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Regional Differences, Temporal Evolution, and Drivers of Rural Hollowing in Coastal Provinces: A Case Study of Fujian Province

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Abstract: This research delves into the spatial and temporal evolution characteristics of rural areas, focusing on understanding the phenomenon of rural hollowing in Fujian Province and other coastal regions. By analyzing data from the Fujian Province Statistical Yearbook and the Social Development and National Economy Statistical Bulletin (2010–2020), employing methodologies such as Pearson correlation and the natural interruption point method in ArcGIS, this study seeks to provide both theoretical and practical groundwork for rural revitalization efforts. The findings of this study yield significant insights. Firstly, a pronounced geographical differentiation emerges in the context of rural hollowing in Fujian province, characterized by a distinctive "high inland and low coastal" spatial pattern. Secondly, despite its coastal location, Fujian Province continues to confront substantial rural hollowing challenges. Although the overall pace of rural hollowing development has been moderate, the persistence of population and economic hollowing is noteworthy. Consequently, the issues of depopulation and economic decline in rural areas remain pressing concerns for Fujian Province. Lastly, the investigation identifies key driving forces behind the phenomenon of rural hollowing, encompassing factors such as arable land area, rural population settlement rate, economic development level, and farmers' net income. These drivers significantly influence the dynamics of rural hollowing. Drawing from the research findings, this study proposes several strategic recommendations to counteract rural hollowing in coastal regions. These include tailoring management approaches to address geographical disparities, enhancing resource allocation and land utilization practices, orchestrating shifts in industrial structure to foster integrated urban–rural development, and emphasizing the revitalization of talent to sustain the progress of rural areas.

Keywords: rural hollowing; regional disparities; chronological evolution; driving factors; coastal provinces

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1. Introduction

Rural hollowing is a consequential global phenomenon that emerges amidst the ongoing urban–rural development transformation. It encompasses the migration of rural inhabitants to urban centers, the abandonment of agricultural land, and a decline in rural economic activities [1,2]. This intricate issue has commanded substantial attention across international research circles. Both developed and developing nations exhibit distinctive facets of rural hollowing. In developing nations, this phenomenon manifests as population exodus, resource scarcities, and deficient infrastructure. For instance, certain African countries confront acute rural hollowing due to factors like climate fluctuations, resource depletion, and economic constraints [3]. Similarly, in developed nations, rural hollowing often parallels urbanization and industrialization, culminating in population outflows and the weakening of rural industries [4]. The genesis of rural hollowing is influenced by an array of elements, encompassing economic, social, and policy-related dimensions. From an economic perspective, the allure of superior employment prospects and relatively higher income levels in urban locales impels the youthful populace and labor pool

to migrate, thereby accelerating the process of rural hollowing [5]. Socially, the erosion of social capital and waning communal ties within rural communities contribute to this phenomenon. Furthermore, policy-related considerations play an instrumental role in rural hollowing dynamics. Governmental investments and preferential policies targeted at urban centers require substantial resources and a large populace, resulting in a dearth of support and development opportunities for rural regions [6]. The body of international research dedicated to comprehending rural hollowing has yielded invaluable insights and experiences that can be readily adapted to diverse nations and regions grappling with analogous predicaments. By engaging in knowledge exchange and mutual learning, countries can collaboratively forge comprehensive solutions to this global challenge, fostering equilibrium in development across urban and rural sectors. Within the context of China, the imperative of addressing rural hollowing takes precedence, with the aim of achieving sustainable development and harmonious, balanced, urban–rural progress. The examination of rural hollowing in coastal regions carries particularly immense weight. China's rapid urbanization from the 1990s onwards has triggered a substantial exodus of farmers to urban areas in pursuit of improved living standards and increased earnings. However, the coastal regions are disproportionately affected by the phenomenon of rural hollowing due to the migration of rural inhabitants and the profound repercussions on the local economy and land utilization. During that era, limitations within the rural land contract system prompted a trend of "constructing new residences without demolishing old ones" in rural locales, leading to certain affluent farmers amassing multiple properties [5,7]. Over time, this unchecked expansion of rural housing, coupled with a high rate of vacancy, eventually evolved into the recognized phenomenon of rural hollowing [8]. Furthermore, the capacity for non-agricultural employment in a given region is intrinsically tied to its economic advancement. The swift growth of coastal urban zones has precipitated the excessive departure of rural populations from their native areas as they gravitate towards non-agricultural occupations. This pattern often engenders land underutilization, abandoned structures, and the deterioration of local industries in rural areas, ultimately coalescing into the phenomenon of rural hollowing [9,10]. The resolution of the rural hollowing predicament in coastal regions is pivotal not only for realizing the overarching objective of revitalizing rural areas but also for comprehending the inherent interplay between "rural revitalization" and "hollowing management." By means of a thorough assessment and precisely targeted measures to combat rural hollowing, policymakers can propel unified urban–rural advancement and efficaciously tackle the predicaments stemming from depopulation and economic regression in these critical zones. Through conducting an in-depth inquiry into coastal rural hollowing, valuable insights can be gleaned to guide and enhance strategies for controlling and mitigating the consequences of this phenomenon in these crucial regions. Thus, the exploration of coastal rural hollowing can make a substantial contribution to the sustainable development and balanced growth of China's urban–rural landscape [11].

Scholars hailing from diverse disciplines, including sociology, economics, and geography, have diligently undertaken extensive investigation into the phenomenon of rural hollowing. Sociological methodologies have been adeptly utilized to delve into the erosion of social capital and the dissolution of communities caused by rural hollowing [8,12]. Economic analyses have scrutinized shifts in employment dynamics and the ever-widening income disparity [13]. Meanwhile, geographic research approaches have meticulously dissected spatial patterns and changes in land utilization. The convergence of these interdisciplinary research methodologies has substantially enriched our comprehensive understanding of the intricacies of rural hollowing [1,14]. Rural hollowing has attained widespread recognition as an inevitable quandary stemming from the coordinated development of urban and rural domains, as well as the interaction of economic systems within China [15]. Scholars have probed the phenomenon from a multitude of perspectives, highlighting its diverse manifestations across diverse spheres such as industry, culture, technology, economy, land, and populace. In their efforts to quantify and categorize the degrees of rural hollowing, researchers have employed various approaches, concentrating

on frameworks encompassing land, population, and economy, or alternatively, considering dimensions spanning land, economy, society, and psychology [16,17]. The extent of rural hollowing is frequently manifest in indicators tied to rural areas' economic progression, societal structure, resource utilization, and cultural values [6]. To comprehensively dissect and assess rural hollowing, researchers have adroitly employed an array of methodological strategies. These include the application of entropy weighting, fixed effects models, and multiple linear regression models to disentangle data correlations and pinpoint the driving forces underpinning the phenomenon [18–20]. A substantial body of research has contributed to an in-depth comprehension of the fundamental concepts, evolutionary trajectories, core attributes, triggers, and prospective countermeasures of rural hollowing, thereby supplying indispensable theoretical support to address this pressing concern.

The existing body of research concerning rural hollowing has unquestionably enriched our understanding of this phenomenon [1,5,16,17]. Nonetheless, its primary focus often centers on specific manifestations of rural hollowing, without a comprehensive comparative analyses of spatiotemporal variations across distinct regions. Furthermore, investigations into hollowing within coastal provinces have been notably limited [21,22]. This study sets out to bridge these critical gaps by focusing on Fujian Province as a paradigmatic case. Our aim is to establish an evaluation index framework that permits an in-depth exploration of the spatiotemporal progression and propelling influences behind rural hollowing in Fujian Province. Employing empirical analyses to discern the spatial and temporal variances in, as well as the driving determinants of, rural hollowing in this specific coastal region, our goal is to obtain invaluable insights into the fundamental underlying patterns of rural hollowing, particularly in relation to land, population, and economy. This research initiative takes us a step closer to unraveling the driving dynamics of rural hollowing in coastal provinces. Through the meticulous identification and analysis of these dynamics, our study intends to provide theoretical groundwork for optimizing governance strategies to address rural hollowing and foster comprehensive urban–rural development in coastal regions. The findings of this study are poised to have significant implications for policymakers and stakeholders engaged in rural development. By contributing to the creation of efficacious strategies that mitigate the impacts of rural hollowing and lend support to the rejuvenation of rural areas, this research endeavor holds practical value that resonates deeply within the realm of policy implementation and sustainable rural progress.

2. Materials and Methods

2.1. Research Area

Fujian Province, situated in the southeastern region of China, embodies a quintessential coastal province bordered by the East China Sea. Its topography follows a progressive decrease in elevation from the northwest to the southeast, characterized by predominantly mountainous and hilly terrains that span more than 80% of its total land expanse. Economically, Fujian Province registered a GDP of CNY 5.31 trillion in 2022, securing the eighth position nationally and the fifth among coastal provinces. However, a conspicuous economic discrepancy is found between rural and urban areas, underscored by a rural–urban income gap index of 2.21:1 within Fujian Province. This metric elucidates that rural residents earn less than half of their urban counterparts, accentuating the significant income disparity. Recent official statistical data spotlight Fujian Province's ongoing struggle with the predicaments of rural hollowing, particularly in the spheres of land, population, and economy. Consequently, the province serves as an illustrative prototype for the investigation of rural hollowing in coastal regions. Within this study, nine administrative divisions within Fujian Province have been selected as the focal points of inquiry. The overarching objective is to holistically evaluate the characteristics of spatial and temporal differentiation associated with rural hollowing and discern the propelling forces steering this phenomenon. The insights derived from this study are poised not only to enrich our comprehension of rural hollowing in Fujian Province but also to yield valuable perspectives for effectively analogous challenges in other coastal provinces.

2.2. Methods

The principal objective of this study is to construct a comprehensive evaluation index framework to scrutinize rural hollowing within Fujian Province, with a focused lens on its land, economy, and population dimensions. The study's core ambition is to gauge the magnitude and attributes of rural hollowing within the province, spanning the years from 2010 to 2020, thereby elucidating its spatiotemporal progression. This pursuit requires the leveraging of ArcGIS, a geospatial analysis tool, to scrutinize the developmental status and shifts in rural hollowing across distinct timeframes and geographical regions [23]. To identify the propelling dynamics behind rural hollowing and pinpoint the pivotal factors contributing to this, the Pearson correlation analysis method will be employed [24]. The outcomes stemming from this study will lay the foundation for informed governance strategies, grounding policy formulation in scientific insights. Ultimately, this article is poised to proffer finely tuned governance recommendations that effectively combat this issue within Fujian Province.

2.2.1. Construction of Evaluation Index System for Rural Hollowing

Land Subsystem: Including land as an evaluative metric offers a window into the agricultural resources and the utilization of rural residential land in distinct cities and regions within Fujian Province. This facet facilitates the exploration of the interplay between agricultural technology, population dynamics, and the allocation of cultivated land [20]. Given the profound dependency of agricultural production on rural land assets, the effective utilization of land provides a direct reflection of the extent of rural hollowing within a given locale. Consequently, indicators encompassing cultivated land area and residential areas are thoughtfully selected. Nevertheless, the direct cross-regional comparison of these two categories proves challenging due to considerable discrepancies. To mitigate this, the proportion of rural cultivated land to residential area emerges as a suitable metric for comparative analysis. This evaluation dimension encompasses five distinct indicators (outlined in Table 1): grain yield per unit area, per capita cultivated land area, land cultivation rate, marginalization rate of cultivated land, and relative diffusion of villages [25].

Table 1. Evaluation index system for comprehensive rural hollowing.

System	Indicator Level	Calculation Methods	Influence	Indicator Weights
Land Subsystem	Grain yield per unit	Total grain production/arable land area	negative	0.058
	Per capita arable land area	Arable land area/total population	negative	0.066
	Land reclamation rate	Arable land area/total area of the region	negative	0.122
	Marginalization rate of cultivated land	Output value of agriculture, forestry, animal husbandry, and fisheries/arable land area	negative	0.077
	Relative diffusion degree of villages	Final rural population/initial rural population	positive	0.097
Population Subsystem	Urbanization rate	Urban population/total population	positive	0.056
	Employment rate in the primary industry	Persons engaged in the primary industry/total population	negative	0.097
	Centrality of village population	Rural population/number of administrative villages	negative	0.036
	Settlement rate of rural population	Permanent rural population/total rural population	negative	0.152
	Rural population change rate	(Rural population at the final stage–rural population at the initial stage)/rural population at the final stage	negative	0.037
Economic Subsystem	Regional economic structure	Value added in the primary industry/GDP	negative	0.031
	Level of economic development	GDP/total population	positive	0.072
	Level of farmers' income	Per capita net income of farmers	positive	0.098

Population Subsystem: The rapid strides taken by the Chinese economy and the simultaneous acceleration of urbanization have fostered a notable surge in labor migration from rural hinterlands to urban centers, thereby accentuating the phenomenon of rural hollowing [26]. The labor force functions as a pivotal internal driver for rural development, underscoring the need to scrutinize the prevailing state of rural labor within Fujian Province. This evaluative dimension comprises five distinct indicators (enumerated in Table 1): urbanization rate, employment rate within the primary industry, centrality of village population, rural settlement rate, and fluctuations in rural population [27,28].

Economic Subsystem: As urban economies experience rapid expansion while rural economies lag behind, aspects such as income disparities and the industrial transformation of urban regions induce the conscious migration of rural populations toward cities, consequently amplifying economic hollowing within rural areas. An appraisal of the economic subsystem facilitates an examination of the tensions arising from the divergent trajectories of urban and rural industries, as well as the economic structures within Fujian Province. It also serves to elucidate the underlying causes of the asymmetrical advancement of urban and rural economies in the region. This evaluative dimension comprises three key indicators (outlined in Table 1): regional economic structure, level of economic development, and the level of farmers' income [22,24].

2.2.2. Methodology for Assessing Rural Hollowing

1. Standardization and Weight Calculation

To ensure uniformity and alleviate the influence of dimensionality across indicators, this study undertook a positive and negative standardization of the data. Moreover, the significance of each indicator was quantified through the employment of the entropy weight method [29,30]. This technique appropriately considers the relative significance of each indicator, thereby facilitating a comprehensive assessment of rural hollowing.

2. Evaluation Method for the Degree of Rural Hollowing

Post-standardization of the data and the determination of weights, as well as scores for the land subsystem, population subsystem, and economic subsystem, were calculated by multiplying the respective standardized data with their corresponding weights [31,32]. This methodology fosters an equitable evaluation of the extent of rural hollowing in different geographical units. The formula governing the calculation of the degree of rural hollowing is as follows:

$$P_k^s = \sum_{i=1}^{3} w_j \times C_k^j \quad (1)$$

Here, P_k^s represents the specific evaluation value of the rural hollowing degree within the s-th subsystem of the k-th sample, with s representing the three subsystems. i represents the sub-indicators within each subsystem, w_j signifying the weight coefficients of different indicators, and C_k^j represents the standardized value of the j-th indicator for the k-th geographical unit in the sample.

3. Driver Factor Analysis

This study employs the Pearson correlation analysis to delve into the interplay between the level of rural hollowing and its driving factors. This widely utilized statistical analysis technique serves to uncover potential internal relationships between variables, pinpointing the primary driving factors influencing the occurrence of rural hollowing [24,26,33]. By conducting this analysis, the study aims to elucidate the factors that have a significant impact on the occurrence and intensity of rural hollowing.

4. Distribution Map of Hollowing Degree

For the purpose of visually illustrating the extent of rural hollowing across different regions, the study utilizes ArcGIS 10.4.1 software [22,23], employing the natural breaks method for data classification based on distribution characteristics [22,23]. This method

facilitates the creation of spatial layout maps depicting the overall land, population, and economic hollowing in Fujian Province. These maps offer a comprehensive panorama of the spatial distribution and intensity of rural hollowing in distinct regions of the province. This approach allows for a clearer comprehension of the geographical trends linked to rural hollowing.

2.3. Data Sources

In order to conduct a thorough analysis of rural hollowing, this study establishes a rural hollowing index system with three core dimensions: land, population, and economic subsystems. The data required for evaluating the 14 secondary indicators (as presented in Table 1) are sourced from two primary references: the Fujian Statistical Yearbook and the Social Development and National Economic Statistics Bulletin.

3. Results

3.1. Spatial Analysis of Rural Hollowing Differences in Fujian Province

The assessment of rural hollowing in Fujian Province adopts a tripartite approach, examining the land, population, and economic subsystems. Drawing on existing research [20,22,24,28], the evaluation outcomes of rural hollowing across each of these subsystems, as well as the overall evaluation results for the province's nine administrative units, are computed and presented in Table 2. These findings illuminate the degrees of land hollowing, population hollowing, economic hollowing, and comprehensive hollowing. Additionally, for a more visually engaging presentation, a graphical depiction (Figure 1) illustrates the levels of rural hollowing across these diverse dimensions [22,23]. Through the application of this comprehensive assessment framework, and by leveraging data from reputable sources, this study facilitates a spatial analysis of rural hollowing disparities within Fujian Province. By scrutinizing the land, population, and economic subsystems, a holistic understanding of the scope and characteristics of rural hollowing emerges, shedding light on the specific challenges confronted by regions within the province.

Table 2. Measurement results of rural hollowing in Fujian Province in 2020.

Region	Land Hollowing	Population Hollowing	Economic Hollowing	Comprehensive Hollowing
Fuzhou	0.149	0.194	0.147	0.490
Xiamen	0.309	0.305	0.201	0.815
Quanzhou	0.210	0.186	0.151	0.547
Zhangzhou	0.123	0.206	0.082	0.411
Putian	0.185	0.152	0.039	0.376
Longyan	0.129	0.109	0.088	0.326
Sanming	0.165	0.098	0.091	0.354
Sanming	0.134	0.101	0.026	0.262
Ningde	0.206	0.101	0.046	0.353

3.1.1. Comprehensive Hollowing

The extent of comprehensive rural hollowing in Fujian Province is closely intertwined with the region's urbanization degree and economic progress. As depicted in Figure 1a, the study zone predominantly comprises regions marked by low-grade comprehensive hollowing, accounting for 80.13% of the entire region. Medium-grade and high-grade comprehensive hollowing sectors make up 18.49% and 1.38% of the study region, respectively. Although the overall level of rural hollowing remains modest, around 20% of regions fall within the medium- to high-grade categories, with a concentration along the coastal areas. Among these, Xiamen emerges as the epicenter, with severe overall rural hollowing, followed by Fuzhou and Quanzhou, which fall within the medium-grade spectrum of comprehensive hollowing. Notably, Quanzhou and Fuzhou boast elevated levels of urbanization in comparison to other areas, except Xiamen. The recent and robust development of urban infrastructure has contributed to the transformation of rural peripheries, erasing

the line between rural and urban areas, and curbing the depth of comprehensive hollowing. Conversely, regions such as Zhangzhou, Putian, Longyan, Sanming, Nanping, and Ningde gravitate towards the low-grade classification. In this group, Nanping, an inland area, records the lowest comprehensive hollowing level. It is characterized by diminished hollowing across the land, population, and economic subsystems. Hence, governance strategies aiming to address rural hollowing in Fujian Province should be tailored to the distinct context of individual regions.

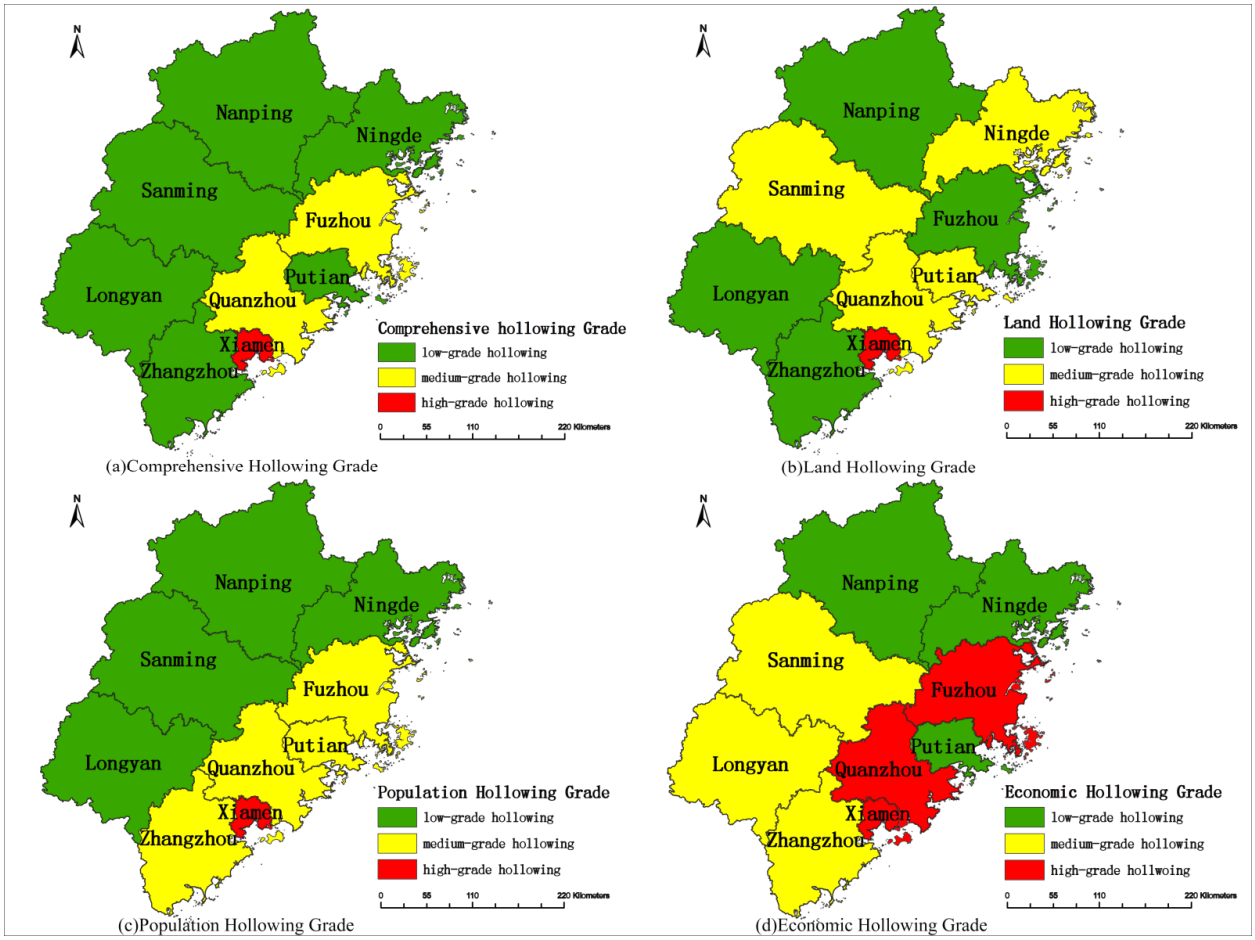

Figure 1. 2020 rural hollowing level in Fujian Province.

3.1.2. Land Hollowing

Figure 1b illustrates that low-grade, medium-grade, and high-grade land hollowing areas in Fujian Province, accounting for 75.43%, 23.19%, and 1.38% of the entire study area, respectively. Overall, the province has a commendable land utilization efficiency. Notably, Zhangzhou stands out with the lowest level of land hollowing due to its propitious natural conditions that facilitate agricultural growth in the Zhangzhou Plain. The flat terrain, accessible transportation, and ample water and thermal resources collectively bolster agricultural productivity and mitigate the marginalization of cultivated land. As a result, Zhangzhou experiences a notably reduced level of land hollowing. Conversely, Xiamen, operating as an economic special zone marked by rapid urban and industrial development, constitutes the sole high-grade land hollowing area. The allure of economic prospects in urban centers has led to a notable trend where farmers are forsaking agricultural pursuits in favor of urban employment opportunities. This phenomenon has resulted in a substantial expanse of uncultivated farmlands and underutilized residential areas, intensifying the issue of land hollowing as urbanization progresses.

3.1.3. Population Hollowing

In Figure 1c, we illustrate the distribution of regions characterized by low-grade, medium-grade, and high-grade population hollowing in Fujian Province. These categories account for 66.33%, 32.29%, and 1.38% of the total study area, respectively. Notably, roughly one-third of the analyzed regions exhibit signs of population hollowing, with a pronounced concentration in coastal areas. Of particular significance is Xiamen, which stands as the only high-grade area, with an urbanization rate of as high as 89.2%, distinctly surpassing other regions. The elevated level of urban development in Xiamen serves as a magnet for migrant labor; however, rural areas are subject to a substantial and enduring outflux of permanent residents, coupled with a dearth of population replenishment. This dual phenomenon has precipitated the levated state of population hollowing within the city. In the medium-grade category, we find Fuzhou, Quanzhou, Putian, and Zhangzhou, coastal cities with relatively robust economies and superior urban development conditions in comparison to their rural counterparts. These locals exhibit a prevalent inclination among agricultural workers to pursue urban employment opportunities, thereby contributing to the manifestation of population hollowing. In contrast, the low-grade areas, namely Longyan, Sanming, Ningde, and Nanping, are located inland and continue to retain a relatively higher proportion of rural inhabitants. Consequently, these regions experience reduced levels of population hollowing due to the more sustained rural residency patterns observed within them.

3.1.4. Economic Hollowing

As illustrated in Figure 1d, the distribution of economic hollowing across Fujian Province showcases that low-grade, medium-grade, and high-grade economic hollowing regions account for 35.58%, 44.55%, and 19.87% of the complete study area, respectively. Notably, a majority of these regions, over half, fall within the medium- to high-grade classifications, signifying a relatively pronounced degree of economic hollowing within Fujian Province. Specifically, the areas encompassing Putian, Nanping, and Ningde display comparatively lower levels of economic hollowing. These locales exhibit less economic development and possess regional GDP figures that are lower than those of other regions. These areas also feature less advanced urban industries. Consequently, a greater number of farmers opt to remain within rural areas and engage in agricultural pursuits. This choice results in a higher proportion of the primary industry occurring within the GDP framework, subsequently leading to a diminished degree of economic hollowing. Conversely, within the medium- to high-grade economic hollowing regions, encompassing Fuzhou, Xiamen, Quanzhou, Zhangzhou, Longyan, and Sanming, there is a discernably elevated rate of rural-to-urban population migration. These areas equally exhibit an economic structure that leans towards secondary and tertiary industries, resulting in a decreased share of the primary industry within the GDP composition. Consequently, this confluence of factors contributes to a heightened level of economic hollowing within these regions.

3.2. Temporal Evolution Analysis of Rural Hollowing in Fujian Province

In order to acquire a more profound comprehension of the origins and progression of rural hollowing within Fujian Province, this investigation examines the state of rural hollowing in 2010 and dissects its temporal evolution. To achieve this, a comprehensive framework integrating land utilization, population dynamics, economic indicators, and an all-encompassing view of hollowing across the province was established [20,22,24,28], as demonstrated in Figure 2.

3.2.1. Comprehensive Hollowing

In the context of 2010, the geographic expanse of Fujian Province showed that 68.61% had low-grade comprehensive hollowing areas, while 30.13% was categorized as medium-grade and 1.3% as high-grade. Contrasting 2020 with 2010, an examination of the regional landscape indicates a rise in low-grade comprehensive hollowing areas. Notwithstanding

the considerable strides made by Fujian Province in mitigating comprehensive hollowing, achieved through the facilitation of advanced agricultural technology, favorable national policies, improved regional economic structure, repatriation of the labor force, and shifts in societal attitudes, the predicament of rural hollowing continues to persist. Significantly, within Xiamen, an economic special zone located on the coast, the degree of comprehensive hollowing reaches its zenith. Therefore, Xiamen stands to gain from harnessing the potential of digital villages and the application of progressive agricultural technology. Prioritizing both qualitative and quantitative breakthroughs is paramount in fully exploiting the limited arable land potential.

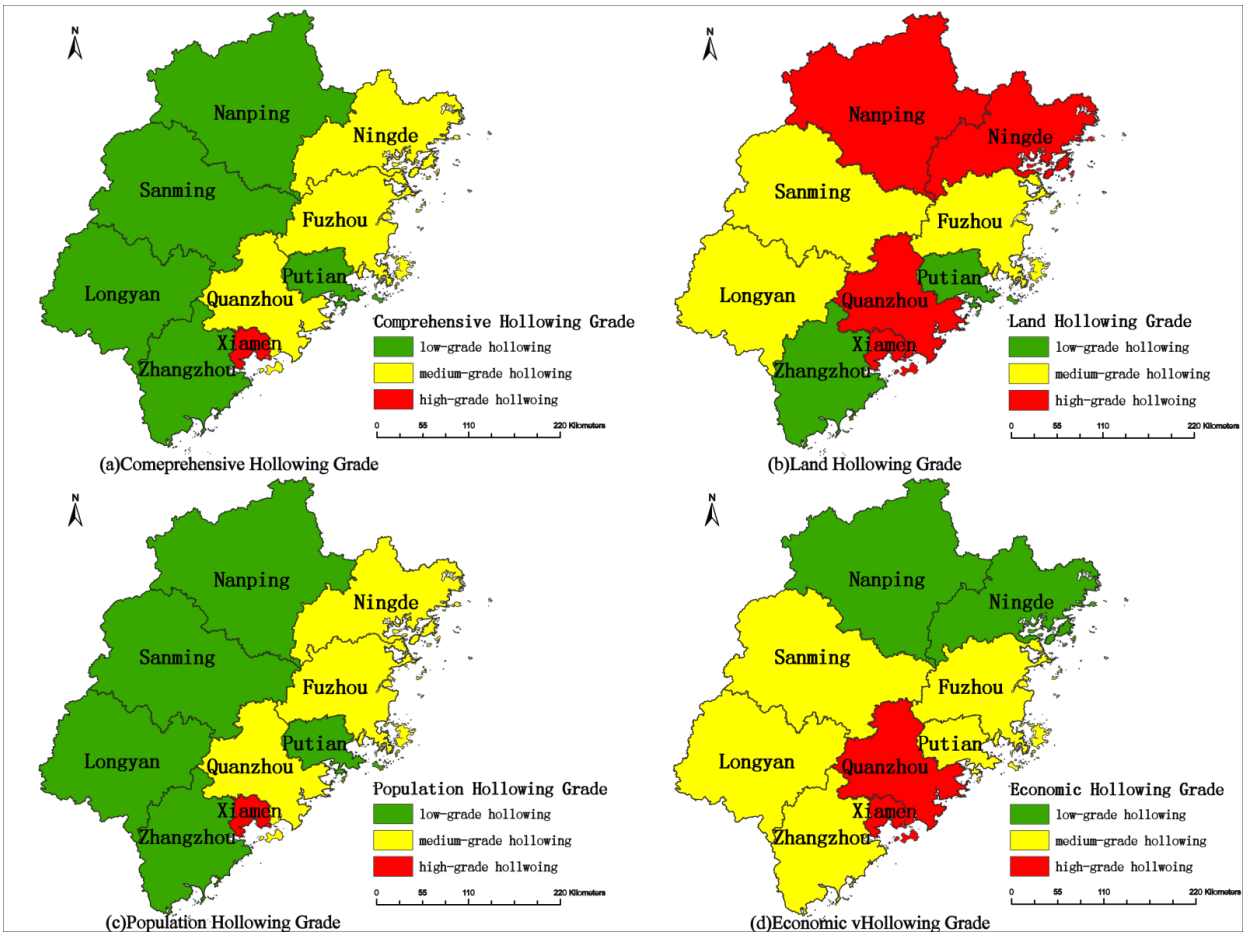

Figure 2. 2010 rural hollowing level in Fujian Province.

3.2.2. Land Hollowing

A comprehensive analysis of Figures 1b and 2b shows a notable shift in land hollowing in Nanping. In 2010, Nanping occupied the lowest GDP ranking in the province, due to inadequate investment in agricultural technology, and the relatively diminished output value from agriculture, forestry, animal husbandry, and fisheries, along with a pronounced degree of land hollowing. However, with the implementation of the rural revitalization strategy, the local administration took proactive measures to facilitate the adoption of agricultural technology. This intervention yielded a substantial increase in grain yield per unit area and the value of output per unit of land. Consequently, this concerted effort resulted in a reduction in land hollowing levels, marking a transition from a high-grade classification to low-grade classification. Throughout the province, most regions either maintained their existing levels of land hollowing or exhibited slight reductions, with the exception of Putian, where land hollowing escalated. This escalation in Putian's land hollowing primarily stemmed from the population–land contradiction. Notably, there was

a decrease of 102.79 hectares in per capita arable land area from 2010 to 2020. Resolving this population–land discord and capitalizing on the available labor resources for agricultural progress are pivotal factors when addressing land hollowing within the Putian region.

3.2.3. Population Hollowing

A comparative analysis between Figures 1c and 2c showed significant shifts in population hollowing, which were particularly evident in Ningde, Zhangzhou, and Putian. Ningde's transition from a medium-grade to a low-grade population-hollowing level signifies an improved rural population scenario. This transformation can be attributed to comprehensive poverty alleviation initiatives and the rapid growth of rural industries. These combined efforts curtailed the outmigration of rural labor, contributing to a decline in population hollowing by the year 2020. Conversely, Zhangzhou and Putian underwent a shift from low-grade to high-grade population hollowing levels within the same timeframe. As coastal regions of Fujian Province, their urbanization processes accelerated, luring rural populations in pursuit of improved opportunities. However, the proximity to the sea also led some individuals to seek opportunities overseas, leading to a gradual decline in the rural population and a consequent elevation in the level of population hollowing. In conclusion, the dynamic transformations in population hollowing witnessed in Ningde, Zhangzhou, and Putian underscore the intricate interplay of rural–urban migration and development dynamics within coastal areas. The imperative lies in implementing effective policies and strategies that can effectively address the challenges posed by population hollowing while simultaneously steering these regions towards sustainable rural development.

3.2.4. Economic Hollowing

A comparison between Figures 1d and 2d reveals that, except for Putian and Fuzhou, the overall degree of economic hollowing across various regions remained relatively stable. Putian shifted from a medium-grade to a low-grade economic hollowing level in comparison with 2010. This change was propelled by a more balanced regional economic structure, highlighted by a noteworthy increase in value added by the primary industry and a rise in per capita net income among farmers. As a result, Putian witnessed a decline in its level. Conversely, Fuzhou underwent a transition from a medium-grade to high-grade level of economic hollowing. Over the study period, Fuzhou's economic progress persisted. However, the secondary and tertiary industries' contribution to GDP surpassed that of the primary industry. This disparity indicated an imbalanced regional economic structure, leading to an uptick in economic hollowing. To effectively mitigate the overall economic hollowing in both Fuzhou and Fujian Province, it is crucial to prioritize swift and high-quality development within the primary industry. This entails striving for a well-balanced industrial structure in regional development, and ultimately working towards achieving equilibrium and sustainability.

3.3. Analysis of Driving Forces of Rural Hollowing in Fujian Province

This study embarked upon an exploration of this topic by drawing upon the pertinent literature. Data from 2020 and 2010 in Fujian Province were selected as samples. Twelve indicators, encompassing aspects such as per capita arable land area, land marginalization rate, and village population centrality, were meticulously chosen to gauge their influential role in steering comprehensive hollowing, as detailed in Table 3.

The comparative outcomes of the analysis are outlined in Table 3. In the year 2010, comprehensive rural hollowing within Fujian Province exhibited positive correlations with the settlement rate of rural populations, the degree of economic development, and the per capita net income of farmers. On the other hand, there was a negative correlation between comprehensive hollowing and per capita arable land area, as well as the regional economic structure. Notably, among these factors, the strongest correlation with rural hollowing was observed in relation to the level of economic development and the settlement rate of rural populations, whereas the correlation was weakest with per capita arable land area. In 2020,

comprehensive rural hollowing in Fujian Province demonstrated a positive correlation with village population centrality, the settlement rate of rural populations, the extent of economic development, and the per capita net income of farmers. Conversely, a negative correlation was noted between comprehensive hollowing and per capita arable land area. Among these variables, the most robust correlation with comprehensive hollowing emerged in relation to the per capita net income of farmers, while the correlation was least pronounced with per capita arable land area. These findings underscore the substantial influence exerted by factors such as per capita arable land area, the settlement rate of rural populations, the level of economic development, and the per capita net income of farmers on the extent of rural hollowing in Fujian Province. The effective mitigation of rural hollowing within the province necessitates the implementation of targeted governance measures aiming to address these influential factors.

Table 3. Comparative analysis of drivers of rural hollowing in Fujian Province.

Variables	2010	2020
Per capita arable land area	−0.676 *	−0.707 *
Marginalization rate of cultivated land	0.575	0.644
Centrality of village population	0.092	0.897 **
Rural population settlement rate	0.876 **	0.737 *
Regional economic structure	−0.707 *	−0.3
Level of economic development	0.877 **	0.726 *
Total regional population	0.107	0.19
Output value of agriculture, forestry, animal husbandry, and fisheries	−0.378	−0.449
Number of agricultural employees	−0.556	−0.565
Total rural population	−0.418	−0.081
Gross Domestic Product (GDP)	0.666	0.621
Per capita net income of farmers	0.725 *	0.976 **

Note: * Significant correlation at the 0.05 level (two-tailed); ** Highly significant correlation at the 0.01 level (two-tailed).

Over the course of the study period, an interesting trend emerged. The correlation between comprehensive hollowing within Fujian Province and the regional economic structure displayed a gradual weakening, whereas the correlation with village population centrality exhibited an increase. These dynamics point to the persistence of rural economic hollowing within Fujian Province from 2010 to 2020, with population hollowing in rural areas becoming more pronounced over time. From the perspective of the regional economic structure, the prevalence of the market economy since the inception of reform and opening up has catalyzed the rapid advancement of secondary and tertiary industries within Fujian Province. However, the development of the primary industry has lagged behind, leading to its contribution to regional GDP significantly trailing that of other industries. The disparity in the regional economic structure has engendered the early emergence of rural economic hollowing in Fujian Province.

Since the inception of the rural revitalization strategy in 2017, local administrations have proactively responded to multifaceted challenges by giving precedence to rural concerns and facilitating agricultural progress through policy incentives and welfare subsidies. These endeavors primarily aim to rationalize the regional economic structure. However, rural individual laborers grapple with distinct challenges in their agricultural pursuits, including instability, the need for long-term commitment, and the influence of seasonality [34]. Consequently, they bear greater economic costs and pressures in comparison to agricultural enterprises [34]. This scenario has given rise to a discernable trend wherein farmers increasingly opt for migrant work in urban centers due to the appeal of a higher salary, improved transportation infrastructure, and access to social welfare resources [1,15]. The sustained outmigration of rural populations has had noteworthy consequences, most notably a reduction in village population centrality and the escalating issue of population hollowing within Fujian Province in recent years. To effectively address these pressing

challenges and foster a balanced development framework between urban and rural areas, it is paramount to implement well-timed and pertinent policies. These policies should aim to distribute labor forces between urban and rural areas while simultaneously devising strategies that efficaciously tackle the complexities posed by the phenomenon of population hollowing.

4. Discussion

4.1. Comprehensive Evaluation of Rural Hollowing

This study presents a comprehensive evaluation system for rural hollowing in Fujian Province, encompassing land, population, and economic dimensions. The findings illustrate that this evaluation system effectively captures the various facets of rural hollowing within the region. Through our analysis, regional disparities in the prevalence of rural hollowing were unveiled, highlighting the persistent challenges encountered by this coastal province [35]. It is noteworthy that population hollowing exhibited an upward trajectory, driven by improved urban conditions and opportunities overseas. Additionally, the study underscores the significant impact of economic hollowing, which surpasses both land and population hollowing, emphasizing the urgency of implementing targeted corrective measures. In contrast to prior research [36], this study offers fresh insights and pivotal discoveries. In contradiction of the notion that coastal areas might be less susceptible to rural hollowing [21], our study reveals that Fujian Province, despite its coastal location, grapples with substantial rural hollowing challenges. This revelation underscores the necessity of adopting specific strategies to combat this issue and adds a new layer of understanding to the existing body of knowledge regarding rural hollowing in Fujian Province.

4.2. Evolving Driving Factors of Rural Hollowing

This study delves into the evolving driving forces of rural hollowing in Fujian Province. Four key factors—namely, per capita arable land area, settlement rate of the rural population, level of economic development, and per capita net income of farmers —have been identified as the principal drivers of rural hollowing. This recognition echoes prior research that has also underscored the significance of these factors in the context of rural hollowing [26]. Notably, over the period from 2010 to 2020, the correlation between comprehensive rural hollowing and regional economic structure has shown a diminishing trend, while the correlation with village population centrality has exhibited an increasing strength. These evolving driving factors emphasize the imperative need for adaptive policies and interventions to effectively tackle the issue of rural hollowing. Comparisons with earlier studies further affirm the pivotal role played by these driving factors in the phenomenon of rural hollowing [1]. The identification of per capita arable land area, rural population settlement rate, economic development level, and farmers' per capita net income as primary influencers aligns with the findings of previous research [1]. This alignment serves to substantiate the robust influence of these factors on rural hollowing. However, the observed shifting correlations among comprehensive rural hollowing, regional economic structure, and village population centrality yield novel insights into the intricate dynamics of rural hollowing, specifically within Fujian Province.

4.3. Implications and Recommendations for Addressing Rural Hollowing

This study emphasizes the necessity of a comprehensive strategy underpinned by the principle of tailoring interventions to the specific manifestations of rural hollowing within Fujian. Understanding the root causes for each locality is deemed pivotal to devising effective solutions [37]. In coastal areas, optimizing agricultural productivity through advanced farming technologies emerges as a primary priority [38]. This involves increasing the value of land and resolving conflicts between land utilization and population dynamics. Strategies such as the efficient allocation of underutilized land, curbing unauthorized construction, and reforming rural land property rights contribute to prudent land resource management. Simultaneously, promoting land transfers and maximizing the potential of

underutilized land can attract external investments, aligning with the overarching goal of rural revitalization. A strategic realignment of the industrial landscape holds equal significance. The relocation of surplus and dominant industries from urban to rural zones aids in rectifying industrial imbalances and safeguarding against resource overexploitation. Harnessing abundant natural resources and nurturing distinctive agricultural, fishing, processing, and service industries fosters an integrated approach to development. This convergence of primary, secondary, and tertiary sectors lays a robust foundation for modern rural progress. Sustaining rural development momentum hinges on nurturing a pool of high-caliber, innovative talent [21]. Overcoming barriers to talent mobility between urban and rural areas, refining local talent development systems, and bolstering talent support mechanisms are indispensable. The swift development of rural infrastructure and improved living conditions serve to incentivize capable individuals to remain in rural settings. Furthermore, the involvement of overseas Chinese entrepreneurs leveraging their resources for rural entrepreneurship is pivotal in amplifying rural revitalization efforts. The implications derived from this study can be used to effectively address the complexities of rural hollowing in Fujian Province and analogous coastal regions. While certain parallels might be drawn with prior research [9], this study underscores the need for province-specific approaches and introduces tailor-made strategies. The focus on resource optimization, industrial restructuring, and talent revitalization offers novel insights and actionable steps to counter coastal rural hollowing, as is evident in the case of Fujian.

5. Conclusions

This study conducted a comprehensive evaluation of rural hollowing within Fujian Province, examining dimensions encompassing land, population, and the economy. The findings underscore the persistent presence of rural hollowing in this coastal region, with economic hollowing emerging as a significant concern. Regional disparities in the prevalence of rural hollowing, particularly within coastal zones, were also highlighted. The driving forces behind rural hollowing were shown to be complex and subject to evolution over time. The implications of this research extend beyond the confines of Fujian Province, with significance for global policymakers and practitioners engaged in rural development and integrated urban–rural planning. The phenomenon of rural hollowing is not confined to specific geographical areas; it is a challenge observed in various parts of the world due to common issues linked to urbanization, shifts in industries, and population dynamics. As such, the strategies outlined in this study, including targeted interventions, resource optimization, and talent revitalization, offer valuable insights for addressing rural hollowing in other coastal regions and other contexts.

This study offers valuable insights into the phenomenon of rural hollowing in coastal areas and provides practical recommendations. Nevertheless, it is crucial to acknowledge certain limitations. The reliance on secondary data sources introduces inherent constraints and potential biases to the analysis. Moreover, focusing solely on a specific region may not capture the complete complexities of rural hollowing across various coastal provinces or non-coastal regions. To enhance the study's robustness and address these limitations, future research should consider integrating primary data collection methods. Furthermore, broadening the scope to include a comparative analysis of rural hollowing across diverse regions worldwide would provide a more comprehensive and nuanced perspective. The implications of this study transcend its immediate context; they hold significance for policymakers and researchers around the world committed to promoting sustainable rural development. However, to obtain a deeper comprehension of the dynamics and underlying causes of rural hollowing, further research is imperative. Considering this, two specific directions for future research are proposed. The first is longitudinal analysis and trend forecasting: longitudinal studies should be conducted to track the evolution of rural hollowing over extended periods to shed light on its temporal patterns. By analyzing historical data and projecting future trends, researchers can develop predictive models that inform proactive policymaking. The second avenue is a comparative, cross-regional

analysis: expanding the analysis to encompass a comparative study of rural hollowing across diverse global regions can facilitate mutual learning. Identifying commonalities and region-specific differences can unveil universal strategies and contextually tailored solutions. In conclusion, the implications of this study transcend its initial scope. Pursuing these research directions has the potential to deepen our understanding of rural hollowing dynamics and causal factors. This collective knowledge empowers policymakers and practitioners worldwide with invaluable insights, enabling them to craft focused and impactful strategies that contribute to sustainable rural development at a global scale.

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