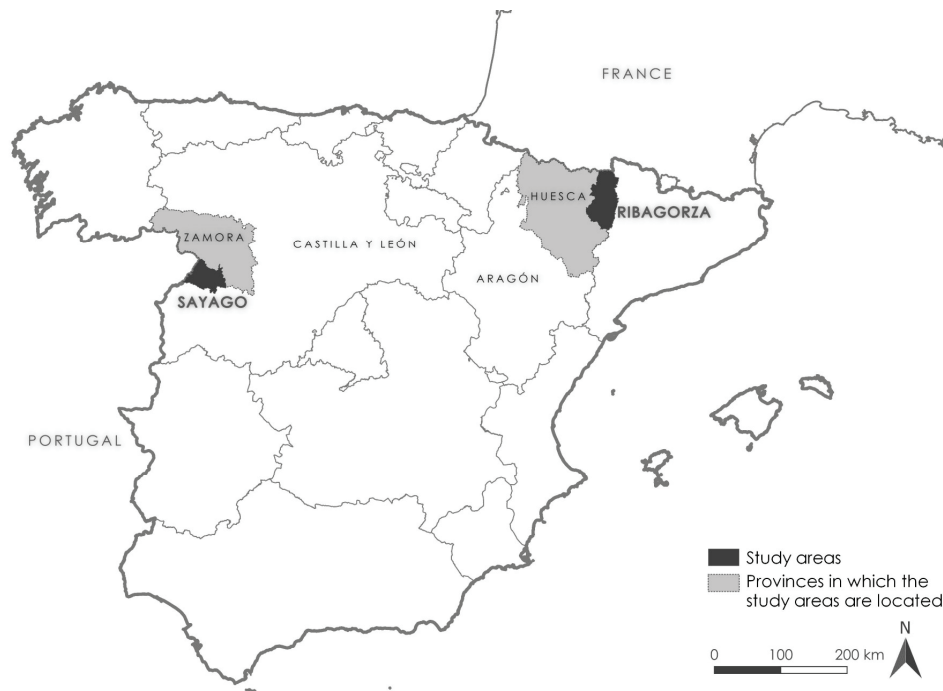


Figure 1. Location of Ribagorza (Huesca) and Sayago (Zamora) in Spain. Source: Guillermo Benito Pérez.

This comparative analysis highlights the diverse factors shaping left-behind areas and, consequently, the limitations of case studies in making broad generalizations. However, it offers new insights into the literature on left-behindness, particularly regarding the role of migration in revitalizing rural border regions, which has been largely overlooked in discussions on left-behindness.

The specific objectives of the paper are as follows: (i) analyze how the borderland condition has influenced the demographic dynamics of the study areas, with a particular focus on recent migration trends; (ii) evaluate and compare the role of immigrants in driving local economic and social development; (iii) identify entrepreneurial initiatives led by immigrants and assess their impact on the local economy; and (iv) examine and compare the influence of the local governance in shaping economic and social initiatives, such as entrepreneurship and immigration policies.

This article is structured as follows. The different sections outline the theoretical framework and research methods used in this study. This is developed by an extensive discussion of the results. First, the demographic profiles of both regions are compared from the mobility and ageing perspectives. Second, the article examines the role of immigrant entrepreneurship, focusing on the type of businesses and initiatives immigrants establish in both regions. Third, the impact of the border is analyzed. Fourth, the role of local governance in shaping regional development through resource mobilization, business

attraction, and the strengthening of social capital is explored. Finally, it concludes with a summary of the findings and recommendations for further research on left-behind areas in Europe.

2. Theoretical Background: Immigration and Local Development in Left-Behind Rural Areas

As stated in the introduction, the condition of left-behindness can be understood as the outcome of the intersection of geographical perspectives on local development, new ruralities, mobility, and borders (Figure 2).

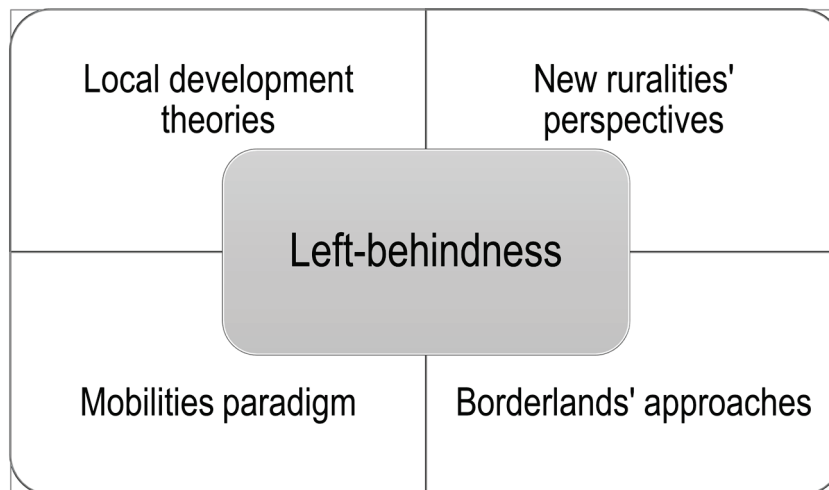


Figure 2. Existing theories in relation to the research topic. Source: Authors. **Note:** The grey colour symbolizes the intersection of various paradigms, emphasizing the notion of “left-behindness”.

Generally, in left-behind areas, immigration increases and economic evolution are interdependent, as growth in the number of people residing in these areas eventually raises labour force participation and overall economic productivity [25,26]. In left-behind rural areas, the relationship between migration and development has often been studied in the context of so-called less developed countries, where migrants’ remittances and resources have somehow helped local development [27,28]. However, due to demographic shifts (i.e., declining birth and death rates leading to smaller household sizes and longer life expectancies) along with the out-migration of young people, many rural regions in the Global North now rely on an influx of new residents for economic growth or even survival [29,30].

The article’s central premise is that, in contexts marked by ageing populations and depopulation, the arrival of new residents is essential for fostering local development of rural communities in Spain. In Southern Europe as a whole, rural–urban migration was substantial during the 1960s and 1970s, driven largely by limited economic opportunities in rural areas [31–34]. In Spain, this migration led to a significant population imbalance, concentrating people along the Mediterranean coast, in the islands, the Basque Country, and Madrid, while leaving much of the country sparsely populated [35,36]. Since the 1980s, traditional rural–urban migration patterns have increasingly been complemented by “counter-urbanization” flows towards rural areas well-connected with major cities [37]. Ironically, in Spain, the improvement of infrastructures (e.g., high-speed trains) has further intensified territorial disparities, concentrating resources, services, and population in large metropolitan regions (most notably Madrid), while remote rural areas continue to experience socioeconomic decline and depopulation [38,39]. This trend has been especially evident since the economic recovery of 2014–2015, when cities regained their central role,

reversing patterns of suburbanization and counter-urbanization [40]. Despite the temporary disruption caused by the pandemic in 2020 and 2021, this pattern has persisted [41].

Immigration, and particularly international immigration, has been decisive in reversing decreasing population trends and maintaining economic activities in rural Southern Europe [42,43]. This is particularly true for intensive agriculture, which is characterized by family-based small farms and a significant dependence on seasonal labour during harvest time [12,44]. Despite this, the role of agriculture in Southern Europe has steadily declined over recent decades in terms of both employment and its share of GDP. In Spain, agriculture accounted for only 2.3% of GDP in 2023 [45] and employed just 6.3% of the workforce in the same year [46]. However, the role of immigrant workers in Southern European rural areas extends beyond agriculture; they also participate in other economic activities, including construction, hospitality, restaurants, and elderly care, all of which are vital to local economies and community welfare [43,47].

In addition to traditional workers, rural areas also attract lifestyle immigrants who relocate, often from abroad, in search of a more fulfilling way of living [48,49]. Lifestyle immigrants are characterized as “relatively affluent individuals, moving either part-time or full-time, permanently or temporarily, to places which, for various reasons, signify for the migrants something loosely defined as quality of life” [48] (p. 621). Consequently, migration is viewed as part of an individual’s life trajectory, with destinations selected based on how well they align with personal life goals [50,51]. Often, these immigrants are retirees [49,52]. However, when lifestyle immigrants are economically active, they tend to prefer self-employment over traditional employment, seeking to maintain a balance between their personal and professional lives in their new environment [53,54]. As a result, the businesses they establish are often small and undercapitalized, possibly because they are concerned that significant business success could interfere with their desired work–life balance [48]. Indeed, research has indicated that lifestyle immigrants’ enterprises have a minimal impact on local economic development and job creation, often because they lack long-term business strategies and are hesitant to hire beyond family members [16,55].

However, studies have also found that lifestyle entrepreneurs play a crucial role in developing and introducing innovative products in niche markets that have been underexplored in rural areas. This activity stimulates local economies and reinforces values related to sustainability, community, and a sense of place [56,57]. These also indicate that immigrants often possess a unique sensitivity towards local cultural and landscape resources, which may be a significant factor in their decision to move to rural areas [58,59]. As a result, lifestyle entrepreneurs might be more likely than long-term local residents to recognize the potential of local culture, landscapes, and nature as viable tourism products and, in doing so, identify business opportunities [54,60]. In other words, these immigrants often contribute to the multifunctionality of rural areas by diversifying their economy through businesses in tourism, hospitality, and services.

Following this last idea, regions with diversified economies generally find themselves better positioned for resilience and growth. Successful rural areas frequently leverage local resources (e.g., unique agricultural products, natural landscapes, or renewable energy potential) to create sustainable job opportunities. They may also attract niche markets, like agritourism or local crafts, which provide additional economic strength [61,62]. On the other hand, rural areas highly dependent on a single industry struggle with economic stagnation, face population loss, and restricted capacity for economic growth and diversity [63], leading to a decline in local social capital and civic engagement [64]. To counter this trend, attracting new residents and encouraging economic diversification are essential for driving local development, particularly by capitalizing on the unique dynamics of

border regions. This approach remains relevant even though border regions are among the least economically diversified areas in Europe and often face significant depopulation [4,5].

From a deterministic geographical perspective, borders are viewed as barriers to economic efficiency, increasing interaction costs and disrupting activity flows [65]. Conversely, some argue that border regions present opportunities for innovative development, aligning with successive EU programmes aimed at fostering cross-border cooperation [66]. Complementing these perspectives, constructivist theory sees borders and border regions as social constructs where identity is continuously negotiated. This approach considers the psychological, social, historical, and cultural factors that define a community, shaping “mental distances” that are constantly created and reshaped [67]. Regardless of the theoretical lens, it is evident that the local government framework of a given border region plays a crucial role in shaping local development, with the potential to either facilitate or hinder economic progress and social well-being [68,69].

Building on the existing literature, this article explores the role of immigrants in driving economic growth, strengthening the foundation for future generations, and improving social welfare in two rural Spanish border regions: Sayago and Ribagorza. Sayago has experienced continuous population decline in recent decades, while Ribagorza has seen a modest demographic recovery, largely fuelled by international immigration. Another key distinction lies in the nature of the border itself. The Pyrenees create a landscape of isolation and discontinuity, particularly in their central region, acting as a true physical barrier. In contrast, Sayago sits along a more porous and accessible border with Portugal, where tourism and commercial initiatives have flourished across the region [70]. However, proximity to Portugal has not halted the trend of depopulation.

In summary, the article analyses the demographic and economic structures of both regions, highlighting the role of immigrants in counteracting depopulation and diversifying the local economy of the two border regions. Before presenting the results, the following section delves into the methodology underlying the project that informs the findings of this paper.

3. Sources and Methods

This paper compares patterns of immigration and local development in two areas in Spain: Ribagorza, in northern Spain, in the Pyrenees (province of Huesca), and Sayago in western Spain, close to the Portuguese border (province of Zamora) (see Figure 1 for location). These regions were carefully chosen for three research projects on which this article is based (For more information, see the following project websites SURDIM: <https://atlantis.uab.cat/hamlets/en/index.html> (accessed on 30 January 2025). ELDEMOR: <https://eldemor.es/en> (accessed on 11 March 2025). RE-PLACE: <https://replace-horizon.eu> (accessed on 5 March 2025).

The first project, SURDIM, was a European-funded initiative focused on mountain rural areas, selecting the Pyrenees as a case study. Within the Pyrenees, Ribagorza illustrates the complexities of mountain regions in Spain, featuring a diverse economy that blends traditional farming with active tourism and skiing. Meanwhile, the ELDEMOR project, a Spanish-led study on rural areas in Portugal and Spain, shares its study area—the Sayago region in Zamora—with REPLACE, an EU-funded project on left-behind areas, those experiencing decline or stagnation in economic, demographic, and social dimensions. Sayago indeed was selected based on a local development index at the municipal level, where it emerged as a prominent left-behind region. This index was applied to measure development at the local level (LAUs) in the European Union, using the concept of community capitals (material, socio-human, and health capitals) [71].

Being both left-behind areas in border regions, the significance of this comparison stems from their contrasting economic and demographic trends: Ribagorza has recently experienced economic revitalization, attracting foreign-born residents, while Sayago faces a sluggish economy, depopulation, and an ageing population, as will be discussed later. The analysis will ultimately allow us to derive insights into the factors influencing successful or unsuccessful local development experiences in rural border regions of Spain, with a particular focus on the role of immigrant entrepreneurship and local governance initiatives.

The methodological framework is guided by a phenomenological approach and qualitative analysis, using interviews with key informants and immigrants. Additionally, those projects incorporated official statistics—mainly Census data and Continuous Population Registers—offering insights into the total population of these areas, including individuals born abroad and those with foreign nationality.

Regarding qualitative data, 32 semi-structured in-depth interviews were carried out with immigrants across the two study areas, with 16 interviews conducted in each region.

Additionally, a total of seven semi-structured interviews were conducted with key informants in each region, including mayors, representatives of entrepreneurs' associations, and local action group officials involved in managing European Union funds.

The selection of interviewees followed a snowball sampling technique. Initially, local public administrations and entrepreneurial associations were contacted to identify foreign-born immigrants residing in the respective areas. Subsequently, previously interviewed immigrants facilitated the referral of additional potential research participants. Gender balance was sought among the informants, even though women outnumbered men in the non-representative sample survey. Additionally, the interviewees spanned different age groups, leading to a wide spectrum of labour integration experiences among immigrants, with an average age group of 45–49. Of the non-representative survey, nearly two-thirds consisted of entrepreneurs and self-employed workers. In the case of Ribagorza, the majority of these individuals were originally from Central and Western Europe, with a smaller portion originating from Latin America and Eastern Europe. For Sayago, entrepreneurs were equally distributed between internal and international immigrants, originally from Europe and Latin America. Although the survey was not representative of the immigrant groups in the studied regions, the interviews achieved a level of saturation, where informants' responses no longer introduced new information, themes, or insights.

In both cases—immigrants and key informants—the average interview duration was approximately one hour, and they were conducted at a location and time convenient for the interviewee. All were recorded and transcribed in full. Participants were also assured that the data collected would be anonymized and, consequently, all the names used in the article are pseudonyms. The analysis of the interview data followed a content analysis method, which involved several stages. Initially, codes were established and organized in alignment with specific interview sections. Subsequently, utilizing the MAXQDA2020 software, the interviews were labelled, and relevant extracts were grouped into distinct topics. Finally, a systematic review and analysis of this information facilitated the abstraction process and the selection of pertinent quotations to illustrate the analysis.

4. Results

4.1. Demographic Trends: Contrasting Migration Profiles

The two study regions share common trends concerning settlement, since both of them are basically rural areas and their population is highly dispersed in the territory. Thus, in Ribagorza (Huesca), only two municipalities (out of 34) have more than 2000 inhabitants in 2021. In Sayago (Zamora), all municipalities are considered to be rural, since none of the 24 exceeds 2000 inhabitants. However, concerning population trends, the

declining population trend in Sayago is clear over the last 20 years, dropping from 9775 in 2001 to 6986 in 2021, but this is not the case in Ribagorza, which shows some population recovery. In the period of 2001–2011, the annual growth for Ribagorza was positive (1% annual), even if this trend reversed in the subsequent decade. In any case, the population has slightly recovered in this *comarca* due to the arrival of international immigrants, with the foreign population representing 13.3% of the total population of Ribagorza (similar to the Spanish average). By contrast, foreigners only account for a scarce 4.2% in Sayago. According to Census data, both counties experienced similar trends concerning ageing, with the percentage of people aged 65 years old standing as high as 44.2% for Sayago (Table 1).

Table 1. Demography of the study areas.

	Ribagorza	Sayago	Spain
Population 2001	11,792	9775	40,847,371
Population 2011	13,036	8593	46,815,916
Population 2021	12,422	6986	47,400,798
Annual growth rate 01–11 (%)	1.0	−1.3	1.4
Annual growth rate 11–21 (%)	−0.3	−2.1	0.1
% Foreign population (2001)	1.7	0.5	3.3
% Foreign population (2021)	13.3	4.2	13.5
% Population 65 and more (2021)	23.4	44.2	19.6

Source: Authors from [72].

The significant difference in the type of immigration these two areas attract is essential for understanding the variations in population dynamics. This is closely tied to the local economic foundation. Over the past two decades, rural tourism has experienced significant growth across Spain due to the LEADER funds for rural tourism development [73], while farming activities have declined. In this context, international immigrants have actively contributed to tourism entrepreneurship in certain left-behind rural regions of Spain. Recognizing the potential of landscapes, nature, and local culture, they have played a key role in establishing businesses and transforming these resources into sustainable and profitable ventures [74].

4.2. Immigrant Business: Creating New Economic Avenues in Border Regions

A central question of the article is whether immigrants, both domestic and international, can establish businesses that create stable economic opportunities for the future and potentially retain and attract new residents. Initially, one might assume that interviewees were financially well-off, so they could start a business. However, upon delving into their narratives, it becomes evident that business success is a consequence of a long process that might rely on other sources of income. In other words, it is compulsory for households to have sufficient savings to cover losses during the initial years of the business, or eventually diversify their income sources, to allow the business to operate with initial financial losses as it gains momentum. The example of Paula (all names provided here are not real names for anonymity reasons), born in Madrid and living in Sayago for more than 20 years, exemplifies this:

“This was a family home. I inherited it from my great-grandfather, who was from Sayago. But restoring it took a lot of effort from both my husband and me. He worked in a health centre and never left his job. When I started the jam business, I had to buy everything from scratch, set up the shop, and apply for permits. . . it was challenging, and we had to

invest in equipment and training. I received European funding through the local business action group, but I'm running the business on my own, and without my husband's steady income, it would have been impossible to make it work." (Spanish female, 60, Sayago).

Similarly to Paula, and as a general rule, entrepreneurs interviewed in the study areas shared that they tend to be self-employed workers, or establish small, family-run businesses, often without hired employees. This pattern has been widely documented in the literature on lifestyle entrepreneurs [53,75].

More relevant than the size of the business is the fact that immigrants are indeed driving innovation within traditional sectors in rural Spain. This applies in both areas. The first example comes from a rural lodge in Sayago that now offers workshops on Peruvian cuisine, and the second is a rafting company in Ribagorza that manufactures its own equipment. Rural tourism and rafting are well-established industries in both regions. In Sayago, there are a total of 28 official rural lodges, with some key informants noting that the market is oversaturated and affected by low professionalism among operators. In Ribagorza, the Campo municipality alone hosts seven companies offering rafting services. However, the added value comes from the new residents who bring fresh perspectives, revitalizing existing businesses and possibly enhancing job opportunities in the area.

"I came straight to (name of the municipality) from Argentina on my first trip to Europe as a rafting instructor. I came for seasonal work and arrived with my boyfriend, who's now my husband. I fell in love with this area for its tranquillity, with mountains and the river nearby, much like my homeland. For eight years, I alternated seasons between here and Argentina. Then, I started a business similar to the one I had in Argentina. Since we couldn't find life jackets, we decided to make them ourselves. My husband, who's very skilled, created a prototype that initially didn't work, but eventually succeeded, and soon everyone in rafting in the area was using our life jackets (. . .) The municipality has provided us with a space, and our plan is to train one or two workers in sewing to help grow the business." (Argentinean female, 33, Ribagorza).

"The rural lodge started with four rooms 20 years ago, and we saw an opportunity to open a restaurant that also served breakfast to our guests. Later, we established the restaurant itself, but we operated by reservation only. Given our somewhat remote location, it really functions as an on-demand restaurant for both hotel guests and external customers (. . .) We also started baking organic bread, which we sell in the village (. . .) Since I'm Peruvian, I incorporate traditional dishes from my homeland as starters, keeping it simple. We even organized a Peruvian cuisine week, which was very successful (. . .) Everything we offer is made from organic products—eggs, suckling lamb, and more." (Peruvian female, 60, Sayago).

Immigrant entrepreneurs also play a key role in the creation and introduction of innovative products into very specific market niches that had been underexplored in rural areas. As examples, the research interviewed Márcia, a Brazilian national who works on cultural activities in a previously abandoned hamlet in Ribagorza, and Michel, a retired French immigrant who has recovered the saffron production on a very scarcely inhabited locality also in the same *comarca*. Another initiative is the case of the business developed by Dutch immigrants in a scarcely inhabited Huesca village, which has progressively expanded to a restaurant, a travel agency, and a small camping area. This young couple passed from being the only workers to employing one person permanently and two more temporarily in the summer season. They also use a wide local social network to create tailor-made tourist packages that are mainly oriented to Dutch tourists (Figure 3).



Figure 3. Village in Ribagorza. Immigrant business. Old school building restored as a restaurant and travel agency managed by Dutch immigrants. Source: Authors.

All these examples illustrate how businesses run by immigrants in small villages have opportunities to grow and diversify their profitable activities over time. This is because they are capable of creating social networks in the territory, and, in the last case, using, at the same time, links with the country of origin. In the case of Sayago, we also found that immigrants have been very active in creating a network of businesses along the territory to promote local products and find synergies between tourism and farming. Thus, under the *Arribes. Ruta del Vino* (Arribes. Wine Route) brand, various local restaurants, wineries, and farm producers (e.g., cheeses) showcase their offerings along a designated route through the region (Figure 4). A local craftswoman (originally from Madrid) created a small plaque with a logo, which made the businesses collaborating on this initiative recognizable.



Figure 4. “Arribes. Ruta del vino” (Arribes. Wine route). Source: Authors.

Social capital then emerges as the most potent competitive advantage for immigrant entrepreneurs, demonstrating their ability to initiate and expand businesses in rural envi-

ronments [76]. It encompasses various dimensions, comprising both immigrant community networks, which may have domestic, binational, or transnational links, and those formed by immigrants within local settings. The interviewees weave a dense network of local connections while maintaining ties to their home countries, as exemplified by the Dutch couple who own a travel agency in Ribagorza.

It is also worth noting that, for the majority of those interviewed, business, social life, and, eventually, friendships are interconnected. This is a crucial aspect to consider when relocating to and settling in Spanish rural areas and aligns with observations in the literature on lifestyle immigrants [77,78]. Our fieldwork also reveals a heightened sensitivity to local identities and nature among immigrants, which contributes to the development of a personal sense of belonging, subsequently reinforcing a broader sense of community in rural settings [57]. Take the example of a cultural initiative led by Márcia, a Brazilian national, in a small village in Ribagorza, which is divided into two small hamlets. While a few local families persist in the lower mountain, the abandoned hamlet uphill has been revitalized by an international group comprising individuals from various origins.

“We have a vibrant collaboration with Graus (Ribagorza’s capital). We actively participated in the local theatre festival (. . .) In our home, we have an outdoor theatre, and presently, we are refurbishing an old cellar to create a more intimate setting—an indoor theatre for around 30 people (. . .) It’s truly charming: from the outdoor theatre, there’s a delightful view of the mountains. People appreciate it (. . .) We organized workshops for children (. . .) Our intention is not to isolate ourselves from the community. We established an association to cultivate stronger connections with the downtown village. Even elderly residents living downhill have made the journey up to attend our performances.”
(Brazilian female, 62, Ribagorza)

Márcia actively participates in the local community, guided by a distinct sense of community that is closely intertwined with the very survival of the locality, and by integrating her knowledge into local practices, this interviewee has shown great local resilience [79]. Related to this idea, there is a clear difference between the broadness of cultural activities in the two study areas. For Sayago, these are largely connected to local celebrations and the seasonal return of emigrants during holiday periods. In Ribagorza, cultural activities have a more stable platform and more local support, and immigrants are involved in activities which go beyond the strictly local perspective (exhibitions, theatre, language learning). All of this may be essential in fostering a strong sense of place within communities, ultimately contributing to their survival and growth. A significant factor influencing the differing approaches to cultural activities is the border effect and local governance, which set distinct priorities in each territory. The following sections delve deeper into these aspects.

4.3. The Border Effects: Work, Tourism, and Trade Through Borders

Physical connectivity has long been a major concern for rural areas in Spain [80], though its impact on retaining population remains debatable. In border regions, the road network plays a crucial role in overcoming physical barriers, directly influencing connectivity with neighbouring countries and shaping cross-border movements. When road infrastructure successfully bridges these barriers, mobility increases, fostering synergies in employment and service provision for residents of adjacent regions.

This is evident in Sayago, where the integration of Spanish and Portuguese road networks facilitates the movement of workers, business customers, and tourists who potentially explore and appreciate the natural and scenic heritage of the region. These interactions strengthen a shared identity shaped by historical isolation and longstanding cross-border communication. This cross-border dynamic is particularly significant in the healthcare sector. The demand for healthcare and caregiving professionals for the region’s

ageing population is so high that it is partially met by Portuguese workers. Nurses and doctors commute from nearby border towns, drawn by higher wages in Spain. This is the case of Sara, who lives in Miranda do Douro (Trás-os-Montes) and works part-time at two nursing homes in Sayago. She also covers sick leave positions occasionally in other municipalities of the Zamora province, as the system operates at the provincial level, but only if the job is within a 30 min drive from her home. According to her words: “I oversee the nursing homes in Muga and Villar del Buey, both located in Sayago, Spain, while residing in Miranda, Portugal, just a 20-min drive away. Like me, many others commute daily from Portugal to work in these facilities, drawn by the slightly higher wages here” (Portuguese female, 48, Sayago). This highlights the importance of roads and private transportation, which, based on fieldwork in the region, are generally of good quality—a view shared by most interviewees.

The border also influences the availability of commercial facilities in Sayago. Miranda do Douro serves as the primary shopping hub for residents in the western part of the region, where lower prices in Portugal have fostered the growth of restaurants and supermarkets catering to local demand. As noted by an interviewee who splits his time between Sayago (in a municipality near the Portuguese border) and Madrid: “When I’m in Sayago, I often shop in Miranda do Douro and eat out at its restaurants”. (Spanish male, 64, Sayago). As a result, only a few small local supermarkets remain in Sayago. In Fermoselle (the most populated town in the area, close to the Portuguese border), the last surviving supermarket continues to operate thanks to Venezuelan immigrants who took over after the previous owners retired. In contrast, the eastern part of Sayago gravitates more towards Zamora city for commercial needs.

The border location has also played a key role in the success of certain nature tourism businesses, exemplified by the Duero-Douro International Biological Station (EBI). Founded by a non-local Spaniard, EBI is a binational centre for research, technological innovation, environmental education, and biodiversity studies in the Arribes del Duero. It successfully integrates natural conservation with the promotion of sustainable ecotourism [81], and benefits from the support of both the Spanish and Portuguese Ministries of Foreign Affairs. According to a key spokesperson at the EBI:

“The Duero-Douro International Biological Station operates in a shared territory. In 2002, two private companies—one Spanish (Europarques España) and one Portuguese (Centro de Turismo Ambiental Luso-Espanhol)—officially established the Station to support the environmental conservation of the Arribes del Duero.” (Spanish male, 58, Sayago).

Ribagorza, on the other hand, does not experience this border-driven economic dynamic, as the Pyrenees act as a natural barrier. There is no direct physical connection to France, as plans for a Benasque-Luchon tunnel were met with strong opposition from environmental groups. Yet the attraction of immigration and businesses driven by immigrants share similarities with patterns observed in other areas of the Pyrenees, where connectivity with France is ensured through land routes and key infrastructure such as the Somport and Bielsa tunnels in the central regions of the mountain range [76].

The physical barrier, however, hinders cross-border collaboration projects in Ribagorza, which is coordinated through the European Grouping of Territorial Cooperation (EGTC) “Pirineos-Pyrénées”, covering the entire Huesca province. Established in 2020, key informants interviewed in Ribagorza did not identify it as a leading organization for local development. In contrast, the “Douro-Duero” EGTC, created in 2009, is highly active in advancing an agenda for self-sustained energy communities on both sides of the border, apart from promoting economic activities, such as wine production and tourism linked with winemakers. This is explained by a key individual responsible for this EGTC:

“We established Efiduero Energy as an energy cooperative (. . .) In 2019, we launched a pilot project for shared self-consumption, implementing it in a specific municipality to assess the model’s viability. The goal was to determine whether energy production through photovoltaic panels installed on municipal rooftops would be sufficient, given that many villages have underutilized infrastructure. The pilot project proved successful, and in 2021, we began the first phase of shared self-consumption with 40 installations. By 2024, we had expanded to 106 facilities. Our cooperative model allows any individual, municipality and company to become a member, provided they reside within the operational area of the EGTC.” (Spanish female, 32, Sayago)

Beyond these locally based projects, large hydroelectric companies in Sayago and Ribagorza generate substantial amounts of electricity for urban areas through an extensive network of dams and reservoirs. In Sayago, the Duero River hosts dams evenly distributed between both countries and there has been no unanimous response to these large-scale energy projects. In contrast, Ribagorza has faced strong opposition to these projects, which are viewed as enterprises that provide no local benefits and serve solely to supply energy to urban centres outside the region. For instance, a local mayor in Ribagorza strongly opposed the large-scale expansion of energy projects in the region. He criticized the extractive model, emphasizing that energy production does not translate into local benefits such as price reductions or fiscal incentives. In his own words:

“In the 1980 s, the most fertile agricultural lands were sacrificed for the construction of hydroelectric dams. In Ribagorza, the electricity generated is sent to Barcelona. Now, there is growing pressure to cover our land with solar panels. Despite producing more energy through renewable sources than we actually consume, we still pay the same rates as everyone else. We have passed a resolution banning the installation of large photovoltaic farms in our municipality, allowing solar energy only for individual consumption. Several companies have shown interest, but my response has been a firm NO, despite their persistence and generous financial offers. However, I have no doubt that they will eventually succeed with other mayors, as they offer substantial amounts of money.” (Spanish male, 62, Ribagorza).

In summary, border regions in Spain experience varying economic and social dynamics influenced by their physical connectivity. In Sayago, the integration of Spanish and Portuguese infrastructure facilitates cross-border movement, fostering employment, commerce, and nature tourism while also addressing local labour shortages, particularly in healthcare. The economic interdependence with Portugal has strengthened historical ties and somehow shaped regional identity. Conversely, Ribagorza, hindered by the natural barrier of the Pyrenees, lacks direct connectivity with France, limiting cross-border exchanges. While immigration and business trends in Ribagorza resemble those in other better-connected Pyrenean regions, transborder local collaboration efforts remain weaker. Additionally, while both regions host large-scale energy projects, Sayago exhibits a mixed response, whereas Ribagorza strongly opposes such initiatives due to perceived economic disadvantages. These contrasting dynamics highlight the critical role of infrastructure in shaping regional development and cross-border interactions.

4.4. Local Governance: Making the Difference Across Regions

Building on the previous section, local governance is essential in leveraging local resources, attracting businesses, and activating local social capital, all of which contribute to economic development. Especially in highly decentralized countries like Spain, the structure and functions of local administrations differ from one region to another. This arises as the first issue to consider when examining whether communities have a voice in the planning and implementation of local projects. Local governments, as the closest level

of administration to citizens, play a key role in this regard. In Spain, particularly in the northern regions, municipalities tend to be small and operate with limited resources. This is true for both Ribagorza and Sayago. Ribagorza consists of 34 municipalities spread across nearly 2500 km² (with Graus, the largest, having 3380 inhabitants in 2024), while Sayago includes 24 municipalities across 1487 km² (with Fermoselle being the most populated, with 1149 inhabitants in 2024) [72].

Local efforts may then be limited by the small size of municipalities and unequal power dynamics with external administrative bodies. However, Ribagorza has an extra-municipal entity, known as a *consejo comarcal* (county council). This institutional structure at the local supra-municipal level is shaped by Aragón's regional policy, which defines the *comarca's* powers to promote, at least in theory, local development. In contrast, Sayago lacks such an entity, as the regional government of Castilla y León does not have this institutional framework. According to some key informants interviewed in Sayago, even cross-border funds are managed by Valladolid, the distant regional capital, which does not share a physical border with Portugal.

Local initiatives in the Ribagorza *comarca* have not yet focused on implementing governance practices; they instead follow a more traditional top-down approach that mirrors the logic of higher-level administrations (regional and national). However, local leaders have acknowledged the shortage of socio-sanitary personnel and have acted by introducing a specialized training course in social services and establishing an effective caregiving network throughout the region. This is particularly crucial in areas with a high proportion of elderly residents. In the case of Sayago, these initiatives have not been necessary due to the availability of Portuguese caregivers who commute daily. Nevertheless, these policies play a vital role in providing essential safety nets and support for vulnerable populations, ensuring they are included in regional development. Notably, in Ribagorza, several interviewed immigrant women have taken on these caregiving roles.

At another level of local administration, provinces in Spain are provided with an institutional framework designed primarily to support small municipalities, often supplying services that these municipalities cannot provide on their own, such as waste collection. Provincial *diputaciones* (provincial councils) typically benefit from a stable budget directly allocated by the central government. In both Huesca and Zamora, provincial authorities have been actively promoting the expansion of digital cable connections within their territories. Interviewees noted that while this initiative has been successful—albeit delayed—it has had little impact on attracting or retaining population (e.g., digital nomads). For example, one interviewee from Madrid, who relocated with his wife to a small municipality in Sayago, experienced years of poor and unreliable digital connections until recent improvements were made. In his words:

“Fiber internet arrived two months ago, and we’ve been living here for 17 years. (. . .) The roads are fine. You wouldn’t believe the high-end cars you see on them. But Internet? It was never a priority. We asked for it, but no one listened. They offered courses on web design or programs for rural women, but without Internet, can you believe that? In the beginning, I had to contract a Portuguese company, and I’d often drive closer to the Portuguese border just to catch the aerial signal from there to send my work. (. . .) I’m a graphic designer.” (Spanish male, 53, Sayago).

The institutional framework is undoubtedly crucial for fostering economic growth at the local level. In Spain, this is exemplified by the Local Action Groups, which are established at a sub-regional level to manage LEADER funds. These groups are intended to support entrepreneurship, facilitate access to finance, and promote education and skill development. In practice, their activities are often limited to small-scale repairs, primarily in the retail, restaurant, and hotel sectors, as well as the purchase of machinery and

equipment. Their efficiency largely depends on how active the groups are in navigating a bureaucratic landscape marked by complex EU requirements, which the local population is often ill-equipped to handle. As one entrepreneur from Sayago noted, these funds tend to be directed toward larger companies with trained staff capable of managing the administrative burden, especially when Local Action Groups are pressured to allocate the funds before the fiscal year ends. Overall, the effectiveness of these groups heavily depends on the personal commitment and initiative of the professionals managing them.

Despite their important role, institutional frameworks can pose challenges to local development, especially when they are weak or inefficient. Their effectiveness in retaining or attracting new residents is often limited. In this regard, Ribagorza has implemented targeted, structured responses to local needs, which have successfully contributed to the creation of a county-based network of health and caregiving professionals. This initiative has been instrumental in bringing in foreign-born professionals to the area, helping to slow down depopulation to some extent. In Sayago, two local initiatives aimed at attracting immigrants have yielded contrasting results—one unsuccessful and the other proving effective. The first effort, led by the Fermoselle municipal government, involved providing facilities for Ukrainian refugees; however, only three families arrived, and all left after a short stay. In contrast, a collaboration between the same municipal government and a private association successfully facilitated the relocation of several Venezuelan families, who have since remained in the community. This is evident in the following testimony from a key informant:

“Fermoselle welcomed three Ukrainian families who had fled from the war. [...] However, they left the municipality abruptly. You can’t force people to stay if they choose otherwise. More recently, 50 Venezuelans arrived simultaneously through a collaboration with a privately run, church-supported Venezuelan association. We assisted them in securing jobs and housing. This is a unique case in Sayago.” (Spanish male, 68, Sayago).

Local governance plays a fundamental role in shaping local development by mobilizing resources, attracting businesses, and fostering social capital. However, its effectiveness varies across regions, as seen in Ribagorza and Sayago. While Ribagorza benefits from a *comarca*-level administrative structure that facilitates regional coordination, Sayago operates within a more fragmented governance system, with decisions often managed at the distant regional level. Despite these challenges, Ribagorza has implemented structured initiatives, particularly in the healthcare and caregiving sectors, which have helped attract immigrant workers and address local needs. In Sayago, immigration initiatives have had mixed results, with some, like the collaboration with a Venezuelan association, proving more sustainable than others. Additionally, despite efforts by provincial authorities to improve digital infrastructure, connectivity issues have hindered economic opportunities in rural areas. Ultimately, the success of local development initiatives depends not only on institutional structures but also on proactive leadership, efficient governance, and the ability to adapt policies to the specific needs of each community.

5. Discussion

The findings of this study highlight the contrasting demographic and economic trajectories of two rural Spanish regions, Ribagorza and Sayago. While both regions share common characteristics, such as a predominantly rural landscape and dispersed population, their demographic trends and capacity to attract immigrants differ significantly. Ribagorza has demonstrated a modest capacity for population recovery, primarily due to international immigration, whereas Sayago continues to experience significant population decline. This divergence underscores the critical role that immigration, particularly international migration, plays in shaping rural demographic trends in Spain [6,7].

The differences in migration patterns are closely tied to the economic structures of the two regions. The growth of rural tourism in Ribagorza has provided opportunities for immigrant entrepreneurship, allowing new residents to engage in business ventures that capitalize on local natural and cultural resources. This phenomenon aligns with broader trends observed in Spain (and elsewhere in Europe), where international immigrants have been active in revitalizing rural areas through entrepreneurial initiatives [9,53,54]. Conversely, Sayago has been less successful in attracting international immigrants, which is reflected in its lower percentage of foreign-born residents. However, it does exhibit an entrepreneurial network, mainly fueled by non-locals that promote synergies between tourism and farming, demonstrating an alternative path to rural economic revitalization.

Immigrant entrepreneurship emerges as a key factor in rural economic development, with new residents introducing innovative business models and diversifying local economies. The case studies presented in this research illustrate how small-scale, immigrant-led businesses contribute to economic resilience, in line with other case studies in Europe. Whether through niche market activities, such as Peruvian cuisine workshops in Sayago or the expansion of nature-based tourism services in Ribagorza, these initiatives demonstrate the potential of immigrant entrepreneurship to enhance rural livelihoods. Moreover, in line with the literature, our results show that the ability of immigrant entrepreneurs to establish and maintain social networks—both locally and transnationally—has been crucial in ensuring the sustainability of their businesses [69,79]. The Dutch-owned travel agency in Ribagorza exemplifies this, leveraging transnational ties to attract Dutch tourists to the region.

The role of borders in shaping local economic and social dynamics is another critical finding of this study. Sayago, situated near the Spanish–Portuguese border, benefits from cross-border labour mobility, trade, and tourism. The integration of road networks facilitates employment opportunities for Portuguese workers in Sayago’s healthcare sector and enhances commercial interactions, as demonstrated by the preference of some Sayago residents to shop in Miranda do Douro. This border effect has strengthened economic interdependencies and helped sustain essential services in the region. In contrast, Ribagorza’s geographical isolation due to the Pyrenees limits cross-border exchanges, reducing opportunities for similar economic synergies with France.

Local governance structures further influence the effectiveness of rural development strategies. Ribagorza benefits from a *comarca*-level administrative framework, which provides an additional layer of coordination for regional initiatives. This structure has facilitated targeted responses to local challenges, such as the creation of a caregiving network to address the needs of an ageing population. Sayago, in contrast, lacks a *comarca* institution, and decision-making authority is concentrated at the distant regional level in Valladolid. This governance disparity has practical implications, particularly in accessing and managing development funds. While Local Action Groups in both regions play a role in channelling EU LEADER funds, our results clearly point out that their effectiveness is often constrained by bureaucratic complexities, limiting their impact on fostering entrepreneurship and retaining population. This should be a priority for local and regional political institutions in Spain.

6. Conclusions

The findings of this study highlight the complex interplay of demographic and economic factors shaping rural Spain. Examining the two left-behind rural areas selected reveals that immigration, entrepreneurship, border dynamics, and governance structures collectively influence the resilience and growth of these regions. Among these factors, immigration emerges as the key driver of local economic and social development, with

immigrants playing a crucial role through entrepreneurial initiatives. Equally significant is the commitment of local governance, which, when supported by a decentralized administrative framework, enables authorities to implement their own economic and social initiatives. Additionally, the impact of border locations varies depending on the physical geography of the region—crossing a riverbed poses a far smaller challenge than surmounting a 3000 m elevation, as illustrated by the two case studies examined. Nonetheless, when cross-border interactions are feasible, they generate positive effects by facilitating labour mobility, tourism, and trade, ultimately enhancing the well-being of the connected areas.

Therefore, Ribagorza's relative success in maintaining population levels and fostering business innovation highlights the importance of immigrant attraction and supportive local governance. Sayago's continued depopulation, despite active local business networks and cross-border linkages, suggests that additional policy interventions are needed to enhance its attractiveness for new residents. Strengthening governance, enhancing economic opportunities, and leveraging border advantages where possible will be essential for sustaining these rural communities in the long term.

Future research should explore immigration and population growth trends, the long-term sustainability of the entrepreneurial initiatives and examine the potential for policy frameworks that can better support rural economic revitalization in Spain's left-behind areas.

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Article

Sustainable Agritourism Development in Romania's North-West Mountain Region: A TOPSIS-Based Evaluation of Strategic Priorities

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Abstract: Rural tourism and agritourism are essential drivers of sustainable economic development in mountain regions, generating income opportunities while preserving cultural and natural heritage. The North-West region of Romania has significant potential in this sector. Yet, tourism development is unevenly distributed, and the integration of local economic activities remains limited, an imbalance that reduces the overall impact of tourism on regional sustainability and economic resilience. To assess viable strategies for agritourism development, the study applies the TOPSIS method, evaluating four key criteria: infrastructure accessibility, diversity of tourism experiences, service quality, and long-term economic sustainability. A survey was conducted with 102 respondents, and the collected data were analyzed using the TOPSIS framework to determine the most effective development approaches. The findings indicated that the ecotourism trails represent the most favorable strategy ($C_i = 0.678$), followed by promoting local products within tourism ($C_i = 0.602$) and expanding rural guesthouses ($C_i = 0.467$). In contrast, integrated tourism packages and tourist information centers ranked lower, suggesting that infrastructure investment and the strategic use of local resources should be prioritized. These insights provide practical recommendations for policymakers, investors, and local stakeholders, emphasizing the need for targeted support in ecotourism and rural economic initiatives. Furthermore, the study contributes to academic research by offering a structured, replicable approach to evaluating rural tourism development. By highlighting sustainable investment directions, the findings support efforts to enhance Romania's rural tourism competitiveness while fostering economic growth in mountain regions.

Keywords: sustainable agritourism; TOPSIS evaluation; rural economic development; ecotourism

1. Introduction

Agritourism represents a strategic approach to economic development, integrating sustainability principles with preserving natural and cultural heritage [1]. In mountain regions, where traditional economic activities face limitations due to geographical constraints and insufficient infrastructure, agritourism emerges as a viable alternative because it stimulates local economies and diversifies income sources for rural communities. By promoting regional identity through authentic products and traditions, agritourism helps mitigate rural depopulation and reduces socioeconomic disparities between urban and rural areas [2]. Experiences of European countries such as Austria, Switzerland, and Italy demonstrate that mountain regions can evolve into competitive tourism destinations when supported by coherent policies and targeted investments [3,4]. These countries have successfully transformed rural mountain villages into vibrant economic hubs by capitalizing on their natural and cultural assets while ensuring environmental sustainability. On the other hand, in Romania, although the potential for agritourism is considerable, its development remains uneven, considering the factors that influence this situation, such as infrastructure accessibility, the diversification of tourism services, and also the capacity of local communities to innovate and adapt to market demands [5]. Recent studies highlight that the long-term success of agritourism depends on its ability to provide authentic and immersive experiences deeply connected to the local environment and traditions [6–8]. Equally important is the active involvement of local populations in shaping and managing tourism initiatives. Also, it is important to specify that beyond its economic benefits, agritourism contributes to biodiversity conservation and the revitalization of marginalized rural areas, positioning itself as a fundamental pillar of sustainable regional development policies.

The North-West region of Romania, comprising the counties of Maramureș, Bihor, Bistrița-Năsăud, Cluj, and Sălaj, possesses considerable agritourism potential due to a distinctive mix of unspoiled mountain landscapes, well-preserved rural settlements, and a rich cultural heritage that continues to attract both domestic and international visitors. This region offers a diverse range of agritourism opportunities, rooted in the valorization of local traditions, craftsmanship, and sustainable rural lifestyles. Maramureș, for instance, is internationally recognized for its UNESCO-listed wooden churches and deeply rooted artisanal traditions [9], while Cluj and Bihor provide extensive mountain trails and ecotourism assets that further enrich the region's appeal [10]. Despite its strengths, agritourism development across the region remains highly uneven. Some locations, such as Răchițele in Cluj and Stâna de Vale in Bihor, have benefited from targeted infrastructure investments and sustained promotional efforts, transforming them into well-established tourist hubs [11]. However, many rural communities continue to face structural limitations, including insufficient infrastructure, underutilized tourism resources, and restricted market access, disparities that are highlighting the pressing need for a strategic and integrated approach to agritourism development, ensuring that investments are directed toward initiatives with the highest potential for economic and social impact. The examining process of this region provides valuable insights into how agritourism can serve as a mechanism for reducing rural-urban development disparities while safeguarding cultural and natural heritage. A thorough analysis of successful agritourism models, coupled with an assessment of the barriers facing less developed areas, can inform the design of tailored policies and strategies, an approach that would foster a more balanced and sustainable economic trajectory for the entire region, maximizing the long-term benefits of agritourism for local communities. A major obstacle regarding the effective development of agritourism in Romania's northwest region is the lack of a well-defined, data-driven strategy that takes into account both tourist expectations and the specific challenges faced by local entrepreneurs [12].

Although the region possesses substantial agritourism potential, many initiatives operate in isolation, lacking coordination and long-term strategic direction, fragmentation that leads to inefficient resource utilization, and deepening developmental disparities among rural communities, limiting the sector's overall impact [13]. In light of these aspects, the research aims to address these gaps by identifying and analyzing the key priorities necessary for sustainable agritourism growth in the region. In this context, the research is guided by three central questions:

- What are the primary priorities for agritourism development in the region, considering both the needs of tourists and the local resources available?
- How can financial, human, and material resources be allocated more effectively to maximize agritourism's economic and social benefits?
- Which development strategies offer the highest potential for success, and what structural or operational challenges hinder their implementation?

To provide a structured and objective analysis, we decided to employ the TOPSIS method (Technique for Order Preference by Similarity to Ideal Solution), a multi-criteria decision-making approach [14]. This method enables the ranking of development alternatives based on economic impact, environmental sustainability, and community involvement. By applying this analytical framework, the research offers a practical tool for policymakers and local stakeholders, facilitating strategic resource allocation and identifying high-impact projects that can drive balanced and sustainable agritourism development.

1.1. The Main Purpose of the Research

The main purpose of the research is to assess and prioritize strategic agritourism development alternatives in the mountainous areas of Romania's North-West region by applying the TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method. The research seeks to identify the key factors influencing agritourism growth, determine the most effective investment strategies, and provide data-driven recommendations for policymakers, investors, and local stakeholders.

By systematically ranking development alternatives based on infrastructure accessibility, diversity of tourism offerings, service quality, environmental sustainability, and economic feasibility, the study aims to offer an objective framework for decision-making. The ultimate goal is to contribute to the sustainable growth of rural tourism, ensuring that resources are allocated efficiently, local economies are strengthened, and agritourism initiatives align with regional development priorities.

The research employs the TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method, a multi-criteria decision-making approach to evaluate and rank agritourism development alternatives in Romania's North-West mountain region. The methodology integrates primary data from stakeholder surveys (guesthouse owners, farmers, local authorities, and tourists) and secondary data from official tourism reports and statistical sources. Four key evaluation criteria—infrastructure accessibility, diversity of tourism offerings, quality of services, and economic sustainability—were weighted based on stakeholder input. The TOPSIS model systematically ranks development alternatives through data normalization, weighting, and distance calculations from ideal and anti-ideal solutions. This approach ensures objective prioritization of investment strategies, providing policy recommendations for decision-makers, investors, and local communities to enhance agritourism growth in a sustainable and economically viable manner.

1.2. Originality of the Research

Existing studies on agritourism in Romania predominantly adopt descriptive approaches, focusing on broad assessments of tourism potential or qualitative evaluations of

visitor experiences [15–20]. While these contributions offer valuable insights, they often lack structured, data-driven frameworks to guide investment decisions and policy formulation. In contrast, this study introduces a quantitative analytical perspective, applying the TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method, a well-established multi-criteria decision-making tool widely used in economic analysis but rarely explored in the context of Romanian rural tourism. By employing this approach, the research provides a systematic and objective mechanism for evaluating and ranking agritourism development alternatives, addressing a significant gap in the existing literature.

A key element of originality lies in the study's methodological framework, which extends beyond the traditional expert-based approach commonly used in similar analyses [21–25]. Instead of relying solely on a narrow expert perspective, this research integrates insights from a diverse respondent base, including agritourism guesthouse owners, farmers, tourists, and local government representatives. This broader participation ensures a more comprehensive and nuanced understanding of the sector, enhancing the reliability and applicability of findings. The use of a structured survey targeting heterogeneous stakeholders strengthens the empirical foundation of the study, allowing for the identification and prioritization of actionable solutions based on economic viability and long-term sustainability.

By bridging theoretical research with practical applications, this study offers a valuable tool for policymakers, investors, and rural entrepreneurs, facilitating evidence-based decision-making in agritourism development. Its data-driven recommendations contribute not only to the academic discourse but also to the formulation of sustainable policies that can foster long-term rural development in Romania.

2. Theoretical Framework and Literature Review

2.1. Definition and Role of Agritourism in Sustainable Development

Agritourism extends beyond conventional tourism by integrating agricultural practices with visitor experiences, creating a sustainable economic model that supports rural development [26]. This sector fosters the promotion of local culture and natural landscapes while providing economic benefits through entrepreneurial activities and diversified income streams. Unlike mass tourism, which often imposes environmental and social pressures on host communities, agritourism follows a more balanced approach, one that seeks to preserve resources while simultaneously driving economic growth [27–29].

In the context of accelerating urbanization and workforce migration to industrial and service sectors, it is a known fact that agritourism presents a viable alternative for revitalizing rural economies [30,31]. Encouraging local entrepreneurship and strengthening short supply chains can help mitigate the risks associated with fluctuating agricultural markets. Furthermore, the expansion of employment opportunities in related sectors, such as hospitality, artisanal crafts, and traditional food production [32], can slow population decline and enhance overall living standards in rural areas.

Mountain regions, in particular, stand to benefit significantly from agritourism because their rich natural landscapes and well-preserved traditions offer unique advantages in attracting visitors seeking authentic rural experiences [33]. However, realizing that the full potential of agritourism requires more than just natural beauty and cultural heritage, a well-structured strategy is necessary to transform these assets into a sustainable economic driver. Without targeted investments in infrastructure, workforce training, and strategic marketing, agritourism risks remaining an underutilized opportunity rather than a key contributor to regional development, a situation in which for agritourism to thrive as a pillar of rural economies, collaboration between policymakers, investors, and local entrepreneurs is essential, and coordinated efforts can ensure that resources are allo-

cated efficiently, maximizing long-term benefits while fostering a resilient and competitive agritourism sector.

2.2. Case Studies and Experiences from Similar Regions

Examining successful agritourism models across Europe reveals that the development of this sector is not spontaneous. Instead, it results from well-structured public policies, strategic investments, and the active involvement of private stakeholders. In numerous EU member states, agritourism has evolved into a key driver of rural economic development [34], effectively integrating tourism with agriculture, a synergy that has not only generated sustainable economic benefits but has also contributed to revitalizing rural communities, particularly in areas facing economic decline.

A compelling example is Austria, where small-scale farms in mountain regions have flourished due to targeted government subsidies and specialized training programs for agritourism operators [35]. These initiatives have enabled farmers to expand their income sources by offering tailored tourism experiences while maintaining the region's agricultural character. As a result, previously isolated Alpine villages have been successfully transformed into internationally recognized tourist destinations, demonstrating the fact that Austria's approach has balanced economic expansion with heritage conservation, preventing the negative externalities associated with mass tourism.

Tuscany, Italy, presents another notable case, illustrating how rural identity can be effectively harnessed to create a thriving agritourism sector [36]. Through a combination of public policy support and entrepreneurial initiatives, traditional farmhouses, vineyards, and olive groves have been repurposed into high-end rural accommodations. The "Agriturismo" [37] brand has become synonymous with quality and authenticity, thanks to a cohesive marketing strategy and the seamless integration of local products and experiences into the tourism offering, a model that highlights the significance of regional branding and identity, important for enhancing a destination's market competitiveness.

A more regionally relevant example is Bucovina, Romania, where rural guesthouses have successfully attracted visitors by promoting local businesses, traditional architecture, and authentic cuisine. However, unlike the Austrian or Italian models, Bucovina's agritourism development has been uneven and fragmented, largely due to the absence of a strategic, long-term vision. The result has been an overconcentration of tourist activity in a few key areas, while other communities with similar potential remain underdeveloped, a disparity that underscores the stringent need for an integrated policy approach, one that ensures balanced investment distribution and mitigates the risks of over-tourism while preserving the sustainability of local resources [38–43].

From these case studies, it can be concluded that a clear pattern emerges: the success of agritourism depends on a coordinated strategy that prioritizes infrastructure development, financial incentives, and effective regional promotion. Without a systematic approach, rural tourism risks becoming disjointed, inefficient, and economically unsustainable. Therefore, collaborative policymaking, public-private partnerships, and targeted financial mechanisms are critical to maximizing the long-term economic and social benefits of agritourism.

Decision models for evaluating tourism development priorities: justification for the TOPSIS method and the relevance of the study. Multi-criteria decision analysis is widely used in economic and strategic planning, with various methodologies available to assess and rank development alternatives and each method presents distinct advantages and limitations, influencing its applicability in different contexts. Within the field of tourism and economic resource allocation, some of the most recognized approaches include:

- Analytic Hierarchy Process (AHP) is a widely used method that relies on pairwise comparisons to determine the relative importance of criteria. While effective for

structuring decision problems hierarchically, AHP becomes increasingly complex and resource-intensive when dealing with a large number of alternatives [44].

- DEMATEL (Decision-Making Trial and Evaluation Laboratory) is a methodology designed to identify cause-effect relationships between decision criteria. It is particularly valuable for analyzing the interdependencies of factors in complex decision-making scenarios but less suited for directly ranking alternatives [45].
- ELECTRE (Elimination and Choice Expressing Reality) is a technique that filters out alternatives that fail to meet predefined essential criteria. Although effective in eliminating unsuitable options, it does not offer a structured ranking of alternatives based on their overall performance [46].
- TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) is a ranking model that assesses alternatives based on their proximity to an ideal solution while also considering their distance from the least favorable option. This method provides an objective and easily interpretable classification, making it highly applicable in contexts requiring clear and actionable results [47].

Among these, the TOPSIS model was chosen for the study due to its practical advantages in economic and strategic decision-making because it was considered that this method is intuitive, does not require extensive pairwise comparisons like AHP, and directly ranks alternatives, making it a suitable tool for prioritizing tourism development strategies.

Its effectiveness has been demonstrated in various domains, ranging from human resource management [48] and investment risk assessment [49] to optimizing public sector funding allocation. In the tourism industry, TOPSIS has been applied in evaluating destination competitiveness, ranking accommodation facilities, and determining infrastructure investment priorities [50]. For instance, in Poland, it has been employed to classify cities based on their touristic appeal [51], while in China, it has facilitated the identification of high-impact investment areas for rural tourism growth [52].

The research proposes the employment of TOPSIS as a decision-making model to evaluate and rank agritourism development alternatives in a structured and data-driven manner. By incorporating quantifiable indicators and well-defined evaluation criteria, this methodology ensures objectivity and comparability in assessing various strategies. Unlike traditional qualitative analyses, which often rely on subjective assessments, TOPSIS provides a systematic and transparent framework, making it easier to identify the most effective solutions based on their economic, social, and environmental relevance.

At the same time, the study contributes to the existing body of knowledge by offering a replicable analytical approach tailored to Romania's agritourism sector. Instead of being guided solely by broad market trends or expert opinions, the study introduces a method that quantifies key decision factors, ensuring that strategic planning is grounded in empirical evidence. The findings are designed to serve as a decision-support tool for policymakers, private investors, and local stakeholders, enabling them to allocate resources efficiently and promote sustainable rural tourism development.

Furthermore, for the northwest region of Romania, applying TOPSIS will facilitate the ranking of agritourism development options based on measurable performance indicators, providing an analytical foundation for informed and strategic decision-making. By reducing the risk of inefficient investments and subjective biases, this approach has the potential to provide a more balanced, long-term, and sustainable expansion of rural tourism in the region.

3. Materials and Methods

3.1. Study Area: The North-West Region of Romania and Its Agritourism Potential

The North-West region of Romania, which includes the counties of Maramureş, Bihor, Bistriţa-Năsăud, Cluj, and Sălaj, presents significant potential for agritourism development [53], potential that stems from a combination of picturesque mountain landscapes, well-preserved cultural traditions, and a rural economy still largely dependent on agriculture. Despite these advantages, the region also faces structural barriers, such as insufficient infrastructure, accessibility limitations in certain areas, and a lack of comprehensive tourism integration within the regional economic strategy.

Maramureş stands out as a key destination for rural tourism, largely due to its traditional wooden architecture, craftsmanship, and distinctive cultural heritage [54]. However, tourism development is concentrated around a few high-profile attractions, including the Mocăniţa steam train on the Vaser Valley and the Merry Cemetery (Cimitirul Vesel) in Săpânţa. As a result, other areas with significant agritourism potential remain underexploited, leading to resource pressures in overcrowded areas while limiting the economic benefits for the broader region.

Bihor boasts a diverse tourism landscape, with renowned spa resorts (e.g., Băile Felix, Băile 1 Mai) and extensive mountain trails in the Apuseni Mountains [55]. However, agritourism remains underdeveloped, largely due to the lack of integration between tourism services and the local economy. While wellness and adventure tourism have flourished, rural tourism has not received the same level of strategic support, leaving many communities without direct economic benefits from tourism-related activities.

Cluj and Bistriţa-Năsăud benefit from better-developed infrastructure and their proximity to major urban centers, which facilitates steady tourist flows. However, despite these logistical advantages, agritourism remains in an early stage, with few structured initiatives leveraging the region's natural landscapes, culinary heritage, and traditional crafts [56].

Finally, Sălaj, though characterized by a strong cultural identity, has struggled to position itself as a notable agritourism destination of the analyzed region. The limited promotion of its rural assets, linked with insufficient investment in infrastructure, has restricted its ability to attract visitors and integrate tourism into its economic framework [57].

These disparities in agritourism development across counties emphasize the need for a comparative assessment based on objective criteria, which is why identifying priority areas for investment and implementing a regionally coordinated strategy could maximize local resource utilization while enhancing the region's competitiveness within both Romania and the broader Central European market.

Given these dynamics, a multi-criteria decision analysis model such as TOPSIS offers a valuable tool for ranking strategic development alternatives and optimizing decision-making in agritourism. The North-West region of Romania is uniquely positioned to expand its agritourism sector, yet its development remains fragmented, influenced by factors such as infrastructure quality, accessibility, marketing efforts, and local economic integration.

To provide a clearer perspective on each county's agritourism potential and challenges, the following table outlines their strengths and weaknesses, offering a comparative framework for identifying development opportunities in the region (see Table 1).

The comparative assessment of the counties in Romania's North-West region highlights significant variations in agritourism development. While each county benefits from distinct natural and cultural resources, disparities in infrastructure quality, promotional efforts, and integration within the local economy influence both the attractiveness and long-term viability of this sector. We consider that addressing these imbalances requires a well-structured development strategy that prioritizes targeted investments, infrastructure

modernization, and enhanced visibility of agritourism offerings. By adopting a more cohesive and regionally coordinated approach, stakeholders can maximize the economic potential of agritourism while ensuring its sustainability and competitiveness in the broader tourism market.

Table 1. Comparative analysis of agritourism potential in the counties of Romania’s North-West Region.

County	Strengths	Weaknesses
Maramureş	Authentic cultural heritage, traditional crafts, attractive mountain landscapes, well-known tourist attractions (Mocăniţa steam train, Cimitirul Vesel)	Uneven tourism development, overcrowding in certain areas, limited accessibility in some mountain regions
Bihor	Tourism diversity (spa resorts, mountain tourism), relatively well-developed infrastructure, better accessibility	Weak integration of rural tourism into the local economy, insufficient promotion of agritourism
Bistriţa-Năsăud	Decent road infrastructure, well-preserved local traditions, proximity to attractive mountain areas	Underdeveloped agritourism sector, lack of coordinated initiatives, modest promotion efforts
Cluj	Major economic center, well-developed infrastructure, good connectivity with other regions, complementary urban tourism	Rural tourism is still in its early stages, predominantly urban-focused development, and lacks a clear agritourism strategy
Sălaj	Distinct cultural identity, underutilized natural resources, potential for niche tourism development	Lack of promotion, poor tourism infrastructure, low investment in the agritourism sector

Source: authors processing based on the bibliographic data [54–57].

3.2. Selection of the Alternatives and the Criteria of the Decision Analysis

Identifying the most effective agritourism development strategies for Romania’s North-West region required a structured and methodologically rigorous approach. The selection of alternatives and evaluation criteria was based on a comprehensive multi-step process that integrated documentary research, expert consultations, and an in-depth analysis of tourism market trends. These methodological components ensured that the decision-making framework was data-driven, aligned with industry realities, and reflective of regional specificities.

To achieve a balanced and well-substantiated selection of alternatives, several critical factors were considered:

- Existing research on rural tourism in Romania and Europe, including comparative studies on agritourism models implemented in countries with similar geographic and economic conditions. The literature provided valuable insights into best practices and common challenges in agritourism development [58,59].
- Assessment of tourist preferences and demand patterns, collected from regional tourism reports and statistical data, to identify trends in visitor expectations and behavioral shifts. This analysis helped pinpoint high-demand agritourism experiences most relevant to the region [60,61].
- Direct consultations with local stakeholders, including public authorities, tourism entrepreneurs, local producers, and rural community representatives. These interviews and focus groups provided first-hand perspectives on economic feasibility, market opportunities, and challenges related to agritourism development [62–64].
- Economic feasibility and long-term sustainability considerations, ensuring that the selected alternatives are financially viable, environmentally responsible, and capable of generating stable income streams for local communities [65,66].

Following these guiding principles, five core agritourism development alternatives were selected, each representing a strategic investment pathway tailored to maximize the region's tourism potential and ensure economic sustainability:

A1: Development of rural guesthouses—Investing in rural accommodations remains a fundamental pillar of agritourism growth. The rising demand for authentic lodging experiences makes this alternative highly attractive, as it generates direct income for rural households and creates employment opportunities within local communities. Drawing from successful European models, where rural accommodations serve as anchors for sustainable tourism, this strategy strengthens the economic resilience of rural areas while preserving cultural authenticity [67,68].

A2: Promotion of local products in tourism—Integrating regional agro-food products, such as artisan cheeses, honey, and handcrafted goods, into the tourism experience is a proven method for boosting rural economies. This alternative diversifies income sources for local producers while enhancing the visitor experience through cultural and gastronomic immersion. As consumer preferences increasingly shift toward authentic, locally sourced products, this approach creates a distinct competitive advantage for the region [69–71].

A3: Implementation of ecotourism routes—Developing thematic hiking, cycling, and nature exploration trails aligns with the growing demand for sustainable and active tourism. This approach leverages the region's natural beauty and biodiversity, supporting tourism growth while reducing visitor concentration in overdeveloped areas. Ecotourism not only enhances environmental sustainability but also stimulates local economies through eco-friendly tourism services [72–74].

A4: Development of integrated tourism packages—Offering bundled tourism experiences that combine accommodation, traditional gastronomy, and local activities enhances economic viability by encouraging longer visitor stays. This model has been successfully implemented in mature tourism markets and is particularly effective in generating steady income flows and boosting regional competitiveness [75–77].

A5: Creation of tourist information centers—One of the main obstacles to rural tourism expansion is the lack of accessible and structured visitor information. Establishing regional information centers can improve tourism coordination and marketing, helping visitors discover lesser-known agritourism attractions. These centers strengthen visitor engagement and serve as a bridge between tourists and local businesses [78–81].

Each of these development alternatives presents a strategic pathway for maximizing agritourism's economic impact in Romania's North-West region, ensuring that investments align with long-term sustainability goals.

3.2.1. Representation of Respondents Across Counties

To further substantiate the selection of agritourism development alternatives, the study included data from respondents across the five counties that comprise the North-West region of Romania. The distribution was as follows: Bihor—28.43% of respondents; Bistrița-Năsăud—25.49% of respondents; Maramureș—24.51% of respondents; Sălaj—15.69% of respondents; Cluj—5.88% of respondents. The high representation of Bihor, Bistrița-Năsăud, and Maramureș in the survey aligns with these counties' strong agritourism traditions and active tourism sectors. In contrast, Sălaj and Cluj had lower response rates, which may reflect underdeveloped agritourism infrastructure or lower industry engagement. However, their inclusion ensures that the analysis remains regionally comprehensive, capturing a broad spectrum of agritourism development levels.

3.2.2. Evaluation Criteria for Agritourism Initiatives

The assessment of agritourism development alternatives required a structured evaluation process, considering key factors that influence investment feasibility and long-term success. As a result, the following dimensions were used as essential evaluation criteria:

C1: Infrastructure accessibility—the degree to which a region is easily reachable plays a critical role in attracting visitors and facilitating business growth. Developed road networks, public transportation access, and essential utilities are fundamental for enhancing agritourism investments, as limited connectivity hinders tourism expansion [82–84].

C2: Diversity of tourism offers—a varied tourism portfolio increases a destination’s attractiveness by catering to different traveler preferences. A balanced mix of nature-based activities, cultural experiences, and gastronomic tourism enhances a region’s market positioning and mitigates seasonality challenges [85–87].

C3: Quality of tourism services—a positive visitor experience depends on high service standards across accommodation, hospitality, and local products. Investing in service excellence fosters tourist satisfaction, repeat visits, and long-term economic stability [88–90].

C4: Economic sustainability—ensuring that agritourism remains profitable is crucial for both investors and rural communities. A self-sustaining tourism sector generates stable benefits by stimulating local economies, creating jobs, and attracting further investment [91–94].

By applying these evaluation criteria in conjunction with the TOPSIS method, a data-driven framework is established for prioritizing agritourism investments. The structured, quantitative approach minimizes subjectivity, enhances strategic planning, and reduces the risk of inefficient resource allocation. Ultimately, the findings support the formulation of a sustainable agritourism development strategy for Romania’s North-West region, ensuring long-term competitiveness and economic resilience.

3.3. Research Design

3.3.1. Demographic Analysis of Respondents

Ensuring a comprehensive and representative dataset, the study utilized a sample of 102 respondents, carefully selected to reflect the diverse range of stakeholders actively engaged in agritourism development. The selection process followed predefined criteria, prioritizing professional experience and level of involvement in rural tourism to ensure a balanced and multi-perspective analysis of both opportunities and constraints within the sector.

The composition of respondents was structured to include key actors shaping the agritourism landscape. Rural guesthouse owners (40%) were surveyed to provide insights on profitability, market demand, and operational challenges. Farmers and local producers (25%) contributed perspectives on integrating local products into tourism services and enhancing rural value chains. Visitors and tourists (20%) were included to capture consumer preferences and key factors influencing travel decisions. Meanwhile, local government representatives (15%) provided viewpoints on policy frameworks, public investments, and tourism-supportive infrastructure development.

A geographical balance across the North-West region of Romania was ensured by distributing responses proportionally across Bihor (28.43%), Bistrița-Năsăud (25.49%), Maramureș (24.51%), Sălaj (15.69%), and Cluj (5.88%). This allocation reflects the varied levels of agritourism development across the counties, ensuring the study captured insights from both established and emerging agritourism destinations. While counties like Bihor and Maramureș have a strong tradition in rural tourism, Cluj and Sălaj are at different stages of sectoral expansion, allowing for a comparative analysis of regional disparities and potential growth trajectories.

To ensure efficient data collection and minimize external biases, the survey was administered online using a structured digital questionnaire. This method facilitated broad accessibility and allowed respondents to complete the survey at their convenience while reducing potential interviewer influence. The survey was distributed through professional agritourism networks, local business associations, and tourism development organizations, ensuring that targeted respondents actively involved in agritourism participated. Additionally, personalized email invitations were sent to selected stakeholders, supplemented by weekly reminder notifications to enhance response rates. The survey remained open for four weeks, ensuring that participants had adequate time to provide well-informed responses.

3.3.2. Questionnaire Development and Validation

A well-structured and methodologically robust questionnaire was designed to ensure clarity, conciseness, and ease of completion, while simultaneously capturing in-depth insights from stakeholders. To prevent ambiguities and respondent fatigue, particular attention was given to formulating and sequencing questions, ensuring that the survey maximized engagement and data accuracy. The data collection took place in 2024, ensuring that the insights gathered accurately reflect the current state of agritourism in Romania's North-West region.

The questionnaire was divided into three core sections, each targeting a specific dimension of agritourism development. The first section focused on demographic information, collecting key respondent characteristics such as gender, age, county of residence, occupation, and tourism-related experience. This segmentation allowed for a deeper interpretation of stakeholder perspectives based on socio-professional backgrounds.

The second section involved the assessment of agritourism development alternatives, requiring participants to evaluate five proposed strategies: rural guesthouses, local product promotion, ecotourism routes, integrated tourism packages, and tourist information centers. Each alternative was rated on a scale from 1 to 10, with four decision-making criteria forming the basis of evaluation: infrastructure accessibility, diversity of tourism offers, service quality, and economic sustainability. This structured rating system allowed for objective comparisons and provided empirical backing for alternative prioritization.

The third section focused on weighting the importance of decision criteria, where respondents ranked the four key factors based on their perceived influence in investment and policy formulation for agritourism development. Using an ordinal scale, this step ensured that the final rankings accounted for stakeholder priorities and sector-specific realities.

To enhance the validity and reliability of the questionnaire, a pilot study was conducted before full-scale distribution. A small yet diverse group of stakeholders, including representatives from each respondent category, participated in this preliminary phase. The pilot study helped identify inconsistencies, assess question clarity, and refine survey wording to eliminate misinterpretations. Based on the feedback received, minor structural and wording adjustments were made to optimize data collection and ensure that the final instrument was well-calibrated for empirical analysis.

By employing a structured, multi-phase approach to questionnaire design and administration, the study minimized response bias, strengthened data accuracy, and ensured a holistic representation of agritourism stakeholders across the North-West region. The methodology also reinforced alignment between survey findings and real-world agritourism challenges, providing a robust foundation for strategic decision-making in rural tourism development.

3.4. The TOPSIS Model: Foundations, Application Procedures, and Statistical Tools Applied

This approach allowed us to objectively rank alternatives by assessing their proximity to an ideal solution while measuring their divergence from the least favorable option. One key advantage of TOPSIS is its ability to introduce transparency and reduce subjectivity, which is relevant in investment and policy decisions within agritourism. To ensure a data-driven evaluation, a structured questionnaire survey and the responses using statistical techniques. By calculating arithmetic means for each alternative, we established a solid quantitative basis for ranking. The implementation followed a standardized six-step methodology, ensuring both reliability and consistency in the findings.

Using a structured model like TOPSIS is essential in agritourism, where decisions must balance economic, environmental, and social considerations. Without such an objective framework, investment choices risk being influenced by short-term market trends rather than long-term sustainability.

The present study highlights the importance of data-driven decision-making in fostering sustainable agritourism development. The application of TOPSIS followed a standardized six-step methodology, ensuring the consistency and reliability of the results:

1. Decision matrix construction: raw data from the questionnaire were structured into a decision matrix, where each row corresponded to an agritourism development alternative, and each column represented an evaluation criterion. This organization of data ensured that all key variables were systematically included for comparative analysis.
2. Normalization of data: given that the selected evaluation criteria used different measurement scales (e.g., rating scores, economic impact values), the dataset was normalized to establish comparability across all factors to eliminate potential distortions in the ranking process.
3. Assignment of weightings to criteria: to reflect the relative importance of each evaluation criterion, weight values were assigned based on survey responses. By incorporating stakeholder priorities, this step ensured that the ranking aligned with real-world market dynamics and policy considerations.
4. Identification of ideal and anti-ideal solutions: the best-performing values for each criterion (ideal solution) and the least favorable values (anti-ideal solution) were determined, an important step in establishing benchmarks, allowing for a more precise comparison of each alternative.
5. Calculation of distances to benchmark solutions: using a Euclidean distance formula, the proximity of each alternative to the ideal solution and its divergence from the anti-ideal solution was computed, and the closer an alternative was to the ideal reference point and the farther it was from the least desirable option, the higher its relative performance score.
6. Computation of the TOPSIS Performance Coefficient (C_i): based on the calculated distances, a performance index (C_i) was assigned to each alternative. This final step allowed for the ranking of agritourism development strategies based on their quantitative viability. Alternatives with higher C_i scores were deemed more suitable for investment and policy implementation, while those with lower scores indicated areas requiring further development or strategic adjustments.

By adopting this methodologically rigorous approach, we can affirm that the study offers a structured decision-making framework for agritourism development as long as the use of TOPSIS enables evidence-based prioritization, facilitating more effective resource allocation, strategic investment planning, and sustainable policy implementation.

4. Results

4.1. Descriptive Analysis of Collected Data

A thorough demographic analysis of respondents is mandatory for capturing stakeholder perspectives on agritourism development in Romania's North-West region. By examining factors such as county of origin, professional background, tourism experience, gender, and age, significant trends that influence rural tourism can be identified. These insights provide a foundation for designing targeted policies that align with regional needs and support sustainable agritourism growth.

The data reveal a high concentration of respondents in Bihor (28.43%), Bistrița-Năsăud (25.49%), and Maramureș (24.51%), highlighting strong regional engagement in agritourism. In contrast, Sălaj (15.69%) and Cluj (5.88%) had lower participation, potentially reflecting slower rural tourism growth. These disparities indicate the need for region-specific development efforts. Regarding their professional roles, farmers (21.57%) and local government representatives (19.61%) emerged as the most engaged, emphasizing the role of agriculture and public policy in agritourism. Meanwhile, guesthouse owners (17.65%) and tourists (17.65%) provide insights into market demand and business operations, while diverse stakeholders (23.53%) contribute additional perspectives. The strong presence of farmers reinforces the link between local production and tourism, while government involvement signals institutional interest in the sector. Tourism experience levels vary, with 60.78% having prior experience in mountain tourism and 39.22% being new to the field. This suggests both a knowledgeable respondent base and a growing interest in agritourism investments. Gender distribution is relatively balanced (52.94% male, 47.06% female), reflecting equal access to agritourism opportunities despite male dominance in farming and governance roles, while the age analysis shows strong engagement from younger generations, with 31.37% aged 25–34 and 21.57% under 25, highlighting rural tourism's appeal to younger travelers and entrepreneurs. Meanwhile, older respondents (35–55+) remain active, presenting opportunities for investment and experience-driven contributions. To enhance comparability, the obtained data were structured into a table, facilitating regional analysis, stakeholder insights, and demographic trends, providing a data-driven foundation for agritourism strategy development (see Table 2).

The demographic profile of respondents provides valuable insights into the stakeholders shaping rural tourism development in Romania's North-West region. The high engagement from counties with strong mountain tourism traditions suggests regional interest in sector growth, while the notable presence of farmers and local government representatives highlights the importance of public-private collaboration. With most respondents having experience in mountain tourism, the data reflect credible industry perspectives and active involvement in its advancement. The balanced gender distribution and strong participation of younger individuals indicate growth potential, emphasizing the need for innovative promotion and policies supporting rural entrepreneurship. At the same time, the findings serve as a foundation for strategic decision-making, guiding efforts to attract investment, optimize local resources, and enhance agritourism's economic sustainability.

Table 2. Demographic analysis of respondents.

Category	Subcategory	Number of Respondents	Percentage
County	Bihor	29	28.43%
	Bistrița-Năsăud	26	25.49%
	Maramureș	25	24.51%
	Sălaj	16	15.69%
	Cluj	6	5.88%
Position in the researched sector	Farmer	22	21.57%
	Guesthouse owner	18	17.65%
	Local government representative	20	19.61%
	Tourist	18	17.65%
	Other category	24	23.53%
Experience in mountain tourism	Yes	62	60.78%
	No	40	39.22%
Gender	Male	54	52.94%
	Female	48	47.06%
Age	Under 25 years	22	21.57%
	25–34 years	32	31.37%
	35–44 years	19	18.63%
	45–54 years	17	16.67%
	Over 55 years	12	11.76%

Source: authors' elaboration based on the results of the questionnaire.

4.2. Application of the TOPSIS Model: Intermediate and Final Results

In this section, the TOPSIS method was employed to evaluate and rank the given alternatives based on specific criteria. The analysis followed a structured process, beginning with the normalization of the decision matrix to ensure comparability across varying units of measurement. Next, the weighted normalized matrix was computed, integrating the significance of each criterion into the evaluation. Following this, both the ideal and negative-ideal solutions were determined, serving as reference points for assessing the relative performance of each alternative. The calculation of distances from these benchmarks allowed for a precise measurement of how closely each alternative aligned with the optimal scenario. Finally, the relative closeness coefficient was computed, establishing a clear ranking of the alternatives in order of preference. The following subsections provide a detailed breakdown of each step, outlining the rationale behind these methodological choices and the key insights derived from the results. The application of the TOPSIS method began with the normalization of the decision matrix, a necessary step to standardize all criteria on a common scale. Given that the criteria varied in units and range, direct comparisons would have introduced bias into the analysis. Normalization eliminated these inconsistencies, ensuring a fair and objective evaluation of alternatives. In this study, four criteria and five alternatives were assessed using the TOPSIS methodology. The decision matrix, constructed based on the survey results, is presented in the following table, forming the foundation for the subsequent calculations (see Table 3).

Table 3. Normalization of the decision matrix.

	C1: Infrastructure Accessibility	C2: Diversity of Tourism Offers	C3: Quality of Tourism Services	C4: Economic Sustainability
A1: Development of rural guesthouses	5.273	5.254	5.367	5.877
A2: Promotion of local products in tourism	5.283	5.462	5.858	5.386
A3: Implementation of ecotourism routes	5.556	5.698	5.65	5.528
A4: Development of integrated tourism packages	5.311	5.254	4.943	5.915
A5: Creation of tourist information centers	5.311	5.509	5.113	5.641

Source: authors' elaboration based on the results of the questionnaire.

The normalization formula applied in this study transformed the raw data into a standardized format, ensuring that all criteria were evaluated on a common scale. This step was essential for maintaining fairness in the comparison process, as it prevented any single criterion from disproportionately influencing the results due to differences in measurement units or magnitude. By normalizing the data, a clearer representation of how each alternative performed relative to the others across all criteria was achieved (see Table 4).

Table 4. The normalized matrix.

Alternatives	C1: Infrastructure Accessibility	C2: Diversity of Tourism Offers	C3: Quality of Tourism Services	C4: Economic Sustainability
A1: Development of rural guesthouses	0.441	0.432	0.445	0.463
A2: Promotion of local products in tourism	0.442	0.449	0.485	0.425
A3: Implementation of ecotourism routes	0.465	0.469	0.468	0.436
A4: Development of integrated tourism packages	0.444	0.432	0.41	0.466
A5: Creation of tourist information centers	0.444	0.453	0.424	0.445

Source: authors' elaboration based on the TOPSIS software computation (<https://onlineoutput.com/topsis-software/>), accessed on 21 January 2025).

To achieve this, we used the following normalization formula:

$$r_{ij}(x) = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}} \quad i = 1, \dots, m \quad ; j = 1, \dots, n$$

4.2.1. Weighted Normalized Decision Matrix

After normalizing the decision matrix, weighting was employed in order to reflect the relative importance of each criterion in the evaluation process. Since all criteria in this study were considered equally significant, each was assigned a weight of 0.25. To incorporate these weights, each value in the normalized matrix by the corresponding criterion weight.

This step ensured that the ranking process accounted not only for the relative performance of alternatives but also for the predefined importance of each criterion. The weighted normalized decision matrix was calculated using the following formula:

$$v_{ij}(x) = w_j r_{ij}(x) \quad i = 1, \dots, m \ ; j = 1, \dots, n$$

After completing the normalization process, the next step was to apply weights to the normalized decision matrix. These weights represented the relative importance of each criterion in the decision-making process, ensuring that the final rankings accurately reflected their significance. In this study, all criteria were assigned equal importance, with a weight of 0.25 each.

By multiplying the normalized values by their respective weights, the weighted normalized decision matrix was obtained. This transformation allowed us to integrate both the raw performance of each alternative and the assigned importance of the criteria, and the weighted matrix served as the foundation for the next steps, where it was identified the ideal and negative-ideal solutions and calculated the distances of each alternative from these benchmarks (see Table 5).

Table 5. The weighted normalized matrix.

Alternatives	C1: Infrastructure Accessibility	C2: Diversity of Tourism Offers	C3: Quality of Tourism Services	C4: Economic Sustainability
A1: Development of rural guesthouses	0.11	0.108	0.111	0.116
A2: Promotion of local products in tourism	0.11	0.112	0.121	0.106
A3: Implementation of ecotourism routes	0.116	0.117	0.117	0.109
A4: Development of integrated tourism packages	0.111	0.108	0.102	0.117
A5: Creation of tourist information centers	0.111	0.113	0.106	0.111

Source: authors' elaboration based on the TOPSIS software computation (<https://onlineoutput.com/topsis-software/>, accessed on 21 January 2025).

4.2.2. Determination of Positive and Negative Ideal Solutions

In this step, the positive ideal solution (PIS) and negative ideal solution (NIS) were used to measure how close each alternative was to the best and worst possible outcomes. The PIS represents the most favorable values for each criterion, while the NIS reflects the least desirable ones. These benchmarks were determined using the following formulas:

$$A^+ = (v_1^+, v_2^+, \dots, v_n^+)$$

$$A^- = (v_1^-, v_2^-, \dots, v_n^-)$$

So that

$$v_j^+ = \{ (\max v_{ij}(x) | j \in j_1), (\min v_{ij}(x) | j \in j_2) \} \quad i = 1, \dots, m$$

$$v_j^- = \{ (\min v_{ij}(x) | j \in j_1), (\max v_{ij}(x) | j \in j_2) \} \quad i = 1, \dots, m$$

where j_1 and j_2 denote the negative and positive criteria, respectively.

The TOPSIS method evaluates alternatives by comparing them to ideal benchmarks. The positive ideal solution (PIS) represents the best possible performance across all criteria, while the negative ideal solution (NIS) reflects the worst. These are identified by selecting the maximum and minimum values for each criterion in the weighted normalized matrix. Serving as reference points, these solutions help measure how close each alternative is to the optimal or least favorable outcome (see Table 6).

Table 6. Positive and negative ideal solutions.

Criteria	Positive Ideal	Negative Ideal
C1: Infrastructure accessibility	0.116	0.11
C2: Diversity of tourism offers	0.117	0.108
C3: Quality of tourism services	0.121	0.102
C4: Economic sustainability	0.117	0.106

Source: authors' elaboration based on the TOPSIS software computation (<https://onlineoutput.com/topsis-software/>, accessed on 21 January 2025).

4.2.3. Distance from Positive and Negative Ideal Solutions

After determining the ideal solutions, further work was made on the Euclidean distance of each alternative from both the positive ideal solution (PIS) and the negative ideal solution (NIS). The distance to the PIS reflects how close an alternative is to the best possible performance, while the distance to the NIS indicates how far it is from the worst-case scenario. These distances were computed using the following formulas:

$$d_i^+ = \sqrt{\sum_{j=1}^n [v_{ij}(x) - v_j^+(x)]^2}, i = 1, \dots, m$$

$$d_i^- = \sqrt{\sum_{j=1}^n [v_{ij}(x) - v_j^-(x)]^2}, i = 1, \dots, m$$

These distances play a key role in determining the relative closeness degree, which ultimately ranks the alternatives. A shorter distance to the positive ideal solution (PIS) and a greater distance from the negative ideal solution (NIS) indicate a stronger overall performance. This relative closeness measure serves as the basis for the final ranking of alternatives (see Table 7).

Table 7. Distance to positive and negative ideal points.

Alternatives	Distance to Positive Ideal	Distance to Negative Ideal
A1: Development of rural guesthouses	0.015	0.013
A2: Promotion of local products in tourism	0.013	0.019
A3: Implementation of ecotourism routes	0.009	0.018
A4: Development of integrated tourism packages	0.022	0.01
A5: Creation of tourist information centers	0.018	0.008

Source: authors' elaboration based on the TOPSIS software computation (<https://onlineoutput.com/topsis-software/>, accessed on 21 January 2025).

4.2.4. Relative Closeness Degree and Ranking of Alternatives

The final step in the TOPSIS method was calculating the relative closeness degree (Ci) for each alternative. This value measured how close an alternative was to the positive ideal solution (PIS) relative to its distance from the negative ideal solution (NIS). A higher Ci

indicated stronger performance, with 1 being the optimal score. Based on these values, the alternatives were ranked accordingly.

$$C_i = \frac{d_i^-}{(d_i^+ + d_i^-)}, \quad i = 1, \dots, m$$

Based on the C_i values, the alternatives were ranked, offering a clear and objective prioritization of options for agrotourism development. This ranking helped identify the most favorable choices, ensuring that decisions were guided by a systematic and data-driven approach (see Table 8).

Table 8. The C_i value and ranking.

Alternatives	C_i	Rank
A1: Development of rural guesthouses	0.467	3
A2: Promotion of local products in tourism	0.602	2
A3: Implementation of ecotourism routes	0.678	1
A4: Development of integrated tourism packages	0.326	4
A5: Creation of tourist information centers	0.316	5

Source: authors' elaboration based on the TOPSIS software computation (<https://onlineoutput.com/topsis-software/>, accessed on 21 January 2025).

4.3. Identification and Prioritization of Agrotourism Development Priorities

In this section of the study, we analyzed the findings of the TOPSIS evaluation to identify and prioritize the most feasible strategies for agritourism development. By ranking the available alternatives, critical insights into which options best meet essential criteria, such as accessibility to infrastructure, the variety of tourism experiences, service quality, and long-term economic sustainability. Understanding these rankings allows us to assess which alternatives hold the greatest potential for fostering sustainable growth in rural tourism. At the same time, to provide a deeper perspective, we focus on the highest-ranked alternatives, examining their key advantages and potential challenges. This approach enables us to evaluate their broader impact on the agritourism sector and determine how they can contribute to regional development, while the findings offer valuable guidance for policymakers and stakeholders looking to implement well-informed, data-driven strategies that support both local economies and sustainable tourism practices.

4.3.1. Ranking of Alternatives Based on TOPSIS Results

By applying the TOPSIS method, we were able to evaluate and rank the alternatives based on their relative closeness degree (C_i) to identify the most effective strategies for agritourism development. This ranking offers critical insights into which initiatives best align with key evaluation criteria and demonstrate the highest potential for success. The top-ranked alternative emerges as the most viable option, whereas lower-ranked ones may need further adjustments, strategic refinement, or additional support to maximize their effectiveness and long-term impact.

Alternative 3: Implementation of ecotourism routes ($C_i = 0.678$)—this alternative emerged as the most promising option, highlighting the growing demand for sustainable and nature-based tourism experiences.

Alternative 2: Promotion of local products in tourism ($C_i = 0.602$)—the second most important alternative is a strong contender, emphasizing the importance of integrating local heritage into the visitor experience.

Alternative 1: Development of rural guesthouses ($C_i = 0.467$)—this alternative represents a valuable option that supports community-based tourism but may require improvements in infrastructure and service quality.

Alternative 4: Development of integrated tourism packages ($C_i = 0.326$)—it is a strategic approach that could enhance visitor engagement but needs further refinement to increase its viability.

Alternative 5: Creation of tourist information centers ($C_i = 0.316$)—while useful, this alternative ranked lower, suggesting that standalone information centers may be less impactful without complementary initiatives.

4.3.2. Analysis of the Top-Ranked Alternatives

Following the analysis, we examined the strengths of the alternatives across key criteria: infrastructure accessibility, diversity of tourism offerings, quality of services, and economic sustainability, gaining valuable insights into their potential for agrotourism development and their impact on the local economy. The highest-ranked alternative, the implementation of ecotourism routes (Alternative 3), proved to be the most promising option, having the shortest distance from the positive ideal solution and the greatest distance from the negative ideal solution, indicating a strong alignment with the best conditions for agrotourism growth. This suggested that ecotourism routes had significant potential to attract nature-conscious travelers, promote sustainable tourism, and preserve the local environment, while also enhancing visitor experiences. Ranked second, the promotion of local products in tourism (Alternative 2) stood out due to its strong performance in economic sustainability and tourism service quality. By integrating locally made products into the tourism experience, this alternative supported regional businesses and traditional crafts, making the visitor experience more authentic and immersive. The results indicated that this approach helped strengthen the connection between tourism and local communities, creating opportunities for sustainable growth. The development of rural guesthouses (Alternative 1) ranked third, showing moderate potential, particularly in terms of infrastructure accessibility and variety of tourism services. Rural guesthouses played a mandatory role in accommodating visitors and offering authentic, community-based experiences, but the analysis suggested that their impact could be improved through better facilities and stronger integration within the broader tourism network (See Figure 1). These findings provided a clear understanding of the most effective strategies for agrotourism development. By focusing on these key areas, we identified pathways to build a sustainable and economically viable agrotourism sector, ensuring long-term benefits for both visitors and local communities.

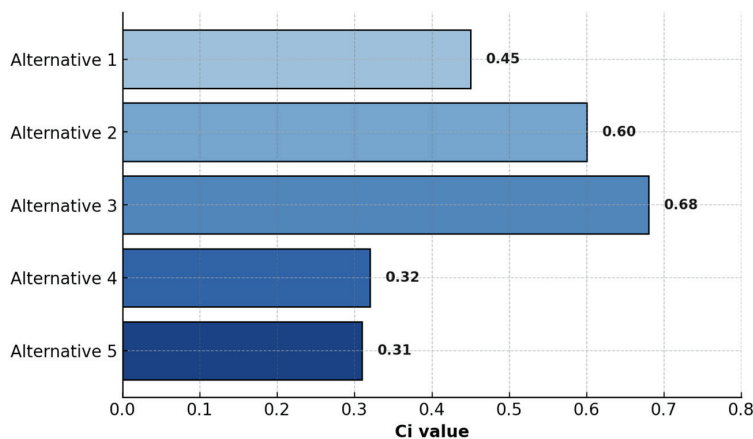


Figure 1. Top-ranked alternatives. Source: authors' elaboration, not derived or adapted from any other source.

5. Discussion

5.1. Practical Implications for Agritourism Development in Romania's North-West Region

The TOPSIS analysis identified ecotourism route implementation (Alternative 3) as the most effective strategy for advancing sustainable agritourism in Romania's North-West region, with a relative proximity coefficient of 0.678. This alternative aligns strongly with key sustainability criteria, including infrastructure accessibility, tourism offer diversity, service quality, and economic viability. Well-planned ecotourism trails not only stimulate adventure tourism but also minimize environmental degradation, ensuring that increased visitor traffic does not compromise the long-term ecological balance of rural landscapes. Compared to unsustainable agritourism practices—such as uncontrolled expansion of tourism facilities in ecologically sensitive areas—responsible ecotourism development fosters low-impact, nature-based tourism, supports local conservation efforts, and provides rural communities with long-term economic incentives to preserve their natural surroundings. The promotion of local products in tourism (Alternative 2, $C_i = 0.602$) emerged as another high-impact approach, reinforcing the integration of rural economies into sustainable tourism development. Establishing local markets, gastronomic experiences, and cultural events around traditional products not only enhances destination attractiveness but also supports small producers and artisans, fostering economic resilience in rural communities. Unlike mass tourism models that rely on imported goods and standardized services, sustainable agritourism strengthens regional identity, promotes seasonal and organic farming, and reduces the environmental footprint associated with large-scale tourism operations. The development of rural guesthouses (Alternative 1, $C_i = 0.467$) holds moderate potential for expanding accommodation capacity in underutilized rural areas. However, sustainability challenges arise when guesthouse expansion lacks proper regulatory oversight, leading to overdevelopment and loss of authenticity. To ensure that community-run lodging establishments contribute to sustainable rural tourism, investments should focus on infrastructure improvements such as transport connectivity, waste management solutions, and responsible visitor management systems.

Conversely, integrated tourism packages (Alternative 4, $C_i = 0.326$) and the creation of tourist information centers (Alternative 5, $C_i = 0.316$) ranked lower. While these initiatives enhance visitor experiences, they are not primary drivers of sustainable agritourism growth. Findings suggest that before prioritizing secondary measures, it is essential to first strengthen core tourism infrastructure and ensure the inclusion of local businesses in sustainable tourism value chains.

Incorporating these results into policy planning and investment strategies can facilitate the long-term viability of agritourism. Unlike unsustainable models, which prioritize short-term economic gains over environmental and cultural preservation, this study underscores the need for strategically structured investments, public-private partnerships, and comprehensive marketing strategies that align economic benefits with sustainability principles.

5.2. Strategic Recommendations Based on the TOPSIS Results

The findings emphasize the need for a cohesive and sustainability-focused agritourism strategy, integrating environmental conservation, economic resilience, and community engagement.

For policymakers, priority should be given to infrastructure projects that enhance accessibility to rural destinations while preserving the region's environmental integrity. This means prioritizing low-impact transportation networks, waste management systems, and zoning regulations that prevent overdevelopment. A well-balanced tourism regulatory framework should also be established to ensure visitor flows are managed sustainably, preventing the negative consequences of overtourism in sensitive ecological areas. For investors, the results highlight opportunities in ecotourism and gastronomic tourism, par-

ticularly in eco-friendly accommodations, sustainable outdoor activity centers, and local product branding. Unlike mass-market investments that often lead to resource depletion, sustainable tourism infrastructure—such as off-grid lodges, farm-to-table restaurants, and agri-experience hubs—can generate long-term returns while aligning with global sustainability trends. Partnerships between investors and local producers can enhance regional supply chains, ensuring that tourism revenues directly benefit rural communities rather than being absorbed by external stakeholders. For local communities, sustainable agritourism presents an opportunity to diversify income streams while preserving cultural traditions and natural heritage. Small-scale producers and rural entrepreneurs can capitalize on regional branding, integrating traditional markets, farm visits, and experiential tourism into a cohesive agritourism offering. Closer collaboration between farmers and tourism operators can create innovative agritourism experiences, maximizing economic impact without compromising environmental sustainability.

Based on the findings and recommendations, a multi-stakeholder approach—involving policymakers, investors, and local communities—is essential to establishing a sustainable agritourism model that balances economic growth with responsible resource management. Unlike conventional tourism approaches, which often prioritize short-term profit over long-term viability, sustainable agritourism ensures that rural development is both economically viable and environmentally responsible, securing long-term benefits for all involved stakeholders.

5.3. Theoretical Implications and Alignment with International Research

The findings of the study contribute to the broader academic discourse on sustainable agritourism development, aligning with international research that underscores the necessity of balancing economic growth with environmental and cultural preservation. Existing studies in European contexts, such as Austria and Italy, mentioned in the introduction of the paper, highlight the transformative role of agritourism in revitalizing rural economies through policy-driven investments in ecotourism and local production integration. Similar to these models, the results of this research reinforce that ecotourism routes and local product promotion represent the most viable development pathways in Romania's North-West region. By emphasizing nature-based tourism and strengthening rural supply chains, these approaches align with established best practices observed in sustainable tourism models across Europe.

Furthermore, international studies on agritourism in North America and Australia suggest that guesthouse development can significantly contribute to rural economic sustainability, provided that regulatory frameworks prevent overdevelopment and environmental degradation [95–99]. This study confirms the findings by demonstrating that, while rural guesthouses have moderate potential for tourism expansion in Romania, their long-term success hinges on infrastructure investments and sustainable visitor management policies. Without these structural interventions, unchecked expansion could lead to loss of authenticity and increased strain on local resources, mirroring the challenges documented in other tourism-dependent rural regions. The findings also relate to research from emerging agritourism markets, such as China, where government-supported tourism information centers and integrated tourism packages have been positioned as key facilitators of sectoral growth [98]. However, in contrast to these contexts, this study found that in Romania's North-West region, these initiatives have lower immediate impact, suggesting that a more fundamental investment in core agritourism infrastructure is necessary before such secondary measures can drive meaningful growth. This distinction highlights the importance of adapting international strategies to local economic conditions and development stages.

By situating these results within the global body of agritourism literature, this research strengthens the theoretical understanding of sustainable agritourism as a multi-dimensional process, dependent on strategic prioritization of investment, policy support, and responsible tourism planning. The findings reinforce the applicability of multi-criteria decision-making tools such as TOPSIS, which was successfully used in this research, in structuring tourism development strategies, further supporting international research advocating for data-driven, sustainability-focused approaches in rural tourism planning.

6. Conclusions

The study applied the TOPSIS methodology to assess and rank agritourism development strategies in Romania's North-West region, providing a structured, data-driven prioritization of alternatives. Findings indicate that the implementation of ecotourism routes represents the most viable and impactful strategy ($C_i = 0.678$), highlighting the region's natural resources and existing infrastructure as strong enablers of sustainable tourism expansion. Beyond environmental conservation, this approach has the potential to stimulate local economic growth, increase sustainable tourist inflows, and enhance rural community resilience. The second-ranked alternative, promoting local products in tourism ($C_i = 0.602$), reinforces the importance of integrating local economies into the tourism sector. The findings suggest that emphasizing regional products, including traditional foods and handicrafts, not only supports local producers but also strengthens cultural identity, positioning tourism as a driver of community-based economic development. Strengthening the connection between tourism and small businesses creates opportunities for sustainable economic diversification and enhances market access for rural producers. The development of rural guesthouses ($C_i = 0.467$) demonstrates moderate potential for expanding accommodation capacity, though its success depends on strategic infrastructure investments, particularly in road access and complementary tourism services. Without these enhancements, expanding accommodation alone may not significantly improve visitor attraction. Lower-ranked alternatives, such as integrated tourism packages ($C_i = 0.326$) and tourist information centers ($C_i = 0.316$), appear to have a lower impact in the early stages of agritourism development. The results suggest that these initiatives become more effective once essential tourism infrastructure is well-established and local businesses are fully integrated into the sector.

Overall, the findings indicate that priority should be given to ecotourism route development, closely followed by promoting local products within tourism, as these strategies exhibit the highest potential for fostering sustainable agritourism and stimulating rural economic growth. However, long-term success will depend on continuous investments in infrastructure, policy support, and active community involvement, ensuring a holistic and sustainable approach to agritourism development in the region.

6.1. Contribution to Sustainable Development and Agritourism

This research contributes to sustainable development by applying a quantifiable decision-making model, offering replicable and adaptable insights for policymakers, researchers, and tourism planners. The results reinforce the strategic role of ecotourism in preserving biodiversity, reducing environmental impact, and ensuring equitable economic benefits within rural communities. The findings further emphasize the importance of balancing natural resource conservation with economic development, ensuring that tourism revenues are distributed fairly across rural areas rather than being concentrated in isolated locations.

By integrating local agriculture, diversifying tourism offerings, and implementing long-term infrastructure improvements, Romania has the opportunity to strengthen

its position in the rural tourism sector. The structured framework developed in this study provides valuable insights for decision-makers, supporting the formulation of evidence-based policies, investment strategies, and further research on sustainable rural tourism development.

6.2. Study Limitations and Future Research Directions

While the TOPSIS method provided a structured and objective ranking of sustainable agritourism development alternatives, several limitations must be acknowledged to enhance future research accuracy. One notable constraint is the equal weighting of evaluation criteria (0.25 for each factor), which may not fully reflect their relative importance in sustainable decision-making. For instance, economic sustainability might have greater significance in regions facing economic hardship, while environmental factors might be more critical in areas with high biodiversity sensitivity. Future studies could address this issue by applying dynamic weighting techniques, such as the Analytic Hierarchy Process (AHP), to refine priority rankings based on regional sustainability needs. Another limitation stems from the sample size, which, while relevant to the North-West region, may not capture wider sustainability dynamics across Romania. Expanding research to additional rural and mountainous regions could enable a comparative assessment, offering deeper insights into regional variations in agritourism sustainability. Additionally, seasonality and evolving tourism trends were not explicitly analyzed. Given that agritourism demand fluctuates across seasons, future research could integrate predictive modeling techniques to evaluate long-term sustainability and off-season tourism potential. The comparison of the TOPSIS method with alternative multi-criteria decision-making frameworks such as ELECTRE or PROMETHEE would also strengthen the methodological robustness of sustainable agritourism decision-making. Furthermore, qualitative insights—such as tourist preferences, environmental impact assessments, and perceptions of local entrepreneurs—should be incorporated to complement quantitative rankings, ensuring that sustainability recommendations reflect both empirical data and community-driven perspectives.

Although the study establishes a solid analytical foundation for sustainable agritourism development, refining methodological precision, expanding geographic scope, and integrating qualitative dimensions will enhance its practical applicability for policymakers and investors, ensuring that future agritourism initiatives are scientifically grounded and sustainability-oriented.

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Article

Tourism Development in Rural Border Territories: A “Phronetic” Approach to Threats and Opportunities

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Abstract: This study emphasises the crucial role of practical wisdom (“*phronesis*”) in the hotel industry, highlighting its impact on ethical behavior, operational reliability, and guest trust. The database was provided by the regional government in Extremadura and the national government in Portugal. Qualitative data from interviews and quantitative data managing from SEM-PLS were provided. In total, 175 rural hotels in Extremadura and Portugal have participated in this study. This study emphasises the significance of integrating ethical leadership with operational excellence to ensure sustainable tourism in rural border territories. It highlights the importance of practical wisdom (“*phronesis*”) in addressing complex ethical dilemmas while balancing cultural preservation and environmental responsibility. Key managerial practices include fostering safe spaces for ethical reflection and integrating technology with cultural sensitivity. These practices help build trust within communities and ensure long-term operational success while respecting local traditions and ecological concerns.

Keywords: “*phronesis*”; ethical leadership; challenges and opportunities; long-term sustainability; hotel management

1. Introduction

The research posits “*phronesis*”, or practical wisdom, as a crucial tool for understanding how tourist actors can address complex ethical, operational and cultural challenges. This work highlights how the integration of the “*phronesis*” with operational excellence ensures sustainability, community well-being, and environmental stewardship. Additionally, it examines how these principles contribute to building trust, enhancing guest satisfaction, and strengthening tourism businesses in border regions.

“*Phronesis*”, as Aristotle described, is practical wisdom that comes from experience and ethical reflection, enabling individuals to make decisions that promote the common good and provides a vital framework for addressing these multifaceted challenges and opportunities inherent to the practice of rural tourism in border areas [1]. Several authors have addressed this issue. Intezari et al. argue that “practical wisdom in hospitality management enables ethical decision-making that balances business objectives with community

welfare” [2]. Tomassini and Baggio show that “*phronesis*” is rooted in personal experience, moral concern, and a commitment to public well-being, challenging the traditional profit-oriented business models; the aforementioned authors demonstrate that “*phronesis*” equips managers to develop sustainable tourism strategies that honour local customs while fostering economic prosperity and organisational effectiveness [3]. Chimirri and Ren [4] highlighting how tourism actors can use phronetic research to navigate socio-political challenges, resource limitations, and cultural diversity, all factors common to the space shared by the regions that make up the Spanish–Portuguese border. Jamal [5] advocates for a virtue ethics-based approach to sustainable tourism education, where “*phronesis*” guides tourism actions and decisions; this author argues that sustainable tourism pedagogy must incorporate knowledge of ethical principles and practical experiences that cultivate virtues like compassion, fairness, and foresight. Pitman et al. [6] reinforce the approaches of Jamal [5] by demonstrating how educational tourism can serve as a platform for teaching ethics through lifelong learning, grounded in the Aristotelian concept of practical wisdom; their research reveals that ethical learning in tourism is not merely theoretical but deeply embedded in real-world experiences and interactions.

Therefore, in border regions characterised by cultural diversity, resource limitations, and socio-political challenges, the “*phronesis*” empowers tourism actors to align his strategies with community priorities, mitigating risks and capitalising the distinctive potential of borderlands [3], ensuring that local values are respected while fostering growth [7].

Unlike standardised managerial approaches, this wisdom reframes tourism management as a relational practice [5], demanding fairness and sensitivity in navigating the nuanced dynamics of these regions. Tourism managers in rural border areas often face the challenge of reconciling international visitor expectations with local cultural norms. Employing “*phronesis*”, they can thoughtfully evaluate such situations, fostering mutual respect and authenticity while addressing immediate concerns.

The integration of this virtue in resolving ethical dilemmas and maintaining operational excellence enables leaders to balance environmental conservation with economic development, handle crises effectively, and respond to guest complaints with fairness and clarity [8]. Reflective practices, such as narrative-based learning or case studies, equip both staff and management to approach these challenges with confidence [9]. Based on the case study of the regions that make up the Spanish–Portuguese border (Table 1), this is precisely the line on which this contribution is based. These territories are characterised by a peripheral position and poor communications to the main centres of economic activity in their respective countries. The main consequence of both factors has been a lower level of development for these regions. However, this handicap, which reinforces processes of emigration and population ageing, has also meant the preservation of a notable cultural, gastronomic and architectural heritage, as well as important natural spaces with different levels of protection on either side of the border. All these elements constitute first-rate tourist resources but, at the same time, face challenges related to cultural preservation, environmental responsibility, and community trust.

In the rural border territories, creating spaces for dialogue further strengthens trust and transparency, enabling stakeholders to refine decision-making and confront ethical concerns collaboratively [10]. For example, candid communication about pricing policies or the ecological impact of tourism initiatives enhances the credibility of operators while appealing to socially conscious travellers prioritising sustainability. By fostering openness and accountability, these practices transform potential risks into opportunities for stronger community relationships and guest loyalty.

Table 1. Rural hotels distributed in regions.

Portugal	Hotels	Spain	Hotels
Portugal North	285	Galicia	189
<i>Viana do Castelo</i>	90	<i>Pontevedra</i>	91
<i>Bragança</i>	110	<i>Ourense</i>	98
<i>Vila Real</i>	85		
Centro	170	Castilla y León	270
<i>Guarda</i>	95	<i>Salamanca</i>	150
<i>Castelo Branco</i>	75	<i>Zamora</i>	120
Alentejo	350	Extremadura	350
<i>Portalegre</i>	120	<i>Cáceres</i>	200
<i>Évora</i>	140	<i>Badajoz</i>	150
<i>Beja</i>	90		
Algarve	70	Andalucía	80
<i>Zona oriental</i>	70	<i>Huelva</i>	80
Total Portugal	875	Total Spain	889

Ultimately, “*phronesis*” guarantees that decisions are not only practical but deeply rooted in ethical principles, promoting cultural preservation, trust-building, and long-term resilience [11]. Embedding this virtue into their operations, tourism leaders in rural border territories can navigate challenges with foresight and compassion, ensuring sustainable success while leveraging the unique opportunities these distinctive regions provide.

The research gap which this contribution is intended to cover is based not only on literature but on the application of “*phronesis*” (practical wisdom) in rural tourism, specifically in border territories as well. While ethical leadership and operational efficiency have been widely studied in urban and corporate settings, there is limited research on their role in rural tourism businesses. Furthermore, the integration of technology in rural hospitality, respecting cultural values, and cross-border tourism initiatives remain underexplored areas.

The questions raised by this study raises are as follows: How does ethical leadership influence sustainable tourism management in rural border areas? In what ways do “*phronesis*” contribute to operational decision-making in rural tourism businesses? How do hotel managers integrate ethical reflection and decision-making into daily operations? What challenges arise in balancing technological advancements with cultural sensitivity in rural tourism? What are the key factors for successful cross-border tourism initiatives in rural territories?

Basically, the research methods employed are related to a qualitative approach based on a case study analysis. This study relies on interviews with hotel managers and case studies of rural accommodation. It examines tourism operations in the Portuguese–Spanish border, focusing on specific protected areas. The thematic analysis addresses the study categorising key themes such as ethical leadership, practical wisdom, operational efficiency, and sustainable tourism practices.

The contributions to research are both theoretical and practical. In the first one, the study deepens the understanding of ethical leadership and “*phronesis*” in rural tourism management, offering a framework that integrates ethical reflection with operational excellence. The practical contributions provide insights for tourism managers on fostering ethical decision-making, balancing technology with cultural values, and developing sustainable cross-border tourism strategies. Managerial implications are also provided. The research

emphasises creating safe spaces for ethical reflection, ensuring operational reliability, and enhancing community trust.

After this introduction, the next section goes into the theoretical framework of the research and formulates the hypotheses to be tested. The third section deals with methodological issues, defines the scope of the study, the items, and the research model based on the construct design. The fourth section shows the results of the research and, in the fifth section, these results are discussed with those offered by the existing literature. The last section offers the most relevant conclusions of the research, warns of its limitations, and shows future lines of work.

2. Literature Review and Hypotheses Development

2.1. “Phronesis” in the Development of Rural Tourism in Border Territories (PDRT)

Rural border territories, with their unique complexities, demand nuanced approaches to issues such as economic uncertainty, environmental vulnerability, and sociocultural tensions [12]. These distinctive circumstances necessitate management strategies rooted in trust-building and engagement with surrounding communities [13]. Practical wisdom empowers hoteliers to convert apparent risks into valuable opportunities by capitalising on the rich cultural diversity inherent in border regions, which provides fertile ground for authentic tourism experiences [14]. In fact, the cross-border initiatives that celebrate local traditions can create sustainable competitive advantages for rural hotels [15].

Navigating operational complexities in such territories also requires innovative solutions in workforce development. Yoopetch et al. [16] observe that training local staff represents both a challenge and an opportunity for rural hotels, while Livingston [17] emphasises the role of ethical leadership in enhancing employee retention and community advancement. The ever-changing nature of rural border areas calls for exceptional resilience within tourism enterprises, a capacity strengthened through “*phronetic*” management practices [18]. This sentiment is echoed by those who argue that ethical reflection strengthens a hotel’s capacity to navigate uncertainties while maintaining community trust [19].

By adopting “*phronesis*” as a guiding principle, hoteliers in cross-border regions can drive sustainable development that not only addresses immediate operational challenges but also supports broader socio-economic growth. Changha et al. [20] argues that hotels guided by practical wisdom become catalysts for positive social change in border regions, a notion further reinforced by Roberts [21], who concludes that ethical management practices in rural hotels contribute to long-term regional development. The integration of “*phronesis*” into tourism operations embodies a comprehensive approach that aligns commercial success with the welfare of local communities.

Achieving “*phronesis*” in the development of rural tourism in border territories relies on six interrelated variables that collectively establish a comprehensive framework for sustainable growth. These interconnected variables collectively illustrate how the integration of ethical leadership, operational excellence, and sustainability creates a robust model for rural tourism in border regions, positioning hotels as transformative agents that generate lasting benefits for local communities while addressing the unique challenges posed by these dynamic territories. Those variables were drawn from the literature review as well as a couple of focus groups in which twenty rural hotel managers participated.

Addressing Threats through Ethical Leadership (TEL) underscores the essential role of “*phronesis*” in shaping hotel management strategies within these regions, where the integration of local knowledge and sustainable practices fosters harmony between business objectives and community welfare. Transforming Challenges into Opportunities (TChO) emerges as a pivotal aspect, as adept managers harness cultural diversity and regional traditions to craft distinctive value propositions, enhancing the appeal of border tourism.

This connects seamlessly with Balancing Operational Excellence with Ethical Standards (OEES), which exemplifies the need for maintaining ethical integrity alongside operational efficiency through refined management approaches tailored to the complexities of rural territories. Furthermore, Building Resilience Through Ethical Reflection (RER) highlights the critical importance of embedding ethical considerations into everyday practices, enabling hotels to adapt effectively to external disruptions such as economic volatility or environmental crises. Within this context, Fostering Long-Term Sustainability (LTS) gains prominence, as enduring success is intrinsically linked to achieving equilibrium between economic viability and social responsibility, ensuring that both community welfare and environmental preservation remain central to operational goals.

2.2. Addressing Threats Through Ethical Leadership (TEL)

The significance of principled governance in addressing challenges within rural frontier territories' hospitality management remains fundamental for sustainable tourism advancement, whereby conscientious leadership provides essential frameworks necessary to navigate multifaceted obstacles inherent throughout cross-boundary destinations whilst maintaining communal trust and environmental integrity [8].

Furthermore, ecological threats demand particular vigilance through value-based administrative approaches, as establishment managers operating near international boundaries must implement sustainable methodologies that safeguard delicate ecosystems whilst ensuring operational viability, noting that such protective oversight proves crucial since frontier regions frequently encounter distinctive natural pressures, necessitating careful equilibrium between visitor accommodation development and preservation initiatives [22,23].

Traditional customs present additional critical dimensions where principled governance demonstrates its worth, given that prosperous establishments along borderlands depend upon administration that honours and maintains indigenous heritage whilst fostering multinational understanding [24]. Moreover, such cultural awareness becomes especially vital as conscientious directors navigate intricate social relationships, nurturing positive engagement with populations on either side of national demarcations, whilst monetary challenges require thorough examination through morally-guided administrative perspectives, wherein directors must harmonise commercial objectives with neighbourhood prosperity, guaranteeing that visitor-related developments benefit local inhabitants [25].

This consideration is especially important for rural frontier accommodations facing unique financial challenges that demand innovative yet ethical solutions. Implementing virtuous management practices not only addresses operational issues but also builds community trust. Leaders who prioritise transparency and ethical decision-making foster resilient organisations capable of overcoming various challenges [26]. This approach is essential for creating long-term solutions that benefit all stakeholders, going beyond immediate obstacles to ensure sustainability. Responsible managers must consider the broader impact of their decisions on both businesses and society, aligning risk mitigation with development goals while respecting local values. Maintaining strong ties with host communities through environmental stewardship, cultural preservation, and economic fairness creates a meaningful, lasting impact [27]. The points outlined below validate the hypothesis under consideration.

H1. *Addressing Threats through Ethical Leadership (TEL) influence "Phronesis" in the development of rural tourism in border territories (PDRT).*

2.3. *Transforming Challenges into Opportunities (TChO)*

The paramount significance of principled governance in addressing vulnerabilities within rural frontier territories hospitality management remains fundamental for sustainable tourism advancement whereby conscientious leadership provides essential frameworks necessary to navigate obstacles inherent throughout cross-boundary destinations whilst maintaining communal trust and environmental integrity [28].

Ecological challenges demand particular vigilance through value-based administrative approaches, as establishment managers operating near international boundaries must implement sustainable methodologies that safeguard delicate ecosystems whilst ensuring operational viability [29]; such protective stewardship proves crucial since frontier regions frequently encounter distinctive natural pressures, necessitating a careful equilibrium between visitor accommodation development and preservation initiatives [30].

Traditional customs present additional critical dimensions where principled governance demonstrates its worth, given that prosperous establishments along borderlands depend upon administration that honours and maintains indigenous heritage whilst fostering multinational understanding. Cultural awareness becomes especially vital when conscientious directors navigate intricate social relationships, nurturing positive engagement with populations on either side of national demarcations. This cultural sensitivity becomes particularly important as ethical leaders must navigate complex social dynamics while fostering positive relationships with communities on both sides of the border [31,32].

Monetary considerations require thorough examination through morally-guided administrative perspectives, wherein leaders must balance profit objectives with community welfare, ensuring that tourism development benefits local populations. This becomes particularly relevant as rural frontier accommodations confront distinctive fiscal obstacles requiring innovative yet ethically sound resolutions [33].

The transformative power of principled leadership in addressing these challenges extends beyond immediate obstacles towards perpetual sustainability, as conscientious administrators must evaluate broader ramifications of their decisions on both commercial enterprises and society, ensuring risk mitigation strategies align with enduring development aspirations whilst respecting regional values and customs, thereby enabling organisations to build resilience against future challenges whilst maintaining strong connections with their host communities through careful attention to environmental preservation, cultural heritage protection, and economic fairness, ultimately creating meaningful impact beyond immediate operational spheres through comprehensive strategies that effectively convert current challenges into opportunities whilst preparing for future possibilities in these unique geographical contexts. The subsequent reasoning reinforces the assumptions made in the hypotheses.

H2. *Transforming Challenges into Opportunities (TChO) influence Addressing Threats through Ethical Leadership (TEL).*

H3. *Transforming Challenges into Opportunities (TChO) influence “Phronesis” in the development of rural tourism in border territories (PDRT).*

2.4. *Balancing Operational Excellence with Ethical Standard (OEES)*

The harmonious integration of operational prowess with moral standards (OEES) remains fundamental for successful hospitality management throughout rural frontier territories, whereby this equilibrium demands careful consideration of both business efficiency and principled responsibilities, as implementation creates frameworks ensuring sustainable practices whilst maintaining integrity [34].

Countryside border establishments face unique challenges from geographic and resource limitations [35]. Hotel managers must craft innovative solutions that optimise operations while upholding ethical standards and community interests, especially when managing constrained infrastructure typical of remote boundary regions [36].

The moral dimension encompasses communal relations and environmental stewardship, whereby successful rural border hotels demonstrate that operational efficiency can be achieved while maintaining strong ethical commitments to local communities and ecosystems, requiring thorough evaluation of how administrative decisions impact neighbouring stakeholders and natural surroundings [37,38].

Personnel development represents another critical aspect where OEES demonstrates essential value, as training and development programs must balance operational needs with ethical considerations, particularly in terms of local employment and fair labour practices, proving especially relevant throughout countryside frontier zones where skilled labour might be scarce [39].

Technological advancements and modernisation must align with ethical principles, respecting indigenous values while enhancing service delivery. Schalock et al. [40] and Robina-Ramírez et al. [41] highlight the importance of continuous evaluation to meet operational and ethical goals. This approach fosters sustainability, stakeholder trust, and competitive advantages, blending excellence with moral standards to navigate rural boundary challenges and create meaningful, lasting impact. As outlined below, the hypotheses can be reasonably substantiated.

H4. *Balancing Operational Excellence with Ethical Standard (OEES) influences Transforming Challenges into Opportunities (TChO).*

H5. *Balancing Operational Excellence with Ethical Standard (OEES) influences Addressing Threats through Ethical Leadership (TEL).*

2.5. Building Resilience Through Ethical Reflection (RER)

The cultivation of organisational fortitude through principled contemplation emerges as a critical component for establishments operating throughout rural frontier territories (particularly given their distinctive vulnerabilities and challenges), whereby this methodology combines systematic evaluation of practices with moral considerations to strengthen administrative adaptability and sustainability. The foundation of such resilience lies in continuous learning and modification, as hotels in rural border regions must develop robust reflection mechanisms that enable them to anticipate and respond to challenges while maintaining ethical integrity, helping organisations build adaptive capacity whilst staying true to their values [42].

Crisis preparedness represents another crucial aspect where moral contemplation proves invaluable, noting that regular ethical reflection sessions enable hotel managers to develop comprehensive crisis response strategies that protect both business interests and stakeholder welfare, becoming particularly relevant in boundary regions where external shocks can significantly impact operations [43].

Community engagement forms an essential dimension of fortitude building, whereby ethical reflection processes must incorporate diverse stakeholder perspectives to ensure resilience strategies that address community needs, strengthening establishments' abilities to navigate complex obstacles whilst maintaining local support [44]. Personnel advancement and empowerment play vital roles in developing organisational strength, as regular ethical reflection sessions contribute to staff development and decision-making capabilities, enhancing overall organisational resilience, which proves essential for long-term sustainability through focused human capital enhancement [45]; additionally, implementation

of contemplative practices must remain systematic and ongoing, since successful hotels integrate ethical reflection into their regular operations, creating a culture of continuous improvement and adaptation [46].

The resilience built through ethical reflection enables hotels to maintain their competitive advantage while upholding their commitment to sustainable practices, thereby creating meaningful impact beyond immediate operational spheres through comprehensive strategies that effectively blend principled contemplation with organisational fortitude, ultimately preparing establishments for future possibilities within these distinctive geographical contexts [47]. The arguments presented below provide support for the hypothesis.

H6. *Building Resilience Through Ethical Reflection (RER) influences Balancing Operational Excellence with Ethical Standard (OEES).*

2.6. Fostering Long-Term Sustainability (LTS)

Fostering long-term sustainability is pivotal in addressing the intricate threats and opportunities present in rural border regions, where distinct cultural, economic, and environmental dynamics intersect. Integrating “*phronesis*” in ethical decision-making, enables hotel managers to navigate these complexities, ensuring tourism development benefits both local populations and natural ecosystems. One significant threat lies in the potential overuse of finite resources. As Aristotle articulated, the virtue of “*phronesis*” is to deliberate well about what is good and expedient for oneself and the community [48].

By adopting resource-conscious strategies, such as reducing water and energy consumption, managers can protect the delicate environments that underpin sustainable tourism. Equally challenging is the risk of cultural erosion, as poorly managed tourism risks marginalising local customs and traditions. Sustainable tourism requires active engagement with local communities to align development with their values and long-term goals [49]. Building genuine partnerships with local stakeholders ensures tourism respects cultural heritage while fostering economic opportunities [50].

Financial instability also looms as a concern, demanding a balanced approach that prioritises both immediate gains and enduring benefits. Tourism in rural regions must focus on resilience by creating diversified income streams that empower local communities [51]. Promoting regional culinary traditions and artisanal crafts not only strengthens local economies but also enhances guest experiences. Furthermore, geopolitical uncertainties, often prevalent in border territories, highlight the importance of inclusive practices. Tourism has the potential to bridge divides by fostering cultural exchange and mutual understanding [52]. Hotels can facilitate dialogue between divided communities, transforming challenges into cooperative opportunities. Resilience becomes indispensable during crises, such as pandemics or environmental catastrophes. The UNWTO [53] underscores that sustainable tourism is not only about preserving resources but also about strengthening the ability of communities to recover from shocks.

Managers exemplifying “*phronesis*” exhibit foresight and adaptability, ensuring continuity in supporting local livelihoods during disruptions. Ultimately, promoting long-term sustainability secures equitable and resilient tourism development in these regions. Aristotle emphasises “*phronesis*” is not just knowing what to do but doing it for the good of others. Through ethical leadership, reflective decision-making, and community-centric collaboration, hotels can address threats while transforming opportunities into enduring advantages. The following evidence serves to justify the proposed hypotheses.

H7. *Balancing Operational Excellence with Ethical Standard (OEES) influences Fostering Long-Term Sustainability (LTS).*

H8. *Transforming Challenges into Opportunities (TChO) influences Fostering Long-Term Sustainability (LTS).*

H9. *Fostering Long-Term Sustainability (LTS) influences “Phronesis” in the development of rural tourism in border territories (PDRT).*

3. Methodology

3.1. Data

The hotel accommodations in Extremadura refer to the range of tourism establishments in this region of Spain, aimed at providing lodging to visitors to the region [54]. These accommodations include a variety of options, ranging from luxury hotels to hostels and rural houses, catering to different types of demand based on tourists’ budgets and preferences. The Junta de Extremadura, through its public platform, manages and publishes a database with detailed information on registered accommodations in the region, facilitating access to up-to-date information on the available offer. This database aims to promote tourism and assist both travellers and sector entrepreneurs in enhancing the visibility of their services. Additionally, the publication is under a free-use license, allowing for its dissemination and reuse under certain conditions.

Table 1 shows the distribution of rural hotels across regions in Spain and Portugal. In Spain, the highest concentration is in Extremadura (350 hotels), followed by Castilla y León (270) and Andalucía (80), totalling 700 hotels. In Portugal, the regions are divided into Norte (285 hotels), Centro (170), Alentejo (350), and Algarve (70), with a total of 875 hotels. Key areas include Cáceres and Badajoz in Spain, and Portalegre and Évora in Portugal, reflecting significant rural tourism development across both countries’ regions.

3.2. Items

Table 2 presents the distribution of rural hotels in Spain and Portugal that contributed to the definition of study items. The study’s items were developed through a combination of a literature review and insights from two focus groups involving 20 rural hotels. The table lists various establishments and specifies their respective countries. In Spain, examples include Finca el Cortiñal Slow Hotel, Castillo de Luna Hotel Restaurante, and Castilla Termal Monasterio de Valbuena. In Portugal, notable hotels include Herdade da Urgeria, Quinta do Barreiro, and Torre de Palma Wine Hotel. These establishments encompass both rural and luxury accommodations, reflecting the diversity of interview sites within these cross-border regions. According to Sánchez-Oro and Robina-Ramírez [55], two focus groups have been delivered: Focus Group 1 explored ethical practices in hotel operations, with an emphasis on decision-making frameworks, team collaboration, and the role of leadership in fostering ethical behaviour. Discussions covered practical wisdom (“*phronesis*”), the creation of safe spaces for ethical reflection, and strategies for addressing ethical dilemmas in rural hospitality. Focus Group 2 concentrated on guest-facing aspects, such as operational reliability, guest trust, and the connection between ethical behaviour and reputation, with specific attention to transparency, sustainability, and crisis management. Three indicators OEE54, PRDT3, and RER 4 were not significant.

Table 3 includes the constructs and highlights key ethical principles and strategies for hotel management that foster a strong reputation and long-term success. “*Phronesis*” in the *Development of Rural Tourism in Border Territories (PDRT)* emphasises the importance of practical wisdom in making ethical decisions in sensitive areas. *Addressing Threats through Ethical Leadership (TEL)* focuses on how ethical leadership can mitigate risks and maintain trust during crises. *Transforming Challenges into Opportunities (TChO)* encourages managers to use obstacles as catalysts for innovation and growth. *Balancing Operational Excellence with*

Ethical Standards (OEES) stresses the need to maintain high operational efficiency while upholding ethical principles. *Building Resilience through Ethical Reflection (RER)* involves fostering resilience by reflecting on ethical practices to navigate difficult situations. Finally, *Fostering Long-Term Sustainability (LTS)* highlights the importance of creating sustainable practices that ensure the hotel's longevity and positive impact on the environment and society. Together, these constructs promote a holistic approach to ethical hotel management. Proposed corrections were adding.

Table 2. Distribution of the interviews.

Hotels	Spain	Portugal
Alojamientos Tajo Internacional	x	
Herdade da Urgeria		x
Dom Dinis Marvao		x
Quinta do Barreiro		x
Finca el Cortiñal Slow Hotel	x	
Hotel Rural Restaurante El Convento	x	
Quinta da Dourada		x
Puerto Roque Turismo Rural	x	
Castillo de Luna Hotel Restaurante	x	
Casa Rural Sierra de San Mamede	x	
Hotel Rural Santo Antonio		x
Herdade do Adaens	x	
Casas da Faia—Nature Guest House		x
Casa da Urra		x
Torre de Palma Wine Hotel, Monforte		x
Conde Rodrigo II	x	
Hotel & Spa Norat Torre do Deza	x	
Castilla Termal Monasterio de Valbuena	x	
Longroiva Hotel Rural		x
Gran Sol de Extremadura	x	

Table 3. Items.

Constructs	Items	References
<i>“Phronesis” in the development of rural tourism in border territories (PDRT)</i>		
PDRT 1	How does practical wisdom guide ethical decision-making in balancing business goals with community welfare?	[1]
PDRT 2	What role does “ <i>phronesis</i> ” play in developing sustainable tourism strategies that honour local customs?	[3]
PDRT 3	How can cross-border initiatives celebrating local traditions create sustainable competitive advantages?	[15]
PDRT 4	In what ways does ethical reflection strengthen a hotel's ability to adapt to uncertainties and maintain trust?	[19]
<i>Balancing Operational Excellence with Ethical Standard (OEES)</i>		
OEES 1	How can rural frontier hospitality establishments balance operational efficiency with ethical responsibilities?	[34]
OEES 2	What innovations can hotel managers develop to address resource limitations without compromising community interests?	[36]
OEES 3	How can personnel development programs in rural hotels align operational needs with fair labor practices?	[39]
OEES 4	How can technological advancements in rural hospitality align with indigenous cultural and ethical values?	[40]

Table 3. Cont.

Constructs	Items	References
<i>Fostering long-term Sustainability (LTS)</i>		
LTS 1	How can “ <i>phronesis</i> ” guide hotel managers in addressing the complex challenges in rural border regions?	[48]
LTS 2	What role does active engagement with local communities play in ensuring cultural preservation and sustainable tourism development?	[49]
LTS 3	How can financial resilience in rural border tourism be achieved, according to Bianchi’s perspective?	[51]
<i>Transforming Challenges into Opportunities TChO</i>		
TChO 1	How does principled governance address vulnerabilities in rural frontier hospitality management?	[28]
TChO 2	What sustainable methodologies can protect ecosystems in cross-boundary destinations?	[29]
TChO 3	How does cultural sensitivity in leadership foster positive relationships with borderland communities?	[31,32]
TChO 4	How can leaders balance profit objectives with community welfare in rural frontier accommodations?	[33]
<i>Addressing Threats through Ethical Leadership (TEL)</i>		
TEL1	How does principled governance contribute to overcoming challenges in rural frontier hospitality management?	[8]
TEL 2	What role does ecological vigilance play in safeguarding ecosystems while maintaining operational viability in border areas?	[22]
TEL 3	How can hospitality management in border regions respect local heritage while fostering multicultural understanding?	[24]
TEL 4	How can directors balance commercial objectives with community welfare in rural frontier hospitality management?	[25]
TEL 5	How can implementing virtuous management practices build resilience and foster long-term sustainability in rural hotels?	[26]
<i>Building Resilience Through Ethical Reflection (RER)</i>		
RER 1	In what ways does crisis preparedness benefit from regular ethical reflection sessions in boundary region hotels?	[43]
RER 2	How can community engagement contribute to building fortitude in rural frontier hospitality management?	[44]
RER 3	What role does personnel advancement play in strengthening organisational resilience in rural hotels?	[45]
RER 4	How does ethical reflection influence long-term sustainability and competitive advantage in rural frontier hotels?	[46,47]

Emails were sent inviting rural hotels mentioned in Table 1, located along the Spanish–Portuguese border, to participate. Initially, 221 hotels responded positively to the invitation. However, the final number of confirmed participants decreased to 175.

3.3. Model

Figure 1 below depicts the relationships between the hypotheses and the items posed.

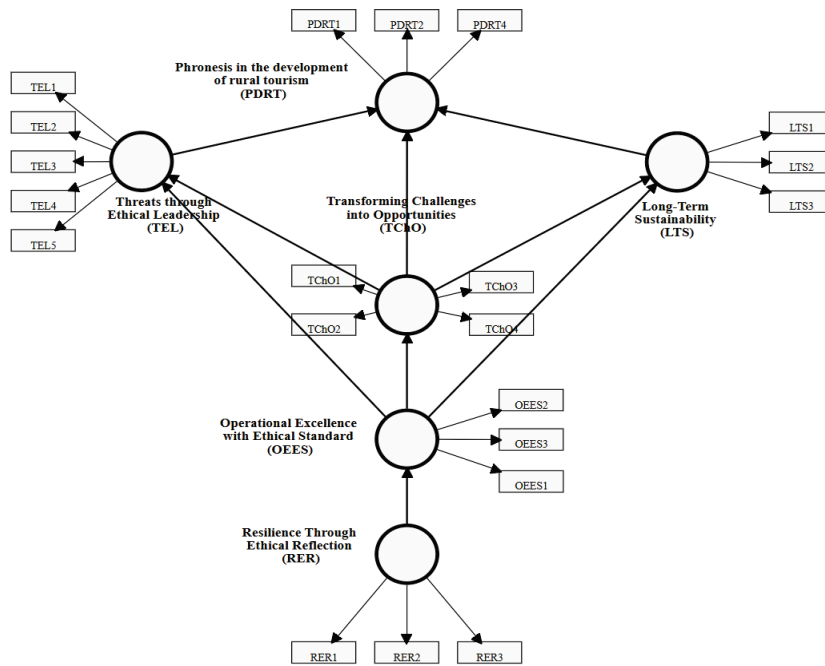


Figure 1. Model.

4. Results

4.1. External Model

The external loadings reflect the relationships between unobserved constructs and measurable indicators. Carmines and Zeller [56] suggest that coefficients above 0.7 are generally deemed satisfactory. However, some researchers caution against strictly adhering to this guideline, as highlighted in Table 4. In the study, three indicators (OEEs4, PRDT3, and RER4) were deleted from the focus groups due to their lack of significance. These indicators were initially considered to measure aspects related to operational excellence, rural tourism development, and resilience through ethical reflection. However, after analysis, it was determined that they did not contribute meaningfully to the understanding of the ethical practices and strategies in rural hotel management. As a result, these indicators were removed to ensure the focus on more relevant and impactful measures in the study.

Table 4. Outer Model Loadings.

	ED	GT	PDRT	RER	RO	OEEs
LTS1	0.890					
LTS2	0.877					
LTS3	0.691					
TEL1		0.782				
TEL2		0.773				
TEL3		0.687				
TEL4		0.684				
TEL5		0.698				
PDRT1			0.801			
PDRT2			0.866			
PDRT4			0.711			
RER1				0.836		
RER2				0.860		
RER3				0.812		
TChO1					0.857	
TChO2					0.855	
TChO3					0.788	

Table 4. *Cont.*

	ED	GT	PDRT	RER	RO	OEES
TChO4					0.816	
OEES1						0.868
OEES2						0.913
OEES3						0.733

Table 5 illustrates the strength of the links between indicators and their underlying constructs, with most values surpassing 0.7, demonstrating robust connections [57]. Reliability was confirmed by Cronbach’s alpha exceeding 0.70 [58]. Furthermore, composite reliability and AVE metrics exceeded the required thresholds, ensuring strong internal coherence and model validity.

Table 5. Reliability metrics.

	Cronbach’s Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
LTS	0.768	0.842	0.863	0.680
TEL	0.748	0.757	0.833	0.501
PDRT	0.709	0.739	0.837	0.633
RER	0.786	0.792	0.875	0.700
TChO	0.849	0.853	0.898	0.688
OEES	0.791	0.814	0.878	0.708

Fornell and Larcker [58] propose that the square root of the AVE for each latent variable can be used to establish discriminant validity. To confirm this between constructs, the square root of the AVE must be greater than the correlation between the constructs. Table 6 presents the square roots of the AVE along the diagonal, alongside the correlations between the constructs. These values are higher than the other correlations between latent variables, demonstrating the adequate discriminant validity of the measurements.

Discriminant validity was assessed using the heterotrait–multitrait method (HTMT), with a conservative criterion of 0.85, and the recommended threshold of 0.95 for conceptually close constructs (Table 7) [59]. The results, all below the 0.85 threshold, support the discriminant validity of the model, confirming an adequate distinction between the constructs analysed.

Table 6. Discriminant Validity Matrix (Fornell–Larcker Criterion).

	LTS	TEL	PDRT	RER	RO	OEES
LTS	0.825					
TEL	0.378	0.708				
PDRT	0.370	0.555	0.795			
RER	0.411	0.592	0.504	0.837		
TChO	0.275	0.396	0.440	0.320	0.829	
OEES	0.392	0.533	0.401	0.364	0.309	0.841

Table 7. Discriminant Validity Matrix (Heterotrait–Monotrait Ratio Criterion).

	LTS	TEL	PDRT	RER	TChO	OEES
LTS						
TEL	0.490					
PDRT	0.479	0.752				
RER	0.514	0.775	0.650			
TChO	0.323	0.494	0.548	0.384		
OEES	0.455	0.687	0.516	0.460	0.359	

This provides good support for our claims of discriminant validity between our measures of transformational leadership at the group and individual levels [59]. On the other hand, the fit indices are the normalised root mean square residual (SRMR), which is 0.074 (Blue Tourism) and 0.070 (Green Tourism) indicating a better fit of the model in line with what Williams, Vandenberg, and Edwards indicate [60] (p. 585).

4.2. Structural Model Analysis

Structural model evaluation explores the interactions among constructs within a conceptual framework, frequently employing methods like Structural Equation Modelling (SEM). This approach evaluates hypothesised relationships, determines direct and indirect effects, and verifies the validity of theoretical structures. Chin [61] categorises R^2 values as follows: above 0.67 for strong explanatory capacity, between 0.33 and 0.67 for moderate, and between 0.19 and 0.33 for weak. In this analysis, the coefficient of determination ($R^2 = 0.385$) indicates a moderately good alignment with the data.

Using the PLS algorithm, T-statistics are calculated via bootstrapping, generating 10,000 resamples to estimate standard errors and T-values for path significance. R^2 values, which range from 0 to 1, reflect predictive ability, with values above 0.10 and T-statistics exceeding 1.64 confirming minimum explanatory adequacy [62].

Table 8 reveals that the relationships between H5: OEES -> TEL (Balancing Operational Excellence with Ethical Standards leading to Addressing Threats through Ethical Leadership) (T-statistics: 8,139) and H1: TEL -> PDRT (Addressing Threats through Ethical Leadership leading to “Phronesis” in the Development of Rural Tourism in Border Territories) are critical for ensuring sustainable tourism growth and stability in rural frontier regions for two main reasons.

Operational excellence (OEES) often requires sound decision-making processes based on ethical principles, which directly influence the way threats are addressed in hospitality settings (TEL). When managers prioritise ethical standards in their operations, they create a robust framework for addressing various challenges, including crises and ethical dilemmas, which are prevalent in border territories. This leadership approach fosters resilience by ensuring that hospitality businesses can swiftly adapt to challenges while maintaining their ethical integrity. By promoting ethical decision-making, leaders can navigate crises with foresight, ensuring that both community welfare and business interests are preserved. This, in turn, supports the building of long-term resilience in hospitality management (PDRT), as organisations guided by ethical leadership are better equipped to respond to emerging risks and uncertainties.

Table 8. Path coefficients.

	Original Sample (O)	2.5%	97.5%	T Statistics (O/STDEV)	p Values
H1: TEL -> PDRT	0.403	0.295	0.508	7.498	0.000 ***
H2: TChO -> TEL	0.256	0.143	0.371	4.427	0.000 ***
H3: TChO -> PDRT	0.239	0.127	0.359	4.018	0.000 ***
H4: OEES -> TChO	0.309	0.313	0.065	4.774	0.000 ***
H5: OEES -> TEL	0.454	0.341	0.558	8.139	0.000 ***
H6: RER -> OEES	0.364	0.242	0.484	5.902	0.000 ***
H7: OEES -> LTS	0.339	0.221	0.457	5.669	0.000 ***
H8: TChO -> LTS	0.170	0.045	0.296	2.642	0.008 **
H9: LTS -> PDRT	0.152	0.040	0.264	2.642	0.008 ***

Results of testing the model significance ** $p < 0.01$. *** $p < 0.001$.

Transforming challenges into opportunities for rural development: The ability of ethical leadership (TEL) to address and navigate challenges effectively enables the transfor-

mation of these challenges into opportunities for the development of rural tourism (PDRT). By adopting a balanced approach to operational efficiency and ethical standards (OEES), tourism managers can recognise potential risks and seize opportunities for growth that benefit both the environment and local populations. This approach promotes a holistic view of tourism development, integrating economic, cultural, and ecological aspects in decision-making. Ethical leadership provides the vision needed to turn complex, cross-boundary challenges into positive outcomes, contributing to the sustainable development of tourism in rural border territories. Thus, the relationship between OEES, TEL, and RER is vital for the establishment of responsible, sustainable, and ethically-guided tourism practices that support both short-term resilience and long-term growth.

5. Discussion

In line with Enz [36], when he considers ethical leadership as an indispensable component of long-term success in hotel management, the results of the research support that the ideas of Operational Excellence and Ethical Standards (OEES) and Transformational Ethical Leadership (TEL), proposed in the theoretical framework, are fundamental to face the challenges inherent to the management of rural tourism in territories where it is crucial to maintain a balance between commercial objectives and ethical standards.

Ethical leadership, grounded in OEES, is not only about maintaining ethical standards but also about aligning operational strategies with broader social and environmental goals. This would be consistent with the conclusions of authors such as Koščak and O'Rourke [34], who highlight, sustainable practices in rural territories require that businesses not only focus on profitability but also consider the well-being of local communities and ecosystems. Attfield [37] suggests that operational efficiency should never come at the cost of ethical commitments, such as environmental stewardship and fostering positive community relations. This view is echoed by Schwartz and Sharpe [1], who argue that ethical leadership is critical in rural territories for navigating the complexities posed by environmental challenges, cultural diversity, and socio-economic tensions, thus ensuring that tourism practices respect local customs and traditions. Ethical leaders, as Guerra-Lombardi et al. [22] explain, must balance the need for sustainable tourism practices with business viability. Their role becomes even more significant in rural tourism, where the integration of local traditions and ecological preservation is vital for the continuity of both business and community welfare. By incorporating ethical leadership, managers can build long-term trust within communities, fostering resilience and contributing to the sustainability of the tourism industry.

A crucial aspect of ethical leadership is practical wisdom which enables managers to address ethical dilemmas while maintaining operational excellence. The results of the research show that the role of "*phronesis*" extends beyond internal hotel operations and into the broader context of rural tourism management. This is particularly relevant in border regions, where the integration of "*phronesis*" allows hotel managers to make decisions that consider the broader social and environmental implications of their actions. In line with these conclusions are the contributions of authors such as Intezari et al. [2] who argue that such wisdom equips leaders to develop strategies that protect both local communities and ecosystems, creating mutually beneficial outcomes for businesses and the areas they operate in. The importance of these principles is further supported by Tambovceva et al. [15] and Yoopetch et al. [16], who emphasise the need for ethical leadership to promote cultural and economic development in rural territories. Ethical leadership, combined with practical wisdom, becomes a tool for ensuring the sustainability of tourism practices, making it a critical component of successful rural tourism management in border regions.

These ideas are especially relevant in a territory that, like the Portuguese–Spanish border, possesses important natural resources such as the Gerês-Xurés Biosphere Reserve, Sierra de Malcata Nature Reserve, or the Natural Parks of Montesinho, Duero Internacional, Arribes del Duero, Tajo Internacional or Valle del Guadiana. The tourism potential of these resources is analysed by Robina-Ramírez et al. [63], who highlight the relevance that factors such as health, well-being, and happiness can have in the practice of tourism in this type of space [64]. Phronetic becomes a crucial factor in guaranteeing the viability of tourism investments in rural areas, thus overcoming the warnings made in this regard by Castellano-Álvarez and Robina-Ramírez [65] or Castellano-Álvarez et al. [66–68].

In line with the findings of Leal-Solís et al. [69], the results of the research show that the Practical Decision-making and Reflective Thinking (PDRT) approach further strengthens the connection between ethical leadership and operational success. On the other hand, the research also shows that Balancing Operational Excellence with Ethical Standard (OEES) demands that the implementation of technological advances in rural tourism be carried out with careful consideration of local cultural values. Castellano-Álvarez et al. [70] or Castellano-Álvarez and Robina-Ramírez [71] warn us about the relevance that these values and local singularities have for the development of the territory, and the truth is that sometimes technological growth can conflict with the cultural norms of local communities. Along these lines would be the conclusions reached by Koščak and O'Rourke [34] who point out that technological advancements in rural hospitality must be approached with ethical responsibility to avoid disrupting local values. This is particularly important in cross-border initiatives that celebrate local traditions while seeking to create sustainable competitive advantages. However, as Sofield [13] and Tambovceva et al. [15] argue, socio-cultural and economic tensions often hinder the success of these initiatives, especially when local staff lack the training to navigate complex cultural dynamics.

This study faced several limitations. First, the geographical focus on rural border areas, while intentional, presented challenges in accessing comprehensive data due to the remoteness of these regions. The limited availability of secondary data sources and the logistical difficulties in conducting primary research constrained the scope of the study. Another limitation was the sample size. Many hotels in these rural border territories are small and independently operated, making it difficult to gather a broad range of perspectives. Additionally, cultural and language barriers in some regions added complexity to the data collection process, potentially impacting the depth and breadth of the insights obtained. Methodologically, the study relied on qualitative approaches, which, while rich in detail, can be subjective and harder to generalise. The reliance on interviews and case studies means that the findings are context-specific and may not be universally applicable to all rural border hotels.

Future research should expand the geographical scope to include a more diverse range of rural border territories. Comparative studies between regions could provide deeper insights into how “*phronesis*” manifests in different cultural and economic contexts. Additionally, incorporating quantitative methods alongside qualitative ones could enhance the robustness of the findings. Future studies should also explore the role of technology in supporting “*phronetic*” management in rural hotels. Another important consideration for future research is the impact of training on fostering “*phronesis*” among hotel managers and staff. In summary, while this study highlights the importance of “*phronesis*” in managing rural border hotels, addressing its limitations through broader, more diverse research approaches and exploring technological and educational interventions will be crucial for future advancements in this field.

6. Conclusions

The results of this research emphasise the critical role of ethical leadership and operational excellence in fostering sustainable tourism practices.

The first key theoretical conclusion is the integration of ethical leadership with operational excellence. This synergy ensures that tourism businesses not only focus on maximising profits but also prioritise the welfare of the local community and environmental stewardship. This enhances the long-term sustainability of tourism in rural border areas and protects the social fabric and natural resources of the region.

Another theoretical conclusion revolves around practical wisdom and ethical reflection. "*Phronesis*", or practical wisdom, allows tourism stakeholders to navigate challenges that involve cultural preservation and environmental responsibility, while ensuring the operational efficiency of the business. By leveraging practical wisdom, leaders can make decisions that respect local traditions and ecological concerns, thus building trust with both staff and guests.

The third theoretical conclusion stresses the importance of ethical decision-making and community trust. Ethical leadership and "*phronesis*" contribute to transparent, consistent decision-making that builds a culture of trust within tourism businesses. This practice strengthens both internal team dynamics and external relationships with the local community. By fostering trust, businesses improve their reputation, ensuring that guests perceive the establishment as ethically responsible and trustworthy.

On the practical side, the study outlines three significant conclusions for tourism managers. First, creating safe spaces for ethical reflection is crucial. By encouraging staff to engage in open discussions about ethical dilemmas, managers can improve decision-making capabilities, which leads to smoother operations, especially in difficult or crisis situations. When employees feel that their concerns are heard and addressed, they become more engaged, leading to higher operational reliability.

Secondly, as technological advancements play an increasingly significant role in rural hospitality, it is essential that managers introduce new technologies in ways that respect local cultural values. Overzealous technological adoption can lead to alienation of the local community, which may perceive these changes as a threat to their traditions. Balancing technological innovation with cultural preservation fosters a more inclusive approach that minimises negative reactions from local communities while improving service quality. This balance also contributes to a more sustainable model of tourism, where modernisation does not overshadow the region's cultural heritage.

A third practical conclusion addresses the importance of cross-border initiatives for sustainable tourism. Cross-border collaborations can offer significant benefits, such as resource sharing and expanded marketing efforts. However, these initiatives face challenges related to socio-cultural differences, logistical issues, and local capacity constraints. For rural tourism managers, it is essential to understand these barriers and work towards overcoming them by investing in workforce development and building local capacity. When effectively implemented, cross-border tourism initiatives can contribute to the long-term development of both the community and the tourism industry.

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Article

Rural Women's Leadership Within the Cocoa Production Chain in Tibú, Norte de Santander, Colombia: A Gender Perspective

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Abstract: This study addresses gender inequality in rural areas, focusing on the structural and socio-cultural constraints faced by women, despite the increasing feminisation of agriculture. The research question posed is: what are the leadership experiences of rural women in the cocoa production chain in Tibú, Norte de Santander, Colombia? The objective is to unveil the leadership experiences of rural women in the cocoa production chain in Tibú, Norte de Santander, Colombia. Using a qualitative and interpretative approach and a case study design, the experiences of ten women cocoa producers were analysed. The coding technique was based on theoretical material, generating two subcategories and the respective theoretical codes. The subcategories are associativity and time use. The findings reveal barriers such as shyness or fear of rejection, low participation in community groups, limited education, decision-making restrictions, unpaid work overload, lack of leisure time, and gender-based violence, factors that perpetuate poverty and hinder their community leadership. However, it highlights how women's leadership and associativity positively impact sustainable agriculture and community cohesion. Although public policies recognise their key role, their implementation remains insufficient. This study highlights the need for comprehensive strategies that overcome inequalities and promote inclusive rural development.

Keywords: leadership; associativity; time use; rural women; gender; Colombia

1. Introduction

In contemporary society, the gender equity gap is still present in both rural and urban areas [1]. In Latin America, rural women continue to face marked structural, social, political, and economic constraints in access to basic services, education, employability opportunities, and security [2], which limit political, social, and family participation, despite constituting a significant part of the world's rural and agricultural labour force [3–7].

Lack of access to land and land titling, limited participation in both personal and public decision-making, lack of spaces for participation and leadership, digital illiteracy, and unequal distribution of time spent on domestic and unpaid care work [8,9], as well as gender-based violence stemming from patriarchal systems, place women in situations of multiple vulnerabilities [10,11], which perpetuate inequality and poverty in rural areas, exacerbated by insufficient institutional, political and social support strategies [12,13].

In rural areas, as a consequence of the social division of labour, women have historically been excluded from activities related to political representation, associativity, and productive participation [6,14–16]. Although the Food and Agriculture Organisation of the United Nations—FAO (2013) [17], recognises women as a key actor in agriculture and the rural economy (FAO), Latin American public policies and socio-cultural conditions have relegated women in daily practice to the sphere of domestic work and unpaid care [18–20]; even in cases where they are able to obtain remuneration, their income is often lower than that of men in similar roles [16].

For all of the above reasons, female leadership and cohesion have emerged as driving characteristics of social and economic development in rural contexts worldwide and they're increasingly recognised in academic literature and public policy [21]. In this sense, the literature has focused on studying female leadership due to its importance for the promotion of women's empowerment and the reduction of gender gaps [22,23], mainly in its impact on decision-making and the barriers they face to exercising and maintaining themselves in positions of power; however, these advances are still insufficient [24,25].

When rural women work in teams, referring to associativity as a pillar of women's leadership, collectivisation and mobilisation efforts for the conservation of the commons are facilitated [26]. These collaborations strengthen support networks and often generate social value by driving rural transformation, having a positive impact on communities and sustainable agriculture, which also benefits food security and fosters environmental protection [27,28].

However, rural women, despite their capabilities and leadership, face numerous barriers such as a lack of economic resources, overburdened unpaid work due to care work within the household and agricultural activities, discrimination, and cultural constraints that reinforce gender stereotypes [29,30]. In addition, structural inequality and limited representation in decision-making spaces create an unfavourable environment that limits their full participation [9,31].

On the one hand, according to the Global Gender Gap 2022 report, which includes information from 146 countries, no country has reached full gender parity and the top 10 countries that have closed their gaps are: Iceland 90.8%, Finland 86%, Norway 84.5%, Sweden 82.2%, Ireland 80.4%, Germany 80.1%; Sub-Saharan African countries such as Rwanda 81.1% and Namibia 80.7%; Nicaragua 81% and New Zealand 84.1% [32]. It is worth noting that Colombia has a gender gap closing rate of 71%. On the other hand, cultural norms and attitudes remain an obstacle to female leadership, as in societies that emphasise subordinate roles for women, these values can discourage women from working or aspiring to leadership positions. In this regard, estimates of women in leadership positions by region for 2023 reveal that the global average is 24%; Central and South Asia 14%; Europe and North America 36%; East and Southeast Asia 22.1%; Latin America and the Caribbean 37.3%; North Africa and West Asia 14.3%; Oceania (excluding Australia and New Zealand) 25.4%; Sub-Saharan Africa 31.1%; Australia and New Zealand 38.2% [33].

According to the United Nations Economic Commission for Europe, the top 10 countries for 2022 with a high rate of women in managerial positions are: Belarus 46.3%; Latvia 45.3%; Republic of Moldova 44.6%; Russian Federation 44%; Poland 42.9%; Kyrgyzstan 42.9%; United States 42.6%; Sweden 41.7%; Ukraine 41% and Kazakhstan 40.8%, and the five countries with low rate are: Turkey 18.5%; Croatia 21.4%; Cyprus 23.1%; Bosnia and Herzegovina 24.1% and Czech Republic 26% [34]. Only 28% of women worldwide hold managerial positions and only 16% chair boards of directors of business organisations [35]. In the case of the Americas, gender equality in leadership positions has been achieved in only 33% of cases. As for political leadership, which is a crucial pillar in gender issues, progress has been slow. As of 1 October, only 30 women are heads of state or government in

the world and they warn that, with these statistics, gender equality will not be achieved for another 130 years [36]. Likewise, in Latin America, 35.8% of women hold seats in national parliaments and in Colombia this figure reaches 28.9% [37].

At the global policy and strategy level, the Sustainable Development Goals (SDGs) provide a key framework for guiding action towards social justice [38]. For the purposes of this article, the focus of this paper is on SDG 5, which highlights the need to achieve gender equality and empower women and girls. These aims are in line with the growing global focus on gender equality and social accountability programmes, which advocate for the inclusion of women in various sectors, including agriculture, as gender equality is considered an essential pillar for sustainable development, promoting women's equal participation in agriculture and ensuring their access to resources and opportunities. However, gender equality is far from being achieved if barriers persist in educational accessibility, opportunities, and participation in decision-making; therefore, actions related to gender equality are most effective when implemented in unison with other SDGs such as SDG 8. Decent work and economic growth, thereby strengthening social justice and at the same time fostering more inclusive and sustainable economic growth [1].

In Colombia, the creation of public policies and regulatory frameworks with a gender perspective have originated as a result of the implementation of the international agenda, aimed at promoting gender equality and making visible the fundamental role of women in development [39]; however, this incorporation into the public agenda, particularly policies to address the inequalities that affect rural women, is still limited [40]. In this sense, Colombia's National Development Plan 2022–2026 highlights the importance of the role of rural women, proposing the implementation of Law 731 of 2002, which seeks to improve access to land and credit and guarantee their participation in territorial planning processes [41].

Although these policies are part of the current framework for action established in the Final Peace Agreement (AFP) [42], from which Decree 902 of 2017 was derived, which created the land fund, namely, subsidy and credit for landless or land-scarce people, defining vulnerable people in rural areas as the main beneficiaries, such as women victims and those who are part of associations and cooperatives [43]. Gender issues in rural development are still incipient, hindering the development of approaches to create mechanisms for the promotion and participation of rural women, overcoming historical limitations, and ensuring a comprehensive rural reform that protects the rights of women in their territories [44].

For all of the above reasons, the following question arises: what are the leadership experiences of rural women in the cocoa production chain in Tibú, Norte de Santander, Colombia? The objective is to unveil the leadership experiences of rural women within this production chain in Tibú, Norte de Santander, Colombia.

Concerning the existing literature, recent studies have evidenced growing trends of feminisation in agriculture, both in Latin America and in Africa and Asia, driven by the migration of male members to cities in search of better economic opportunities, a phenomenon linked to urbanisation and lack of employability in the countryside, which has placed women as the main responsible for subsistence agriculture and family care [16,21,45–48].

Likewise, among the main research in the current literature that has focused on studying the female leadership of rural women, several stand out (namely, [22,24,26,28,30,49–54]). However, similar studies on rural women's leadership in the Department of Norte de Santander, Colombia, have not been identified in the literature, making this work a novelty. This study contributes to knowledge on the empowerment of rural women in the cocoa production chain, identifying structural and individual barriers that limit their participation and leadership. It provides evidence on the impact of socio-cultural context and gender-based violence on their associativity, as well as on the role of self-efficacy, self-esteem, and

the redistribution of gender roles in the transformation of social norms. It also highlights the importance of time use as a key factor in gender inequality and emphasises the need for gender-sensitive public policies to strengthen women’s leadership and autonomy in rural settings. These findings provide inputs for the design of interventions and strategies that promote their active participation in territorial development and gender equity.

Finally, the general structure of the article is as follows: 1. Introduction; 2. This section deals with three sub-sections: 2.1. Associativity, 2.2. Use of Time, 2.3. The Need for a Gender Perspective; 3. Materials and Methods. This section includes 3.1. The Setting of the Study: The Context of the Municipality of Tibú and 3.2. Methodology Used. 4. Results, 5. Discussion, and 6. Conclusions.

2. Rural Women’s Leadership

Rural women’s leadership is an approach to how women exercise leadership from their experience and gender perspective and refers to the ability of women to motivate, influence, and mobilise people or rural communities towards the achievement of common goals, under which skills and values such as female empathy, listening skills, collaboration, social sensitivity, and cooperation are combined and characterised because they promote more horizontal and inclusive power relations focused on caring for people and the environment [45,49,53,54]—i.e., values-based leadership—facilitates change and fosters teamwork focused on common benefit [55].

Rural women’s leadership involves the promotion of sustainable practices, human resource management, participation in community organisations, and the capacity to organise collectively to improve living conditions and create consensus, and it is a key process for the conservation of ancestral knowledge, social cohesion and associativity, and community resilience [16,56–58]. In this sense, Figure 1 shows the central category of study: Rural women’s leadership. For the purposes of this article, two subcategories were considered, namely, associativity and time use within rural women’s experiences.

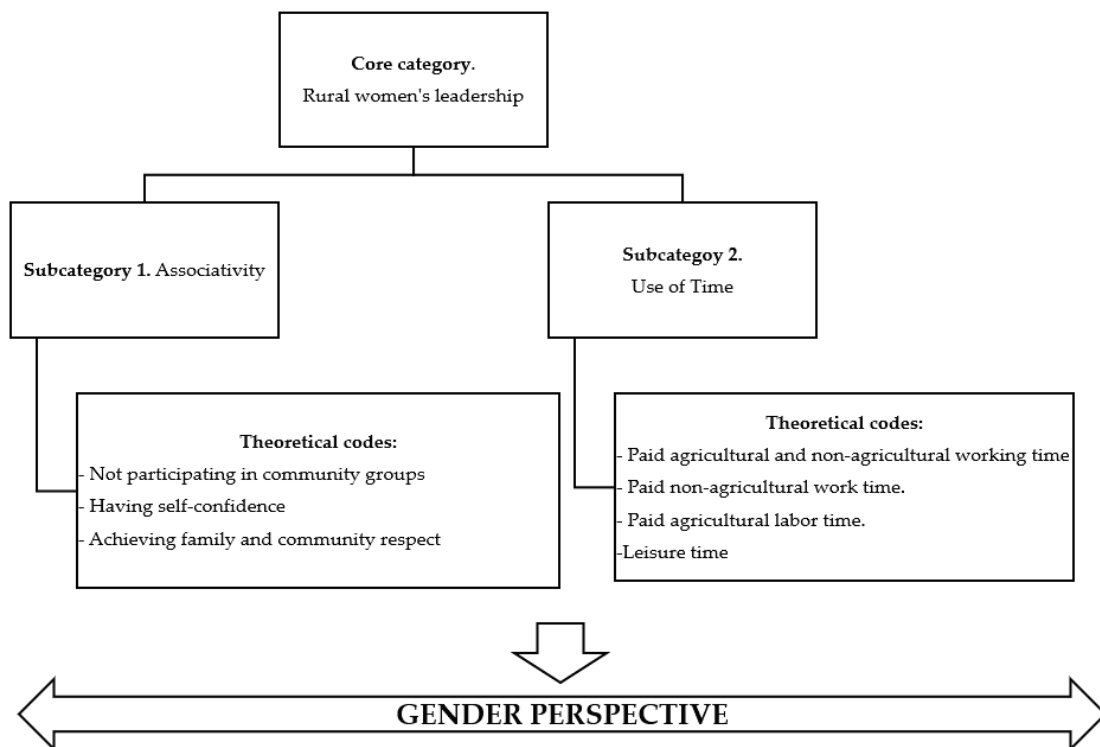


Figure 1. Rural women’s leadership: subcategories and theoretical codes. Source: prepared by the authors, based on [26,46,50].

Rural women's leadership seeks to challenge traditional and hierarchical structures, proposing more inclusive forms of leadership oriented towards social sustainability and poverty alleviation [59]. This concept implies the promotion of participation and mutual support as opposed to competition among women themselves, as well as the ability to influence their rural communities, promoting changes in local social and productive dynamics. Rural women play an important role in the sustainability and improvement of the quality of life of their communities through the initiatives they lead, where they combine ancestral knowledge with innovations [49]. This leadership is strongly influenced by the particularities of the rural environment, where women must challenge cultural, economic, and social barriers to access spaces of power.

Therefore, there is a need for gender-sensitive interventions in rural settings to recognise women's empowerment and role. This intervention involves social structure, politics, as well as awareness, attitude, and other family issues, i.e., addressing empowerment through leadership as an alternative for sustainable livelihoods [50,51,60].

2.1. Associativity

Women's associativity is understood as a form of organisation characterised by collective cooperation that allows women to voluntarily join efforts to achieve common objectives, whether legally constituted or not, to generate economic and social value through productive, commercial, and consumption activities [61,62].

This concept is based on principles of solidarity and collaboration, improved productivity and sustainability, as well as promoting comprehensive social development, and is particularly relevant in rural contexts [63], where women's participation is limited due to challenges linked to precarious employment, unpaid care burdens and economic marginalisation [64,65].

From a theoretical perspective, associativity has been understood as a mechanism that generates social capital [66], exalting how social cohesion and participation centred on relationships of trust, norms and networks facilitate cooperation and collective action in a community to achieve individual and group goals and contribute to the construction of communities with greater capacity for agency and development [52,67]. This organisational mechanism, in addition to being key to rural development, is intertwined with the premise of promoting individual and collective empowerment, as women cooperate with each other, create networks of support and trust, mutual respect, and reciprocity, vital elements for confronting structural inequalities that limit their economic autonomy, thus facilitating access to economic opportunities [68,69].

From a gender perspective, it is crucial to recognise that women's associativity is positioned as a transformative strategy for the recognition of women, as it challenges cultural and social norms that legitimise inequality by recognising them as agents of change and economic development [70]. Labour marginalisation and the lack of recognition of unpaid work limit women's ability to organise themselves and access resources that enhance their autonomy and self-confidence; however, women's associations emerge as an initiative to promote gender equity and improve their living conditions, as they have proven to be effective in overcoming these barriers, facilitating access to markets, technological knowledge and financing, while strengthening women's leadership and promoting respect for different environments [69].

2.2. Time Use

This refers to the distribution of the hours that a person spends on various activities on a daily basis, especially in relation to paid and unpaid activities. In the case of women, it is crucial to analyse this concept, because they reveal the unequal allocation of time in

comparison with men since their time is divided between domestic chores, productive work, caring for others and leisure, facing a disproportionate burden of unpaid work together with domestic chores. From a capabilities approach, the importance of real opportunities that people have to have a life in dignity which, concerning time, is understood as a fundamental resource that enables women to develop capabilities such as autonomy, social participation, and the pursuit of personal wellbeing [71].

Although women have begun to decrease the time spent on care activities within family settings, they often face restrictions to participation in productive, educational, or recreational activities and also continue to spend on average more time on unpaid domestic work than men [72]. Furthermore, the fact that women do not have autonomy and control over their time and are at the service of others is related to a lack of empowerment and autonomy [18], as in fulfilling this overload, they often give up their personal time and professional development, which reflects a limitation in participating fully in the economy [9,18]. Finally, from the capabilities approach, equity requires considering time as a fundamental resource for well-being and freedom, since opportunities to decide how time is used are essential for empowerment [73]. By redistributing household responsibilities equitably and ensuring access to tools that alleviate the domestic burden, space could be made for women to participate more fully in social, economic, and political life, strengthening their capabilities and their overall well-being.

From a gender perspective, feminist epistemological currents have been influenced by a connection between academic studies and activism, as well as institutional openness to integrate gender issues in research, in particular, to make visible the experiences of women, as well as their role and participation in society [74]. The incorporation of these perspectives in the scientific sphere provokes a rethinking of the role of science in the legitimisation of traditional gender structures and relations [75]. Part of the argument of this article, therefore, is that women's participation in agriculture alone is not sufficient to transform the constraints women face as a result of their subordination and lack of representation.

Recent studies indicate a trend towards promoting rural women's participation and empowerment through agroecological practices. Although the theoretical principles and foundations advocate for equity, this does not materialise in everyday practice [12]. Further research shows that these initiatives do not encourage women's participation, but rather relegate them to a passive role, mainly as farmers' wives [76–78].

When a gender perspective is incorporated into this sector, the results show significant improvements in the quality of life and greater empowerment of women [76]. It is generally accepted that leadership is an essential part of women's empowerment. The study category of rural women's leadership takes the associativity and the use of rural women's time as enabling elements for their full participation and collaboration in multiple spheres, namely, domestic, social, and political.

For this reason, the gender perspective for the present case is placed at the service of women's emancipation insofar as it relates to the experiences of leadership mainly in the rural Colombian context of the municipality of Tibú in the Department of Norte de Santander, Colombia.

3. Materials and Methods

3.1. Study Setting: The Context of the Municipality of Tibú

The municipality of Tibú is located in the Catatumbo region in northeastern Colombia and has historically been a disputed area due to its natural wealth and location. This region, which is part of the department of Norte de Santander and shares a geographical border with Venezuela, has been under the control of various organised armed groups, which has generated a context of violence and marginalisation of its inhabitants [79]. The expansion of

coca leaf cultivation in the 1980s intensified the armed conflict, deepening the breakdown of the social fabric and weakening peasant and popular organisational processes [80]. This context has not only generated forced displacement of rural communities but has also critically and systematically affected rural women, who experience multiple exposures to gender-based violence, due to a patriarchal system nurtured by the war.

In this region, the presence of the state is limited; therefore, the communities lack basic quality services such as an efficient health system, they are exposed to social and environmental risks, and the armed conflict itself is centred on the land dispute, which hinders families in its tenure and use [81,82]. The exploitation of energy resources and the expansion of monocultures, such as African palm, together with drug trafficking, have fragmented the ecosystems, affecting the territories, including those of the Barí indigenous reservation [79].

These dynamics perpetuate the precariousness of rural women, exposing them to the perpetuation of poverty and to greater risks of sexual violence, exploitation, and forced displacement, since they are in a position of subordination and limited access to resources and economic opportunities. Finally, this situation of structural violence not only reproduces social inequalities but also reinforces gender vulnerabilities, particularly affecting rural women in their aspirations to improve their quality of life.

Catatumbo in Colombia shares characteristics with other regions of the world affected by protracted conflicts, illicit economies and lack of state presence. In Latin America, it resembles the Valle de los ríos Apurímac, Ene y Mantaro (VRAEM) in Peru and the Chapare in Bolivia, where coca cultivation has generated violence, although with differences in state response and territorial control. In Peru, in the VRAEM, the conflict is mainly related to remnants of insurgent groups such as Sendero Luminoso, while in Catatumbo, Colombia, territorial control is contested by a diversity of armed actors, including post-demobilisation groups and criminal structures linked to drug trafficking. In Bolivia, the partial regulation of coca has allowed small producers to be integrated into legal commercialisation systems, while in Catatumbo, Colombia, the criminalisation of coca cultivation has generated greater tensions and repression, mainly affecting peasant communities [79,80].

In Africa, the Kivu region in the Democratic Republic of Congo presents similar dynamics but centred on the exploitation of minerals such as coltan and gold; while, in Kivu, the conflict is highly linked to transnational mining dynamics, in Catatumbo, Colombia the territorial dispute is more centred on the production of illicit crops and the control of drug trafficking routes [81,83].

In Asia, the Shan state in Myanmar experiences violence linked to opium production, although, with greater autonomy of local groups, there are autonomous enclaves that have managed to establish governance structures parallel to the state, while, in Colombia, the presence remains intermittent and fragmented [80,84].

3.2. Methodology Used

The research was developed under a qualitative approach, with an inductive and interpretative orientation, which sought to understand the leadership of rural women in the municipality of Tibú, Norte de Santander, Colombia, considering diverse realities, integral and constructed for the understanding of the phenomenon [85]. In this sense, the purpose of the article is to reveal the leadership experiences of rural women from a gender perspective in this municipality.

Primary information was obtained from ten interviews with rural women in the municipality of Tibú. The criteria for selecting the participants included being of legal age, residing in this municipality, having Colombian nationality, living in different dwellings, sharing a rural environment, being dedicated to cocoa cultivation combined with unpaid

work such as domestic and care work, being in the first link of the production chain, and having been potentially affected by the armed conflict, gender-based violence, and forced displacement or return from Venezuela. Table 1 details the socio-demographic characteristics of the key informants.

Table 1. Characteristics of key informant.

Code	Municipality of Residence	Age	Education Level	Marital Status	# of Dependents
RWT01	Tibú	35	Partially completed primary school	Separated	3 minors and 1 senior citizen
RWT02	Tibú	56	Partially completed primary school	Married	3 adults and 1 senior citizen
RWT03	Tibú	71	Partially completed primary school	Domestic Partnership	3 minors
RWT04	Tibú	41	Partially completed secondary school	Married	2 minors
RWT05	Tibú	40	Partially completed secondary school	Domestic Partnership	2 minors
RWT06	Tibú	44	Completed secondary school	Domestic Partnership	2 minors and 1 senior citizen
RWT07	Tibú	37	Completed secondary school	Married	2 minors
RWT08	Tibú	26	Technical level	Unmarried	2 adults
RWT09	Tibú	33	Technical level	Domestic Partnership	3 minors
RWT010	Tibú	22	Professional	Unmarried	0

Source: prepared by the authors. RWT01: Rural woman from Tibú 01.

The interviewed group was contacted via the Asociación de Hogares Juveniles Campesinos in Norte de Santander, Colombia. This organisation, which acted as a strategic ally, facilitated the researchers' safe entry into territories impacted by the Colombian armed conflict. The association leaders participated in the selection of the women interviewed, following previously defined inclusion criteria. The interviews were conducted in March 2024. Each participant signed an informed consent form, and to protect their identity, they were assigned a code (see Table 1). In this article, the central category of the study is rural women's leadership and it is approached from two subcategories: (1) associativity and (2) use of time (see Figure 1).

It is worth noting that the family and work environment of this population maintains constant structural characteristics, as well as economic, political, and social conditions that do not change significantly over time, which allows the experiences narrated to reflect the current reality and contribute to the understanding of the phenomenon.

The qualitative approach adopted to approach reality was based on a case study design, focusing on the knowledge derived from the experience of the case and the influence of its social, political and other contexts [86]. This method facilitated an understanding of the

actions and meanings associated with the events and allowed for continuous and dynamic interaction between the researcher and the participants [87].

The case study was conducted using the following guidelines [86,88,89]:

1. Definition of the case and its relevance: The case addressed is the leadership of rural women in Tibú, Norte de Santander, Colombia. This topic is relevant because of the experiences of these women in the face of challenges related to associativity and the use of time from a gender perspective.
2. Type of case study: This is a single study, whose unit of analysis is rural women cocoa producers in the aforementioned context.
3. Collection of primary information: It was carried out through ten interviews with rural women, who constitute the total number of beneficiaries of the research project financed by the Ministry of Science, Technology and Innovation (MINCIENCIAS) of Colombia, with the code [Cod. 102882 CT 235-2023]. The interviews were recorded, transcribed verbatim, coded, and analysed.
4. Data analysis: The analysis was carried out using grounded theory, which includes the following stages:
 - Open coding: Identifying concepts in the narratives, comparing response patterns and detecting information saturation, i.e., when the collected data no longer contributes new elements [90]. Open coding allowed for the identification of key concepts in the participants’ narratives, which led to a series of initial codes.
 - Axial coding: Creating emergent subcategories by grouping open-ended codes with thematic affinity. Through axial coding, we grouped these codes around two main subcategories: associativity and use of time, which emerged as fundamental aspects of rural women’s leadership in the context analysed.
 - Selective coding: Development of core categories by grouping the subcategories defined in axial coding, contrasting the results with the literature [91–94]. Selective coding allowed the integration of these subcategories around the central category of Rural Women’s Leadership, which facilitated the identification of significant patterns and their contrast with existing literature.

Finally, the interview transcripts and the coding file in Nvivo are available in open access in a dataset hosted in the Mendeley Data repository [95].

4. Results

The leadership experiences of rural women in Tibú, Norte de Santander, Colombia are presented below. The interviews were coded using a theory-based methodology, considering the two theoretical subcategories described in Figure 1. Each subcategory was organised using theoretical codes that allowed for the identification of significant patterns of women’s leadership. During this analysis, emerging codes also emerged that enrich the theoretical subcategories, revealing additional perspectives that enhance the understanding of rural leadership (see Table 2).

Table 2. Theoretical subcategories and associated codes.

	Theoretical Code Used *	Theoretical Code Not Used **	Emerging Code	References ***
1. Subcategory associativity				
Not participating in communitygroups	X			1
Having self-confidence	X			2

Table 2. Cont.

	Theoretical Code Used *	Theoretical Code Not Used **	Emerging Code	References ***
Achieving family and community respect	X			1
Aspiration of associativity			X	7
Existence of social norms			X	3
Knowledge transfer			X	3
Gender roles and stereotypes			X	5
Gender-based violence			X	1
2. Subcategory use of time				
Paid agricultural and non-agricultural working time	X			1
Paid non-agricultural work time	X			2
Paid agricultural labour time	X			2
Leisure time		X		0
Agricultural and non-agricultural unpaid working time			X	2
Unpaid non-agricultural working time			X	6
Unpaid agricultural working time			X	1

Source: prepared by the authors. * Theoretical code used in the interview coding process. ** Theoretical code not used in the interview coding process. *** Total number of times the code was referenced.

4.1. Subcategory Associativity

The results obtained in this subcategory highlight key features of the case study around women's participation and group work. On the one hand, barriers were identified such as the lack of participation in community groups due to personal factors such as shyness and individual isolation, although despite this, positive characteristics also emerge such as self-confidence and the ability of the participants to transform stereotypes around cocoa cultivation, being a tool that encourages respect within families and the community. Among the emerging codes, an interest in creating an association is highlighted, manifested in the desire to join together, diversify the use of cocoa, and strengthen their skills and productive practices; this process is influenced by social norms that encourage collaboration and group commitment, as well as the exchange of experiences. However, there are still challenges related to gender roles and stereotypes that limit the full integration of women in certain productive spaces. There is also evidence of gender-based violence, which impacts their personal and community trajectories.

There is a lack of participation in community groups linked to personal factors such as shyness and the desire for independence or individualism as indicated by RWT01:

RWT01 'I am a bit shy; I hardly share almost anything; I almost always live alone and not with a team'.

It can be seen how internal barriers such as introversion or fear of social rejection can limit women's integration into group work or leadership. This attitude also corresponds to the culture of mistrust that exists among the population of the municipality of Tibú, related to the context of armed conflict. This individual experience could also influence the ability to establish support networks, access shared resources and opportunities for growth in the community.

On the other hand, two of the rural women interviewed illustrate how self-confidence becomes a key element for rural women's leadership and empowerment. As shown below, interviewee RWT01 highlighted her ability to take on productive roles within cocoa farming, counteracting gender stereotypes and highlighting her competence in practices traditionally associated with masculinity.

RWT01 'Showing that we can grow cocoa, that we women can work it because it is not difficult'.

Another experience highlights the interest in facing the changes that the local agricultural system is going through, marked by the transition towards crops such as African palm, as RWT10 pointed out. In this context, cocoa is promoted as a sustainable alternative that, in addition to having advantages over other crops, makes it possible to recover a cocoa farming tradition that has been abandoned.

RWT10 'Many plantations have been replaced by palm trees, but it can be shown that cocoa can be produced'.

Other life routines revealed that rural women manage to gain appreciation and recognition of their community involvement through their participation in leadership roles and the aspiration to move towards associativity, teamwork, and the exchange of knowledge, as revealed in the testimony of RWT05:

RWT05 'Each of us has our strengths and we should use them in favour of working together in the association. We must to accept each other as we are, participating in my case with what I know, giving what I can support and my group accepts me, I will be there 100% supporting each other'.

Furthermore, this narrative underlines the importance of recognising individual strengths and using them for the benefit of the group, highlighting the mutual respect and acceptance that are fundamental to maintaining the commitment to organising and forming the association. It also highlights how these elements inspire women to contribute their own capacities, which converge with the collective capacities and thus strengthen cohesion and support networks.

Five emerging codes were generated in this subcategory of associativity: (1) aspiration of associativity; (2) existence of social norms; (3) knowledge transfer, (4) gender roles and (5) stereotypes and gender-based violence (see Table 2).

In this regard, the testimonies of the women interviewed reflect a common desire to associate as a strategy to improve cocoa cultivation and diversify its uses as they move up the production chain (see Table 3).

Table 3. Aspiration of associativity.

Code- Key Informant	Testimonials
RWT01	'Joining forces to further strengthen cocoa'.
RWT02	'Do different things with cocoa and the money can be seen'.
RWT03	'... to be more united, knowing the same as the partners'.
RWT05	'We have to put a lot of effort into it, because we cannot move this project forward with mental laziness. The benefit should not always be economic, but also knowledge that allows us to know things about the crop and to grow the crop faster'. 'To have access to technical assistance, soil studies, to certify the crop, to make it clean so that it has an added value'.
RWT06	'... going beyond just selling the cocoa bean to creating products to sell to earn more money'.
RWT08	'... to do other things with the production chain'.

Source: prepared by the authors.

As can be seen in Table 3, the participant RWT05 emphasised the relevance of the union as an impulse to strengthen cocoa cultivation, while RWT02 and RWT06 highlighted the interest in innovating to the extent that new derivative products would allow them to generate greater income. On the other hand, RWT03 expressed the importance of the need for greater cohesion among the group and the need to exchange experiences and knowledge as a basis for collective empowerment.

Likewise, RWT05 highlighted the relevance of associativity to achieve constant training around technical knowledge for crop improvement that allows going beyond the first link in the production chain. He also mentioned necessary elements that add value to future by-products, such as technical assistance, knowledge of the soil and constancy where clean cultivation is validated. Finally, the testimony of RWT08 showed an interest in generating new opportunities within the cocoa production chain, with the potential to broaden the impact of the work of rural women farmers, going beyond the simple direct sale of the beans.

It was also observed how the women interviewed accentuated the importance of commitment and group work, both conceived as norms that should exist when associating because they promote an environment of trust and solidarity (see Table 4). For RWT04, participating and working as a team is part of the collaboration, whereas RWT06 stressed that these agreements should be based on the absence of rivalry and the strengthening of mutual support. Finally, the testimony of participant RWT07 expressed a need for the promotion of values such as responsibility, such as attending meetings, which is essential for group cohesion (see Table 4).

Table 4. Existence of social norms.

Code- Key Informant	Testimonials
RWT04	'We have to work and support each other, come to the meetings'.
RWT06	'... rules can be to commit to meetings, to ask questions, to collaborate, not to have competition for the other partner'.
RWT07	'A lot of commitment, responsibility, attendance at meetings'.

Source: prepared by the authors.

Likewise, the willingness of the women to transfer their knowledge and experiences to others was also evident (see Table 5), seeking to strengthen teamwork and improve their cocoa crops and production, as a necessary tool for the development and improvement of the living conditions of those who are part of the associative process.

Also in Table 5, interviewee RWT04 expressed the relevance of teaching about marketing and sales channels, simultaneously RWT05 highlights collaboration through sharing the practical knowledge they have gained from their experience. As for RWT06, she underlines the importance of this knowledge including farming techniques, as well as the importance of organisation to optimise the crop.

From a gender perspective, this case study illustrates how rural women challenge traditional gender roles and stereotypes that restrict their participation and recognition in the cocoa production sector.

Table 5. Knowledge transfer.

Code- Key Informant	Testimonials
RWT04	'Well, explaining to them how it works, where to sell the cocoa'.
RWT05	'... sharing my little knowledge in the broad field of cocoa work, i.e., what has worked for me'.
RWT06	'... sharing with them about the importance of having their own crops, about some techniques that make cultivation more favourable, about being very organised'.

Source: prepared by the authors.

As can be seen in Table 6, the testimonies for this case study show how certain roles traditionally associated with domestic and care activities have been feminised tasks. The narrative of interviewee RWT01 pointed out the discrimination to which they are exposed for carrying out work that requires the use of objects of force associated with the masculine, such as the use of the 'scythe', as they are limited to domestic work. Likewise, participant RWT06 reiterated the association between gender and the sexual division of labour, stating that even though the workforce in the fields is seen as a male responsibility, women contribute by harvesting and drying tasks in cocoa cultivation.

Table 6. Gender roles and stereotypes.

Code- Key Informant	Testimonials
RWT01	'Even if we assume that there are jobs women do, sometimes we are rejected for doing them or get judged. For example, I know how to use a scythe, but sometimes they discriminate against me for that, they tell me that women belong in the house'.
RWT05	'There is a lot of male chauvinism here, but you have to know how far you can go as a woman. We are in the 21st century and many laws have changed and we can participate in other things'.
RWT06	'He does the hardest work, our contribution as women is better seen in at home'.
RWT08	'... the cleaning of the crop is in charge of men and women carry out activities related to pruning, harvesting and drying'.
RWT09	'... women have various trades, we are in the kitchen, everywhere'.

Source: prepared by the authors.

In contrast, it was observed that women have become more aware of roles and responsibilities in these allocations, challenging traditional division and encouraging their participation in spheres beyond care and reproduction. For example, RWT05 noted that despite the macho patriarchal structure, women are increasingly empowered to engage in activities that foster their agency and participation outside the home and care for others. For their part, RWT08 and RWT09 again highlighted the division of labour, i.e., although men are in charge of the hard tasks, women maintain fundamental participation in cocoa production and other trades, where they alternate to carry out activities in the fields and at home. This underscores a demand for inclusion in the public, active, and transformative spaces of the production chain, challenging roles and stereotypes that hinder the full realisation of their potential.

Finally, another finding in this subcategory points to a historical, social, political, and cultural problem that has made women vulnerable due to a patriarchal system that, through chauvinism, reproduces violence against women, their lives and bodies, and which has gradually ceased to be naturalised.

RWT03: 'At the beginning, the second husband used to beat me, he used to come home drunk, but not anymore because that's over'.

This testimony revealed an experience of domestic violence characterised by physical violence, associated with alcohol consumption and the exercise of power by the man over the woman. However, it is emphasised that not being in this situation at the moment represents a significant change, ignoring the consequences that these experiences of abuse have for women's lives.

4.2. Subcategory Use of Time

The findings in this subcategory emphasise the dynamics related to the use of rural women's time in paid and unpaid work and productive activities, as well as the time spent on leisure, notably, leisure time plays a crucial role in fostering leadership and empowerment. On the one hand, it became evident that the participants in this study dedicate time to both paid agricultural work such as the cultivation of bananas, cassava or palm, and on the other hand, they dedicate time to non-paid agricultural activities, such as a "piñata-making business" (a traditional object at children's parties, a hollow figure made of cardboard or papier-mâché, decorated and filled with sweets, toys or small surprises). It is hung up so that children, blindfolded, try to break it with a stick and collect its contents).

However, they spend a significant part of their time on unpaid agricultural and non-agricultural activities, such as domestic chores of housekeeping, food preparation, caring for their children, taking care of the chickens and activities related to processing cocoa for home consumption, which, although productive, do not generate income. This double burden significantly limits women's access to leisure time, a result of traditional gender roles that hinder their full participation in spaces designed to develop skills for personal and community growth. The lack of time for leisure stands out as a structural barrier that affects leadership and community participation, restricting women's opportunities to improve their living conditions and consolidate their role in the productive chain.

About rural women's paid agricultural and non-agricultural work time, it was observed how they distribute their time between different productive and non-productive activities from which they earn income.

RWT03: 'I help to plant bananas, I plant palms, I build fences (a structure that delimits land or properties in the countryside), I dedicate myself only to agriculture'.

In the case of RWT03, although he perceives it as a 'help' in farming activities, rather than a job, his participation in planting and other activities associated with the crops is evident.

In terms of non-agricultural paid work time, it is highlighted how rural women diversify their activities to generate income, as RWT08 highlights.

RWT08: 'I work in an office, and I get paid, I am an assistant'.

This shows their incorporation into the formal labour sphere, playing a role in an environment other than farming. Another experience shows an entrepreneurship initiative resulting from women's independent work to generate income, as expressed by RWT09.

RWT09: 'Together with my sister we have a piñata-making business, we sell breakfast surprises, and decorations for parties and events'.

Paid agricultural work time, on the other hand, shows how women participate in productive activities related to agriculture to generate their income. In this case, RWT01 stated: RWT01: 'I plant bananas, cassava, maize and sell it', which highlights her role in the cultivation and commercialisation of basic products; RWT05 stated: 'we have palm because sometimes it does not provide income, we sell surprise breakfasts', a narrative that reflects the diversification of other alternative crops as a strategy to guarantee family economic

stability, highlighting the effort to balance both productive responsibilities and contribute to the family’s livelihood.

In this subcategory of use of time, three emerging codes were identified: (1) agricultural and non-agricultural unpaid working time; (2) unpaid non-agricultural working time, and (3) unpaid agricultural working time.

The case of rural women who distribute their time simultaneously in unpaid activities both in the home and in the fields was also highlighted. In this sense, RWT06 said:

RWT06 ‘My role is to work at home and in the fields. I tend the household, but I also tend the plants in the field. I cut the weeds’.

This is evidence of how household responsibilities are combined with agricultural work. Similarly, RWT07 said:

RWT07: ‘Sometimes what is also difficult is that one has to project oneself into everything, I get up in the morning, make breakfast, work on the cocoa and return home to finish the household chores that I have pending’.

This narrative reflects the continuous work overload to which women are exposed in alternating between these socially unrecognised responsibilities. This unpaid and socially invisible work time is essential for the sustenance of both family and rural dynamics, as well as other productive activities, highlighting the efforts made by rural women, both in the public and private spheres.

Similarly, women’s unpaid non-agricultural work reflects the multitude of tasks they perform without compensation, underscoring the responsibilities tied to traditional gender roles and the sexual division of labour—an issue that tends to be more pronounced in rural contexts.

Participants such as RWT04, RWT06, and RWT07, recognise and perceive themselves as ‘housewives’, highlighting that, by attending to these family care activities, they occupy a large part of their time, in addition to using the short time remaining to care for animals as part of these tasks, as mentioned in RWT02. The testimony of RWT06 revealed the challenge for women to balance the time spent on care activities (see Table 7).

Table 7. Unpaid non-agricultural working time.

Code- Key Informant	Testimonials
RWT02	‘Yes, I cook, do housework, look after the pigs, the chickens and the sheep’.
RWT04	‘Housewife’.
RWT06	‘Housewife’. ‘...time between taking care of my daughters, my mum and farming is always enough’.
RWT07	‘A lot of commitment, responsibility, attendance at the meetings’. ‘Homemaker all the time’.
RWT08	‘Household activities’.

Source: prepared by the authors.

These testimonies show the burden of unpaid work that women face, creating barriers that limit their time available for other work or community opportunities, highlighting the need for recognition and social, cultural, and political support to reduce these inequalities.

Finally, in the unpaid agricultural work time that rural women carry out in their daily lives, RWT04 mentioned that she also ‘Helps to pick cocoa beans, dry them, remove the monilia (disease caused by a fungus) and sell them as well’, contributing significantly to the work of the first link in the production chain, although these tasks are not always remunerated.

5. Discussion

5.1. Subcategory Associativity

The findings of this case study, with the category associativity, suggest four challenges and opportunities for the participation and empowerment of rural women in the cocoa production chain, as shown in Figure 2.

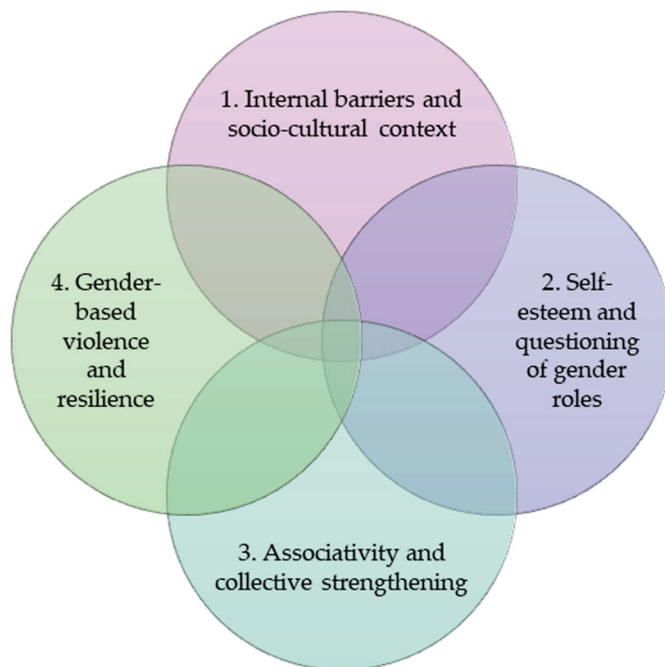


Figure 2. Challenges and opportunities for rural women's participation and empowerment. Source: prepared by the authors.

Regarding internal barriers and the socio-cultural context, the findings reveal shyness, isolation, and fear of social rejection that limit the integration of rural women in group work and community leadership. These barriers are influenced by the socio-cultural context of distrust and violence related to the armed conflict in the municipality of Tibú. This situation occurs because the Colombian–Venezuelan border encourages, facilitates, imposes, and invisibilises diverse dynamics, as the presence of armed groups and their powers reinforce the conditions of high violence and risk towards women [96].

In this regard, self-efficacy, understood as a person's belief in their ability to organise and execute actions to achieve a goal or outcome, plays a crucial role in motivation and persistence in group activities, and its absence can perpetuate a cycle of exclusion [97]. This finding reveals the commitment and responsibility of the actors that make up the Quintuple Helix at regional and national levels (university, business, state, civil society and environment) [98–100], i.e., initiatives and efforts for knowledge transfer, transformative innovations, and the empowerment of women and rural communities must be generated and articulated.

In this sense, the key factors that foster rural women's empowerment are organic farming, education, increased agricultural knowledge, marketing skills, changed cultural perspectives, and participation in economic activities [101]. Regarding adult education with a focus on rural women, it should be through popular education centres close to their homes and inspired by the method of Paulo Freire and his pedagogy of liberation, through literacy and popular education as a means to reach social justice [102].

Furthermore, it emphasises the importance of individual capacities as a basis for collective participation through the exercise of inclusive and active citizenship that de-

mands a greater understanding of the micro-politics of participation as a situated practice, which implies approaches that locate spaces of participation in the places where they occur by considering the possibilities of participation in the face of historical, political, social, and cultural particularities [103]. In this context, empowerment processes must consider both structural constraints and internal factors that affect women's ability to participate in decision-making spaces [104].

Concerning self-esteem and questioning of gender roles, there was also evidence of an increase in the self-confidence of some of the interviewees, reflected in the ability of rural women to challenge gender stereotypes in cocoa production, which is fundamental to their empowerment. This shift towards individual agency is essential for human development [105]. This finding is consistent with Colombian women's narratives, developments and experiences of long-term peacebuilding, and how women initiate processes that lead to peace, even amid conflict [106]. Other factors that raise rural women's self-confidence and give them the confidence to make decisions and to participate and speak in public are respect from their husbands, other household members, and the community [107].

On the one hand, the redistribution of roles and the valuing of women's work are also necessary advances for social justice [108]; on the other hand, from the capabilities approach, the transformation of social norms observed in the case of rural women is an example of how individuals can influence structural change [109].

Associativity and collective empowerment are reflected in the desire to associate and collaborate to strengthen cocoa cultivation and diversify their products and also reflect a strategy to overcome individual and structural barriers. This finding is consistent with other studies that reveal that membership in cooperatives or farmer groups not only increases women's decision-making power within a household but also the adoption of better agricultural practices and economic well-being is highly correlated with high levels of women's decision-making [110]. Similarly, women's participation in social activities equips them with knowledge through self-help groups, which also sensitises them to their rights, and enables them to build social networks and assume leadership roles within their communities [107].

In this sense, shared norms and cooperation to manage common resources in a sustainable way [111] are fundamental to the success of rural women's cooperative work. This teamwork and the generation of support networks constitute a form of social capital [66,112], which drives community development. This social capital is strengthened through the exchange of ancestral knowledge, experiences, and knowledge among rural women leads to the interaction of social, cultural, and economic forms of capital [113], improving productivity and empowering rural women.

Finally, this study exposed testimonies on gender-based violence and resilience that reflect how patriarchal structures perpetuate rural women's vulnerability. However, overcoming these situations also demonstrates their resilience and capacity to transform their environment. It is, therefore, essential that rural women recognise episodes of gender-based violence, whether physical, sexual, psychological, economic, emotional, social, vicarious or patrimonial, as this recognition is an essential step in dismantling the oppressive structures that perpetuate these forms of violence [114].

Furthermore, these findings are consistent with previous studies which indicate that access to only economic resources is insufficient for rural women to fully exercise their decision-making power. This occurs when discriminatory social norms and beliefs toward women weaken the bargaining power that could be derived from obtaining income or assets [115]. Strengthening this agency therefore requires challenging existing gender relations and actively promoting women's economic empowerment. In the face of this

reality, gender relations are dynamic and can be renegotiated through empowerment processes [116].

In addition to individual, collective, economic, psychological, social, and political empowerment, legal empowerment is fundamental to ensuring safe environments in which women can fully develop. Such empowerment is strengthened by promoting awareness of their legal rights, improving policies that protect them, and strengthening laws against perpetrators of violence against women [117].

Women's empowerment, therefore, requires building a society and political environment, free from discrimination, violence, and harassment related to the fact that they are women, where they can actively participate in development and decision-making. This is essential for achieving sustainable development [118,119]. Finally, this study motivates the need for the implementation of public policies and programmes that address both the structural causes of violence and the strengthening of individual capacities.

5.2. Subcategory Use of Time

Regarding the subcategory use of time, the results reveal that rural women in this case study bear a disproportionate burden of paid and unpaid work. This significantly restricts their right to leisure and cultural activities, which, notably, were not recognised as part of their daily lives despite being essential for empowerment and the development of leadership skills. This finding coincides with Martha Nussbaum, who argues that time is an essential resource for the development of human capabilities, such as autonomy and social participation [73]. From this perspective, the lack of available time prevents women from fully participating in community leadership and decision-making.

The unequal distribution of time between paid productive activities and unpaid domestic and care work, as shown in the results, evidences that, despite progress on gender issues, gender roles persist. This situation coincides with the results of a study that revealed that although women have started to reduce their time spent on care activities, they continue to dedicate more hours to domestic work compared to men, and when they are able to work, their earnings are lower than those of their male counterparts, reflecting a disproportionate burden [72].

The lack of social valuation of unpaid work, such as caring for homes and even animals, reinforces the structural barriers to female leadership. The invisibility and silence of this reality limit women's ability to exercise their autonomy, as they prioritise the needs of the household over their personal and professional development [18]. This situation is exacerbated in rural contexts, where women play a key role in subsistence agriculture; however, their role is still underestimated in terms of social and economic recognition [3].

Along these lines, testimonies on entrepreneurship initiatives show that, although women find ways to generate income, these are often conditioned by the burden of unpaid work that they must simultaneously manage. This dual role not only perpetuates inequalities but also reflects the sexual division of labour, deepening gender gaps in terms of time and resources [82,120].

As mentioned above, the lack of time for leisure, identified as a barrier to leadership, aligns with the capabilities approach, which highlights the importance of holistic well-being for women [71]. Equitable redistribution of domestic responsibilities and access to tools that alleviate workloads could open spaces for women to participate more actively in leadership and community empowerment processes [9]. At the structural level, the results highlight the need for gender-sensitive public policies that address inequalities in time allocation. The implementation of Law 731 of 2002 in Colombia, aimed at improving rural women's access to resources and participation in planning processes, is a step in this

direction [41]. However, the limited application of these policies limits their real impact on rural women's well-being and leadership.

Finally, the findings reveal that time use not only reflects gender inequalities in rural areas but also serves as a structural barrier to women's leadership. Addressing these barriers requires implementing strategies to equitably redistribute time and recognise the value of both paid and unpaid women's work. Such actions will not only foster individual and collective empowerment but also enhance the economic and social development of rural communities.

Achieving women's empowerment (greater autonomy, recognition, and visibility of their contributions) and ensuring their access to guarantees of other human rights, as well as their participation, is a political right that must go hand in hand with the permanent improvement of their living conditions and greater possibilities for development.

6. Conclusions

The participation and empowerment of rural women in the cocoa production chain are conditioned by internal and structural barriers derived from the socio-cultural context. Factors such as shyness, fear of social rejection and distrust, influenced by the violence in the region, limit their integration in collective spaces. Self-efficacy and education are essential to overcome these barriers, and strategies such as the Quintuple Helix can boost social and economic development through knowledge transfer and the creation of transformative initiatives.

Associativity is key to strengthening cocoa production and generating economic opportunities for rural women. Participation in cooperatives and support networks improves decision-making, access to technical knowledge and autonomy in the agro-productive sector. It is essential to promote policies and programmes that strengthen women's leadership and participation in rural development.

The unequal distribution of time between paid and unpaid work remains an obstacle to rural women's development. The excessive burden of domestic responsibilities limits their access to training and decision-making spaces. Policies for equitable redistribution of time and recognition of unpaid work are essential for their well-being and leadership. In addition, ensuring legal protection and an environment free of violence would contribute to empowerment and gender equity in rural areas.

Limitations of the research:

The research is based on a case study in a specific region of Colombia, which allows for in-depth analysis but may limit the generalizability of the findings to other rural contexts with different socio-economic and cultural dynamics.

The research does not delve into quantifiable indicators of the impact of women's participation in the cocoa production chain; therefore, future research could complement these findings with quantitative analysis.

Future research perspectives:

It is recommended to extend the study to other rural communities to contrast similarities and differences in barriers and opportunities for women's empowerment in diverse agricultural contexts.

Future research could further explore the effectiveness of educational programmes and intervention strategies based on popular education and women's leadership approaches, using methodologies such as Freire's pedagogy of liberation as a reference.

It would also be relevant to analyse in greater detail the impact of associativity on the economic autonomy of rural women through longitudinal studies that allow for the evaluation of changes over time.

From a public policy perspective, future research could evaluate the implementation and effectiveness of government programmes aimed at improving rural women's access to productive resources and decision-making spaces.

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Article

Balancing Tradition and Innovation: The Role of Environmental Conservation Agriculture in the Sustainability of the Ifugao Rice Terraces

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Abstract: This study investigates the continuation of Environmental Conservation Agriculture (ECA) practices among farmers in the Ifugao Rice Terraces, a Globally Important Agricultural Heritage System (GIAHS) in the Philippines. Through a cross-sectional survey of ECA farmers in the municipality of Banaue, this research explores the socio-demographic, environmental, and economic factors influencing the adoption and persistence of ECA. The findings reveal that while access to resources such as high-yielding seeds, modern farming equipment, and financial support is important for the adoption of ECA, the shift toward high-yielding varieties has contributed to a decline in the cultivation of Tinawon rice, which is vital for maintaining the ecological balance and cultural heritage of the terraces. This study underscores the importance of balancing modern agricultural practices with the continued cultivation of Tinawon rice to preserve biodiversity, soil health, and cultural identity, while also enhancing agricultural productivity. Additionally, the roles of community-based support systems, market access, and financial incentives are highlighted as key factors in sustaining ECA practices. Climate change presents both challenges and opportunities for adaptation, making it essential to integrate traditional knowledge with modern techniques to build resilience. Understanding the factors that shape ECA continuation is crucial for refining initiatives that address both the economic and cultural contexts. By emphasizing the importance of tailored, community-driven interventions, this study provides critical insights for enhancing ECA adoption in the Ifugao Rice Terraces, contributing to climate resilience and the long-term sustainability of this significant agricultural heritage system.

Keywords: environmental conservation agriculture; Globally Important Agricultural Heritage System; Ifugao farmers; Ifugao rice terraces; climate change mitigation; sustainable agriculture

1. Introduction

Agriculture plays a crucial role in shaping the cultural, economic, and ecological landscapes of communities around the world. A prime example of this is the Ifugao Rice Terraces in the Philippines, which are recognized as part of the Globally Important Agricultural Heritage Systems (GIAHSs). This designation, granted by the Food and Agriculture Organization (FAO) of the United Nations, highlights the terraces' exceptional value for

both sustainable agriculture and cultural preservation [1]. These terraces, with their complex systems of irrigation and soil management, have sustained local farming communities for centuries. The Ifugao Rice Terraces are a model for sustainable farming, blending traditional agricultural practices with modern conservation techniques. These techniques include the use of natural fertilizers, contour farming, and biodiversity preservation, which contribute to the terraces' ecological health. These methods help mitigate soil erosion, maintain water systems, and enhance resilience to climate change, ensuring the long-term sustainability of the terraces and their surrounding environment. However, the Ifugao Rice Terraces face increasing pressures from modern agricultural practices, climate change, and socio-economic challenges [2]. This study focuses on ECA farmers within the GIAHS area of Ifugao, specifically in the municipality of Banaue, to explore the continuation of Environmental Conservation Agriculture (ECA) practices. ECA is seen as an effective means of fostering sustainability and resilience in the face of climate change while preserving traditional agricultural knowledge and practices.

This research aims to explore the socio-demographic, environmental, and economic factors that are associated with the adoption and continuation of ECA among these farmers. It also seeks to investigate the interplay between climate change, agricultural practices, and the long-term sustainability of the Ifugao Rice Terraces. The findings of this study have implications for improving agricultural policies and support systems to sustain traditional farming systems in the face of modern challenges, ensuring that these heritage sites continue to thrive for generations to come.

1.1. Environmental Conservation Agriculture in the Ifugao Rice Terraces

The Ifugao Rice Terraces stand as a remarkable testament to indigenous agricultural practices that prioritize environmental sustainability. Recognized as a UNESCO World Heritage site in 1995, the terraces are renowned for their intricate irrigation systems and their role in fostering local biodiversity. However, these agricultural systems are increasingly threatened by the impacts of climate change, deforestation, and the encroachment of commercial farming practices [2–4]. As a result, preserving these agricultural heritage systems has become a pressing priority, not only for cultural conservation but also for promoting sustainable farming practices that can serve as models for other regions facing similar challenges.

The concept of a GIAHS, introduced by the Food and Agriculture Organization (FAO) in 2002, underscores the significance of traditional agricultural systems in maintaining biodiversity and advancing environmental sustainability [5]. The GIAHS designation highlights agricultural landscapes that have evolved over time, where indigenous farming methods have developed in harmony with the natural environment [1]. In 2011, the Ifugao Rice Terraces were recognized as a GIAHS site, embodying the ideal of blending culture, agriculture, and environmental stewardship.

ECA is an innovative farming approach that merges traditional and modern practices to enhance sustainability, resilience, and climate adaptation [6]. ECA emphasizes reducing chemical inputs, conserving water, improving soil health, and preserving local biodiversity [7]. Studies in Japan have demonstrated how ECA contributes to mitigating climate change by reducing greenhouse gas emissions, showcasing its potential as a sustainable farming practice [8,9]. In the context of the Ifugao Rice Terraces, traditional farming practices already align closely with the principles of ECA, offering a strategy to maintain the delicate ecosystems of the terraces while ensuring food security for local farmers.

For generations, Ifugao farmers have employed sustainable methods that naturally fall under the umbrella of ECA [6,10]. They use organic fertilizers and pesticides, practice composting, and implement crop rotation to maintain soil health and fertility. Additionally,

indigenous pest management techniques, such as utilizing natural predators or plant-based solutions, help control pests without resorting to harmful chemicals [11]. These time-tested practices not only protect the environment but also contribute to the resilience of the rice terraces against environmental pressures.

While ECA supports the adoption of high-yielding and drought-resistant crop varieties, it ensures that these crops are cultivated using organic inputs or sustainable practices. This approach ensures that increased productivity does not come at the expense of the terraces' environmental health. By combining modern crop varieties with traditional, environmentally friendly practices, ECA allows farmers to enhance productivity without compromising the ecological integrity of the rice terraces. This integration of traditional knowledge and modern sustainable techniques exemplifies the core values of ECA, ensuring farming practices remain environmentally resilient, economically viable, and culturally sustainable.

However, the introduction of high-yielding varieties, while offering higher yields and greater resilience, has led to a decline in the cultivation of Ifugao's heirloom rice, particularly the Tinawon variety [12]. Cultivated in the terraces for several decades, Tinawon rice is a key element of both the ecological and cultural identity of the terraces. This traditional variety is well-adapted to the terraces' unique microclimates and irrigation systems, offering resilience to local environmental conditions and contributing to the region's biodiversity. Tinawon rice is also prized for its distinct flavor and nutritional value. The highest recorded harvest of Tinawon rice was in 2015, with 26,070.25 metric tons (MT) across 8338.25 hectares. However, production declined sharply in the following years, falling to just 4239.9 MT over 1493.60 hectares in 2020, representing a decrease of approximately 83.7% in production over five years. According to Rovillos et al. (2024), several other factors contributed to this decline. The long growing period required for Tinawon is a major challenge, especially in comparison to high-yielding varieties, which can be planted two to three times a year and offer faster returns [12]. Additionally, the labor-intensive nature of Tinawon production demands the involvement of the community throughout the entire process of production. This has become increasingly difficult due to socio-economic factors such as outmigration, where individuals seek better employment opportunities and higher education outside of rice farming [13]. These combined challenges have made it harder for local communities to sustain Tinawon production, leading to a shift toward more economically viable alternatives.

The loss of Tinawon rice and the resulting ecological imbalances underscore the complex challenges facing the Ifugao Rice Terraces [14]. While high-yielding varieties offer short-term economic gains, their widespread adoption has led to biodiversity loss, soil degradation, and the rise of new pests, further intensifying the challenges faced by farmers. These issues highlight the need for a more balanced approach that enhances productivity while preserving the ecological integrity of the terraces and maintaining the cultural heritage tied to traditional crops like Tinawon.

ECA offers a potential solution by promoting sustainable farming practices such as organic inputs, crop rotation, and integrated pest management [8]. Through ECA, Tinawon can be prioritized in designated areas to preserve its cultural and ecological significance, while high-yielding varieties can be cultivated in less prioritized areas using reduced chemical inputs or organic alternatives. This approach helps prevent soil erosion and mitigates the decline of Tinawon planting, ensuring its continuous cultivation. By finding a middle ground, this strategy supports the preservation of Tinawon, the heirloom rice variety of Ifugao, while allowing farmers to earn additional income from high-yielding varieties. This integrated framework fosters a balance between traditional farming practices and modern agricultural needs, ensuring the sustainability of the rice terraces.

Climate change represents a significant threat to traditional agricultural systems worldwide, including in the Philippines [3]. Ifugao Province, in particular, has experienced shifts in weather patterns, such as rising temperatures, more frequent typhoons, and altered rainfall patterns [12]. These climatic changes exacerbate existing farming challenges, including water scarcity, soil erosion, and crop damage. In response, many farmers have adapted by altering planting schedules, diversifying crops, and adopting improved water management techniques. Studies show that these adaptive strategies are crucial for maintaining agricultural productivity and ensuring the livelihoods of farming communities in the face of climate change [14,15].

A growing body of literature suggests that the continuation of sustainable agricultural practices, such as ECA, is strongly influenced by socio-economic factors, including farmers' access to resources, education, and financial support [6,16]. For example, access to high-yielding seeds, modern farming equipment, and irrigation systems is often a barrier to the adoption of conservation agriculture in rural communities. Socio-demographic factors, such as age, education, and community networks, also play critical roles in shaping farmers' decisions to adopt and sustain sustainable farming practices [17]. Additionally, cultural values, including the importance of traditional knowledge and practices, influence the willingness of farmers to integrate modern techniques, with some expressing concerns about the compatibility of new practices with indigenous rituals and beliefs [18].

Despite these challenges, the potential benefits of ECA are evident. Research shows that sustainable practices not only help mitigate climate change but also improve soil health, enhance water retention, and increase biodiversity [19,20]. Furthermore, ECA has socio-economic benefits, such as improved crop yields, enhanced food security, and the empowerment of marginalized groups, including women and youth in farming communities [21]. By exploring the factors that influence the adoption and continuation of ECA among Ifugao farmers, this research aims to contribute to the broader discussion of the role of traditional agricultural systems in fostering sustainability and resilience in the face of modern challenges.

1.2. Theoretical Foundation

The theoretical foundation of this study is grounded in several key frameworks that address the intersections between traditional agricultural practices, sustainability, and climate change adaptation. These include the Sustainable Livelihoods Framework (SLF), Ecological Modernization Theory (EMT), and Resilience Theory. Together, these theories provide a comprehensive lens through which to examine the continuation of Environmental Conservation Agriculture (ECA) practices in the Ifugao Rice Terraces, focusing on how socio-economic, cultural, and environmental factors influence farmers' decisions and practices.

(A) Sustainable Livelihoods Framework (SLF)

The Sustainable Livelihoods Framework (SLF), developed by the Department for International Development (DFID), posits that individuals and households pursue sustainable livelihoods by drawing upon various types of capital—natural, human, social, physical, and financial—within a context of vulnerability, policies, and institutional structures [22,23]. In the case of the Ifugao Rice Terraces, the SLF helps explain how farmers leverage traditional knowledge (human capital), community networks (social capital), and natural resources (natural capital) to maintain sustainable farming practices amidst challenges such as climate change and economic constraints. This framework is particularly relevant to understand how farmers balance their immediate needs, such as food security and income generation, with longer-term sustainability goals.

In the context of the Ifugao farmers, the SLF highlights the critical role of social capital, where strong community networks facilitate the exchange of agricultural knowledge and resources. These networks enable farmers to access support for ECA practices, adapt to climate-induced stressors, and maintain traditional practices that align with sustainability objectives. Furthermore, the SLF suggests that the availability of financial resources (financial capital), such as subsidies or access to microcredit, plays a significant role in supporting sustainable farming practices and overcoming economic barriers.

(B) Ecological Modernization Theory (EMT)

Ecological Modernization Theory (EMT) argues that modern societies can achieve environmental sustainability through technological innovation, institutional reform, and the integration of environmental goals with economic and social development [24,25]. In this study, EMT provides a lens for understanding the integration of modern environmental conservation practices with traditional agricultural systems in the Ifugao Rice Terraces. The concept of “ecological modernization” suggests that the adoption of sustainable farming practices, such as ECA, can enhance environmental outcomes without compromising economic development. The theory posits that technological advances, such as improved irrigation systems and drought-resistant crops, can complement traditional agricultural techniques to increase productivity and environmental resilience.

In the Ifugao context, EMT allows us to explore how farmers incorporate modern sustainable agricultural practices (e.g., organic farming and water management techniques) alongside indigenous practices, like composting and crop rotation. The interplay between these approaches demonstrates the potential for ecological modernization in preserving heritage farming systems while promoting climate adaptation and sustainability. Furthermore, the theory’s emphasis on institutional support underscores the role of government policies, subsidies, and community-driven initiatives in fostering the widespread adoption of ECA.

(C) Resilience Theory

Resilience Theory focuses on the capacity of systems—whether ecological, social, or economic—to absorb disturbances, adapt to change, and transform to ensure long-term sustainability [26,27]. Resilience, in this context, is the ability of farmers in the Ifugao region to maintain and adapt their agricultural practices in response to challenges such as climate change, economic hardship, and the erosion of traditional knowledge. The theory is particularly pertinent to understanding how farmers develop adaptive strategies, such as altering planting schedules or diversifying crops, to cope with shifting weather patterns, reduced water availability, and other climate-related disruptions.

By applying Resilience Theory, this paper explores how the ECA practices adopted by farmers serve as mechanisms for building resilience in agricultural systems. These practices—such as organic farming, soil conservation, and integrated pest management—are seen as strategies that enable farmers to maintain the integrity of their farming systems in the face of external stressors. The theory also provides a basis for understanding the dynamic relationship between the social and ecological systems in the Ifugao Rice Terraces, where the resilience of one system supports the resilience of the other, fostering a sustainable and adaptive farming community.

Together, these theoretical frameworks offer a multidimensional perspective on the continuation of ECA practices in the Ifugao Rice Terraces. They highlight the complex interactions between economic, social, cultural, and environmental factors that influence farmers’ decisions, providing a foundation for analyzing the factors that drive the adoption and sustainability of ECA practices in this culturally and ecologically significant region.

2. Study Area and Methods

This research centers on ECA practices among farmers within the GIAHS, specifically focusing on the province of Ifugao. Since 2011, Ifugao has held the distinction of being the only site in the Philippines recognized as part of the Globally Important Agricultural Heritage Systems (GIAHSs). This province is renowned for the Ifugao Rice Terraces, a remarkable example of human ingenuity and sustainable agriculture that has gained global recognition. Inscribed as a UNESCO World Heritage Site in 1995, these terraces are celebrated not only for their aesthetic and cultural value but also for their advanced engineering and environmental harmony. Declared national treasures in the 1970s through Presidential Decrees 260 and 1505, the terraces faced significant challenges in the early 2000s, including neglect and a lack of maintenance, which led to their inclusion on the World Heritage in Danger list in 2001. Thanks to concerted efforts by national and local governments, as well as the active participation of the Ifugao community, extensive restoration projects were undertaken. These initiatives addressed structural damages, revived traditional farming practices, and promoted sustainable tourism, culminating in the terraces' removal from the Danger list in 2012. Today, the Ifugao Rice Terraces not only symbolize resilience but also serve as a model for the preservation of cultural landscapes and sustainable agricultural systems in the face of modern challenges.

This study examines two of the five rice terrace clusters in the province: the Batad and Bangaan terraces, located in the municipality of Banaue (Figure 1). Banaue, categorized as a 4th class municipality with an annual income between PHP 40 million and PHP 60 million, is home to 20,652 people across 18 barangays, including Batad and Bangaan, which are both recognized GIAHS clusters. The municipality's classification reflects its economic status and development level.

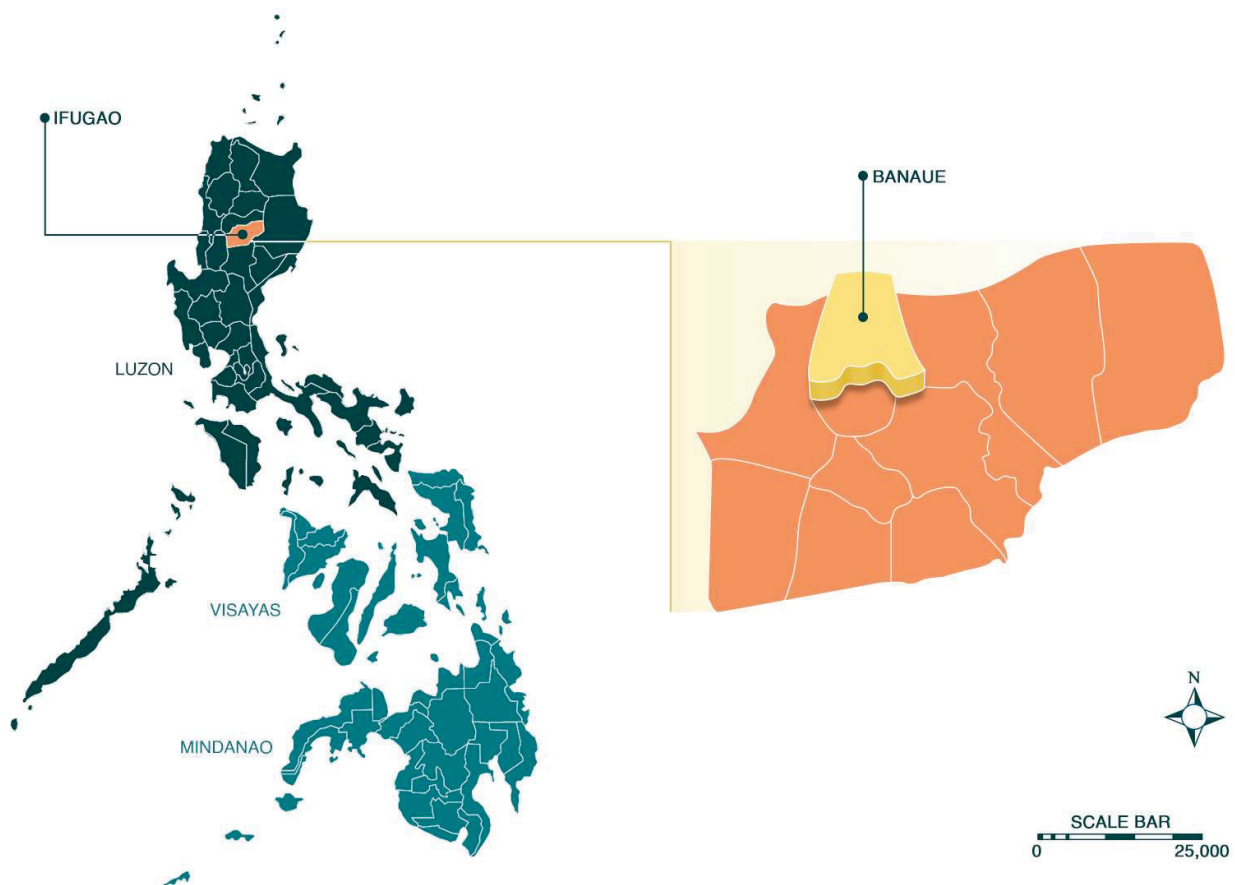


Figure 1. Sampling site of this study.

This research was conducted by the GIAHS Center of Ifugao State University (IFSU), which is dedicated to preserving the terraces through focused research, community engagement, and cultural restoration. The Center also works on agricultural revitalization, biodiversity documentation, and the development of national databases for the indigenous systems associated with the rice terraces. This study was undertaken in collaboration with the Environmental Conservation Agriculture (ECA) project led by Dr. Keshav Lall Maharjan at Hiroshima University.

Preliminary consultations with key stakeholders, such as the mayor of Banaue and local agricultural officers, were conducted to secure approval for this study. A comprehensive list of GIAHS farmers in Banaue was compiled, and from this list, a random sample of 252 farmers was selected for participation. The primary selection criterion was that participants must be farmers within the Batad and Bangaan rice terrace clusters of Banaue, which are officially designated as GIAHSs by the FAO. Data collection took place between December 2022 and January 2023, utilizing a standardized questionnaire administered through face-to-face interviews. These interviews were conducted by field researchers from the IFSU GIAHS Center who were fluent in the local Ifugao language and translated the responses into English for analysis. This study also included additional data collection methods such as focus group discussions, key informant interviews, and on-site observations, which helped enrich the data and provide a deeper understanding of the farmers' practices.

This study adhered to ethical standards outlined in the Declaration of Helsinki, receiving approval from the Ethics Committee of the Graduate School for International Development and Cooperation at Hiroshima University (Approval code: HUIDEC-2022-0090). Researchers followed strict ethical guidelines to ensure the integrity and ethical conduct of this study, and all participants provided informed consent.

The questionnaire gathered socio-demographic and farming-related information, as well as data on ECA practices among farmers in the rice terrace communities of Banaue. The continuation of ECA practices was evaluated using a five-point scale (1-strongly no, 2-no, 3-unsure, 4-yes, 5-strongly yes), which served as the dependent variable in regression analyses. Ordinal logistic regression was used to identify significant factors influencing ECA practices among farmers, with the model fit, goodness-of-fit, and parallel lines tested in SPSS v.27 (IBM, New York, NY, USA). Correlation analyses, including Phi and Cramer's V, Chi-square, and Spearman's correlation analyses, were also performed to deepen the understanding of the data.

This comprehensive research will contribute valuable insights into the sustainability of the Ifugao Rice Terraces and serve as a resource for enhancing environmental conservation agriculture efforts in the region.

3. Results

3.1. Socio-Demographic and Farm-Related Data of ECA Farmers in the Rice Terrace Clusters of Banaue

The study sample of 252 ECA farmers highlights several noteworthy characteristics (Supplementary Table S1). A higher proportion of female respondents (56.7%) compared to males is notable, as farmer-focused studies are often male-dominated. The farmers are predominantly middle-aged, with the largest age groups being 40–49 years old (22.2%), 30–39 years old (20.6%), and 50–59 years old (18.3%), collectively comprising 61.1% of the productive age range of 30–59 years. They also exhibit extensive farming experience, with 67.4% having over 20 years of practice, including 21.0% with 20–29 years and 19.0% with 30–39 years of experience. Newer farmers, with less than 10 years of experience, account for a smaller portion at 14.3%, suggesting a predominantly seasoned farming

population capable of intergenerational knowledge transfer. In terms of education, 50.4% of respondents completed elementary school, and 32.5% attained a high school education. Most farmers (65.9%) are married, and more than half (51.6%) live in small households with 2–4 family members, followed by 26.2% with medium-sized families of 5–6 members. Nearly half (43.3%) are affiliated with agricultural organizations, and 89.3% have identified farm inheritors, ensuring the continuity of farming traditions.

In terms of challenges faced in farming, the top issues include low crop yields (98.8%), drought and water scarcity (88.9%), limited irrigation facilities (86.9%), insufficient farming equipment or work animals like carabaos (swamp buffaloes: *Bubalus bubalis carabanesis*) (77.4%), lack of access to high-yielding crop varieties (74.2%), a shortage of labor (73.8%), and insufficient income (67.9%). Despite these challenges, nearly all farmers (99.2%) expressed their intent to continue farming over the next 5 to 10 years.

Economically, farming remains a subsistence-level activity for most respondents, with 77.4% earning PHP 20,000 or below annually and only 4.8% earning above PHP 40,000. Farming expenses are similarly modest, with 65.1% spending PHP 10,000 or below and only 9.9% incurring costs above PHP 25,000. The majority (97.2%) farm primarily for self-consumption, with 94% relying on personal savings as their main source of capital. Farmers also generate supplementary income through remittances from relatives working abroad or outside Ifugao (25.0%), tourism-related activities (24.2%), selling handicrafts or artisan goods (3.6%), and woodcarving and craftsmanship (2.4%).

Farmers widely practice environmentally friendly techniques aligned with ECA principles (Figure 2), such as composting (91.3%), indigenous pest management (85.3%), crop rotation (76.6%), and the application of organic fertilizers (76.2%). Notably, 65.5% avoid chemical pesticides and fertilizers, demonstrating a strong commitment to sustainable agriculture. These practices align with the broader goals of conserving resources while maintaining productivity, highlighting the farmers’ role in promoting ecological balance in their communities.

ECA methods being used (n=252)

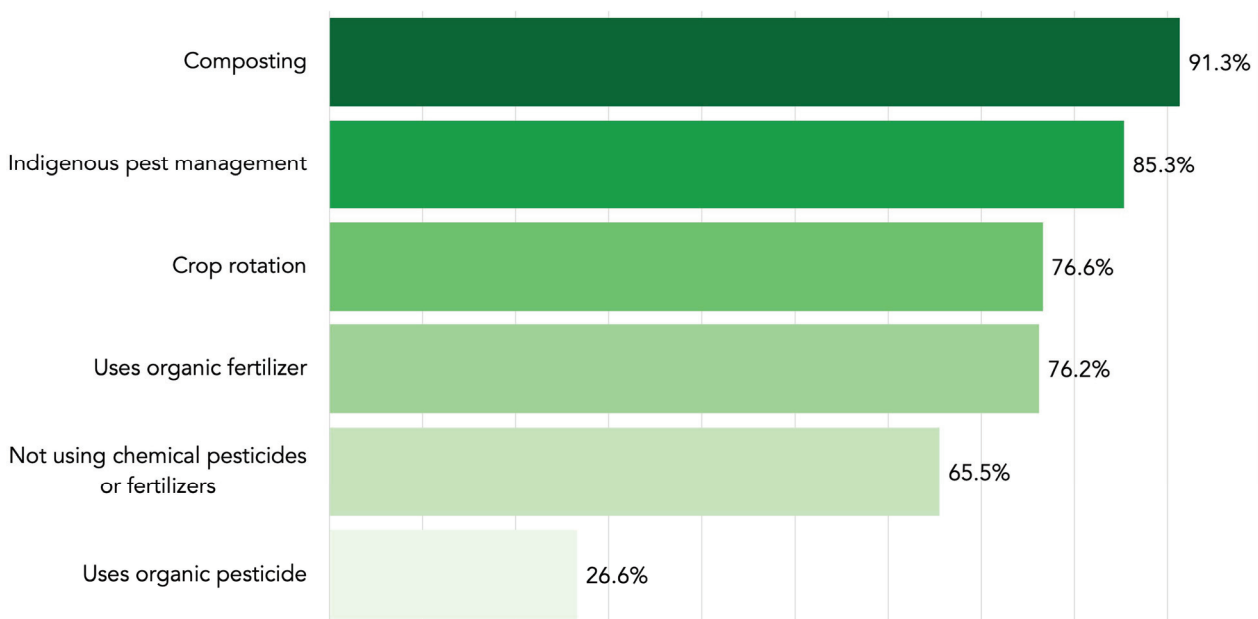


Figure 2. ECA methods being used by the Ifugao GIAHS farmers in this study.

The community values traditional practices, as more than half (56.7%) still incorporate rituals in farming, although only 46.9% believe these rituals remain helpful. These customs are closely tied to the planting of Tinawon rice, an heirloom variety grown in the Ifugao Rice Terraces. Among the rituals that some farmers maintain are tungaw, ngirin, and urpi. Tungoh/tungaw is observed after the mumbaki performs the lukya, marking the first time rice bundles are taken out of the granary or alang for family consumption. Tungoh/tungaw is a day of idleness where people stay home and visitors are not allowed to enter the village. This practice fosters communal rest and reflection. After tungoh/tungaw, other families in the village may perform their own lukya, signifying the interconnectedness of the community's cultural traditions. Ngilin/ngirin starts on the eve of the harvest and is resumed early in the morning of the harvest day. This ceremony is performed before harvesters arrive to reap, aiming to implore the gods and ancestral spirits to grant blessings on the harvest. It also seeks to appease 'jealous' gods, ensuring that the rice harvest proceeds without interference. This rite underscores the community's belief in the spiritual guardianship of their agricultural activities. Kulpi/urpi is performed when new leaves begin to sprout on transplanted rice plants, marking the start of the weeding season. This ritual asks the gods to protect the growing plants, demonstrating the community's proactive care and spiritual connection to their crops. These rituals emphasize the deep cultural and spiritual ties the Ifugao people have with their land and farming traditions. By weaving these ceremonies into the cultivation of Tinawon rice, the community preserves its ancestral heritage while sustaining the rice terraces—a UNESCO World Heritage Site—and passing on valuable indigenous knowledge to future generations. Notably, 84.5% receive farming subsidies, with 76.2% finding them beneficial.

When considering their priorities in farming, farmers emphasized achieving peace of mind (84.9%), minimizing expenses (79.4%), fostering camaraderie (79%), ensuring a high crop quality (78.2%), and maximizing income and yields (78.2%). Their key sources of farming information include co-farmers (94.8%), barangay officials (24.2%), and agricultural technicians (23.4%), while their motivations to adopt ECA practices are influenced by co-farmers (63.9%), family or ancestors (40.1%), and media sources (32.9%).

Farmers identified several key needs to support their agricultural activities (Figure 3). The top priorities include improved irrigation facilities (97.6%), solutions for managing soil erosion in the rice terraces (94.0%), access to modern machinery or carabaos (84.1%), diversified income opportunities (84.9%), high-yielding seed varieties (82.5%), and fair and competitive pricing for harvested crops (66.3%).

Overall, this study portrays a resourceful and experienced farming community navigating economic constraints while balancing traditional and sustainable practices. Their widespread adoption of environmentally friendly techniques underscores a commitment to ecological resilience and productivity. By prioritizing cultural values, collaborative networks, and sustainable agricultural methods, these farmers exemplify a harmonious integration of heritage and innovation, ensuring continuity and adaptability amidst economic and environmental challenges.

Support needed for farming (n=252)

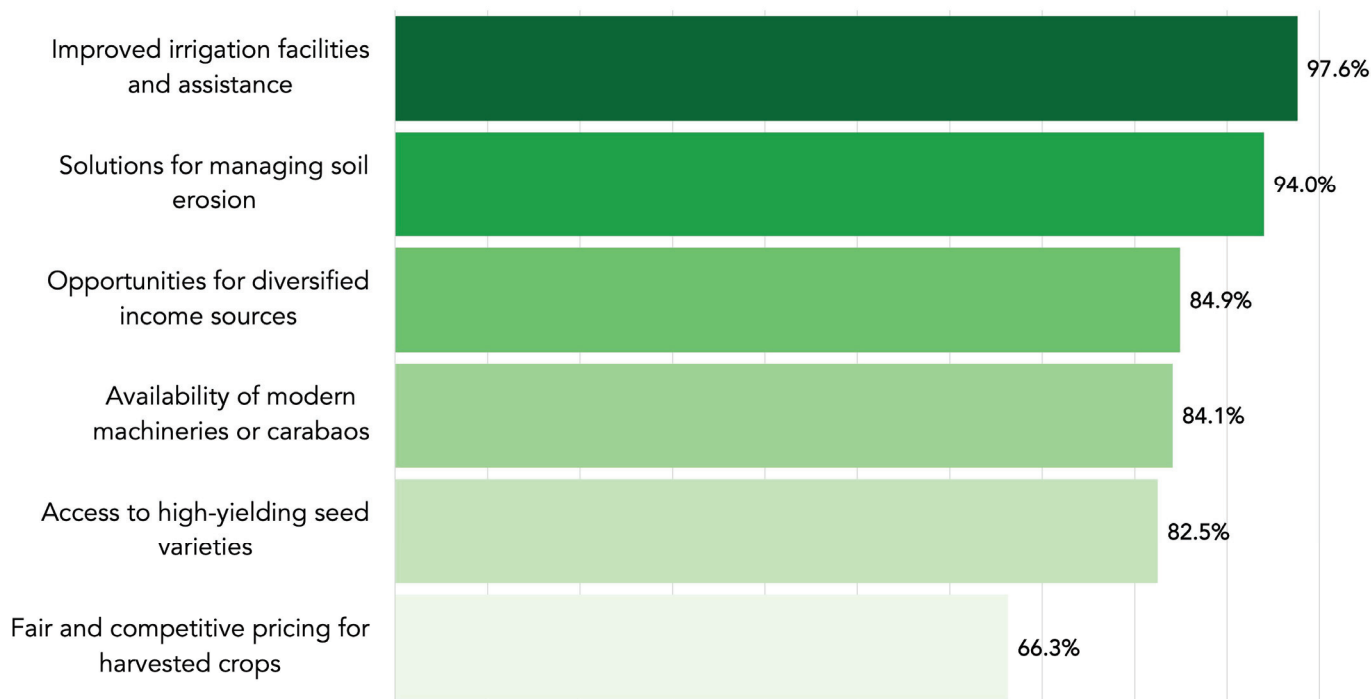


Figure 3. Key needs identified by the Ifugao GIAHS farmers to support their agricultural activities.

3.2. ECA-Related and Climate Change-Related Data of ECA Farmers in the Rice Terrace Clusters of Banaue

A majority of the farmers (82.2%) believe that climate change impacts farming in Ifugao (Supplementary Table S2). The most commonly perceived effects include landslides and erosion (98.0%), crop damage or loss (92.5%), and the loss of arable farmland (88.5%). Other notable impacts are an increased typhoon intensity or frequency (83.7%), changes in the crop distribution (77.8%), rising temperatures or extreme heat (76.6%), and shifts in seasonal patterns (75.4%). To cope with these challenges, farmers employ adaptive strategies such as adjusting planting schedules or staggering crop planting (89.7%), planting high-yield or drought-resistant crop varieties (84.9%), and implementing water management techniques (84.9%). Other strategies include strengthening pest management practices (47.6%), diversifying crops or planting alternative crops (46.4%), practicing sustainable land management (37.3%), and modifying or repurposing farmland (12.7%).

The majority of farmers (88.1%) also believe that their Environmental Conservation Agriculture (ECA) practices mitigate climate change. Interest in ECA remains high, with 48.0% expressing strong interest and 50.0% showing extreme interest. However, only 68.2% indicated that they are likely to continue practicing ECA, while 27.4% are unsure, and 4.4% are unlikely to continue. The key reasons for continuing ECA include promoting personal health and well-being (95.6%), contributing to the local and global environment (94.0%), reducing the use of chemical pesticides and fertilizers (91.7%), achieving better crop quality (81.0%), and building consumer trust (66.7%). Economic motivations include enhancing income opportunities (32.5%), following government recommendations (31.3%), and meeting high consumer demand (31.3%).

Farmers identified numerous benefits of ECA, particularly its ability to enhance soil health (95.2%), safeguard water resources (94.8%), and protect biodiversity (89.7%). ECA is also credited with improving crop quality (84.5%), attracting visitors to Ifugao (82.9%), and mitigating the effects of climate change (79.0%). Additional benefits include supporting

local industries (75.4%), boosting groundwater levels (57.5%), reducing the risks of flooding and drought (57.1%), and increasing farming income (52.4%).

Beyond its environmental contributions, farmers recognize ECA's broader societal and economic benefits. Most respondents (88.5%) agree that ECA strengthens tourism in Ifugao, while 81.4% believe it empowers youth, women, and the elderly in the community. Additionally, 81.8% agree that ECA supports the Sustainable Development Goals (SDGs), and 89.7% view it as economically, socially, and environmentally sustainable. Many farmers (91.2%) feel that ECA improves their quality of life, and 76.2% see it as a tool to strengthen the economy of Ifugao. However, fewer respondents (73.8%) agree that ECA helps reinforce local organizations, with 25.4% uncertain about this aspect.

Overall, the findings illustrate strong support for ECA practices among farmers, highlighting its perceived effectiveness in mitigating climate change, promoting sustainability, and improving livelihoods. However, the areas of uncertainty suggest opportunities for further education and support to maximize ECA's benefits across Ifugao's farming communities.

3.3. Relationships Between Socio-Demographic and Farm-Related Factors and ECA Continuation

The findings identify key factors influencing farmers' continuation of Environmental Conservation Agriculture (ECA), providing critical insights into the economic, social, cultural, and environmental dynamics shaping adoption (Tables 1–3). Farmers' reliance on financial resources and agricultural inputs significantly affects their likelihood of continuing ECA. For instance, farmers who avoid chemical inputs are 0.53 times more likely to continue ECA. Additionally, farmers who perceive drought as a significant challenge are 1.7 times more likely to adopt ECA, underscoring its perceived effectiveness in water management and drought mitigation. Access to high-yielding seeds is another critical factor; farmers with limited access to these seeds are 54% less likely to continue ECA, highlighting the need for productive inputs to sustain conservation practices. Similarly, financial support plays a pivotal role, with farmers who depend on loans from individual moneylenders or lending institutions being nearly twice as likely to adopt ECA, emphasizing the necessity of accessible credit systems for sustainable farming.

Income diversification, or having other sources of income aside from farming, also influences ECA adoption. Farmers engaged in handicraft sales are 4.7 times more likely to continue ECA, likely because their supplemental income supports their farming activities. Conversely, a reliance on tourism-related income and remittances decreases the likelihood of adoption by 35% and 39%, respectively, suggesting that alternative income sources may reduce the dependence on farming and conservation practices. Market access further impacts adoption; farmers who sell directly to consumers are three times more likely to continue ECA, benefiting from higher profit margins, while reliance on middlemen decreases adoption likelihood by 62%. These findings emphasize the economic incentives and challenges linked to sustaining conservation agriculture.

Water management and resource needs are also crucial in determining ECA continuation. Farmers who recognize irrigation as essential are 3.7 times more likely to continue ECA, reflecting the importance of addressing water management issues in agricultural practices. Conversely, farmers who perceive a need for equipment are 48% less likely to adopt ECA, possibly due to challenges in accessing or maintaining the modern tools necessary for conservation. Access to drought-resistant crops presents another barrier, as farmers who consider these crops important are 46% less likely to continue ECA, likely due to difficulties in obtaining or effectively utilizing them. Interestingly, farmers who prioritize minimizing expenses are 2.00 times more likely to continue ECA. This suggests that ECA may be perceived as a cost-effective approach by reducing the reliance on expensive chemical inputs or by leveraging organic alternatives that align with the principles of sustainable farming.

Table 1. Relationships of socio-demographic and farm-related factors with farmers' ECA continuation in the rice terrace clusters of Banaue, Ifugao.

Predictor	Estimate	Odds Ratio	Significance
ECA methods being used ^a			
Uses organic fertilizer	−0.265	0.77	0.243
Uses organic pesticides	0.093	1.10	0.618
Not using chemical pesticides or fertilizers	0.633	0.53	0.002 **
Crop rotation	−0.257	0.77	0.228
Composting	0.185	1.20	0.596
Indigenous pest management	−0.187	0.83	0.492
Challenges faced in farming ^b			
Drought and water scarcity	0.538	1.71	0.002 **
Insufficient income	0.727	2.07	0.296
Low crop yields	0.231	1.26	0.501
Limited irrigation facilities	0.015	1.02	0.945
Shortage of labor	0.216	1.24	0.366
Lack of access to high-yielding crop varieties	−0.767	0.46	0.009 **
Insufficient farming equipment or work animals (i.e., carabaos)	0.200	1.22	0.525
Soil erosion and land degradation	−0.031	0.97	0.916
Sources of farming capital ^c			
Loans from individual moneylenders or fellow farmers	0.676	1.97	0.007 **
Financial support from relatives or friends	−0.076	0.93	0.675
Personal savings or own funds	−0.033	0.97	0.93
Loans from lending institutions or banks	0.680	1.97	0.037 *
Sources of income aside from farming ^d			
Woodcarving and craftsmanship	−0.877	0.42	0.125
Selling handicrafts or artisan goods	1.544	4.68	0.019 *
Tourism-related activities	−0.437	0.65	0.017 *
Remittances from relatives working abroad or outside Ifugao	−0.489	0.61	0.006 **
Support needed for farming ^e			
Access to high-yielding seed varieties	0.047	1.05	0.829
Improved irrigation facilities and assistance	1.312	3.71	0.020 *
Solutions for managing soil erosion	−0.181	0.83	0.669
Availability of modern machineries or carabaos	−0.646	0.52	0.021 *
Opportunities for diversified income sources	−0.360	0.70	0.206
Fair and competitive price for harvested crops	0.212	1.24	0.244
Selling place for harvested crops ^f			
Direct to consumer	1.101	3.01	0.000 **
Public market	0.12	1.13	0.749
Trader or middleman	−0.977	0.38	0.042 *
Self-consumption	−0.54	0.58	0.358
Important considerations for farming ^g			
Maximizing income and crop yields	0.151	1.16	0.519
Access to financial support	0.212	1.24	0.413
Minimizing expenses	0.695	2.00	0.016 *
Reliable seed supplies	−0.118	0.89	0.587
Use of pest-resistant crop varieties	−0.42	0.66	0.095
Ensuring high crop quality	−0.159	0.85	0.576
Planting drought-resistant crop varieties	−0.609	0.54	0.034 *
Learning from the success of other farmers	−0.643	0.53	0.051
Maintaining strong relationships with other farmers (i.e., camaraderie)	0.215	1.24	0.606
Achieving peace of mind	0.207	1.23	0.633

Table 1. Cont.

Predictor	Estimate	Odds Ratio	Significance
Sources of information in farming^h			
Seed suppliers or traders	−0.208	0.81	0.53
Agricultural technicians	0.066	1.07	0.738
Co-farmers	0.163	1.18	0.756
Barangay officials	1.542	4.67	0.000 **
Motivators to adopt ECAⁱ			
Co-farmers	−0.043	0.96	0.814
Farmer leaders	1.296	3.65	0.000 **
Information seen/heard from media sources	−0.580	0.56	0.005 **
Family or ancestors	0.248	1.28	0.197

* Significant at $p < 0.05$. ** Significant at $p < 0.01$. ^a Link function: complementary log-log $f(x) = \log(-\log(1 - x))$; goodness-of-fit pseudo R-square Cox and Snell: 0.079; Nagelkerke: 0.086; McFadden: 0.033; test of parallel lines: Chi-square = 39.298, df = 18, sig = 0.248; model fit: Chi-square = 20.793, df = 6, sig = 0.003. ^b Link function: complementary log-log $f(x) = \log(-\log(1 - x))$; goodness-of-fit pseudo R-square Cox and Snell: 0.071; Nagelkerke: 0.077; McFadden: 0.029; test of parallel lines: Chi-square = 28.649, df = 24, sig = 0.234; model fit: Chi-square = 18.507, df = 8, sig = 0.018. ^c Link function: complementary log-log $f(x) = \log(-\log(1 - x))$; goodness-of-fit pseudo R-square Cox and Snell: 0.056; Nagelkerke: 0.061; McFadden: 0.023; test of parallel lines: Chi-square = 15.297, df = 12, sig = 0.226; model fit: Chi-square = 14.558, df = 4, sig = 0.006. ^d Link function: complementary log-log $f(x) = \log(-\log(1 - x))$; goodness-of-fit pseudo R-square Cox and Snell: 0.071; Nagelkerke: 0.078; McFadden: 0.030; test of parallel lines: Chi-square = 11.605, df = 12, sig = 0.478; model fit: Chi-square = 18.694, df = 4, sig = 0.001. ^e Link function: complementary log-log $f(x) = \log(-\log(1 - x))$; goodness-of-fit pseudo R-square Cox and Snell: 0.048; Nagelkerke: 0.052; McFadden: 0.020; test of parallel lines: Chi-square = 27.807, df = 18, sig = 0.165; model fit: Chi-square = 12.412, df = 6, sig = 0.003. ^f Link function: complementary log-log $f(x) = \log(-\log(1 - x))$; goodness-of-fit pseudo R-square Cox and Snell: 0.161; Nagelkerke: 0.175; McFadden: 0.070; test of parallel lines: Chi-square = 19.562, df = 12, sig = 0.176; model fit: Chi-square = 44.235, df = 4, sig = 0.000. ^g Link function: complementary log-log $f(x) = \log(-\log(1 - x))$; goodness-of-fit pseudo R-square Cox and Snell: 0.121; Nagelkerke: 0.131; McFadden: 0.051; test of parallel lines: Chi-square = 22.583, df = 30, sig = 0.832; model fit: Chi-square = 32.417, df = 10, sig = 0.000. ^h Link function: complementary log-log $f(x) = \log(-\log(1 - x))$; goodness-of-fit pseudo R-square Cox and Snell: 0.174; Nagelkerke: 0.189; McFadden: 0.076; test of parallel lines: Chi-square = 18.846, df = 12, sig = 0.192; model fit: Chi-square = 48.078, df = 4, sig = 0.000. ⁱ Link function: complementary log-log $f(x) = \log(-\log(1 - x))$; goodness-of-fit pseudo R-square Cox and Snell: 0.158; Nagelkerke: 0.172; McFadden: 0.069; test of parallel lines: Chi-square = 53.356, df = 12, sig = 0.175; model fit: Chi-square = 43.446, df = 4, sig = 0.000.

Table 2. Spearman’s correlation analyses between socio-demographic, farm-related, ECA-related, and climate change-related variables and ECA continuation by farmers in Banaue, Ifugao.

Variable	Correlation Coefficient	Significance
Farming experience	0.126 *	0.045
Rituals are helpful in farming	−0.301 **	0.000
Interest in ECA	0.385 **	0.000
Climate change affects farming in Ifugao	0.182 **	0.000
Subsidies are helpful in farming	0.155 *	0.014
ECA helps mitigate climate change	0.159 *	0.012
ECA helps strengthen tourism in Ifugao	0.428 **	0.000
ECA helps strengthen the youth, women, and elderly in Ifugao	0.416 **	0.000
ECA is economically, socially, and environmentally sustainable	0.225 **	0.000
ECA helps strengthen the economy of Ifugao	0.405 **	0.000
ECA helps improve the lives of farmers in Ifugao	0.243 **	0.000
ECA helps strengthen local organizations in Ifugao	0.305 **	0.000

* Significant at $p < 0.05$; ** significant at $p < 0.01$.

Social and cultural factors play significant roles in influencing ECA adoption. Community-based guidance, particularly from barangay officials and farmer leaders, strongly affects continuation, with farmers who receive information from barangay officials being 4.67 times more likely to adopt ECA, and those guided by farmer leaders 3.65 times

more likely. In contrast, farmers influenced by the media are 44% less likely to continue ECA, potentially reflecting distrust in media sources or the limited relevance of general information compared to localized and specific guidance. Cultural practices present additional challenges, as farmers adhering to traditional farming rituals are less likely to adopt ECA, indicating a potential conflict between ritual-based and modern conservation practices. Addressing these cultural barriers will be essential to bridging traditional practices with sustainable agricultural methods.

Table 3. Correlation analyses between farm-related data and ECA continuation by farmers in Banaue, Ifugao.

Variable	Test	Statistic	Significance
Member of an agricultural organization	Pearson's Chi-square	25.809 **	0.000
	Phi and Cramer's V	0.320 **	0.000
Have rituals in farming	Pearson's Chi-square	−24.024 **	0.000
	Phi and Cramer's V	−0.309 **	0.000
Planting other rice varieties aside from <i>Tinawon</i>	Pearson's Chi-square	16.445 **	0.002
	Phi and Cramer's V	0.256 **	0.002

** significant at $p < 0.01$.

Intrinsic motivations and the perceived benefits of ECA strongly drive its adoption. Farmers who view ECA as mitigating climate change or empowering marginalized groups, such as youth, women, and the elderly, are significantly more likely to continue its practices. Additionally, ECA's perceived contributions to strengthening local economies, improving livelihoods, and supporting community organizations act as strong motivators for adoption. Interest in ECA correlates strongly with its continuation, emphasizing the importance of fostering enthusiasm for conservation practices. Farmers who perceive that climate change impacts farming and who see subsidies as helpful also show higher rates of adoption, though these external factors appear secondary to intrinsic motivations and perceived community-level benefits.

Membership in agricultural organizations is another important factor, showing a moderate positive association with ECA continuation. Membership provides access to resources, knowledge, and collective support, all of which encourage the adoption and maintenance of conservation practices. Diversification of crops, such as planting rice varieties other than *Tinawon*, also shows a positive association with ECA, albeit to a lesser extent. This suggests that introducing complementary or resilient crops aligns with sustainable agricultural practices, potentially enhancing the resilience of farming systems.

The findings emphasize the multifaceted nature of ECA adoption, highlighting the centrality of economic, environmental, and social factors in influencing continuation. Financial incentives, such as access to loans, productive inputs, and direct market channels, play a pivotal role in motivating adoption, while environmental considerations, such as improved water management, also drive interest. Community-level support, particularly from local officials and farmer leaders, significantly shapes decision-making, while broader media campaigns are less effective. Cultural practices, including the reliance on rituals, present barriers that need to be addressed by promoting compatibility between traditional and modern conservation methods. Programs aiming to enhance ECA adoption should prioritize providing financial resources, facilitating access to essential agricultural inputs, promoting localized guidance, and fostering intrinsic motivations by emphasizing the economic, environmental, and social benefits of ECA. By addressing these factors, the adoption of sustainable agricultural practices can be effectively supported, enhancing the resilience and livelihoods of farming communities.

3.4. Relationships Between ECA-Related and Climate Change-Related Factors and ECA Continuation

Farmers who perceive flooding as a climate change effect are 1.5 times more likely to continue ECA, suggesting that the threat of flooding motivates them to adopt conservation strategies (Table 4). In contrast, farmers who perceive extreme heat as a significant challenge are 52% less likely to continue ECA, indicating that heat-related conditions make it difficult to adapt conservation practices. Similarly, farmers who view seasonal shifts as a major challenge are 60% less likely to continue ECA, underscoring the difficulty of aligning conservation efforts with unpredictable seasonal changes.

Table 4. Relationships of ECA-related and climate change-related factors with farmers’ ECA continuation in the rice terrace clusters of Banaue, Ifugao.

Predictor	Estimate	Odds Ratio	Significance
Perceived effects of climate change ^a			
Flooding	0.404	1.50	0.026 *
Landslides and soil erosion	0.617	1.85	0.324
Increasing temperatures or extreme heat	−0.728	0.48	0.017 *
Increased typhoon intensity or frequency	0.062	1.06	0.841
Changes in crop distribution	0.116	1.12	0.621
Shifts in seasonal patterns	−0.92	0.40	0.004 **
Sea level rise	−0.03	0.97	0.923
Drought	0.069	1.07	0.777
Damage to houses and infrastructure	0.36	1.43	0.054
Loss of arable land or farmland	0.443	1.56	0.108
Crop damage or loss	−0.171	0.84	0.631
Reasons for ECA continuation ^b			
To contribute to local and global environment protection	−0.609	0.54	0.094
To build and maintain consumer trust	0.781	2.18	0.000 **
To promote personal health and well-being	−0.333	0.72	0.488
To enhance income opportunities	0.634	1.89	0.009 **
To meet high consumer demand	0.056	1.06	0.809
To achieve better crop quality	−0.237	0.79	0.332
To minimize the use of chemical pesticides and fertilizers	−0.073	0.93	0.847
To follow government recommendations	−0.164	0.85	0.379
Effects of ECA on farming ^c			
Mitigates the effects of climate change	−0.182	0.83	0.425
Enhances soil health	−0.511	0.60	0.248
Protects and sustains biodiversity	−0.269	0.76	0.404
Safeguards water resources	−0.455	0.63	0.307
Boosts groundwater levels	0.505	1.66	0.009 **
Improves crop quality	0.058	1.06	0.818
Reduces the risk of severe flooding and drought	−0.411	0.66	0.043 *
Increases farming income	0.56	1.75	0.002 **
Supports and promotes local industries	0.312	1.37	0.156
Attracts people to visit and stay in Ifugao	−0.329	0.72	0.222

* Significant at $p < 0.05$. ** Significant at $p < 0.01$. ^a Link function: complementary log-log $f(x) = \log(-\log(1 - x))$; goodness-of-fit pseudo R-square Cox and Snell: 0.159; Nagelkerke: 0.173; McFadden: 0.069; test of parallel lines: Chi-square = 35.421, df = 33, sig = 0.355; model fit: Chi-square = 43.721, df = 11, sig = 0.000. ^b Link function: complementary log-log $f(x) = \log(-\log(1 - x))$; goodness-of-fit pseudo R-square Cox and Snell: 0.171; Nagelkerke: 0.186; McFadden: 0.075; test of parallel lines: Chi-square = 63.591, df = 24, sig = 0.337; model fit: Chi-square = 47.176, df = 8, sig = 0.000. ^c Link function: complementary log-log $f(x) = \log(-\log(1 - x))$; goodness-of-fit pseudo R-square Cox and Snell: 0.100; Nagelkerke: 0.109; McFadden: 0.042; test of parallel lines: Chi-square = 60.151, df = 30, sig = 0.436; model fit: Chi-square = 26.633, df = 10, sig = 0.003.

Economic incentives also play a crucial role in driving ECA adoption. Farmers who prioritize consumer trust are 2.18 times more likely to continue ECA, highlighting the importance of public perception in motivating conservation practices. Additionally, farmers are nearly 1.9 times more likely to continue ECA when it leads to financial benefits, emphasizing the significance of economic incentives in sustaining these practices.

Farmers who perceive ECA as beneficial for groundwater conservation and reducing the risk of severe flooding and drought are 1.66 and 0.66 times more likely to continue, indicating that improvements in water resources and addressing water-related challenges strongly motivate ECA adoption. However, those who perceive ECA as ineffective in reducing flooding or drought are 34% less likely to continue, suggesting that dissatisfaction with the expected outcomes of ECA can hinder its continuation. On the other hand, farmers who experience financial benefits are 1.75 times more likely to continue ECA, further reinforcing the importance of economic rewards in supporting conservation practices.

Overall, the results show that the decision to continue ECA is driven primarily by tangible benefits, such as financial gains and environmental outcomes like improved groundwater levels. Farmers are motivated by the perceived effects of climate change, like flooding, while challenges like extreme heat and seasonal shifts pose significant barriers to ECA adoption. The importance of building consumer trust is also evident, indicating that market-driven incentives play a key role in encouraging conservation practices.

The findings suggest that both economic and environmental factors are critical for the continuation of ECA. To enhance adoption rates, support programs should focus on addressing key challenges, such as heat adaptation and seasonal shifts, while emphasizing the economic and environmental benefits that resonate most with farmers.

4. Discussion

This study sought to explore the continuation of Environmental Conservation Agriculture (ECA) practices among farmers in the Ifugao Rice Terraces, focusing on the socio-demographic, environmental, and economic factors influencing their decisions. The findings from this research shed light on the interplay of these factors and their implications for the sustainability of the rice terraces. The results provide valuable insights into the motivations and challenges that drive ECA adoption, while also highlighting the roles of community dynamics, access to resources, and climate change as central factors shaping the agricultural practices of the Ifugao farmers. Below are the key findings that emerged from our study, which we have also integrated with our theoretical frameworks.

(a) Economic Factors and Resource Access as Key Determinants of ECA Adoption

One of the most prominent findings in this study is the significant roles that economic factors and access to resources play in the adoption and continuation of ECA practices [28]. Farmers who have access to financial support, such as loans, and those who are able to obtain high-yielding seed varieties are more likely to continue practicing ECA. This aligns with the Sustainable Livelihoods Framework (SLF), which emphasizes the importance of various forms of capital—particularly financial capital and physical capital—in shaping farmers' ability to pursue sustainable livelihoods [22,29]. However, this study revealed limitations in the availability and equitable distribution of these resources, which has resulted in unequal access among farmers. These disparities underscore the challenges in ensuring the inclusivity of ECA programs, particularly for smallholder and marginalized farmers. In the context of Ifugao farmers, the reliance on financial resources (such as loans) or supplementary income (e.g., from handicrafts) highlights how economic pressures influence farmers' ability to maintain ECA practices. As many farmers depend on subsistence farming, which generates limited income, the need for additional financial resources is critical to support their agricultural endeavors [30].

The findings emphasize the multifaceted nature of ECA adoption, highlighting the centrality of economic, environmental, and social factors in influencing continuation [31]. Financial incentives, such as access to loans, productive inputs, and direct market channels, play a pivotal role in motivating adoption. Furthermore, this study found that farmers with limited access to high-yielding crop varieties or modern farming equipment were less likely to continue ECA. This finding underscores the Ecological Modernization Theory (EMT), which suggests that modern technological advancements—such as the adoption of improved irrigation systems and drought-resistant crops—can complement traditional agricultural techniques to increase productivity and environmental resilience [24,32]. A lack of access to such technological resources can hinder the integration of modern environmental conservation practices, which limits the farmers' ability to adapt to climate change and sustain ecological balance [33].

(b) Environmental Challenges and Climate Change Adaptation

This research revealed that climate change is a significant concern for Ifugao farmers, with the majority perceiving its impacts on their farming practices [3]. Farmers reported facing climate-induced challenges such as an increased typhoon intensity, changes in rainfall patterns, and soil erosion, all of which threaten agricultural productivity. A limitation of the current adaptation efforts is that they are largely reactive and lack long-term planning and institutional support. This shortfall limits the ability of farmers to fully integrate sustainable practices into their climate resilience strategies. Despite these limitations, they have adopted various adaptive strategies, including adjusting planting schedules, planting drought-resistant varieties, and strengthening water management practices. These adaptive strategies are in line with the core tenets of Resilience Theory, which emphasizes the capacity of agricultural systems to absorb disturbances, adapt to change, and transform to ensure long-term sustainability [26,34].

Resilience Theory is particularly relevant in understanding how Ifugao farmers have coped with the challenges posed by climate change [35]. By diversifying crops, using traditional soil conservation methods, and integrating modern techniques, the farmers have demonstrated an ability to adapt to the fluctuating environmental conditions. The integration of these adaptive strategies with sustainable farming practices under the framework of ECA highlights how resilience can be built through a combination of traditional knowledge and modern innovations. The perceived benefits of ECA—such as improved soil health, water conservation, and biodiversity protection—serve as mechanisms for building resilience in the agricultural systems of Ifugao, ensuring that farmers can continue to grow crops despite the environmental challenges they face [20].

(c) Community Support and Social Capital

A significant finding of this study is the role of community support in sustaining ECA practices [36]. Farmers who receive guidance from local agricultural leaders or barangay officials were significantly more likely to continue practicing ECA. This supports the Sustainable Livelihoods Framework (SLF), which stresses the importance of social capital—community networks, social relations, and collective resources—in achieving sustainable livelihoods [22]. However, this study also highlights a limitation in the reliance on informal community networks, which may lack the capacity to address broader structural issues, such as market access, resource constraints, and climate adaptation. In Ifugao, strong community ties and networks facilitate the exchange of agricultural knowledge, resource-sharing, and support for ECA practices. These community connections also help farmers adapt to climate-induced challenges, providing a sense of solidarity and shared responsibility for maintaining sustainable agricultural practices [37].

Interestingly, this study also found that the media influence was less effective in encouraging ECA adoption, suggesting that localized guidance from trusted community members is far more impactful than generic information from broader media sources. This finding emphasizes the importance of community-driven initiatives in promoting sustainable agriculture [17,38]. By fostering stronger local organizations and networks, stakeholders can ensure that the knowledge and support necessary for the continuation of ECA practices are available at the grassroots level.

(d) Cultural Practices and Their Influence on ECA Adoption

Another crucial theme emerging from the findings is the tension between traditional cultural practices and the adoption of modern conservation methods [39]. Many farmers continue to follow traditional farming rituals, which remain central to their agricultural practices. However, this study revealed that adherence to these rituals is inversely related to the adoption of ECA practices. This suggests that the deep-rooted cultural values and beliefs that shape farming practices may sometimes create barriers to the integration of modern agricultural practices. The tension highlights a limitation of current ECA programs, which often fail to account for the cultural dimensions of farming practices. Without integrating cultural considerations, the programs risk alienating farmers and reducing adoption rates [40].

The findings indicate the need to address barriers by promoting compatibility between traditional and modern conservation methods [41]. The conflict between traditional and modern practices underscores the relevance of Ecological Modernization Theory (EMT), which suggests that modern environmental practices can coexist with traditional farming systems if they are integrated thoughtfully [24,42]. In Ifugao, the challenge lies in bridging these two approaches to farming. A key opportunity for promoting ECA lies in integrating indigenous knowledge with contemporary conservation techniques, respecting cultural values while introducing innovations that enhance productivity and environmental sustainability [43]. Programs that facilitate this integration—through community dialogues or farmer-led workshops—could help mitigate the cultural barriers that hinder the widespread adoption of ECA.

(e) Economic Benefits and the Role of Market Access

Economic motivations play a significant role in driving the continuation of ECA practices [44,45]. Farmers who perceive the benefits of ECA, such as improved crop quality, increased consumer trust, and enhanced environmental outcomes, are more likely to continue practicing it. This study also revealed that farmers with direct access to markets were more likely to continue ECA, suggesting that economic incentives tied to market access are a crucial driver for the adoption of sustainable practices. Nonetheless, market access limitations, including logistical challenges, inadequate infrastructure, and a lack of market linkages, hinder farmers' ability to maximize the economic benefits of ECA practices. This finding aligns with both Sustainable Livelihoods Framework (SLF) and Ecological Modernization Theory (EMT), which highlight the importance of economic incentives and market-driven approaches in promoting sustainable practices [22, 24]. Farmers who can sell directly to consumers, bypassing intermediaries, are better able to reap the financial rewards of their sustainable agricultural efforts, creating an economic incentive for maintaining ECA.

Programs aiming to enhance ECA adoption should prioritize providing financial resources, facilitating access to essential agricultural inputs, promoting localized guidance, and fostering intrinsic motivations by emphasizing the economic, environmental, and social benefits of ECA [44]. By addressing these factors, the adoption of sustainable

agricultural practices can be effectively supported, enhancing the resilience and livelihoods of farming communities.

Furthermore, the perceptions of ECA as a means of increasing income, improving water resources, and reducing the environmental impact of farming are powerful motivators [46]. While financial incentives such as government subsidies are helpful, the broader economic benefits of ECA—including its contributions to local tourism and food security—serve as compelling reasons for farmers to continue adopting and refining these practices.

5. Conclusions and Recommendations

The continuation of Environmental Conservation Agriculture (ECA) practices among Ifugao farmers is influenced by a complex interplay of economic, social, environmental, and cultural factors. This study highlights the significant role of access to resources, such as high-yielding variety seeds, modern farming equipment, and financial support, in facilitating the adoption of ECA practices. Farmers with better access to these resources are more likely to continue ECA, whereas those facing resource constraints, such as limited irrigation facilities and drought-resistant crops, are less likely to sustain these practices. Economic incentives, including access to direct markets and supplementary income sources like handicrafts, also play a pivotal role, as market linkages provide better economic returns and enhance the viability of sustainable farming. Conversely, a reliance on intermediaries and an insufficient market infrastructure diminish the economic benefits of ECA, underscoring the need for targeted interventions to bridge these gaps, particularly for smallholder and marginalized farmers.

Environmental challenges and climate change have emerged as both motivators and deterrents to ECA adoption. Farmers recognize ECA's effectiveness in mitigating the impacts of climate change, such as soil erosion and water scarcity, which are critical for the ecological stability of the rice terraces. However, extreme heat and unpredictable seasonal shifts remain significant barriers, revealing the necessity for adaptive support systems and innovative solutions to help farmers manage these challenges. This study also reveals a tension between traditional cultural practices and modern conservation techniques, as adherence to traditional farming rituals is inversely related to ECA adoption. This highlights the need for culturally sensitive approaches that integrate indigenous knowledge with contemporary methods, ensuring compatibility while enhancing productivity and sustainability. Programs that promote dialogue and collaboration between farmers and conservation advocates can facilitate the coexistence of these approaches, preserving heritage while advancing agricultural innovation.

The findings underscore the importance of community support in sustaining ECA practices. Farmers who receive guidance from barangay officials or local agricultural leaders are more likely to continue ECA, reflecting the critical role of localized, trust-based networks in fostering sustainable agriculture. However, this study finds that broader media campaigns are less effective in driving adoption, suggesting that localized and community-driven initiatives are better suited to address the specific needs of farmers in Ifugao. Furthermore, ECA practices are shown to contribute significantly to the sustainability of the Batad and Bangaan rice terrace clusters in Banaue by addressing site-specific challenges, such as mitigating soil erosion and improving water management. These benefits extend beyond environmental conservation, as ECA also strengthens local tourism, empowers marginalized groups, and fosters economic resilience. By aligning ECA with the Sustainable Development Goals, stakeholders can amplify its role in promoting food security, poverty alleviation, and climate resilience in the region.

To ensure the sustained adoption of ECA, there is a need to improve access to financial resources, modern farming tools, and drought-resistant crops through targeted

subsidies, grants, and credit programs tailored to the needs of farmers. Strengthening local organizations and networks through training and capacity-building initiatives can further enhance farmers' resilience and adaptability. Addressing cultural tensions by integrating traditional and modern practices can help bridge the gap between heritage and innovation, creating a holistic approach to agricultural sustainability. Improving market access and infrastructure to facilitate direct-to-consumer sales will provide better economic returns for farmers, reducing the reliance on intermediaries and enhancing the profitability of sustainable practices. Additionally, adaptive strategies, such as the introduction of improved irrigation systems, planting calendars, and diversified crop options, can help farmers better cope with the impacts of climate change.

Future research could explore the long-term impacts of ECA adoption and assess how cultural, economic, and environmental factors evolve over time in shaping sustainable agricultural practices in heritage sites like the Ifugao Rice Terraces. Examining the roles of education, gender dynamics, and generational shifts in influencing ECA adoption can further inform targeted policy interventions. Investigating innovative models that integrate tourism and agriculture may also unlock new opportunities for economic growth while preserving cultural and environmental heritage. By addressing these areas, ECA can fully realize its transformative potential to sustain the ecological and socio-economic integrity of the Ifugao Rice Terraces, ensuring the resilience and prosperity of its farming communities for generations to come.

Supplementary Materials: The following supporting information can be downloaded at <https://www.mdpi.com/article/10.3390/agriculture15030246/s1>: Supplementary Table S1. Socio-demographic and farm-related data of the ECA farmers in the rice terrace clusters of Banaue, Ifugao; Supplementary Table S2. ECA- and climate change-related factors of the ECA farmers in the rice terrace clusters of Banaue, Ifugao.

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Article

The Rural Economy and Family Firms: A Bibliometric Analysis Through Scientific Maps

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Abstract: Since the beginning of the research on the family business and rural economy, there has been a problem with the delimitation of the concepts. Given this problem, this study's main objective was to identify and visualize the intellectual structure of these two issues through scientific maps. To meet this objective, an evaluation of scientific performance and production was carried out with bibliometric indicators to extract the main research topics around these two areas through an analysis of the co-occurrence of keywords with scientific maps. The results show that research on family businesses and rural economy is booming, especially on family businesses that have higher productivity and performance. Regarding the main topics studied regarding family businesses and the rural economy, a total of 16 main themes were detected, highlighting the topic of entrepreneurship. The study of land management in transboundary environments is a potential line of future research.

Keywords: family firms; rural economy; bibliometric; science mapping; co-word analysis

1. Introduction

The business fabric of rural areas is characterized by the presence of greater atomization; unlike large urban areas, a greater presence of small businesses—and micro-enterprises—is detected, where we find the common presence of family businesses. In this sense, if we take, as an example, the specific case of Extremadura—a region that is located on the Spanish border with Portugal, with a greater prevalence of rural areas and a population density that aligns with the Spanish average, 91.5% of private companies are family-owned, generating 85% of employment and with a weight of 84% of GDP in the private sector. However, these same data for the national total are reduced to 89% regarding the volume of companies, 67% employment, and a representativeness of GDP in the Spanish private sector of 57% [1]. It is necessary to identify the intellectual structure related to the family business and the rural economy, to analyze the lines of studies that are produced from research on family businesses, as well as to determine the importance of the topics related to the rural economy [2].

Before starting with this work, we must mention that both the family business and the rural economy, or more specifically the rural environment, due to their types, have presented problems in their delimitation, which is a clear limitation when approaching their study [3]. Firstly, if we focus on what is meant by family business, many authors have tried to catalogue them according to different criteria. Specifically, Barroso [4] made a masterful synthesis of them, pointing out key factors defining them: ownership, control, family involvement, continuity, family renewal, management, and self-perception, concluding that the most accepted definition is the one agreed upon and approved by the European Group of Family Businesses (GEEF), which broadly summarized them as family businesses,

regardless of size, if they meet a series of requirements: “1. The majority of the votes are owned by the person or persons of the family who founded or founded the company; or they are owned by the person who has or has acquired the company’s share capital; or are owned by their wives, parents, child(ren) or direct heirs of the child(ren). 2. The majority of the votes can be direct or indirect. 3. At least one representative of the family or relative participates in the management or governance of the company. 4. The definition of a family business applies to listed companies if the person who founded or acquired the company (its share capital), or his relatives or descendants own 25% of the voting rights to which the share capital entitles him” [4–6]. Secondly, if we focus on the definition of what the rural world is, the literature presents an even greater variety of definitions depending on the purpose for which the rural world is analyzed, which is why, we can generally consider the rural world as areas in which the majority of the population resides outside urban centers, with population density being a key factor in this definition. In some cases, such as EUROSTAT, less than 100 inhabitants per km² was established, while, for the OECD, a density of less than 150 inhabitants per km² was established [7,8]. In this sense, the important nuance that led us to conduct this research was the capacity of companies to link with the local community where they are located [9,10]; some family businesses obtain such a link with the territory that, even if they are not in a location that economic theory considers optimal, they create development and adoption strategies to stay located in their local community [11–13], a fact that is also linked to the rural world [14–17].

This link between the rural environment and family businesses is partly explained by the findings of researchers specialized in regional economics, with industrial districts, local production systems, or other definitions that describe the economies of the agglomeration of companies in the same territory being some of the most studied topics [18,19]. These studies have been based on the postulates of Marshall [20–22] and Becattini [23–25] and have been conducted in rural areas [26–30] due to the variety of types that these realities can present [31], which currently have their own denominations as rural districts [32–34], agro-food districts [35–37], quality agri-food districts [38,39], or localized agri-food systems [40]. In summary, these are highly represented by family enterprises, especially small- and medium-sized ones with a strong connection to the territory [41–44].

This is why it was necessary to map and compile the studies on family businesses in rural areas; knowledge of both topics can help improve the implementation of rural and industrial development policies. In this way, our main objective in conducting this research was to verify, through bibliometric techniques, the lines of studies that have emanated from research on family businesses and to evaluate the importance of the topics related to the rural economy, allowing us to know what have been the most-studied points and the emerging themes (new lines of study) or lines of research that have already been exhausted. Thus, we can see the common points, allowing us to improve research and knowledge about the situation and the prospects of family businesses in rural areas. In short, the existing literature indicates that the main types of businesses in rural areas are small and micro-businesses of family origin. This type of company has a greater connection to the territory due to the stewardship attitudes that have been identified in studies on family businesses [45].

In a first analysis of the literature, we did not find any study that synthesized the existing studies on family businesses in rural economies. Specifically, when we looked at the studies that synthesized the literature on family businesses, we found that they covered the following topics: 1. analyses of the literature generated in specific journals on specific [46–48] or general topics [49–52]; 2. internationalization [53–56]; 3. sustainability and aspects that affect it over time (professionalization, entrepreneurship, succession, technology, innovation, etc.) [57–65]; 4. studies on specific sectors, such as tourism [66], or specific areas, such as Asia [67]. In the case of the economy in rural areas, studies that synthesized the literature are scarce, since the predominant methodology in this area has been the case study.

To carry out this analysis, we divide this paper into six sections. First, in this Introduction, we present this work and carry out a preliminary analysis of the literature. Secondly, we show the methodology and sources that were used in this analysis. Thirdly, we present the results obtained regarding the bibliometric methodology and the mapping of the literature. And, finally, we present the conclusions drawn.

2. Materials and Methods

To contextualize the intellectual structure of family businesses and the rural economy, we used SciMAT v.1.1.04 software (Granada, Spain) [2,68–71]. This choice was due to the academic support from Cobo's doctoral thesis [71] and the accumulated experience of various researchers with this tool [2,72–74], a fact that allows us to highlight the advantages of this software, which were as follows: 1. It allowed us to comply with all the requirements and steps described in specialized studies regarding the methodology of carrying out bibliographic and/or bibliometric studies [75]. 2. The software helped us analyze the co-occurrence of the keywords of the analyzed works, interconnecting the cross-cutting themes, and, therefore, giving us a faithful image of the intellectual structure [76,77] through a visual representation that benefits the reading of the results obtained [78]. 3. The advantages and limitations of the tool are defined in the literature [79,80], including the large number of documents that can be analyzed.

Bibliometric work is approached through two fundamental procedures. First, an analysis is presented that synthesizes the details the scientific production of research through traditional bibliometric indicators (volume of documents, citations, h-index, place of publication, etc.) [68,81]. Second, scientific maps are created and analyzed through co-occurrence relationships to extract the themes of the area under study [68,82–84]. This double analysis allows the monitoring of the studies generated in these fields of study, as well as the understanding of the intellectual structure obtained and the evolution that the publications have followed, that is, new topics that have been discarded over time, as well as to know the main advantages and disadvantages of the field of study [85].

To carry out the analysis, the first step is choosing four key aspects that mark the success of the analysis and systematization of the information [75], such as 1. the type of studies to be used (in our case, we focused only on indexed scientific articles, because we were sure that they passed a review process, and, therefore, in our opinion, they had the maximum scientific validity) [86]; 2. the database from which information is extracted (In our case, we chose the Social Sciences Citation Index (SSCI) of the Web of Science (WoS). The choice of this database over others such as SCOPUS, which is also widely used in economics and business studies [87,88], was due to the fact that WoS allows a longer time for analysis [2] and is considered the priority indicator when evaluating the quality and impact of scientific production) [89]; 3. the unit of analysis to be used for the creation and analysis of scientific maps (i.e., the keywords). Thus, the analysis of the co-occurrence of keywords allows the identification of the basic themes in a scientific field by showing its conceptual and cognitive aspects [2,71]. 4. In the search strategy in this case, the concepts of "Rural Economy" and "Family firms" were selected, and the search was carried out by topic, from which we selected the articles that contained these concepts in the title, abstract, and keywords [2]. In this way, we obtained a total of 3641 articles published from 1958 to 2024.

Once we focused our study, we delved into the keyword co-occurrence analysis [90]. Thus, a co-occurrence relationship was established when two keywords *i* and *j* were found in the same document together. As Cobo [71] pointed out, this type of analysis allows us, based on conceptual and cognitive aspects, to carry out a scientific mapping based on the bibliometric network obtained through the union of keywords through co-occurrence relationships.

In order to obtain significant information about the field through the keyword co-occurrence analysis, we should normalize the bibliometric network [2]. Term normalization establishes a weight for each keyword equivalent to its importance in the corpus [71]. With

normalization, we assign greater importance to keywords with low frequency but high co-occurrence compared to those with high frequency and low co-occurrence [71]. At this point, we selected the equivalence index [91], $c_{ij}^2/e_i e_j$, where c_{ij} is the co-occurrence between words i and j , while e_i and e_j are the frequencies with which the words i and j appear in all documents. If two keywords always appear together, the equivalence index is equal to one; however, if they do not appear together in any document, their equivalence index is equal to zero. This is the recommended and most popular index for the normalization of scientific maps based on co-word analysis [2,68,91].

Once the network was normalized, we created the scientific map by applying clustering techniques to divide the set of elements into different subsets whose nodes were strongly linked to each other (clusters) and weakly linked to the rest [2,71]. In this work, we used the clustering algorithm based on simple centers, which had the advantage of automatically returning clusters tagged with the most central node of the group [2,71]. In this way, each topic obtained (cluster) was represented by different nodes or keywords, with the size of the sphere of each node being proportional to the number of documents associated with that keyword and the thickness of the lines between two keywords being proportional to their equivalence index [2,71].

Once we obtained the topics, we proceeded to evaluate the positioning that each one presented in the selected research area. To this end, a strategic diagram was used [92]. This allowed us to place each topic according to its centrality (reflected on the x-axis) and its density (reflected on the y-axis).

Centrality measures the degree to which a topic interacts with other topics. In this way, centrality measures the strength of a topic's external links with the rest. This centrality is measured as $c = 10 \cdot \sum e_{kh}$, where k a keyword for one topic, and h is a keyword for another topic. Density informs us of the degree of cohesion that each of the themes presents within themselves, and this is represented by the formula $d = 100 \frac{\sum e_{ij}}{w}$, where i and j are two keywords of the same theme, and w is the number of keywords (nodes) that form the topic [71].

Depending on the centrality and density of each topic, we classified them into four categories in the strategic diagram [2,71,92]:

- Motor themess: They have a high centrality and density. These are highly developed and relevant topics in study.
- Basic or transversal themes: hey have a high centrality but a low density. These are topics that have a high interconnection with the rest of the topics but are not very developed in themselves.
- Highly specialized topics: They have a high density but a low centrality. These are topics that are very developed but isolated from the rest of the topics. They are of marginal importance.
- Emerging or disappearing themes: They have a low centrality and density. These are topics that have little development and inter-relation with the rest of the topics. Under this category are topics that are no longer being studied and new topics that are emerging.

In Figure 1, the flow chart summarizes the process carried out in the bibliometric analysis of this research on the rural economy and family business.

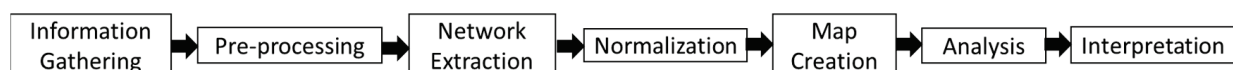


Figure 1. Workflow of science mapping analysis [2]. Source: Own elaboration.

3. Results

This section is divided into two subsections. First, the results of the evaluation and analysis of scientific performance and production are presented through bibliometric indicators to demonstrate the general aspects of the research area under study. Subsequently,

we focus on the creation and analysis of scientific maps that allowed us to extract the main research topics around the rural economy and family businesses, as well as to evaluate the positioning of these topics.

3.1. Evaluation and Analysis of Scientific Performance and Production

In total, 1904 articles were analyzed, which have been published in 615 journals and accumulated a total of 48,755 citations (average of 35.61 citations per article).

As can be seen in Figure 2, the study of the rural economy and family businesses began, following the studies indexed in the WoS, in 1958 with Manchester Jr. [93]. From then until the present day, a vast corpus has been produced, showing an upward trend in this area of research, especially since 2007. There has been growing research interest, especially important in the case of family businesses, where researchers have focused their efforts on obtaining knowledge about this type of company.

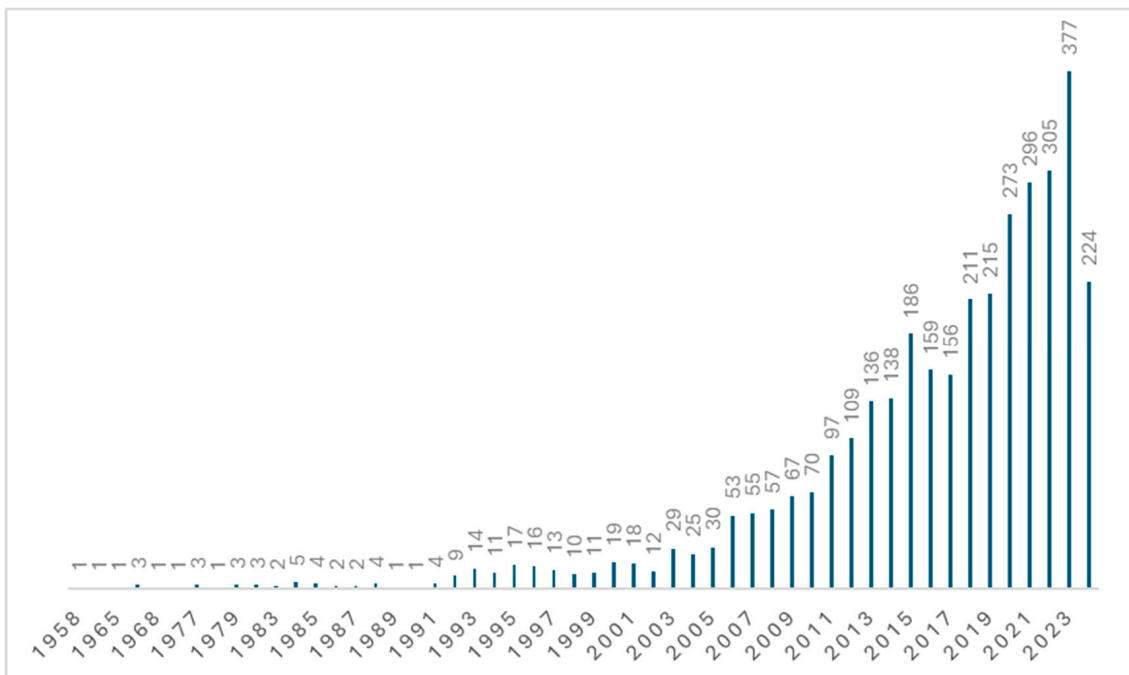


Figure 2. Evolution of scientific production on family businesses and the rural economy. Source: Own elaboration.

Table 1 shows the most productive authors in the area. As we already mentioned, the subject of family business has been well studied; therefore, the leading referenced author focused on this line of research.

Table 1. Leading authors in the areas of family business and rural economics.

Author	No. Documents
De Massis, Alfredo	78
Kellermanns, Franz W.	55
Chrisman, James J.	41
Calabro, Andrea	39
Miller, Danny	38
Voordeckers, Wim	35
Chirico, Francesco	33
Eddleston, Kimberly A.	32
Kammerlander, Nadine	29
Le Breton-Miller, Isabelle	28

Source: Own elaboration.

When analyzing the most cited works in Table 2, we find little inter-relation between the two topics in the referenced articles. As we can see, most of the articles focus on the study of various aspects related only to family businesses, while only one of the articles is related to the rural economy, as shown in Table 3, where the journals on the subject are presented.

Table 2. Articles in the areas of family business and rural economy.

Title	Journal	Authors	Year	Citations
Founding-family ownership and firm performance: Evidence from the S&P 500	<i>JOURNAL OF FINANCE</i>	Anderson, RC, Reeb, DM [94]	2003	2621
Socioemotional wealth and business risks in family-controlled firms: Evidence from Spanish olive oil mills	<i>ADMINISTRATIVE SCIENCE QUARTERLY</i>	Gomez-Meji a, LR, Haynes, KT, Nuñez-Nickel, M, Jacobson, KJL, Moyano-Fuentes, J [95]	2007	2333
How do family ownership, control and management affect firm value?	<i>JOURNAL OF FINANCIAL ECONOMICS</i>	Amit, R, Villalonga, B [96]	2006	1995
Socioemotional Wealth in Family Firms: Theoretical Dimensions, Assessment Approaches, and Agenda for Future Research	<i>FAMILY BUSINESS REVIEW</i>	Cruz, C, Gomez-Mejia, LR, Berrone, P [97]	2012	1483
The Bind that Ties: Socioemotional Wealth Preservation in Family Firms	<i>ACADEMY OF MANAGEMENT ANNALS</i>	Cruz, C, Gomez-Mejia, LR, Berrone, P, De Castro, J [98]	2011	1276
Variations in R&D investments of family and nonfamily firms: behavioral agency and myopic loss aversion perspectives	<i>ACADEMY OF MANAGEMENT JOURNAL</i>	Chrisman, JJ, Patel, PC [99]	2012	931
Are family firms more tax aggressive than non-family firms?	<i>JOURNAL OF FINANCIAL ECONOMICS</i>	Chen, X, Chen, SP, Cheng, Q, Shevlin, T [100]	2010	811
Founding family ownership and the agency cost of debt	<i>JOURNAL OF FINANCIAL ECONOMICS</i>	Anderson, RC, Mansi, SA, Reeb, DM [101]	2003	806
Family Involvement, Family Influence, and Family-Centered Non-Economic Goals in Small Firms	<i>ENTREPRENEURSHIP THEORY AND PRACTICE</i>	Chrisman, JJ, Chua, JH, Barnett, T, Pearson, AW [102]	2012	745
Comparing the agency costs of family and non-family firms: Conceptual issues and exploratory evidence	<i>ENTREPRENEURSHIP THEORY AND PRACTICE</i>	Litz, RA, Chrisman, JJ, Chua, JH [103]	2004	745

Source: Own elaboration.

Table 3. Journals in the areas of family business and rural economics.

Journal Name	No. of Documents	%
<i>JOURNAL OF FAMILY BUSINESS STRATEGY</i>	201	5.81%
<i>FAMILY BUSINESS REVIEW</i>	164	4.74%
<i>ENTREPRENEURSHIP THEORY AND PRACTICE</i>	156	4.51%
<i>SUSTAINABILITY</i>	122	3.52%
<i>JOURNAL OF BUSINESS RESEARCH</i>	103	2.98%
<i>SMALL BUSINESS ECONOMICS</i>	86	2.48%
<i>JOURNAL OF SMALL BUSINESS MANAGEMENT</i>	71	2.05%
<i>JOURNAL OF BUSINESS ETHICS</i>	59	1.70%
<i>JOURNAL OF RURAL STUDIES</i>	54	1.56%
<i>INTERNATIONAL JOURNAL OF ENTREPRENEURIAL BEHAVIOR AND RESEARCH</i>	52	1.50%

Source: Own elaboration.

3.2. Creation and Analysis of Scientific Maps

Having analyzed the performance and productivity of the literature on the rural economy and the family business, we studied the main topics that have been researched on the family business and the rural economy and evaluated their positioning based on the analysis of co-occurrence of keywords. To this end, keywords that had a frequency greater than or equal to six in the sample and a minimum frequency of co-occurrence of

three were selected for the topics. As for the range of keywords established for each cluster, the minimum was 3, and the maximum was 12.

From this analysis, a total of 16 clusters representative of the main research topics on the rural economy and family business were obtained (see Appendix A). Table 4 shows the different topics as well as their keywords.

Table 4. Main topics in research on rural economy and family business.

n°	Topics	Keywords
1	Entrepreneurship	Entrepreneurship; socioemotional wealth; strategic decisions; succession; governance; agency; innovation; behavior; management; organization; ownership; performance
2	Land	Land; income; productivity; urban economy; village economy; inequality; population; climate; ecosystem and socioeconomic status; efficiency; farming; forest management.
3	Career	Career; self-efficacy; self-employment; student entrepreneurship; support for rural business; adolescents; attitudes; embeddedness; intergenerational; motivation for succession; perceptions of family firms; planning research.
4	Emerging economies	Emerging economies; institutions, culture and family; international diversification; transaction cost economics; institutional theory; investment; joint ventures; banking; development; entry; foreign; group affiliated companies.
5	Commitment	Commitment; satisfaction; social context; trust; stewardship theory; employees; orientation; perspective; job; leadership; psychology; relatedness.
6	Knowledge	Knowledge; competitive strategy; small and medium enterprises (SMEs), social class; networks; capabilities; dynamic capabilities; generational change; systems; technology; values; absorptive capacity.
7	Gender	Gender; property; roles; success factors; woman; determinants; labor markets; challenges; education; employment; female entrepreneurship; finance.
8	Top management	Top management; resource; risk; start-up factors; unified systems perspective; conflict; decisions; founder; team; cohesion; creativity; future.
9	Growth	Growth; policy analysis; poverty; survival analysis; tourism; industry; reform; credit; divergence; evolution; involvement; nonfarm enterprises.
10	Identity	Identity; next generation; qualitative analysis; reputation; sustainable; boundaries; business brand; case based research; communication; consequences; consumer behavior; exploration.
11	Controlled firms	Controlled firms; internationalization; separation; stakeholder groups; theoretical model; cognition; cultural cluster; dimensions; directions; goals; human assets.
12	Environment	Environment; long-term orientation; management systems; participation; benefits; adaptability; design; ethics; green economy.
13	CEO	CEO; professionalization of family owned companies; compensation; executive coaching.
14	Acquiring firms	Acquiring firms; mergers; shareholders.
15	Capital structure	Capital structure; debt; trade.
16	Opportunities	Opportunities; new firms; transgenerational.

Source: Own elaboration.

The research was then explained according to what the research focused on in each of the topics.

1. Entrepreneurship: This topic includes many studies, from which we find that studies on the relationship between rural economy and family business is scarce, with research on family business predominating. At the intersection of the search (family firms, rural and entrepreneurship), we found 76 documents in which specific cases of entrepreneurship in rural areas were analyzed, although they did not indicate that they were studies of the broader effect when we found cases of the specific area, for example, a case of the Småland region in Sweden [104] or Tioman Island in Malaysia [105].

2. Land: This topic highlights land management within the rural economy and family business. Our search returned 16 documents, among which the agricultural enterprises and the transition from agricultural production to the business system in the countryside stood out, e.g., DeVore [106] and Magnan et al. [107].

3. Career: It is a vital issue for business control and therefore for the management and administration of family businesses for both current managers and possible successors.

Studies such as those of Schröder et al. [108] analyzed the factors determining the choice of professional career of adolescents with experience in family businesses from the different points of view of adolescents and parent. As a result, they found that the adolescent's identification with the family business, perceived work rewards, and parents' succession preference significantly influenced adolescents' intentions to choose a professional career. Tolentino et al. [109] demonstrated how professional adaptability and entrepreneurial intentions are enhanced by prior exposure to the family business and thus offered an understanding of successful adaptation in the context of the entrepreneurial career. The intersection of this topic with family firms and rural returned only six documents.

4. Emerging economies: This is a topic that is related to issues of both the rural economy and development as well as all types of companies, including family businesses. A refinement of the search gave us 11 documents shared among all the topics. In this sense, we found many case studies, such as the one carried out by Wangu [110], in which they determined the points of interest that mark the orientation of small farmers to the market and the marketing agreements that they obtain to try to take advantage of milk production in rural areas of Kenya as a mechanism for rural development. But, we did not only find studies linked to the agricultural sector but also other works also such as Huerta-Álvarez [111], who identified tourism possibilities in specific cases of emerging economies through the analysis of the brand value of the tourism resources in these regions. Therefore, we can highlight the search for solutions to improve the economic dynamism in emerging regions.

5. Commitment: In the joint search with the topics "family firms" and "rural", only nine results were returned, because this topic is more correlated with family firms in general, as highlighted by authors such as Cruz et al. [112], who analyzed the results of hiring family members for a company, finding that there was an increase in sales but with a decrease in profitability. Marques et al. [113] studied whether, how, and why the scope of engagement is value-based. Based on an interpretative method of theory, they analyzed 12 case studies of Spanish family firms, indicating the patterns of influence of participation and family values.

6. Knowledge: This topic has been important in most of the fields studied and of capital importance for the management and control of the family business and the development of the rural economy. Tokarczyk et al. [114] studied whether the qualities of family business managers contribute to the acquisition of a competitive advantage within the markets and improvements in variables such as strategic focus, customer orientation, family relationships, and operational efficiency. De Massis [115] demonstrated the importance of technological knowledge of the members of family businesses in order to develop new products and expand technological development by family participation.

7. Gender: Research on gender has extended to the family business and the rural economy, with studies analyzing the increase in the management and administration of companies by women. Fairlie and Robb [116] compared women-owned businesses with men-owned businesses in the U.S. The results showed that women-owned businesses were less successful than men-owned businesses due to variables such as having less start-up capital and less previous work experience in a family business. They also observed that women business owners worked fewer hours, which had implications for the company's bottom line. Hytti et al. [117] analyzed how daughters act in family businesses and construct identities as leaders of them, finding that daughters construct their identities and leadership in their interactions with others and oppose the use of the gender scripts available to them.

8. Top management: Senior management is a very influential body within any company, whether it is family-owned or not, when it comes to decision making, strategies, etc. Stewart and Hitt [118] studied the reasons why family firms should behave more like nonfamily firms and become professionalized, since many of them do not do so or only do so partially, and analyzed the modes of professionalization. Schjoedt et al. [119] investigated family business and startup teams, the formation and composition of their components, the relationship between team members, generational involvement, and the

influence of organizational experience. As a result, they observed that relationships are more important than different skills in determining the effectiveness of both the family business and new companies.

9. Growth: Growth indicates the evolution of the rural economy and the family business over time and the different changes produced in them. With respect to the family business, studies such as those of Olson et al. [120] identified strategies for families to use to increase the success and growth of their business. Business assets, the age of the business, management, the owner's time in the business, family employees, and hiring temporary help all resulted in accomplishments for the business. In rural economics, studies such as those by Huang and Rozelle [121] analyzed the importance of technology versus institutional innovation in China's rural economy. Their results showed that the adoption of technology was the most important factor in the growth of rice yields and, therefore, of the rural economy.

10. Identity: Identity is based on the essence of the family business, which encompasses its business management model and policy. De Massis and Kotlar [122] studied different business cases, defining the unit of analysis, selecting specific cases, collecting and analyzing information, and presenting results in order to provide guidelines that are useful for family business researchers. Also, based on the identity of the firms, Binz et al. [123] analyzed whether family firms are perceived more positively by consumers than nonfamily firms, focusing on preferences or indifference toward the services or products offered by one or the other. As a result, they observed consumer preference for products and services offered by family businesses.

11. Controlled firms: Controlled firms have focused on the existing limitations in family businesses when it comes to operating and managing themselves. Sundaramurthy and Kreiner [124] investigated the boundaries of identity and family work, analyzing the integration between family and business identities, describing the contingencies that influence this integration, and managing the limitations. On the other hand, Goel et al. [125] reviewed the literature on ownership and governance related to family businesses, expanding the research perspectives to both the family system and the business system.

12. Environment: The research on the environment is based on different variables that can affect the management or development of both the family business and the rural economy. Craig et al. [126] analyzed how factors such as family influence, family business culture, and planning systems function as drivers of innovation and company performance. The result obtained was that family influence positively affects family culture, which in turn improves the ability of families to be strategically flexible, and positively impacts the company's innovation and performance. Dangelico [127] studied the variables that affect the perspective of market profits, observing that being a family business positively influences product differentiation, the availability of new technologies, and foreign ownership of the company.

13. CEO: The CEO ("Chief Executive Officer") or executive director of the company oversees strategic and administrative decision making, being a fundamental figure for the evolution of the company, whether it a family business or not, and which is closely linked to succession within the family business. Miller et al. [128] analyzed the CEO–Business succession relationship and identified the problems generated, finding that intergenerational succession is closely related and predetermined by personal factors. Other studies such as those by Chang and Shim [129] looked at the transition from family to professional management and found that companies that move from family to professional CEOs performed better, being more pronounced in families that maintained high ownership control but without leaving a family legacy.

14. Acquiring firms: This topic is included within business strategies such as acquisitions, mergers, etc., in order to achieve the evolution, development, and improvement of companies. Miller et al. [130] studied the diversification of acquisitions by family owners and their implications. They found that there was a reduction in the risk of their wealth through the diversification of acquisitions and an increase in the level of family ownership.

Worek et al. [131] looked at the differences between how family businesses differ from nonfamily businesses in their acquisition goals. The findings demonstrated the importance of analyzing the type of property to understand the objectives that generate strategic decisions, such as acquisitions, with nonfinancial objectives being the most prominent in acquisitions.

15. Capital structure: Capital structure is a very influential factor in both family and nonfamily businesses as it indicates how they balance debts and equity capital to finance their investments. Pindado et al. [132] analyzed the relationship between family control and the corporate capital structure, considering the nature of the debt policy and the ownership structure of family firms. They found that debt sensitivity to cash flow movements is less pronounced in family businesses. Acedo-Ramirez et al. [133] studied a total of 2093 Spanish private companies, 68% of which were family businesses, and compared whether or not their capital structure differed from that of nonfamily businesses. The results show that family businesses are more indebted than nonfamily ones. They also noted that the factors influencing the capital structure are different between family and nonfamily businesses and that the financial structure of family businesses changes with the size of the business and the life cycle of the business.

16. Opportunities: This topic mentions business opportunities and the creation of new companies and strategies to evolve and develop. Davidsson [134] reconceptualized the term entrepreneurial opportunities, using a theoretical construct based on external enablers, entrepreneurial ideas, and trust in order to obtain theoretical precision and guidance with respect to empirical opportunity-based research. Wiedeler and Kammerlander [135] analyzed the capabilities of new managers in order to ensure the long-term survival of their firms and developed a framework of the factors that affect the internal corporate entrepreneurship activities of future firm managers that encourage or impede the development of entrepreneurial capabilities in order to contribute to the understanding of entrepreneurial learning and family firming.

Having analyzed the issues that made up the areas of rural economy and family business, we observed the level of development of each of them and their importance. Table 5 shows the centrality for each of the topics, measuring the degree of interaction of a topic with the rest, and the density, which indicates the degree of internal cohesion of a topic. The definitions of centrality and density were detailed in Section 2. Centrality range and density range were used to measure the centrality and density in relative terms considering all topics.

Table 5. Centrality and density of each theme.

Topic	Centrality	Centrality Range	Density	Density Range
Entrepreneurship	116.2	1	34.7	1
Land	11.36	0.44	4.35	0.56
Career	11.25	0.38	4.97	0.81
Emerging economies	13.61	0.5	12.7	0.94
Commitment	34.77	0.94	5.22	0.88
Knowledge	27.21	0.88	3.57	0.5
Gender	17.09	0.62	4.37	0.62
Top management	26	0.81	3.32	0.44
Growth	25.62	0.75	1.4	0.19
Identity	14.07	0.56	3.3	0.38
Controlled firms	20.97	0.69	1.2	0.12
Environment	6.97	0.31	1.14	0.06
CEO	4.12	0.25	2.11	0.31
Acquiring firms	2	0.12	4.91	0.75
Capital structure	1.83	0.06	4.78	0.69
Opportunities	2.67	0.19	1.8	0.25

Source: Own elaboration.

We can see that the topic with the highest degree of interaction was entrepreneurship, followed by commitment and knowledge. Regarding density, entrepreneurship

continued to be the topic with the greatest development, followed by emerging economies and commitment.

Once the centrality and density of the topics were analyzed, the next step was to analyze the strategy diagram presented in Figure 3. The size of the spheres in each cluster shows us the number of documents associated with each topic.

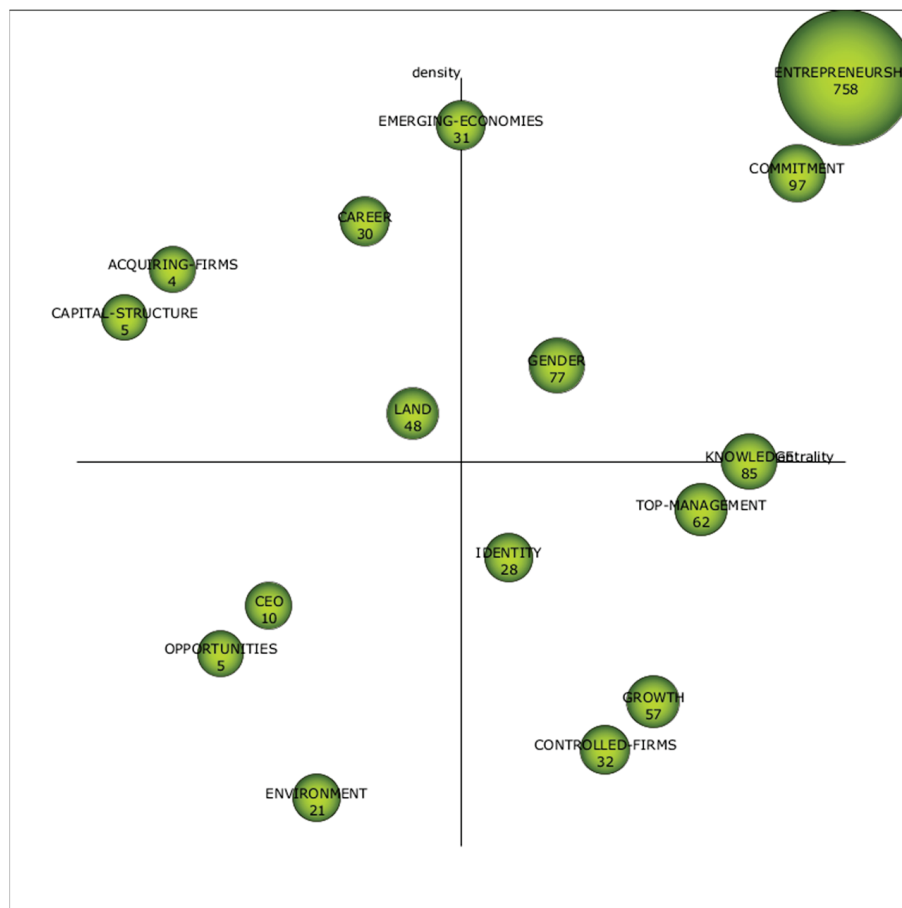


Figure 3. Strategic diagram of the main topics in the research on the rural economy and family business. Source: Own elaboration.

On the upper-right side, the driving topics are shown, which are the topics that had the strongest relationship with the rest and that were more developed: entrepreneurship, gender, and commitment. These are very important topics that allowed the formation of the scientific field. The most prominent for the number of documents, as well as for its greater centrality and density, is entrepreneurship.

In the lower-right part are the transversal or basic themes: topics closely related to the rest but which, in themselves, are not very developed. Here, we find the topics senior management, growth, controlled companies and identity.

The less central themes are defined as peripheral; they are framed in the upper-left and lower-left sides. In the upper-left margin, the most developed topics are shown, which are less related to the others: topics that are very defined in themselves but, however, have not been analyzed along with other topics. These are land, professional career, capital structure, and acquired companies. In the lower-left quadrant, we have the least developed topics that are least related to the rest, which are environment, CEO, and opportunities, which are emerging or disappearing topics. In our case, these three themes are emerging themes within the areas of research analyzed.

It should be noted that the topics of emerging economies and knowledge are in intermediate positions. Thus, emerging economies is located between a driving theme and

a specific theme, while knowledge is between a driving theme and a basic or cross-cutting theme. Due to this positioning, although they cannot objectively be categorized into one type or another, it can be determined that they are outstanding topics due to their good centrality and density.

We then evaluated the productivity and impact of each topic. Table 6 shows the number of documents, the h-index (h articles out of the total number of articles on the topic that have at least h citations), and the number of citations for each topic. For this evaluation, we took the main documents, which were those that contained at least two keywords on the topic.

Table 6. Productivity and impact of each topic.

Topic	No. of Doc.	H Index	Citations
Entrepreneurship	758	78	24,169
Land	48	15	576
Career	30	11	655
Emerging economies	31	12	931
Commitment	97	27	2541
Knowledge	85	24	1906
Gender	77	25	2148
Top management	62	22	1980
Growth	57	20	1208
Identity	28	13	572
Controlled firms	32	16	791
Environment	21	10	431
CEO	10	6	606
Acquiring firms	4	3	199
Capital structure	5	5	154
Opportunities	5	3	272

Source: Own elaboration.

The topic of entrepreneurship stood out from the rest both in terms of the number of documents (758), h-index (78), and total citations received (24,169). Following entrepreneurship, the topics with the most papers, the highest h-index, and the most citations received were commitment (97 papers, h-index of 27, and 2541 citations received), knowledge (85 papers, h-index of 24, and 1906 citations received), and gender (77 papers, h-index of 25, and 2148 citations received). It should be noted that these topics coincided with the motor themes except for knowledge, which was located right on the axis between the driving themes and the basic or transversal themes.

On the other hand, the topics that had the lowest productivity and impact were acquiring firms, capital structure and opportunities. In this regard, acquiring firms was the topic that presented the fewest documents (4); together with opportunities, which had the lowest h-index (3), the topic that has received the fewest citations is capital structure. In this case, opportunities was detected as an emerging topic, which justified the reduced impact and productivity; however, acquiring firms and capital structure were cataloged as specific topics. This low productivity and impact of these two issues indicate signs of disappearing.

4. Conclusions and Discussion

With the aim of identifying and visualizing the intellectual structure around family businesses and the rural economy, as well as checking the lines of studies that have emanated from research on family businesses and evaluating the importance of topics related to the rural economy, this study, through bibliometric techniques, verified the common points that allow improving the research and knowledge on the situation and prospects of family businesses in rural areas.

To achieve the proposed objective, the performance and production of the selected research area were evaluated through bibliometric indicators, and the main research topics

around family business and rural economy were extracted through an analysis of the co-occurrence of keywords with scientific maps.

The results obtained show how research on family businesses and the rural economy is trending upward, with a growing interest in research on family businesses.

Focusing on productivity by authors and journals and the performance of articles, it was shown that the most productive authors belonged to the family business research area, as well as that the most productive journals mainly included studies on family business. Along the same lines, when analyzing the most cited works, we found little inter-relation between family business and the rural economy, showing that most of these articles are related only to aspects of family businesses, except for one that was related to the rural economy.

By analyzing the scientific maps created from the analysis of co-occurrence of key keywords, 16 main research topics were detected on family business and the rural economy: entrepreneurship, land, career, emerging economies, commitment, knowledge, gender, top management, growth, identity, controlled firms, environment, CEO, acquiring firms, capital structure, and opportunities.

By analyzing the centrality and density of each topic, it was possible to classify the different topics detected according to their level of development and their importance in the research on family businesses and the rural economy. Thus, the following were detected as driving themes, that is, as the most important topics: entrepreneurship, gender, and commitment. While entrepreneurship and commitment were especially focused on family businesses, research on gender extended to both family businesses and the rural economy. As for the transversal or basic topics, that is, topics that have been little developed but are closely related to the rest, the topics of senior management, growth, controlled companies and identity were detected. These topics have especially focused on family businesses. Regarding the isolated topics (topics that have been well developed but are not very related to the rest), land, professional career, capital structure, and acquired companies were identified. In this case, land is a subject that has focused on the rural economy, while career and acquiring firms have more specialized on family businesses. However, we detected that capital structure has been a common theme for both family businesses and rural economies. The relevant group of topics for future research is known as emerging topics. Thus, the emerging themes in the research on family businesses and the rural economy are environment, CEO, and opportunities. Of these topics, with the exception of CEO, which is more focused on family businesses, environment and opportunities are topics closely related to research on family businesses and rural economics. Finally, although emerging economies and knowledge are in intermediate positions, their positioning places them very close to driving issues, so they can be considered among the important topics in both family business research and rural economy.

Focusing on the productivity and impact of each topic, it was shown that entrepreneurship is the most prominent topic, in terms of the number of documents it contains, its h-index, and its total citations received. This, together with its position as a driving force, shows that the current research on family businesses is closely linked to the study of entrepreneurship in these companies. Far behind, entrepreneurship is followed by commitment, knowledge, and gender, which, although they are also outstanding topics, have not achieved the impact of entrepreneurship.

Special mention to be made of the least productive issues and of those with the least impact. The least prominent topics are acquiring firms, capital structure, and opportunities. Among these topics, the positioning of acquiring firms and capital structure as specific topics shows signs of disappearance; however, the positioning of opportunities as an emerging topic justifies its low productivity and impact.

Overall, the findings show that inter-related research between family business and rural economy is scarce, with the productivity and performance of the research on family business predominating. However, some common points were found in relation to these two areas, which include the research in relation to the topics of entrepreneurship,

emerging economies, knowledge, gender, top management, growth, environment, capital structure. and opportunities. Along these lines, an important gap was found in the literature that incipient studies are beginning to analyze: the study of the cross-border environment in the management of family and/or rural businesses, showing itself as a future research opportunity.

These findings have important implications for researchers. The low production on the rural economy highlights the need for more research in this area, which is especially relevant in recent years as the Sustainable Development Goals have highlighted the importance of greater and better development of the rural economy to achieve sustainable growth. At the same time, within family businesses, the potential for research on entrepreneurship shows how this topic, which is already important, continues to be a good avenue for research with numerous gaps that must be addressed. Likewise, research on CEO succession in family businesses as an emerging topic is a relevant opportunity for future research. On the other hand, with respect to the inter-relationship between family businesses and the rural economy, research on the environmental factors that promote family and rural businesses stands out as a future study opportunity for researchers. In this sense, innovation and the consideration of cross-border regions are relevant factors that require further research. Greater knowledge of these issues can contribute to greater knowledge for these companies, allowing their survival and future growth.

Finally, after reviewing all the existing literature on family businesses and the rural economy, we reached the following conclusions on economic policies that could be implemented:

- (1) Entrepreneurship in the rural world, understood as personal self-employment, should be promoted. The consumer market is smaller and therefore the companies that can cover it must be smaller in size; where appropriate, diversified; or cover more than one need or product.
- (2) Actions should be promoted that encourage the entrepreneurship of women. This is one of the main issues addressed in the gender issue, as women are a group that must be addressed in rural areas so that they do not fall into social exclusion.
- (3) Another of the most important issues in the rural world is the environment. Most companies depend on the conservation of the environment, both for the resources it provides and for tourism, so the health of the environment must be balanced with sustainable entrepreneurship.

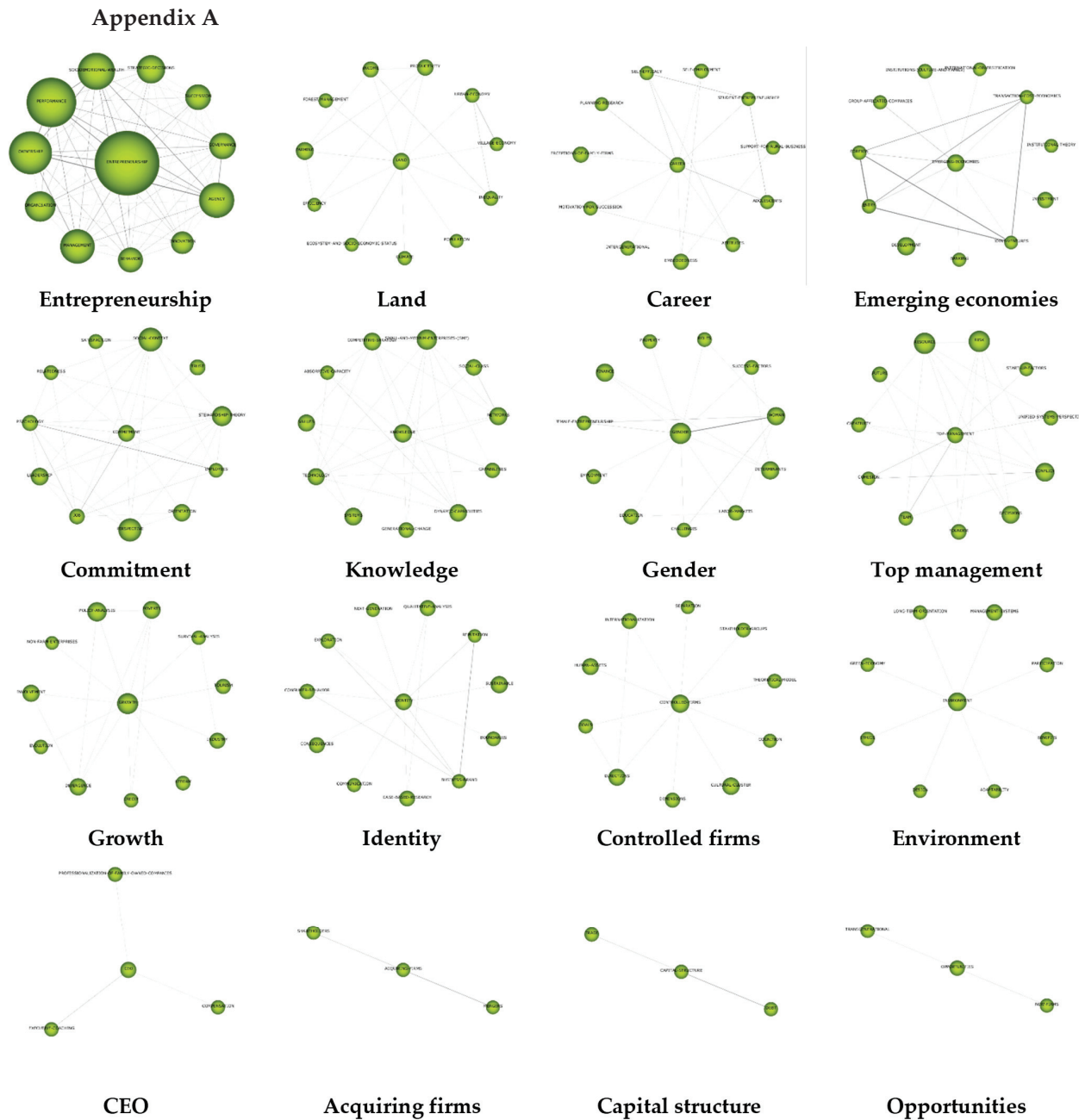
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Article

The Impact of Digital Rural Construction on Rural Revitalization-Empirical Evidence from Chinese County Panel Data

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Abstract: High-quality economic growth across society is increasingly being driven by the quickly evolving digital economy, with digital villages integrated into various aspects of rural development, construction, and governance, providing essential digital support for achieving comprehensive rural revitalization. By employing county-level panel data from China spanning 2018 to 2020, the Rural Revitalization Index was constructed and applied at the county level, and empirical tests were performed in combination with the Digital Village Index. The results demonstrate that the establishment of digital villages greatly enhances the progress of rural revitalization, with the sub-dimensions of digitalized rural economies and rural lifestyles playing particularly positive roles. Based on this, the mechanisms through which digital village construction empowers rural revitalization were examined, with the process being summarized as “factor aggregation–entities cultivation–market integration.” Further analysis demonstrates that the empowerment effect of digital village construction on rural revitalization is more pronounced in counties that are not major grain producers, have longer road networks, and are located closer to Hangzhou. Thus, it is essential to continue advancing digital village initiatives, identify integration points based on rural functional roles and resource endowments, and explore pathways to fully realize their empowering effects on rural revitalization.

Keywords: digital countryside; rural revitalization; factor aggregation; subject cultivation; connecting to markets

1. Introduction

Rural modernization offers an effective approach to mitigating poverty and inequality [1], enhancing the agricultural industry [2], and fostering environmental protection and sustainable development [3]. However, rural areas continue to encounter challenges such as limited activity types, inadequate public services [4], outdated infrastructure, and loose social networks [5]. Moreover, the historical village culture [6], unique tourism resources [7], and ecological advantages of rural areas remain underdeveloped, leaving substantial untapped potential. In the context of rapid global digitalization, a major force behind high-quality economic growth is the booming digital economy [8]. By integrating data elements into various rural sectors, accelerating the digital transformation of rural production and livelihoods, and establishing digital village development as a new avenue for rural advancement, the creation of digital villages can act as a catalyst for rural rejuvenation. The issue of “agriculture, rural areas, and farmers” has always been a focal point of the government of China. China’s agricultural and rural development has entered a new phase with the implementation of the rural revitalization policy. Since the comprehensive promotion of rural revitalization, various regions have actively explored pathways for implementation, forming mainstream governance models such as rural elite governance [9],

regional resource development [10], and grassroots Party leadership [11]. However, challenges such as insufficient innovation in resource coordination and inadequate grassroots governance capabilities led by the Party still exist in the course of development. Digital villages can be integrated into various aspects of rural life, services [6], development, construction, and governance, offering essential digital support for the comprehensive achievement of rural revitalization.

Currently, many countries worldwide are actively advancing the integration of the digital economy with traditional sectors. The construction of digital villages serves as an effective response to the challenges encountered in rural revitalization. The European Union introduced the “Smart Villages” concept in its 2017 policy documents, which has since been actively promoted [12]. Further, the Common Agricultural Policy, one of the EU’s most prominent rural development initiatives, also includes measures to enhance digital services in rural areas [13,14]. In India, the Digital Village Project aims to boost productivity and improve the living standards of rural communities [15]. Similarly, South Korea’s Smart Village Strategy seeks to facilitate rural industrial upgrading and enhance rural economic growth [16]. In China, the government’s increasing focus on digital village development signals a strong commitment to advancing rural digitization. In 2018, the country proposed the implementation of the Digital Village Development Strategy for the first time. In 2019, the “Digital Village Development Strategy Outline” was issued [17], providing clear direction for empowering rural revitalization through digital village construction. In 2020, the “Digital Agriculture and Rural Development Plan (2019–2025)” and the “2020 Key Work Points for Digital Village Development” were successively released [18,19], accelerating the digitalization process in rural areas, marking the entry into a new stage of digital village construction. In 2021, the “Digital Village Guide 1.0” was issued [20], providing guidance on the specific implementation of digital villages in China. The 2023 Central No. 1 Document placed a strong emphasis on the necessity of fully implementing the action plan for the development of digital villages [21], accelerating the use of big data in rural and agricultural areas, and advancing the field of smart agriculture. This promotes the deep application of digitalization in rural areas, expanding the boundaries of rural development. The government’s consistent emphasis on digital village construction reflects a strong commitment to advancing rural digitalization. Thus, can the construction of digital villages effectively address the existing gaps in the implementation of the rural revitalization strategy and drive rural revitalization? If a positive impact exists, what are the specific mechanisms through which it operates? This paper aims to explore these questions.

2. Literature Review

As a post-poverty alleviation strategy, rural revitalization has consistently garnered attention from the academic community [22,23], with existing research delving deeply into its core concepts and economic effects [24,25]. Zhang and Zhuang [24] point out that high-quality rural revitalization represents the fundamental guiding philosophy in addressing rural development challenges during the new phase of the new era. This concept is primarily reflected in the optimization and transformation of the development modes, orientations, content, and priorities related to “three rural” development. The central tenet of Xi Jinping’s rural revitalization strategy encompasses a people-centered approach [26], the goal of promoting agricultural and rural modernization, and the application of scientific thinking methodologies [25]. Research on the economic effects of rural revitalization focuses on variables such as improving farmers’ livelihoods [27], enhancing entrepreneurship and return migration employment opportunities for farmers [28,29], promoting common prosperity [30], and coupling rural revitalization with new urbanization [30,31], green logistics of agricultural products [32], and the digital economy [33]. China’s counties and rural-urban borderline areas have developed into important hubs for new urbanization and coordinated rural rejuvenation initiatives, serving as an efficient link between urban and rural areas for industrial development. This synergy creates more employment op-

portunities for the agricultural population and leverages the comprehensive development capacities of both urban and rural areas to promote common prosperity [30].

The digital economy has gradually evolved into a third form of human economic activity, following agricultural and industrial economies [34], initially proposed by Bowman [35]. Two important branches of the digital economy are information technology and e-commerce [36], with digital villages emerging as a derivative product of e-commerce development [37]. Roberts et al. [38] pointed out that rural areas are establishing new connections with urban cores and global markets through information and communication technologies. As digital technologies become increasingly integrated into various sectors, the development of digital villages has emerged as a central focus in global rural development strategies. In contrast to the “Digital Villages” concept proposed in China, the term “Smart Village” is more commonly adopted internationally. Scholars have examined the key aspects and development experiences of smart village initiatives across different countries. Somwanshi et al. [15] highlighted that the central objective of India’s smart village development is the effective integration of rural resources through information technology to deliver high-quality public goods and services to residents. In the South Moravian region of the Czech Republic, Vaishar and Št’astná [39] emphasized that improving villagers’ digital literacy is the main priority in smart village efforts. A case study from Canada by Young [40] similarly demonstrated that enhancing digital literacy should be the core focus while advancing rural digitalization comprehensively. The European Union, on the other hand, prioritizes fostering collaborative communities between villages, towns, and cities to jointly advance public governance [41]. In China, digital technologies can permeate various aspects of rural economic and social development, which enhances the integration and optimization of resource allocation, leading to disruptive innovation and creative destruction. This facilitates the exploration of the unique characteristics and strengths of different rural areas, thereby expanding the pathways to rural revitalization [42].

The Rural Revitalization Strategy represents a deliberate approach designed to tackle the significant challenges confronting rural regions once they attain a specific level of development, facilitating their progression to a more advanced stage. However, the implementation of the strategy encounters multiple bottlenecks, such as inefficient flows of production factors, disruptions in value chain operations, and blockages in supply-demand chains. Existing literature suggests that the digital economy, with its high quality, efficiency, and precision, can serve as a new strategic option to alleviate these bottlenecks in rural revitalization [33]. According to Yang and Liu [43], leveraging digital technology in rural areas and restructuring urban-rural spatial relationships through new digital logistics infrastructure can accelerate the flow of urban and rural elements, which is an essential hardware foundation for rural industrial development. Chen [44] asserts that the digital economy can optimize industrial structures, improve operational efficiency, reduce transaction costs, and increase land productivity, thereby contributing to the extension of rural industrial chains and the enhancement of value chains. Räisänen et al. [45] noted that digital innovation has the potential to strengthen the competitiveness of micro and small enterprises in rural areas, helping to bridge the digital divide in these regions. Fishman et al. [46], in their study of digital villages in India, found that combining low-cost IoT systems with satellite data can be effectively utilized in smallholder farming in developing countries, significantly reducing production costs, enhancing the precision of agricultural operations, and improving human capital development.

A survey of the body of research indicates that studies on the theoretical connotations and economic effects of digital villages and rural revitalization are relatively comprehensive, offering important theoretical insights and a foundational framework for this study. However, most empirical analyses of their measurement and influencing factors are limited to provincial-level panel data, with few studies focusing on the construction of county-level indices for rural revitalization and digital villages [47,48]. Additionally, studies on the impact of digital village development on rural revitalization remain largely theoretical [49], and empirical work mostly relies on provincial-level data [50]. To address this gap, this

paper aims to contribute in two key areas: First, by utilizing the Digital Village Index from Peking University's New Rural Development Research Institute, this study conducts a more precise and systematic examination of the effects and mechanisms of digital village development on rural revitalization. By applying county-level panel data from China for the period 2018–2020, this research extends the construction and application of the Rural Revitalization Index to the county level. The large dataset helps mitigate endogeneity issues, thereby enhancing the robustness of the empirical findings. Second, based on practical experiences from China's rural revitalization initiatives, this paper proposes a theoretical framework of "factor aggregation–entity cultivation–market integration" to analyze how digital village development influences rural revitalization, offering new perspectives and empirical evidence to deepen the understanding of its role in the broader rural revitalization strategy.

3. Theoretical Analysis and Research Hypothesis

3.1. The Direct Impact of Digital Village Construction on Rural Revitalization

The "Outline of the Digital Village Development Strategy" provides a clear definition of digital villages [17]. The concept of a "digital village" refers to a modern agricultural and rural development process that is fueled by the integration of digital technologies, such as networking and informatization, into the economic and social advancement of rural areas and the enhancement of farmers' digital literacy. As this paper discusses, the creation of "digital villages" refers to the incorporation of digital technologies into every facet of rural society and the economy [51]. The goal is to use digital tools to optimize rural environments and boost economic growth, thereby promoting the all-encompassing growth of digital villages and quickening the modernization of rural and agricultural areas [52]. According to the "2020 County-Level Digital Village Index Research Report," digital villages comprise several key elements: digital infrastructure, the digitalization of the rural economy, digital governance, and digital rural life. Rural infrastructure serves as the foundation for digital applications, supporting broader digital adoption; the digital economy is a critical driver for rural revitalization, fostering economic prosperity and high-quality development; digital governance is key to ensuring effective governance in rural revitalization, offering refined management that meets diverse community needs [53]; and digital rural life enhances quality of life by providing rural residents with better resources and equal access to services typically found in urban areas.

The comprehensive requirements for rural revitalization include industrial prosperity, ecological livability, cultural vitality, effective governance, and affluent living [26]. Specifically:

- **Industrial Prosperity:** This refers to a vibrant state where various sectors and a diversified rural economy interact and integrate. The focus should be on promoting the integration of agriculture, manufacturing, and services, establishing a comprehensive and multi-functional modern rural industrial system, and fostering the coordinated development and prosperity of all rural industries [54].
- **Ecological Livability:** This involves enhancing pollution control mechanisms and establishing ecological oversight across industries, improving pollution management at the source, and elevating the quality of the rural living environment. These efforts aim to create a solid ecological framework for sustainable green development [55].
- **Cultural Vitality:** This refers to fostering a cultural environment in rural areas grounded in socialist core values. It aims to create a harmonious and orderly rural society, with a focus on developing well-educated and skilled new-generation farmers [56].
- **Effective Governance:** In China, rural governance should center around strengthening grassroots Party organizations, with economic development as the foundation. It encompasses raising the overall level of governance in areas such as culture, livelihood, and environmental sustainability [57].
- **Affluent Living:** From the farmers' perspective, affluent living not only entails sustainable family livelihoods and material well-being but also relies on the availability of basic public services that provide a sense of security and well-being [58].

Digital villages incorporate digital technology into different elements of rural production, government, and life [59]. They are centered around big data and are supported by technologies like cloud computing, artificial intelligence (AI), and the Internet of Things (IoT). This integration reshapes rural production structures and resource allocation, improves production efficiency and farmers' incomes, reduces production costs and risks, enriches lifestyles and cultural development, strengthens governance effectiveness, and promotes environmental protection, thus broadening the scope of rural rejuvenation. Digital villages integrate advanced digital technologies to comprehensively upgrade traditional agricultural value chains, fostering the modernization and enhancement of the agricultural sector. By applying big data analytics to optimize agricultural production, digital villages enable smarter farming practices, cutting costs while simultaneously improving both crop yields and product quality. E-commerce platforms further help expand market access, injecting new vitality into rural economies and driving industrial prosperity [60]. In terms of environmental management, digital village construction allows for real-time monitoring and early warning systems for rural environmental conditions, enabling quick identification and resolution of pollution issues. Additionally, these digital initiatives promote sustainable farming and living practices, raising environmental awareness among farmers, which, in turn, helps protect the ecological balance and creates a more livable rural setting [61]. The digital platforms and information services established as part of the digital village initiative enhance farmers' access to information and improve educational opportunities, contributing to the cultivation of more civilized rural customs while strengthening social cohesion [62]. By implementing digital governance platforms, digital village construction facilitates open governance and streamlined public services, improving governmental efficiency and service delivery. The use of big data and AI technologies further optimizes social governance systems, enhancing public safety and community management [63]. As a result, digital village initiatives not only contribute to industrial growth and environmental sustainability but also create new employment opportunities and income streams for farmers. Moreover, digital services like online education and telemedicine become more accessible, offering farmers a more convenient and efficient quality of life [64]. By embedding digital technologies into every aspect of rural revitalization, digital villages align with the overall objectives of rural revitalization and comprehensively facilitate its realization.

H1: Digital village construction can contribute to the realization of rural revitalization.

3.2. Indirect Impact of Digital Village Construction on Rural Revitalization

Elements are the most basic units of rural production and life, and improving agricultural productivity and efficiency requires the infusion of capital and labor elements. The development of digital villages leverages digital assets to establish network-based credit platforms, enhancing the openness and transparency of rural production processes [65]. This reduces the credit risk for farmers, facilitates access to greater loan capital [66], and boosts capital investment, promoting capital aggregation. As a result, it enables the expansion of production scale, deepens the integration of digital technologies into agricultural production, and ultimately enhances production efficiency, contributing to the broader goal of achieving industrial prosperity [60]. A greater number of agricultural technicians are entering the production workforce because of the thorough incorporation of digital technologies into farming, which spurs technical advancements and upgrades in conventional agricultural value chains. Smart agriculture, precision farming, and digital management tools significantly boost productivity while attracting more skilled agricultural technicians [67]. At the same time, new sales channels, such as e-commerce platforms, live streaming, and short videos, provide diversified roles for those engaged in primary industries. To adapt to modern agricultural practices, farmers are motivated to learn new agricultural knowledge and technologies, enhancing their skill sets and transforming them into high-quality farmers who fulfill the requirements of contemporary agriculture development [68]. Smart agriculture is promoted by the digital village through the use of

cutting-edge technologies, including drones, artificial intelligence, satellites, and the Internet of Things, enabling accurate predictions of climate changes and mitigating the adverse effects of natural disasters on crops. This approach also enhances the precise application of fertilizers and soil treatments, increasing agricultural competitiveness within the broader industrial landscape [69]. Consequently, the sector attracts more investment and skilled professionals, leading to the concentration of essential resources. The large-scale infusion of both capital and labor drives the optimization of the agricultural sector, boosting its competitiveness and enabling farmers to benefit from economies of scale. This not only increases their income but also reduces pollution, thereby advancing the realization of rural revitalization.

H2: Digital village construction empowers rural revitalization, and development is achieved through the mechanism of factor agglomeration.

Farmer cooperatives have become a powerful tool for transforming rural economic development in China. They are essential in many areas for encouraging industrial development and rural rejuvenation because they provide a means for dispersed rural households to participate in large-scale modern agriculture and establish connections with markets [70]. Establishing digital infrastructure, in particular, and building digital villages have broadened villagers' access to information, challenged their traditional perceptions, and enhancing their willingness to establish farmer cooperatives [71]. This lays a solid foundation for cultivating new agricultural business entities in the modernization of both agriculture and rural regions. Modern information technology is integrated across different stages of the agricultural value chain in the production sector. Smart agriculture, driven by big data, systematically records and analyzes data before, during, and after agricultural production, thereby improving the administrative efficiency of large-scale production within farmer cooperatives [72]. This also reduces the production risks posed by natural disasters and fosters a professionalized [73], modern agricultural environment conducive to large-scale operations, creating a favorable production environment for farmer cooperatives. In terms of distribution and sales, the integrated growth of trade and commerce has been encouraged by the establishment of digital communities, replacing traditional field-side transactions with networked sales platforms [74], such as mobile applications and live streaming. Modern logistics services, including those provided by SF Express and YTO Express, have greatly facilitated the growth of rural e-commerce by enabling unified sorting, collection, and transportation [75]. The organized, large-scale production and sales structures of new agricultural business entities naturally provide advantages in this domain. The integrated development of commerce and trade catalyzes the establishment and growth of farmer cooperatives, which are the driving force behind agricultural modernization and rural revitalization. These cooperatives organize scattered and relatively weak farmers into larger-scale operations [76], effectively utilizing the technological support provided by digital villages to propel rural revitalization.

H3: Digital village construction empowers rural revitalization, and development is achieved through the main cultivation mechanism.

As rural economies continue to develop, rural markets have become increasingly complex and diversified [77]. Rural markets promote the movement of goods between the production and consumption sectors in addition to acting as exchange locations for agricultural goods and services [78]. The construction of digital villages, by creating a new sales model of "agricultural production + live streaming + offline stores," enables timely collection of consumer feedback and addresses diversified consumer needs. This system provides consumers with real-time feedback, accelerates the circulation of agricultural products, and ensures the quality and safety of agricultural goods through synchronized production monitoring [79]. Transparent and publicly available data further assure consumers of product safety. E-commerce platforms eliminate regional and geographical

limitations, unlocking the market potential of agricultural products to a greater extent [80]. At the same time, digital village construction allows farmers to quickly access information about other products available in the market via online platforms. The robust modern logistics system makes the goal of “bridging the last mile in rural development” a reality, providing convenience to rural consumers and unlocking the potential of the rural consumption market [81]. By overcoming the constraints of geographical distance and space, digital village construction extends the rural industrial chain and creates new business models for rural development. Leisure agriculture and agricultural complexes have become new icons of rural development, while activities such as plantation visits and crop picking have emerged as popular recreational pursuits for urban residents [16]. This expansion of market opportunities not only increases farmers’ income sources but also enhances their overall sense of well-being. The economic incentives provided by market expansion encourage farmers to strengthen their efforts in protecting rural ecological civilization, thereby further advancing rural revitalization’s objective.

H4: Digital village construction empowers rural revitalization, and development is achieved by connecting market mechanisms.

4. Empirical Strategy and Data Description

4.1. Model Setup

This study builds a two-way fixed-effects model to examine how the development of digital villages affects rural revival, specifically under the model:

$$rural_{it} = \beta_0 + \beta_1 digital_{it} + \sum \beta_j control_{ijt} + \eta_i + \mu_t + \varepsilon_{it} \quad (1)$$

In this context, i represents the individual county, t denotes the sample time period, $rural_{it}$ refers to rural revitalization, and $digital_{it}$ is the primary explanatory factor that shows the state of construction of digital villages. $control$ stands for a set of control variables that influence the development of rural revitalization. β_0 denotes the constant term, β_1 represents the coefficient of the core explanatory variable, and β_j corresponds to the coefficient of any control variable, where j indicates any such control variable. η_i represents the individual fixed effects of the sample while capturing the features of endowments at the county level that remain constant across time. μ_t signifies time fixed effects, which control for macro-level factors at the national level. ε_{it} represents the residual term that is independent of region and time.

4.2. Description of Variables

Dependent variable: Rural revitalization. The measurement of rural revitalization is usually based on its theoretical connotations, constructing an index system centered on five dimensions: industrial development, ecological sustainability, rural civilization, efficient governance, and improved living standards [82]. Zhang Ting et al. [83] approached rural revitalization by defining five key dimensions as secondary indicators. For each of these secondary indicators, three tertiary indicators were identified, leading to a total of 15 tertiary indicators. Subsequently, 44 fourth-level indicators were selected as the most detailed sub-indicators, forming the rural revitalization evaluation index system. This system was then empirically tested using rural data from 11 provinces. This paper draws on related research findings from academia [84,85], while taking into account the actual conditions in rural areas, to construct a county-level rural revitalization index. First-level indicators are used to construct the five main pillars of rural revitalization: industrial prosperity, ecological sustainability, rural civilization, efficient government, and improved living conditions. Second-level indicators are used to provide more detail for each of these pillars. The specific details of the variables are shown in Table 1. After data cleaning, the entropy method was employed to assign weights to the variables (Table 1) [86]. To avoid the dependent variable’s small value inflating the estimated coefficients of the explanatory variables and making interpretation difficult, the final county-level rural revitalization

index was multiplied by 1000 and used as the dependent variable, with the variable name denoted accordingly. The Rural Revitalization Index, as a proxy for the explanatory variable, is primarily derived from data published in the China County-Level Economic Statistical Yearbook. The data on carbon dioxide emissions is taken from the study by Chen et al. [87].

Table 1. 2018–2020 County Rural Revitalization Evaluation Indicator System.

Primary Indicator	Secondary Indicator	Explanation	Unit	Indicator Description	Weight
Industrial Prosperity	Degree of industrial integration	Industrial integration coefficient	-	Positive	0.0003
	Agricultural development level	Added value of the primary industry/Gross Domestic Product (GDP)	%	Positive	0.0989
Ecological Livability	Pollutant emissions	Carbon dioxide emissions	tons	Negative	0.0047
	Healthcare conditions	Number of hospital beds in healthcare institutions	count	Positive	0.1865
Rural Civilization	Level of educational resources	Number of students enrolled in regular secondary schools	people	Positive	0.1916
	Level of cultural services	Total collection of public libraries	thousand volumes	Positive	0.1892
Effective Governance	Grassroots democratic organizations	Number of village committees	count	Positive	0.1750
	Government intervention capacity	General public budget expenditure/Gross Domestic Product (GDP)	%	Positive	0.0762
Affluent Living	Rural residents' income	Per capita disposable income of rural residents	yuan	Positive	0.0759
	Urban-rural income gap	Ratio of per capita disposable income of urban and rural residents	%	Negative	0.0017

The weight of indicators in the rural revitalization index rating system, as shown in Table 1, reveals that “Rural Culture and Civilization” holds the highest weight, followed by “Effective Governance” and “Ecological Livability.” In comparison, “Industrial Prosperity” and “Wealthy Livelihood” have relatively lower weights. This indicates that the future goals of rural revitalization should focus more on aspects that reflect the “soft power” of rural areas, particularly in enhancing rural culture and ecological livability. These aspects are the core drivers of rural resurgence.

Core explanatory variable: The New Rural Development Research Institute of Peking University developed the Digital Village Index, which measures the extent of digital village construction. This index comprises four sub-indices: rural digital infrastructure, economic digitalization, digital governance, and digital rural life. It is one of the limited datasets available focusing on the county level, built with eight indicators obtained from national data and web scraping, in addition to 21 indicators obtained from Alibaba Group and its affiliates. The index is calculated gradually from the bottom up and standardized using a logarithmic efficiency formula. The original index values range between 0 and 100, but for ease of interpretation in the empirical analysis, the Z-score standardized version of the index is employed, except in the descriptive statistics section. The Digital Village Index, obtained from Peking University’s County-Level Digital Village Index (2018–2020), provided a final sample of 1,781 valid observations after excluding counties with significant missing data.

Other control variables. To provide a precise understanding of the impact of digital rural development on rural revitalization and achieve more reliable estimation outcomes, this paper builds on prior research while taking into account the specific characteristics of the sample data. Eight variables were selected to control for the influence of other county-level factors on rural revitalization: county-level financial development (fin), county-level savings rate (dep), county-level fiscal self-sufficiency rate (pub), county-level export level (exp), county-level digital infrastructure (fig), county-level consumption level (con), and

enterprise development in the county (fir). The specific definitions are shown in Table 2. The control variable data were sourced from the China County Economic Statistical Yearbook for the years 2019–2021, which provided the economic characteristic data for counties from 2018 to 2020. After excluding missing data and removing samples impacted by changes in administrative divisions, the data were compiled into a county-level panel dataset.

Table 2. Control variables and their definitions.

Variable Name	Variable Symbol	Definition
County-level Financial Development	fin	Ratio of loan balance of financial institutions to Gross Domestic Product (GDP)
County-level Savings Rate	dep	Ratio of household savings balance to Gross Domestic Product (GDP)
County-level Fiscal Self-sufficiency Rate	pub	Ratio of general budgetary expenditures to general budgetary revenues
County-level Export Level	exp	Logarithmic value of total exports
County-level Consumption Level	con	Ratio of total retail sales of consumer goods to Gross Domestic Product (GDP)
Enterprise development in the county	fir	Number of industrial enterprises above county scale (number)

5. Results and Discussion

Using a systematic methodology, this chapter does an empirical analysis to assess the impact of building digital villages on rural revitalization: baseline regression, robustness evaluations, mechanism testing, endogeneity assessments, heterogeneity analysis, extended analysis, and discussion. The baseline regression presents empirical evidence of the direct effect of digital village construction on rural revitalization, addressing the first part of the theoretical framework. Endogeneity tests account for the potential presence of omitted variables and bidirectional causality between variables, thereby strengthening the validity of the empirical results. Robustness checks demonstrate the stability of the baseline regression outcomes, reinforcing the generalizability and reliability of the findings. Mechanism tests verify that the variables mediating the effect of digital villages on rural revitalization are valid, supporting the second part of the theoretical framework. Heterogeneity analysis highlights how the impact of digital village construction varies depending on differences in group endowments, providing more targeted evidence for policy recommendations. The extended analysis identifies the effects of digital village construction on sub-indicators of rural revitalization, offering a more detailed and concrete understanding of its impact. Table 3 summarizes the descriptive statistical characteristics of the variables.

Table 3. Descriptive statistical characteristics of the variables.

Variable Names and Symbols	Observations	Mean	Standard Deviation	Minimum	Maximum
Rural Revitalization (rural)	5,343	11.0200	4.2830	3.6190	42.4600
Digital Rural Development (figure)	5,343	52.1200	13.1200	4.5470	94.6700
County-level Financial Development (fin)	5,343	1.0200	0.8750	0.0405	23.5100
County-level Savings Rate (dep)	5,343	0.9280	0.4650	0.0284	7.3450
County-level Fiscal Self-sufficiency Rate (pub)	5,343	7.9710	10.0600	0.1170	155.20
County-level Export Level (exp)	5,343	9.0310	1.4860	0.0010	16.4100
County-level Consumption Level (con)	5,343	0.3620	0.2660	0.0056	9.0260
Enterprise development in the county (fir)	5,343	90.5100	129.6000	1.0000	1,7370
Capital gathering (capital)	5,343	1,4350	5,467.0000	0.2660	296,258.0000
Talent Gathering (people)	5,343	0.2930	0.1480	0.0014	1.3600
Number of new registrations of specialized farmers' cooperatives (Inrceo)	5,343	1.9470	1.4250	0.0000	6.5030
Average registered capital of specialized farmers' cooperatives (Inrceos)	5,343	4.0370	2.2010	0.0000	14.8800
Market Potential Index (mp)	5,124	110.6000	40.3900	27.1900	202.3000

5.1. Baseline Regression Results and Analysis

The study assesses the impact of digital rural development on rural revival using a two-way fixed effects model. Table 4 presents the linear regression outcomes of the Digital Village Development Index and its sub-indices on rural revitalization. The dependent variable in this analysis is the Rural Revitalization Index, while the primary explanatory variable is the Digital Village Development Index. The sub-indices of this index consist of digital infrastructure, rural economic digitalization, rural governance digitalization, and rural life digitalization. Both the Digital Village Index and its sub-indices have been standardized using Z-Score for the regression analysis. As the table illustrates, the marginal effect coefficient of digital rural development on rural entrepreneurship is 0.0919, indicating that, after controlling for other economic variables affecting rural revitalization, a one standard deviation increase in digital rural development corresponds to an average 9.19% increase in rural revitalization. This result confirms Hypothesis H1, arguing that increased digital rural development levels encourage rural regeneration. The regression results for the different sub-dimensions of the Digital Rural Development Index on rural revitalization are shown in Table 4 in Columns (2) through (5). The digitalization of rural life and the rural economy has substantially positive coefficients, implying that digital rural development has been integrated into various stages of rural economic development, injecting new growth drivers that further rural revitalization. Moreover, digital rural infrastructure has enriched the range of services available to rural residents, significantly improving their quality of life and sense of well-being, thereby directly contributing to rural revitalization. However, digital infrastructure has a negative and statistically negligible effect on rural revival. A potential reason for this could be that digital infrastructure has yet to be transformed into productive forces in the agricultural sector, as the development of smart agricultural equipment remains lagging. Additionally, there is currently insufficient technology assistance for the digital transformation of rural infrastructure [88], which explains why it has not yet had a direct positive effect on rural revitalization. The effect of digital governance on rural revitalization is positive but not statistically significant. This could be because adequate digital expertise and active village involvement are necessary for effective digital government in rural areas. However, the digital transformation of rural government is similarly hampered by a lack of village elites qualified to facilitate this shift, as villagers typically exhibit a poor willingness to participate in governance under the existing approach. Therefore, promoting the reconstruction of rural digital governance structures and fostering rural elites to support digital governance reform is a crucial and urgent task [9].

Table 4. Benchmark regression results.

	Explained Variable: Rural Revitalization				
	(1)	(2)	(3)	(4)	(5)
z_figure	0.0919 *** (0.0342)				
z_infastructure		−0.0102 (0.0154)			
z_economic			0.0498 ** (0.0228)		
z_govern				0.0066 (0.0189)	
z_life					0.1294 *** (0.0196)
con	0.6096 *** (0.1976)	0.6314 *** (0.1051)	0.6222 *** (0.1051)	0.6312 *** (0.1051)	0.5587 *** (0.1050)
exp	0.4461 ** (0.1795)	0.4636 *** (0.1380)	0.4597 *** (0.1379)	0.4642 *** (0.1380)	0.3775 *** (0.1378)
fir	−0.0013 * (0.0007)	−0.0013 *** (0.0004)	−0.0012 *** (0.0004)	−0.0013 *** (0.0004)	−0.0014 *** (0.0004)

Table 4. Cont.

	Explained Variable: Rural Revitalization				
	(1)	(2)	(3)	(4)	(5)
pub	−0.0017 (0.0036)	−0.0024 (0.0028)	−0.0019 (0.0028)	−0.0024 (0.0028)	−0.0014 (0.0028)
fin	0.0607 ** (0.0272)	0.0581 ** (0.0266)	0.0594 ** (0.0265)	0.0595 ** (0.0265)	0.0457 * (0.0264)
dep	0.2692 ** (0.1361)	0.2779 ** (0.1154)	0.2804 ** (0.1152)	0.2787 ** (0.1154)	0.2143 * (0.1150)
constant term	2.7048 (2.4655)	2.4205 (2.0151)	2.4371 (2.0125)	2.3976 (2.0155)	4.1063 ** (2.0185)
County fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
N	5,343	5,343	5,343	5,343	5,343
R ²	0.434	0.432	0.433	0.432	0.439

Note: The heteroskedasticity clustering robust standard errors of the estimated coefficients are reported in parentheses. *, **, and *** stand for significance levels of 10%, 5%, and 1%, respectively.

5.2. Endogenous Processing

The baseline regression model may suffer from endogeneity issues caused by omitted variables, reverse causality, and measurement errors. On the one hand, some unobservable omitted variables may be endogenous to the growth of digital rural areas, which in turn could affect the progression of rural revitalization. Conversely, the greater the degree of rural rejuvenation, the more diverse the application scenarios for digital technologies, leading to increased demand for these technologies. It influences the advancement of digital rural development by hastening the development of digital rural areas. Additionally, measurement errors might be embedded in the data used for the Digital Rural Index. Specifically, the majority of the data used to generate the index in this study came from Alibaba Group. Therefore, certain counties with high levels of digital rural development that utilize products or services from other internet companies may have been underestimated, resulting in biased estimates.

The paper uses the instrumental variable method for additional estimation based on this. Based on Zhao et al.'s [89] study, the instrumental variable for the Digital Rural Index is the logarithm of the product of “the number of fixed telephone lines in 1984” and “the number of national internet users in the previous year” and “postal and telecommunications business volume in 1984” at the prefecture level. The primary rationale is that the national internet user count, fixed telephone lines, and postal and telecommunications business volume are all closely related to a region’s digital development and can reflect the level of digital rural development in a county. Additionally, the “number of national internet users in the previous year,” “number of fixed telephone lines in 1984,” and “postal and telecommunications business volume in 1984” are historical data that do not impact the current development of rural revitalization in the counties, meeting the exogeneity condition. Table 5 displays the regression results using the instrumental variable in the first two columns. There is a substantial association between the chosen instrumental factors and the degree of digital rural development, as shown by the first-stage regression’s regression coefficient of the instrumental variable on digital rural development, which is considerably positive at the 1% level. Furthermore, the endogeneity, over-identification, and weak instrument tests are all passed by the instrumental variables. The fact that digital rural development encourages rural revitalization is further supported by the second-stage regression results, which are in accordance with the baseline regression.

Table 5. Endogeneity and robustness tests.

	Instrumental Variable Regression			Robustness Check		
	Stage 1	Stage 2		Substitution of Explanatory Variables	Remove the Top 100 Counties for Rural Revitalization	Exclusion of Counties
Number of fixed-line telephones in 1984	1.7210 *** (0.2122)		z_figure	0.1510 *** (0.0449)	0.0797 *** (0.0275)	0.0828 *** (0.0306)
Postal and telegraphic traffic in 1984	1.3929 *** (0.1022)		con	−0.9468 *** (0.2089)	0.7185 *** (0.1167)	0.8291 *** (0.1225)
z_figure		2.325 *** (0.2361)	exp	0.3197 (0.2019)	0.3881 *** (0.1359)	0.3575 *** (0.1365)
con	0.1877 ** (0.0906)	0.0972 (0.3176)	fir	0.0070 *** (0.0008)	−0.0011 ** (0.0005)	−0.0017 *** (0.0005)
exp	0.2903 *** (0.0954)	−0.0311 (0.2914)	pub	0.0091 *** (0.0029)	−0.0010 (0.0027)	−0.0005 (0.0026)
fir	−0.0003 (0.0003)	−0.0002 (0.0009)	fin	0.1113 ** (0.0448)	0.0481 * (0.0263)	0.0449 * (0.0255)
pub	−0.0079 *** (0.0029)	0.0160 * (0.0066)	dep	0.6732 *** (0.1594)	0.2202 * (0.1148)	0.1526 (0.1133)
fin	0.0186 (0.0267)	0.0795 (0.0619)	constant	−8.5721 *** (2.2523)	3.5793 * (1.9922)	4.6095 ** (1.9543)
dep	0.3262 *** (0.1054)	−0.0674 (0.3334)	County fixed effects	Yes	Yes	Yes
County fixed effects	Yes	Yes	Year fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	N	5,343	5,064	4,362
Observations	5,343	5,343	R ²	0.116	0.423	0.431
Kleibergen-Paap Wald rk F statistic		94.837				
Kleibergen-Paap rk LM statistic		45.837 ***				

Note: The heteroskedasticity clustering robust standard errors of the estimated coefficients are reported in parentheses. *, **, and *** stand for significance levels of 10%, 5%, and 1%, respectively.

5.3. Robustness Tests

Robustness tests were performed in this paper by substituting the dependent variable and excluding particular samples. First, in accordance with Wang et al. [90], the logarithm of per capita GDP was employed as a stand-in variable for rural rejuvenation. Table 5’s Column (3) displays the regression results. In keeping with the baseline regression results, the Digital Rural Index’s regression coefficient on per capita GDP is considerably positive at the 1% level. Table 5’s columns (4) and (5) present the regression findings following the exclusion of the top 100 counties in terms of county-level cities and rural rejuvenation, respectively. The outcomes stay in line with the baseline, demonstrating the validity of the baseline regression conclusions.

5.4. Mechanism Testing

The theoretical analysis section suggests that digital rural development may impact rural revitalization through a mechanism of “factor aggregation–entity cultivation–market connection.” To examine this mechanism, the following model was constructed to test how digital rural development influences the progress of rural revitalization:

$$M_{it} = \beta_0 + \beta_1 digital_{it} + \sum \beta_j control_{ijt} + \eta_i + \mu_t + \varepsilon_{it} \quad (2)$$

where M_{it} represents the mechanism variable, and the remaining variables’ meanings align with Equation (1). Capital and talent are crucial elements for driving rural revitalization.

The degree of capital and talent concentration reflects the factor aggregation effect brought about by digital village development. In this study, capital and talent aggregation are employed as proxy variables for factor accumulation. Specifically, capital aggregation is measured by the ratio of total fixed asset investment to the county's administrative area, while talent aggregation is calculated as the ratio of employees in the secondary and tertiary industries to the county's administrative area. Farmers' cooperatives, as one of the key representatives of modern agricultural business entities, reflect the rural capacity to cultivate new agricultural entities through their growth in number and scale. Therefore, entity cultivation is assessed by the number of newly registered cooperatives and their average registered capital. The deepening connection between rural areas and the market is captured by the market potential index, which serves as a proxy for market connectivity, following the definition provided by Wang et al. [90]:

$$MP_c = \sum_j \frac{Population_{ij}}{Distance_{cj}}, c \neq j \quad (3)$$

where $Population_{ij}$ denotes the number of permanent residents in county j in year i , and $Distance_{cj}$ is the straight-line distance from county c to county j .

The mechanism tests' regression findings are shown in Table 6. Building digital villages has a very favorable impact on capital agglomeration at the 10% level and talent agglomeration at the 5% level with respect to the factor agglomeration mechanism. This suggests that digital villages, by leveraging data elements to build modern network information platforms, substantially reduce credit risks in rural areas and promote the widespread adoption of digital finance and mobile payments. These platforms and tools significantly lower the barriers to financial investment, allowing external investors to engage in investment activities more transparently and conveniently. Furthermore, digital village construction improves the allocation of national social capital, fosters the acquisition of social capital through diversified cooperative relationships and joint networks [91], and thereby facilitates capital factor agglomeration. The aggregation of capital provides the fundamental material support for rural revitalization, fostering new momentum and industries for rural development. It guides capital towards advantageous industries, enhancing capital allocation efficiency and generating economies of scale and agglomeration effects, thereby promoting the advancement of rural revitalization. Digital village construction, through the introduction of modern information technology and intelligent methods, brings new development opportunities to rural areas. The development of new digital technologies like artificial intelligence, 5G, big data, and the Internet of Things, along with the advancement of digital village initiatives, digital service platforms—such as smart healthcare and intelligent logistics—are connecting rural needs with urban service provision [92]. This shift alters the talent demand structure in rural areas, increasing the demand for highly skilled individuals proficient in digital technologies and management. Such changes create broader development prospects and employment opportunities, attracting more talent to rural areas. In parallel, farmers are proactively adapting to modern agricultural production by learning and applying advanced digital technologies, leading to a transformation in rural talent composition. The agglomeration of talent injects new vitality into rural revitalization, fostering new business models and making the development of specialized industries and green, sustainable growth possible. Additionally, it enhances rural governance capabilities and the provision of public services while also playing a role in the preservation of traditional culture, ultimately contributing to the progress of rural revitalization. Hypothesis 2 was tested.

Table 6. Mechanism testing.

	Agglomeration of Elements		Master Cultivation		Connecting Market Market Potential
	Capital Gathering	Talent Gathering	Quantities	Ballpark	
z_figure	0.0034 *	241.2066 **	0.0637 **	0.1561 **	21.1295 ***
	(0.0020)	(96.4227)	(0.0317)	(0.0778)	(0.6625)
con	0.0001	401.8507	0.2127 *	0.3393	5.0241 ***
	(0.0078)	(384.9917)	(0.1266)	(0.3106)	(1.6533)
exp	0.0062	−1,109.7130 **	−0.2981 *	−0.7307 *	−1.3348 ***
	(0.0102)	(499.8999)	(0.1644)	(0.4033)	(0.3149)
fir	0.0000	0.6108	−0.0007	0.0011	0.0068
	(0.0000)	(1.6327)	(0.0005)	(0.0013)	(0.0044)
pub	0.0001	0.2266	0.0062 *	0.0159 *	0.1416 ***
	(0.0002)	(10.1218)	(0.0033)	(0.0082)	(0.0524)
fin	0.0096 ***	175.2340 **	0.0754 ***	0.1135 *	−3.4872 ***
	(0.0017)	(82.8157)	(0.0272)	(0.0668)	(0.5134)
dep	0.0528 ***	1,064.9466 ***	0.3485 ***	0.7770 ***	6.6756 ***
	(0.0056)	(277.5610)	(0.0913)	(0.2239)	(0.6532)
Constant	−0.5042 ***	−3,584.9766	−0.3024	−0.5255	30.6734 ***
	(0.1082)	(5,328.5081)	(1.7523)	(4.2984)	(9.7380)
County fixed effects	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES
N	5,343	5,343	5,343	5,343	5,124
R ²	0.040	0.010	0.012	0.009	0.469

Note: The heteroskedasticity clustering robust standard errors of the estimated coefficients are reported in parentheses; *, **, and *** stand for significance levels of 10%, 5%, and 1%, respectively.

In terms of the mechanism for fostering new organizations for rural development, at the 5% statistical level, there is a considerable beneficial influence of the creation of digital villages on the number of recently registered farmers' cooperatives and the average size of their registrations. This indicates that digital village initiatives have facilitated both the growth and expansion of farmers' cooperatives. The agricultural production industry's use of technologies like big data, artificial intelligence (AI), and the Internet of Things (IoT) has sparked the creation of new agricultural management organizations, improving the caliber of rural labor and playing a significant role in productivity gains [93]. Farmers' cooperatives, as one form of these new agricultural management entities, benefit from digital innovations by achieving more intelligent production processes, resulting in greater efficiency and improved product quality. Moreover, digital village construction has accelerated the digital transformation of agricultural management. Farmers' cooperatives are utilizing digital tools for financial, membership, and supply chain management, thereby improving efficiency, increasing transparency, and lowering operational costs. Additionally, digital e-commerce has expanded the sales channels for cooperatives, hastened the turnover of agricultural products, and enhanced both their profitability and competitiveness. As a bridge between smallholder farmers and the broader goals of rural revitalization, farmers' cooperatives offer an effective mechanism for improving farmers' organizational levels. They enable small-scale farmers to better mitigate market risks and enhance their bargaining power. Cooperatives also reduce transaction costs and uncertainties, contributing to more stable income growth for farmers. By integrating land resources—either through land transfers or equity-based models—cooperatives can consolidate fragmented plots across villages, facilitating large-scale production and realizing economies of scale [94]. This not only maximizes labor productivity but also encourages farmers to prioritize the long-term sustainability of the land, thereby achieving both economic and ecological benefits. As the driving force behind village development, farmers' cooperatives also contribute significantly to enhancing the “soft power” of rural communities. They play an active role in preserving local cultural heritage, supporting vulnerable groups, and improving the delivery of high-quality public services, all of which foster the overall development of rural revitalization. Hypothesis 3 was tested.

At the 1% statistical level, the development of digital villages has significantly increased market potential in terms of the market integration mechanism. This suggests that digital village initiatives have enhanced the penetration of rural e-commerce, fostering direct connections between e-commerce platforms and farmers, and improving farmers' capabilities to leverage modern distribution technologies to access markets [95]. Consequently, agricultural products can reach markets faster and more efficiently. Through e-commerce platforms, agricultural goods can overcome geographical barriers and expand their sales channels more effectively. Traditional agricultural sales models often involve multiple intermediaries, which increase costs and reduce farmers' profit margins. By enabling direct e-commerce procurement, digital village construction reduces intermediary steps, lowers transaction costs, and enhances the market competitiveness of agricultural products. Additionally, the application of big data technologies within digital village development aids in collecting and analyzing market information, increasing market transparency. This allows farmers and agricultural enterprises to better grasp market demand and trends. With this data, farmers can develop more precise marketing strategies and offer differentiated products and services tailored to distinct consumer groups. This process enhances both the market visibility and brand reputation of agricultural products, thereby strengthening their competitiveness. The unlocking of market potential and the enhancement of competitiveness directly contribute to increased income for farmers and improved living standards. As farmers adapt their product supply based on shifting market demands, the growth in consumer markets and rising demand drive industrial transformation in rural areas. This, in turn, facilitates the refinement of industrial chains, promotes industrial upgrading, and advances the broader goals of rural revitalization. The regulatory function of the market mechanism enables more efficient allocation and utilization of rural resources. In competitive markets, high-quality resources tend to flow into sectors with greater development potential and market prospects, thereby fostering balanced rural economic development and furthering the realization of rural revitalization. These findings confirm the validity of Hypothesis 4.

5.5. Heterogeneity Analysis

China's vast territory, with its rich topography and diverse climates, results in varying agricultural advantages across different regions, leading to distinct agricultural functional roles for different provinces. This paper divides the overall sample into three categories: main grain-producing areas, non-grain-producing areas, and pastoral areas, and conducts regression analysis accordingly. The regression results, as shown in columns (1) to (3) of Table 7, indicate that digital rural development has a positive impact on rural revitalization in main grain-producing areas. It does, however, have a detrimental but not statistically significant impact on rural revival in pastoral areas. The possible reason is that pastoral areas are often characterized by vast territories and complex terrain, which increase the difficulty and cost of building network infrastructure. Unstable or incomplete network coverage limits the application of digital technologies. Additionally, farmers in pastoral areas may face challenges in adopting digital technologies due to lower educational levels, limited ability to accept and apply these technologies, and little assistance and training, which makes it challenging for individuals to learn and use new technology. The function of digital rural development in fostering rural revitalization is further limited by the dearth of varied application scenarios and the low level of digital technology adoption in pastoral areas. In contrast, at the 1% level, digital rural development has a strong positive impact on rural regeneration in non-grain-producing areas. This suggests that by embedding digital technologies into agricultural production, distribution, and other fields, non-grain-producing areas have greatly improved agricultural productivity. Additionally, rural e-commerce has expanded sales channels, reduced transportation costs, and increased farmers' direct income. Digital rural governance has also enhanced rural governance and public service provision, thereby improving farmers' well-being. Furthermore, big data has strengthened farmers' market orientation, allowing rural areas to better leverage their

locational advantages. As a result, rural areas are developing new business models, such as green agriculture and leisure agriculture, while promoting ecological protection, achieving ecological benefits, and ultimately contributing to the realization of rural revitalization.

Table 7. Heterogeneity analysis.

	Agricultural Location			Road Mileage		Distance to Hangzhou	
	Major Agricultural Region	Grazing Land	Non-Food-Producing Regions	Long	Short	Proximal	Far
z_figure	0.0069 (0.0459)	−0.0293 (0.0456)	0.1427 *** (0.0431)	0.1817 *** (0.0428)	0.0320 (0.0369)	0.1071 *** (0.0395)	0.0362 (0.0381)
con	0.8386 *** (0.1838)	0.1631 (0.1393)	0.7115 *** (0.1963)	1.2621 *** (0.1919)	0.3500 *** (0.1280)	0.4131 *** (0.1374)	0.9744 *** (0.1672)
exp	0.4198 *** (0.1527)	−4.1993 (6.1208)	−0.0021 (0.3765)	0.3767 ** (0.1892)	0.4077 ** (0.2022)	−0.1572 (0.2579)	0.6711 *** (0.1532)
fir	−0.0017 *** (0.0005)	0.0023 (0.0050)	0.0037 *** (0.0010)	−0.0028 *** (0.0006)	0.0005 (0.0006)	−0.0103 *** (0.0018)	−0.0003 (0.0004)
pub	0.0018 (0.0059)	−0.0021 (0.0028)	0.0114 * (0.0067)	0.0008 (0.0054)	−0.0036 (0.0034)	−0.0015 (0.0031)	−0.0014 (0.0090)
fin	−0.3183 *** (0.0848)	0.0507 ** (0.0246)	0.1679 * (0.0961)	−0.2008 *** (0.0687)	0.1043 *** (0.0289)	0.0725 ** (0.0302)	0.0810 (0.0915)
dep	−0.1642 (0.2279)	0.3164 ** (0.1298)	0.3509 (0.2974)	−0.2719 (0.2246)	0.3461 ** (0.1397)	0.4937 *** (0.1450)	−0.2735 (0.2345)
constant	10.6404 *** (3.5155)	42.4570 (56.1999)	4.2663 (5.3999)	11.3659 *** (3.5618)	1.4236 (2.6477)	4.5838 (2.9846)	8.7762 ** (3.6461)
County fixed effects	YES	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES	YES
N	2,601	747	1,995	2,671	2,672	2,671	2,672
R ²	0.518	0.245	0.413	0.434	0.452	0.355	0.542

Note: The heteroskedasticity clustering robust standard errors of the estimated coefficients are reported in parentheses; *, **, and *** stand for significance levels of 10%, 5%, and 1%, respectively.

Road mileage is a measure of a county’s infrastructure development, which can have an impact on the rate at which digital rural development advances and the scope of its use. Large internet companies, such as Alibaba Group, originated in Hangzhou and have had a radiating effect outward. Therefore, there exists a strong correlation between the degree of digital rural development and the spherical distance between a county and Hangzhou. Based on this, the paper conducts a heterogeneity analysis using road mileage and spherical distance from Hangzhou as criteria. Counties were sorted in ascending order according to their highway mileage and distance from Hangzhou, and the median was identified. Counties with highway mileage less than or equal to the median were grouped as the “shorter mileage” sub-sample, while those exceeding the median formed the “longer mileage” sub-sample. Similarly, counties located closer to Hangzhou than the median distance were grouped as the “closer” sub-sample, while those at or beyond the median were assigned to the “farther” sub-sample. Regression analyses were then conducted for both sub-samples. Digital rural development, as predicted, has a greater favorable effect on rural rejuvenation in counties that are closer to Hangzhou and have longer roads. In contrast, in counties with shorter road mileage and greater distance from Hangzhou, although digital rural development also has a positive effect on rural revitalization, it is not statistically significant. One probable explanation is that the latter lags behind the former in terms of digital infrastructure and strategies for digital rural development. These counties may require more capital investment and financial support for digital rural development, which slows its progress. Additionally, the application scenarios and degree of digital technology adoption remain limited, leading to a delayed effect on promoting rural revitalization.

5.6. Expanded Analysis

The five sub-dimensions that make up the Rural Revitalization Index are industrial prosperity, ecological livability, rural civilization, efficient government, and comfortable living. Digital rural development was regressed against each of these sub-dimensions. The findings of the regression in Table 8 demonstrate that the growth of ecological livability, rural civilization, and wealthy living are strongly aided by digital rural development. Its effects on the sub-dimensions of industrial prosperity and effective governance are positive but not statistically significant. Through the introduction of information technology, digital rural development enables more precise monitoring and assessment of rural ecological conditions, allowing for timely protection of the rural environment and enhancing ecological benefits. Additionally, the internet and mobile communication technologies have broken down barriers to information dissemination, broadening farmers’ perspectives and enhancing their understanding of the external world. Simultaneously, online streaming and short videos have facilitated the wider spread and sharing of rural culture, promoting cultural exchange and integration across regions and ethnic groups. Digital consumption and digital healthcare have directly improved the quality of life and happiness of farmers, allowing them to tangibly experience the benefits of digital rural development. The lack of expected progress in industrial development may be attributed to the limited application scenarios and insufficient depth of digital technology usage in the agricultural sector. Agricultural digitization requires more funding, technology, and talent, and its development tends to be long-term and delayed. Therefore, there hasn’t been as much of an impact of digital rural growth on industrial prosperity. Regarding the sub-dimension of effective governance, although digital governance is gradually being implemented in rural areas, changing the traditional governance mindset of villagers is not an overnight process. Villagers’ passive, reactive governance approach requires grassroots cadres to use modern digital technologies to guide them, ensuring that the diverse and differentiated needs of villagers are met through digital governance. Among the sub-dimensions, ecological livability and affluent living exhibit the most substantial effects, followed by rural civilization. Consequently, the positive impact of digital rural development on rural revitalization is primarily realized through ecological livability and affluent living sub-dimensions.

Table 8. Digital Rural Construction Pairwise Dimension Regression.

	Rural Revitalization				
	Thriving Industry	Ecologically Livable	Local Customs and Civilization	Effective Governance	Prosperous Life
z_figure	0.0065 (0.0155)	0.1378 *** (0.0172)	0.0457 *** (0.0107)	0.0022 (0.0021)	0.0982 *** (0.0058)
con	0.3125 *** (0.0619)	0.1223 * (0.0686)	0.0319 (0.0428)	0.0387 *** (0.0085)	−0.0232 (0.0231)
exp	−0.0753 (0.0804)	0.5001 *** (0.0890)	0.3102 *** (0.0555)	−0.0075 (0.0111)	0.2464 *** (0.0300)
fir	−0.0021 *** (0.0003)	0.0003 (0.0003)	0.0002 (0.0002)	−0.0001 ** (0.0000)	0.0002 * (0.0001)
pub	−0.0006 (0.0016)	−0.0006 (0.0018)	0.0000 (0.0011)	0.0046 *** (0.0002)	0.0025 *** (0.0006)
fin	0.1133 *** (0.0133)	0.1174 *** (0.0147)	0.0387 *** (0.0092)	−0.0047 ** (0.0018)	0.1297 *** (0.0050)
dep	0.7672 *** (0.0446)	0.5679 *** (0.0494)	0.2103 *** (0.0308)	−0.0103 * (0.0062)	0.8170 *** (0.0166)
constant	−7.4320 *** (0.8570)	−9.3735 *** (0.9490)	−3.3615 *** (0.5921)	1.1489 *** (0.1181)	−11.6310 *** (0.3193)
County fixed effects	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES
N	5,343	5,343	5,343	5,343	5,343
R2	0.123	0.115	0.050	0.114	0.585

Note: The heteroskedasticity clustering robust standard errors of the estimated coefficients are reported in parentheses; *, **, and *** stand for significance levels of 10%, 5%, and 1%, respectively.

5.7. Discussion

This study, using county-level panel data from China between 2018 and 2020, empirically demonstrates the positive role of digital villages in advancing rural revitalization [96]. The empirical analysis, rooted in theoretical insights, examines both direct and indirect effects step by step. Unlike prior studies that rely on case studies or micro-survey data [52,97], this research employs a comprehensive regional dataset and a detailed indicator system, resulting in findings with broader applicability. By focusing on county-level data, the study also better addresses endogeneity concerns and aligns with the spatial development needs of rural revitalization at the county level [47,98]. As such, the conclusions provide valuable insights for regions seeking to promote rural revitalization through digital village initiatives. In contrast to other studies that analyze the impact of digital village development through indices such as the Digital Village Development Index [99], this research approaches the issue from the standpoint of rural revitalization. It demonstrates how digital village construction, by integrating advanced technologies, enhances agricultural modernization and productivity, extends the agricultural value chain, and implements real-time environmental monitoring to bolster ecological conservation. Additionally, information platforms contribute to improving villagers' cultural awareness, while digital governance tools enhance administrative efficiency. Remote education and digital healthcare further elevate the quality of rural life, contributing to greater convenience and well-being [64]. Ultimately, digital villages play a pivotal role in driving rural revitalization by fostering industrial prosperity, ecological sustainability, cultural advancement, efficient governance, and improved living standards.

In the first part of the empirical analysis [100], building on previous research, we conducted regressions using sub-indices of the Digital Village Development Index. Notably, rural economic digitalization and rural life digitalization demonstrated significant effects, while rural infrastructure digitalization and rural governance digitalization did not positively impact rural revitalization. One possible explanation is that rural infrastructure data shows little variation across China despite significant differences in the Rural Revitalization Index among counties. Thus, rural infrastructure digitalization did not contribute significantly to revitalization [101]. For rural governance digitalization, improving governance effectiveness in rural areas may require shifting from a model of passive involvement to encouraging active participation by farmers, thereby enhancing governance capacity and performance [102]. In terms of mechanism testing, this study introduces a new theoretical framework, focusing on "factor aggregation–entity cultivation–market connection." By establishing information platforms, Digital villages attract capital and talent, enabling smart agriculture to boost productivity and increase farmers' willingness to collaborate, thereby fostering the growth of farmer cooperatives. The transparency in agricultural production and the competitiveness of products are further enhanced, while e-commerce platforms help tap into rural market potential. This mechanism of influence distinguishes our findings from studies that focus primarily on industrial restructuring and upgrading, providing a fresh perspective [103]. Regarding heterogeneity analysis, we investigate the differing effects of digital villages on rural revitalization across regions and population groups based on specific endowment characteristics. This targeted approach strengthens both the conclusions and policy recommendations of this study. Lastly, in the extension analysis, we examine how digital villages influence various sub-indices of rural revitalization. While the positive effects on ecological livability, rural civilization, and affluent living were clear, the impact on industrial prosperity and effective governance was less significant. This may be due to the need for long-term digital investment in industrial development and a shift in mindset towards more proactive governance participation in rural areas [104].

6. Research Conclusions and Policy Recommendations

In order to handle the "three rural" (agricultural, rural areas, and farmers) challenges of the new period, one important tactic is rural rejuvenation. The digital economy may

be incorporated into rural life, governance, and the economy by building digital villages. This will serve as a driving force for high-quality development across society and provide a digital boost for the full fulfillment of rural rejuvenation. To improve the role of digital dynamics and address deficiencies in rural development, research on the effects of building digital villages on the regeneration of rural areas is essential. This paper starts with the reality of digital village construction and rural revitalization practices, outlining the theoretical mechanisms through which digital villages promote rural revitalization. Based on county-level data from 2018 to 2020, a bidirectional fixed effects model is constructed for empirical analysis. The study finds: First, digital village construction empowers rural revitalization, particularly through the digitalization of the rural economy and rural life, both of which play a positive role. This conclusion holds true even after multiple robustness checks, including substituting the explained variables and considering the impact of sample selection bias and endogeneity. Second, digital village construction attracts capital and talent through the creation of information platforms, providing material and human resources for rural development. The application of digital technology opens up new opportunities for cultivating new rural entities. Digitalized production, sales, and management significantly enhance the competitiveness of farmers' cooperatives. The economies of scale generated by cooperative production not only increase farmers' income but also emphasize the ecological protection of farmland. Digital e-commerce transcends spatial and temporal limitations, allowing farmers to directly engage with product and consumer markets. This expands sales channels while increasing digital consumption, leading to simultaneous improvements in income and quality of life. Therefore, the mechanism through which digital village construction empowers rural revitalization can be summarized as "factor agglomeration—entity cultivation—market connection." Third, from the perspective of agricultural regional heterogeneity, the conclusion that digital village construction empowers rural revitalization holds in non-grain-producing areas, is positive in grain-producing areas, and is negative in pastoral areas, although none of these impacts are statistically significant. From the perspective of county-level road mileage and proximity to Hangzhou, the empowering effect of digital village construction on rural revitalization is more pronounced in counties with longer road mileage and closer proximity to Hangzhou. The promotion of rural revitalization by digital village construction is mainly realized through the sub-dimensions of ecological livability and affluent living. The research findings mentioned above lead to the following policy suggestions being put forth:

First and foremost, the government ought to keep pushing forward with the digital village strategy's execution. Based on the functional positioning and resource endowments of different rural areas, a scientifically sound and reasonable digital village development strategy should be formulated, specifying the foundational conditions, key tasks, phased goals, action plans, and implementation steps. The government should adopt a differentiated approach and advance in stages. Moreover, it is crucial to increase financial investments in rural digital infrastructure, strengthening the construction of broadband networks and mobile communication systems in rural areas to improve network communication capabilities and lay a solid foundation for the future digital transformation of rural areas. Secondly, the government should enhance digital skills training for farmers, improving their information literacy and operational capabilities. Meanwhile, a special fund should be established to support rural youth in utilizing digital technology for innovation and entrepreneurship, fostering new momentum for the digital economy in rural areas. In terms of digital governance, grassroots organizations should strengthen the promotion and guidance of farmers, shifting away from the traditional passive governance model and encouraging farmers to actively participate in rural governance affairs. Thirdly, social capital should be encouraged to participate in the construction of digital villages, forming a diversified investment mechanism driven by "government leadership, enterprise follow-up, and broad farmer participation." Through policy guidance and the establishment of incentive mechanisms, more capital should be attracted to the field of digital village construction. Digital financial institutions should be encouraged to offer online services in rural areas to alleviate the

credit pressures on farmers. Fourthly, relying on the National Key R&D Program and critical agricultural technology innovation projects, the government should accelerate the research and application of technologies and equipment such as intelligent breeding design and smart agricultural machinery. Efforts should be intensified to deeply integrate digital technologies like the Internet of Things (IoT) and big data with traditional agriculture, promoting the development of a contemporary rural industrial system and the digital revolution of agriculture.

It is critical to recognize this study's limitations: First, since the Digital Village Development Index only provides data for 2018–2020, our analysis is constrained by this short time frame, limiting our ability to assess the long-term effects of digital village development on rural revitalization. We plan to extend this research once the Index is updated with more recent data, enhancing the robustness of our findings. Second, due to missing county-level data, we adopted a cautious approach in selecting the secondary indicators for the Rural Revitalization Index. Consequently, the current sub-indicators may not fully capture the five dimensions of rural revitalization, potentially impacting the conclusions drawn from our empirical regression. Future studies will aim to expand the range of secondary indicators to ensure more comprehensive and representative data. Finally, in constructing the Rural Revitalization Index, we utilized the entropy method, an objective weighting technique. However, this method led to significant variations in weights between data with large and small ranges, potentially distorting the balance among the five dimensions of rural revitalization. To address this, future research will explore alternative methods, such as combining subjective and objective weighting, to better reflect the actual conditions of rural revitalization across different counties.

This study represents a preliminary empirical exploration, and there are numerous aspects regarding the impact and role of digital villages in rural revitalization that require further investigation. First, while this paper analyzes rural revitalization using national-level data, in reality, different regions have developed diverse revitalization models based on their local resource endowments. Exploring the specific effects of digital village construction on each of these models through case studies would be a valuable and intriguing direction for future research. Second, rural revitalization spans multiple dimensions, including ecological livability, industrial prosperity, effective governance, rural civilization, and affluent living. Although this paper briefly examines the impact of digital villages on each of these dimensions in the extended analysis, further detailed exploration is needed to provide deeper insights. Finally, this study relies on county-level data and does not incorporate micro-level survey data from individual households. Investigating the effects of digital villages on individual farmers in the context of rural revitalization would also be a promising area for future research.

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