

Article

Do Protected Areas Exacerbate Rural Shrinkage? Research on China's Gaoligong Mountain Region from an Institutional-Space Perspective

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Abstract: China's territorial development is subject to multiple influences in new political, social, and economic contexts. In an era of increased globalization and urbanization, the construction of protected areas (PAs) as part of globalization has had a “double-edged sword” effect on China's rural development; their impact has left a deep imprint on rural development, and understanding their relationship helps to achieve multiple goals. This paper discusses the changes in the urban–town–village system in the region where the Gaoligong Mountain Nature Reserve is located in China and attempts to analyze the impact of PAs on rural shrinkage. We found that the institutional embedding of PAs as a policy tool has led to regional differentiation and village shrinkage and expansion. Secondly, PAs stimulate changes in evolutionary paths in different types of villages by common forces through demographic, factor, capital, and policy constraints or incentives; however, the formation of new industrial spaces of ecotourism has a damping effect. We conclude that the embedding of PAs has led to a reconfiguration of spatial rights and capital in regional development, changing the original path of rural development. Adaptive development strategies must be established to safeguard this in future development.

Keywords: protected area (PA); institutional space; rural shrinkage and expansion; tourism development; Gaoligong Mountain



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1. Introduction

Shrinkage and expansion are two opposite and unified aspects in the civilizational process of human settlement development [1]. They occur in cities and rural areas [2–4]. Global economization and urbanization have led to and are more profoundly affecting this process, including the late industrialization in Europe and North America, the post-Ford economy in developing countries, and the transition from planned to market economies in Western Europe. These exacerbate the very different situation of high-concentration and withering development, resulting in the emergence and spread of rural abandonment, old age, and hollowing out [5]. The hypothesis of “long-term growth” or even “infinite growth” is only a phasic phenomenon [6–8]. Mainly due to falling fertility rates, many cities and regions are likely to continue to “shrink” in the coming decades, especially in China, even with some increases in population due to migration [9]. China's resident population in rural areas is decreasing at a rate of 1.6% per year, while residential land is growing at a rate of 1% per year—a dilemma of “shrinking people and expanding land” [1]. This poses a huge challenge for shrinking regions: how to maintain better public services and retain investment in businesses and infrastructure despite the plight of a declining population. This phenomenon is more evident in areas protected by nature reserve policies than in common areas [10–12].

In 2019, the Chinese government proposed “Building a nature reserve system with national parks as the mainstay” to promote China’s ecological civilization in conjunction with the global system of PAs and the conservation of natural ecosystems and to support the achievement of the Sustainable Development Goals (SDGs) in order to promote the social–ecological systems of the global goals [13]. By 2025, China will have a natural reserve system that includes national parks, nature reserves, and nature parks [14]. Among these, nature parks include various feature categories, such as forest, geological, and World Heritage Sites [15]. Human activities are prohibited in nature reserves. In contrast, national parks and nature parks can develop ecotourism without compromising ecological conservation, especially through the building of entrance towns to encourage the development of recreation and hospitality services. Therefore, the construction of different types of PAs actually forms institutional spaces with special control elements. These factors are intertwined and will affect China’s rural development even more profoundly in terms of ecological migration, forced relocation, and loss of productive resources.

The essence of rural shrinkage is the weakening of built-up areas, function, and character due to shrinking population and industry. Rural shrinkage is a global issue, but coping strategies are locally adaptive. Numerous cases have proved that natural disasters, epidemic diseases, economic crises, structural transformation, armed conflicts, and unnatural disasters can trigger the shrinkage and expansion of settlements [16–18]. As a global model of environmental development, the construction of PAs is profoundly affecting the changes in rural settlements, resulting in a range of phenomena, such as the decline and even the disappearance of villages. Rural shrinkage is usually described in terms of concepts such as “hollowing out (village)”, “over-thinning”, and even terms with strong emotional coloring, such as “recession”, “withering”, and “crisis”. “More people and less land” is China’s primary national condition, especially in mountainous and canyon areas. The phenomenon of rural shrinkage is equally present [19]. The interventions in the institutional spaces of PAs will encroach on capital, such as land and forest products, on which people depend for their livelihoods. So, has the construction of PAs exacerbated rural shrinkage, and how can the development of PAs and rural areas be better coordinated to make them sustainable? In the past 20 years, as rural development has received more attention, there have been many studies on rural land-use change [20], rural transformation [21], rural hollowing mechanisms [22], and rural area evolution [23]. Research on rural shrinkage remains insufficient. How do PAs affect rural shrinkage or expansion through institutional space? This question has not been effectively answered, especially under China’s public land ownership and individual contracting system. Therefore, this paper explores whether the institutional spaces of PAs merely bring about the regional characteristics of rural shrinkage.

This paper aims to apply the concept of institutional space to the Gaoligong Mountains region of Southwest China to answer three research questions. First, how to understand the impact of the construction of PAs on rural shrinkage or expansion from the perspective of institutional space? Second, how does the institutional space of a PA affect this process from the perspective of population and land-use change? Thirdly, can this evolving rural development demonstrate a more extraordinary sustainability?

2. Theoretical Framework

2.1. Institutions and Institutional Space

An institution is a series of rules, law-abiding procedures, and moral and ethical norms of behavior that have been developed. There are formal institutions (such as laws, regulations, ordinances, decrees, standards, norms, etc.) and informal institutions (such as customs, codes of conduct, etc.) along with their implementation mechanisms [24]. Once an institution is established in a certain range, it will have a binding effect on the types and numbers of actors in that range, and the combinations and relationships of natural capital, human capital, social capital, and financial capital will change accordingly [21,25].

The institution of PAs can be understood as a series of laws and regulations, standard codes, and supervisory regulations formed for the protection of specific objects. Different

types of PAs form different institutional spaces due to the different contents and intensities of constraints. The game of economic interests based on resource scarcity and spatial immovability leads to the reconfiguration of infrastructures and public service facilities in the areas where PAs are located, forming different development constraints and incentives. For example, the construction of nature reserves restricts the use of forest resources, planting and breeding, and some other traditional behaviors in the experimental zones and the buffer zones [26], including corresponding activity intensities and contents. New institutions construct new spaces. Different institutional arrangements produce different types of spaces, assign different ecological service values to the places where they are located, and guide adaptation towards the reproduction of new physical and social spaces [27].

2.2. Rural Shrinkage and Smart Decline

Over the past decade, researchers have argued that “smart decline” belongs to regional development patterns. The term refers to green infrastructure developments that focus on improving the quality of life of existing residents by preserving ecological and economic possibilities for the restoration of declining areas, rather than attempting to expand development [28]. It is a planning and management strategy proposed in backward economies when growth supremacy fails to address the root causes of existing and new urban problems (such as gentrification) and is defined by Popper as “planning for less: fewer people, fewer buildings, fewer land uses” [29]. Smart decline calls for acknowledging and respecting the reality of shrinking populations without completely rejecting “growth supremecism” [30], but rather emphasizing the need to confront decline head-on. Meanwhile, smart decline advocates a new philosophy of progressive economic growth and improved quality of life by actively reducing population sizes and construction and building-land areas to promote optimal development [31,32].

The well-known concept is the shrinking city, which was proposed to describe urban population reduction and economic decline in the post-industrialization process [33,34]. It has been widely used in the rust belts of post-industrial Europe and the United States. Hospers analyzed the shrinkage of European cities and found that it includes counteracting shrinkage and accepting shrinkage [35]. However, there is a paucity of research applying this concept to rural areas in Europe and the United States [36]. In particular, it is important to note that population loss and hollowing out due to rural shrinkage in China has become a serious and well-known problem [37].

The core of smart recession is to face up to the second transformation path from the level of internal improvement. This is the case for rural decline, which scholars have applied to rural research in the past ten years. Rural shrinkage is not the same as rural decline. In the context of rural decline, the optimization of the rural development is to be achieved under conditions of corresponding changes in the way rural production is organized. The concept of rural decline has been applied to Japan, Malaysia, Denmark, and other places to explain sustainable rural development strategies under shrewd shrinkage [38,39]. In Sweden, Josefina Syssner believes that extremely sparse population structures and ambitious welfare assignments are closely related to population decrease [40,41]. Smart decline in rural regions focuses on promoting the transformation of planning concepts, reducing construction scales, and transforming development strategies to promote sustainable growth.

2.3. Protected Areas and Rural Development

The construction of PAs is an effective means of coping with the sharp decline in natural system biodiversity, improving ecosystem services, and ensuring ecological security. However, it can affect the development of internal and surrounding rural communities to varying degrees, generating various constraints, such as cost-effectiveness, development restrictions, and social culture, which often lead to reactive community development [42,43]. When PAs are established, extreme protection or laissez-faire can be ineffective for rural development [44]. The closer the distance to the core zone, the more obvious the conflict between humans and wild animals and the greater the possibility of policy control and

regulation. In addition, PAs can restrict productive activities in strictly ecological PAs, including logging, traditional hunting, and grazing, which is tantamount to cutting off the livelihoods of indigenous peoples and is an indirect form of eviction. It has left villages hollowing, leaving vacant houses, unoccupied land, and degraded public services [45].

On the other hand, the surrounding areas allow the development of ecological organic industry, ecotourism, etc. Under the guidance of policies and industries, populations will also gather in the peripheral tourist attractions, and industrial villages will improve the vitality of the rural economy to the profit of the communities in question [46]. Rural development in re-concentrated areas needs smart growth [47], which means the search for growth that simultaneously satisfies economic and community development, and environmental protection focuses on where and how new growth should take place by replacing the original production and living spaces. This migration of rural populations, guided by PAs, triggers migration between villages, resulting in some villages shrinking while others grow. Generally speaking, balancing the positive and negative effects of rural shrinkage brought about by PAs is closely related to factors such as national conditions, management models, and incentive policies [48]. However, in other places, such as the communities around the Philippine Forest Reserve, the socio-economic status of the communities close to the reserve will be higher, which has become a clear counterexample [49].

PAs are managed for multiple, often competing, goals, including biodiversity conservation, community livelihoods, and tourism [50]. Conflicts can arise where biodiversity conservation objectives restrict resource access to forest communities. Similarly, different levels of prohibitions can cause livelihood impacts, such as restricted production modes and operations and reduced income and job opportunities for community residents, and can hinder the achievement of conservation goals [51–53]. Community attitudes toward PAs are primarily influenced by costs and benefits, household size, occupation, education level, and awareness of or participation in livelihood projects [54], so investigating the natural and management characteristics of PAs allows for greater robustness [55]. Given this, local communities are able to contribute to broader biodiversity conservation goals as they manage their surroundings and establish PAs. However, rural communities neglect natural ecology and wildlife conservation when there is low efficiency and livelihood resources are inadequate [56]. Therefore, it is necessary to meet the social, economic, cultural, and spiritual needs of present and future generations through reasonable financial resources and administrative jurisdictional authority configurations and management using renewable resources and environmental capacity [57].

Rural shrinkage occurs more frequently in a globalizing world [58]. In many countries and regions, population decrease in rural areas is more common [59], including Europe, the United States, and parts of Asia [60], and has become a severe threat to the sustainable development of rural areas [61]. The need for studies of rural decline is evident in a postmodern time to create a new rural reconstruction model [62]. Rural decline must be achieved through the subtraction of abandoned space and facility renewal to achieve an organic combination of rational withdrawal and reorganization of resources, improve land-use efficiency, promote the optimization and adjustment of rural spatial structures, and find economic opportunities [63].

2.4. Institutional Spaces, Protected Areas, and Rural Development

Different institutional arrangements produce different spaces. Nature reserves and World Natural Heritage sites are two different types of PAs. The construction of a natural reserve limits the protection and development activities of an area by defining different functional zones. Afterwards, it will shape very different activities, intensities, and contents, and shape the spatial characteristics and spatial values of corresponding institutions, such as recreational values, ecological and environmental values, etc. In heritage areas, the market value of natural resources can be activated through the development of ecotourism. Since nature reserves and natural heritage sites require different levels of conservation intensity, they are also subject to different control regimes, which in turn have different impacts

on regional development. It follows that the establishment of different institutions of PAs will embed new management requirements for sites, which is equivalent to the formation of new institutional spaces to accommodate the reproduction of new material and social spaces, so the production logics and processes within a certain range will be recombined and connected spatially, thus forming a new spatial structure and spatial form [27].

Therefore, through the above analysis, we built an innovative research framework around institutions, reserves, and spaces to analyze the evolutionary path of rural shrinkage (Figure 1). Before the construction of a PA, the development of a region will behave as a natural development according to the pattern of the established urban–town system. Once a PA is constructed, it is equivalent to one or more types of reserve systems embedded directly within the space of the administrative area. It will create heterogeneous spatial patches whose development paths will change according to the institutional control of the PA in which they are located, including changes to the inputs and outputs of different regions in terms of the economy, public facilities, social services, culture, etc., thus changing the original town system’s hierarchical structure. Such changes brought about by the embedding of the PA will have a reciprocal effect on the development of different places in the region, which in turn will guide the direction of rural population outflow and inflow. If this new pattern is to be maintained in a sustainable direction, it must be optimized by adopting the concept of smart decline to avoid the problems of systemic instability in the early stages of the new pattern, so that the deterioration of rural shrinkage can be avoided in the foreseeable period.

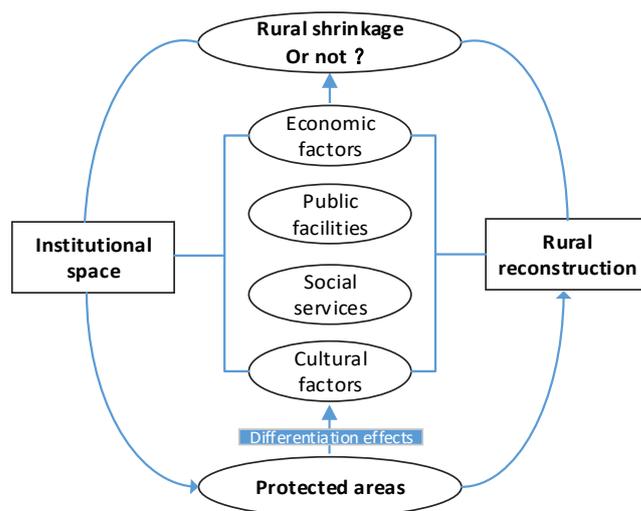


Figure 1. Rural shrinkage and rural reconstruction guided by protected land intervention.

3. Data Source and Methodology

3.1. Case Study Background

The Gaoligong Mountain area (GMA) is located at the intersection of the three geographic regions of East Asia, South Asia, and the Qinghai–Tibet Plateau, with a surface area of 17,000 km² (Figure 2). It is mainly located in Gongshan County, Yunnan Province. The area has been known to Western science since the early 1860s, the British zoologist Anderson having led Burmese expeditions in 1868 and 1875 and collected birds, amphibians, and fish specimens. In June 2003, it was named a World Heritage site by the World Heritage Centre.

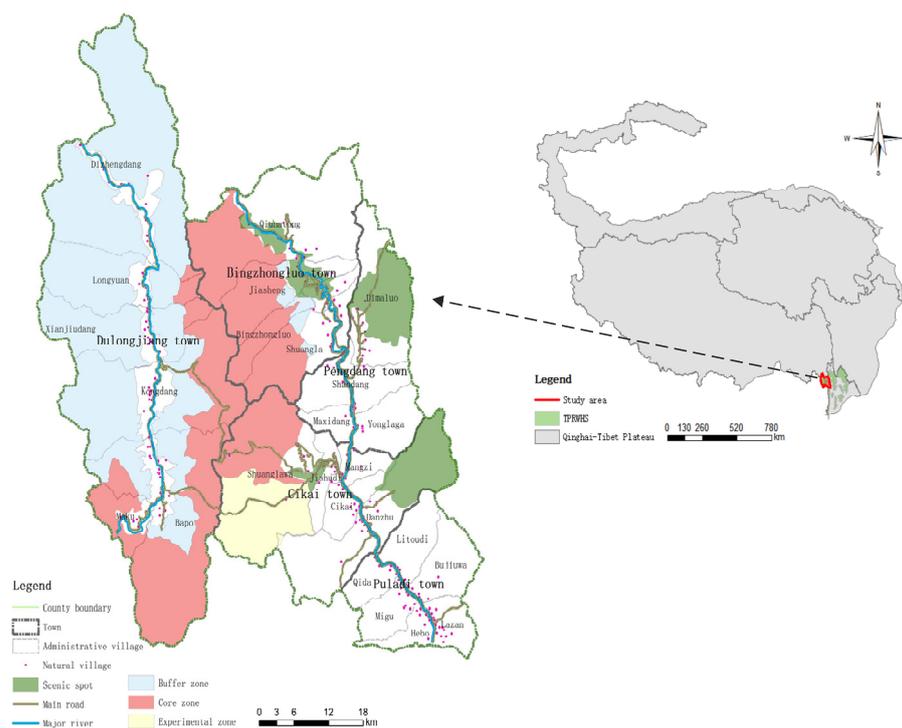


Figure 2. The location of the Gongshan area in the case study.

There are 5 townships and 25 administrative villages with a stable population of about 30,000 in Gongshan County. Since 2003, the population of the rural areas has been in a steady state. The incidence of poverty in different townships in Gongshan County reaches 56%–75%. Following the establishment of the Gaoligong Mountain Nature Reserve in 1986, traditional logging and forest resource extraction were banned, thus limiting the development of local industries and decreasing employment opportunities. After becoming a World Heritage Site, the Chinese government's pledge to stop issuing prospecting and mining licenses in favor of trying to achieve ecological conservation and address poverty through the development of ecotourism has become a complex issue for local governments. Since 2010, the Chinese government has been on the road to poverty alleviation. Through the construction of the forest ecological protection system, the Forestry Bureau of Gongshan County provides at least one ranger position for each family, and each person receives a monthly subsidy of RMB 800. Guided by the ecotourism industry, the rural population continues to migrate, and those towns with faster industrial development have become areas of population inflow, while those villages in the interior of nature reserves have experienced exoduses.

From 2018 to 2019, all five towns and townships had negative growth, with rural population growth of -1.94% and urban population growth of -1.23% , but the poverty incidence dropped to 2.4%. From 2019 to 2020, except for the township of Pinzhonglo (0.05%) and Dulongjiang (0.25%), others are in negative growth (-0.80%). Except for growth in Jiangxiang (0.25), other towns and townships all experienced negative growth (-0.80%). It was not rural–urban migration but rural–rural migration that occurred. Although the region has implemented political ambitions to develop PAs and regional economic and social cohesion and has implemented some physical interventions in tackling rural development, the most fundamental factor is the local barriers of the PAs. Therefore, we have focused on the relationship between PAs and rural settlement changes.

3.2. Data Sources

This paper used an analysis method combining a quantitative model and remote sensing image verification. Firstly, we established the measurement method of rural

shrinkage to determine whether rural shrinkage was in fact occurring. Then, villages with large changes were selected for comparative verification of the rural construction landscape during the study period.

In order to obtain detailed research data and investigate the field, a research team of three teachers and four students went to Gongshan County from 9 to 18 October 2021. We adopted a participatory survey method and invited the Governor of Gongshan County, the Director of the County Forestry Bureau, the County Natural Resources Bureau, and the Science and Technology Bureau as guides and interpreters to conduct a region-wide survey of the five townships in Gongshan County. Firstly, the research team held meetings and talks with the town government to listen to their explanations and analyses of the issue. Questions asked concerned the differences in systems between the Gaoligong Mountain Nature Reserve and the Three Rivers World Heritage Site, the impact of both on the local area after their construction, and the ways in which the two systems constrain and incentivize local development; secondly, field interviews were carried out with local residents and we asked them about the types of employment and changes in income levels after the construction of the conservancy; thirdly, we selected a sample line survey to comprehensively observe the villages distributed on both sides of the Nujiang River and the Dulongjiang River.

The data used in this paper include remote sensing image data, land-use type data, and demographic and economic statistical data. Their sources were: (1) remote sensing image base map data, including DEMs, river systems, and other elements, from the China Water Economics Thematic vector data and historical image data resources collected by the Note Map Data Co., Ltd., on site; (2) land-use type data from a national land-use survey database released by the Chinese government, including two periods (phase two (2010) and phase three (2020)), which came from data released by the Chinese government; (3) demographic and economic data from various economic and social surveys in Gongshan County, as well as demographic data provided by the Civil Affairs Bureau of Gongshan County. Part of the population data came from the summary of the permanent population of the township in the seventh national census.

3.3. Methods

Given the poor availability of economic indicators broken down to rural areas, this paper defines rural shrinkage primarily in terms of population movement and land use. The difference between the permanent and registered populations reflects the population outflow, and the nature of land use was considered to judge the efficiency of resource utilization. Regarding rural shrinkage, the core indicators of shrinkage are population decline and vacant functions [64]. The definition of urban shrinkage is mainly marked by population loss, and some studies have added additional dimensions, such as economic recession and dilapidated spatial quality [65,66]. This article draws on the theory of shrinking cities and defines rural shrinkage as a permanent population less than the registered population or as permanent population decrease. Similarly, rural shrinkage includes population shrinkage, land-use shrinkage, industrial shrinkage, and cultural shrinkage. The decisive indicators are population shrinkage and land-use shrinkage. Therefore, this paper uses two indicators, population change and vacant residential land, to measure rural shrinkage. The difference between the resident population and the registered population reflects population movement. The increase or decrease in residential land reflects the change in rural construction land attributes.

First, we established a method for measuring the population shrinkage index (Su) based on the permanent population to directly reflect the rural population's decrease. This article divided the study area into towns and villages and used the socio-economic indicators in the statistical yearbook to match them one by one. In order to reflect the

overall situation of the permanent population, this paper selected permanent population data for analysis. The calculation formula used was:

$$S_u = \frac{P_r - P_u}{P_r} \quad (1)$$

where S_u is the shrinkage measurement value based on the permanent population; P_r is the permanent rural population in the base year; and P_u is the permanent rural population.

On the other hand, we established a method for measuring rural shrinkage based on rural land use. Since rural shrinkage is mainly manifested in the control and abandonment of villagers' houses, the difference in the plot ratio for rural residential land is slight [67]. The proportion of construction land corresponding to control and desertion was used as the basis for the shrinkage measurement. The proportion of the total area of construction land controlled and abandoned in a particular village was the contraction value of the village.

At this time, the land used for rural residential areas was determined. The land-use data used in this article were from "The Second National Land Survey in 2010" and "The Third National Land Survey in 2019" of Gongshan County. Due to the differences in the classification standards used in the two periods of data collection, to reduce the impact on the extraction of land categories, the data were refined. We converted the classification system of "The Third National Land Survey" into the classification system of "The Second National Land Survey" to carry out the unification of land-use types. Then, the land-use types were divided into twelve types, namely, cultivated land (01), garden land (02), woodland (03), grassland (04), commercial service land (05), industrial and mining storage land (06), residential land (07), public management and public service land (08), special-use land (09), transportation land (10), water area and water conservancy facility land (11), and other land (12). Using ArcGIS to extract the plots for residential land (07), the distribution of rural residential areas in the research area was obtained to calculate the land-use shrinkage index (S_c) using the data from the second and third national land surveys.

$$S_c = \frac{A_h - A_k}{A_k} \quad (2)$$

where S_c is the measurement value based on the shrinkage of residential land and A_h and A_k represent the total construction land area at the end of the study and in the initial stage, respectively. If S_c is less than 0, it is in contraction; if is greater than 0, it is in expansion; if it is 0, it is stable.

To integrate the estimation of population shrinkage and land-use shrinkage and establish the composite shrinkage index (S) of rural shrinkage, the following formula was used:

$$S = S_r/S_c \quad (3)$$

where $S_r < 0$, $S_c > 0$ indicates that population shrinkage is dominant; $S_r > 0$, $S_c < 0$ indicates that residential land-use shrinkage is dominant; and $S_r < 0$, $S_c < 0$ indicates that population shrinkage and residential land-use shrinkage are occurring simultaneously. If $-1 < S_r < 0$, the degree of population shrinkage is less than the residential land-use shrinkage; if $S_r < -1$, the degree of residential land-use shrinkage is less than the population shrinkage; and if $S_r > 0$, $S_c > 0$, this indicates no contraction but rather an expansion state.

4. Results

4.1. Coexistence of Rural Population Shrinkage and Growth

During the study period, the permanent population of the study area increased slightly (Figure 3). From 2009 to 2020, the permanent population increased by 1500 people, and the permanent population in rural areas increased by 1200 people. In comparison, the registered population of Gongshan County decreased by up to 1700, which was in contrast to the urbanization patterns in other urban areas in China. The urban population in the study area was declining, and the rural population in the administrative area was increasing.

This was mainly due to barriers to the PA on urban land. On the other hand, there were more beautiful tourist destinations in the rural areas around the PA, which increased the rural population's ability to absorb the tourist employment population. From 2009 to 2020, tourism revenue increased from RMB 60 million to RMB 303 million.

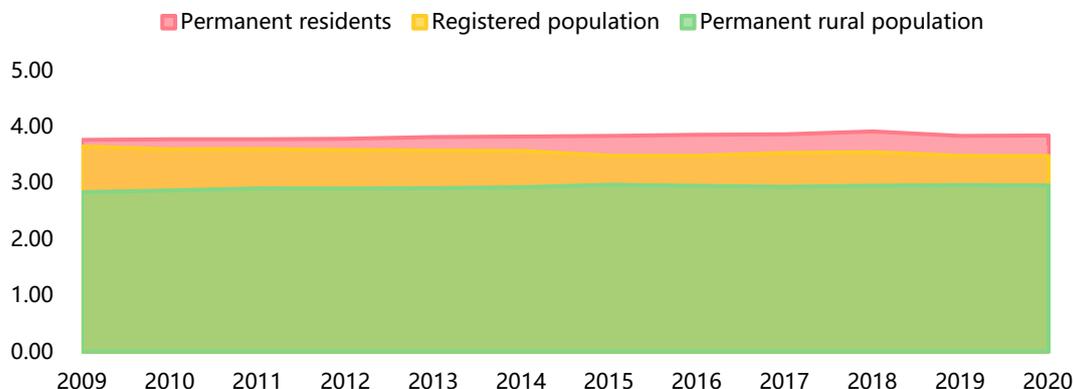


Figure 3. Population changes in the study area (2009–2020).

The increase in the overall population does not mean that the subordinate township and village levels were all growing. From the perspective of population changes in townships, towns and villages located in the primary traffic area and with representative scenic and recreational nodes of heritage sites showed population growth. Bingzhongluo Township increased by 521 people, Pengdang Township increased by 166, and Cikai Town and Dulongjiang Township increased by 166 and 220, respectively. The populations of Jiangxiang and Prati townships decreased by 728 and 559 people, respectively. Similar characteristics were also shown at the administrative village level. The administrative villages with reduced populations were often far from the central city and the main nodes of the heritage site, including Danzhu Village (−398), Hebo Village (−74), Mangzi Village (−71), Masidang Village (−35), Kongdang Village (−24), Qiunatong Village (−22), and Bujiuwa Village (−19). The administrative villages with increasing populations were mainly the villages near where the towns were located, including Bingzhongluo Village (595), Yonglaga Village (126), and Litoodi Village (203). See Appendix A for specific data.

In terms of the population contraction index (Table 1), the population underwent a slight expansion of 0.0549. The main reason for this was that local expansion was more significant than shrinkage. At the township level, except for Cikai Town, the other four towns were in a state of population expansion. The largest increase was observed for Prati Township (0.1411), followed by Bingzhongluo (0.0887) and Dulongjiang (0.0723). Pengdang Township underwent a minor population expansion (0.0301). At the village level, the six administrative villages were characterized by shrinking populations, including Mangzi Village (−0.05) and Danzhu Village (−0.17) in Cikai Town, Qiunatong Village (−0.02) in Bingzhongluo Township, Jia Sheng Village (−0.06) and Masidang Village (−0.07) in Pengdang Township, Kongdang Village (−0.02) in Dulongjiang Township, and Bujiuwa Village (−0.02) in Prati Town. The other administrative villages belonged to the population-expansion type, among which Bengzhongluo Village (0.33), Bapo Village (0.24), and Lazan (0.32) showed greater population expansion.

4.2. Diversification of Rural Land under the Growth of Ecological Land

Under the influence of the construction of the Gaoligong Mountain Nature Reserve, a dynamic reconstruction is taking place. From 2009 to 2019, the residential land areas generally showed a shrinking trend, from 51.79 hectares in 2009 to 50.90 hectares, with a shrinkage rate of 0.089 hectares/year. Cikai Township is the county seat of government and the administrative service center of Gongshan County and it has relatively good public service facilities and educational and medical resources. However, due to the constraints

of the canyon topography, there is a serious shortage of land for industrial development and residential construction, and population loss and residential land reduction are still occurring. In 10 years, Cikai Township decreased by a total of 103.83 hectares, with Cikai Village decreasing the most, reaching -68.48 hectares.

Table 1. Measurement results for population- and land-contraction values at three levels.

Study Area	Population Shrinkage Index	Land-Use Shrinkage Index	Composite Index	Shrinkage (Yes or No)
Gongshan County	0.0549	-0.0200	-2.7450	Yes
Cikai Town	-0.0295	-0.5455	0.0541	Yes
Cikai Village	0.07	-0.8364	-0.0837	Yes
Mangzi Village	-0.05	-0.2870	($-$) 0.1742	Yes
Jishudi Village	0.12	-0.1300	-0.9231	Yes
Shuanglaw Village	0.01	-0.0015	-6.6667	Yes
Danzhu Village	-0.17	-0.5211	($-$) 0.3262	Yes
Bingzhongluo Town	0.0887	0.1162	0.7633	
Qiunatong Village	-0.02	-0.8150	($-$) 0.0245	Yes
Jiasheng Village	-0.06	3.0615	-0.0196	
Bingzhongluo Village	0.33	0.0417	7.9137	
Shuangla Village	0.02	-0.1093	-0.1830	Yes
Pengdang Township	0.0301	0.8223	0.0366	
Dimangluo Village	0.03	1.6162	0.0186	
Shangdang Village	0.01	0.2472	0.0405	
Masidang Village	-0.07	1.0012	-0.0699	Yes
Yonglaga Village	0.09	0.9322	0.0965	
Dulongjiang Township	0.0723	0.3657	0.1977	
Dizhengdang Village	0.04	0.3181	0.1257	
Longyuan Village	0.03	0.8647	0.0347	
Xianjiudang Village	0.07	-0.0729	-0.9602	Yes
Kongdang Village	-0.02	0.7457	-0.0268	Yes
Bapo Village	0.24	0.0739	3.2476	
Maku Village	0.12	1.2599	0.0952	
Prati Township	0.1411	-0.1023	-1.3793	Yes
Litoudi Village	0.18	0.1346	1.3373	
Qida Village	0.10	-0.1023	-0.9775	Yes
Migu Village	0.03	0.3210	0.0935	
Hebo Village	0.07	-0.2425	-2.2887	Yes
Lazan Village	0.32	0.1260	2.5397	
Bujiuwa Village	-0.02	0.0724	-0.2762	Yes

Except for Cikai Township, other townships showed different trends of change. The added values of Bingzhongluo, Pengdang Township, and Dulongjiang Township exceeded 10 hectares. The increase in Prati Township was relatively tiny, being just 2.84 hectares. The main reason is that the three townships of Bingzhongluo, Dulongjiang, and Pengdang have relatively good heritage landscape resources. With improvements in access over

the last decade, they are becoming important viewing and reception service points for heritage sites, attracting influxes of tourism and employee populations. At the village level, the administrative villages with residential land expansion are mainly concentrated in two types of areas (Figure 4). One includes the villages around scenic areas, such as Jiasheng Village (23.41), Maluo Village (11.59), and Kongdang Village (4.50). The other villages are in the middle of the traffic corridor, such as Masidang Village (7.59), Longyuan Village (3.99), Xianjiudang Village (2.44), Latodi Village (3.80), and Laza Village (3.59). On the contrary, those administrative villages that belong to the shrinking type are mainly those that are located in areas with large mountain slopes or at the edge of administrative areas, including Cikai Village (−68.48), Danzhu Village (−21.46), Hebo Village (−5.23), and Qiu That barrel village (−11.48).

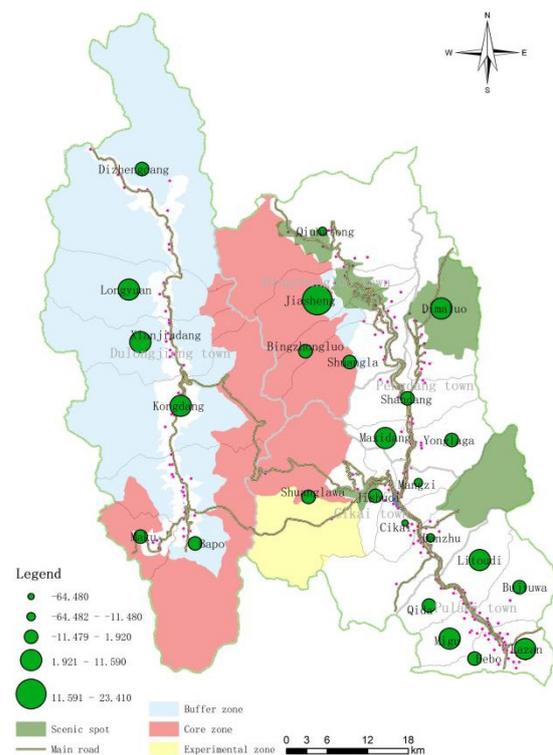


Figure 4. The change in residential land in the study area.

Apart from the residential land, there are two conversion directions for other land uses. First, many lands were converted into ecological lands under the strict restrictions of the Gaoligong Mountain Nature Reserve. The scales of woodland, grassland, and garden land have increased significantly, and water area and water conservancy facility land has also increased. In addition, the economic function of land use has been strengthened, and a large amount of cultivated land has been converted into transportation land, public management and public service land, and commercial land. The scale of support for urbanization developments, such as facilities, road infrastructure, parks, and commercial services, has also increased significantly.

The trend for the land-use shrinkage index was more prominent (Table 1), with an overall mean of -0.0200 . At the township level, Cikai (-0.5455) and Prati (-0.1023) exemplified shrinkage of land use. Dulongjiang (0.3657) and Bengzhongluo (0.1162) showed expansion. At the village level, ten administrative villages had land-use shrinkage status, including five administrative villages in Cikai Town, Qiunatong Village (-0.8150), and Shuangla Village (-0.1093) in Bingzhongluo Town, Xianyiudang Village (-0.0729) in Dulongjiang Township, Qida Village (0.1023), and Hebo Village (-0.2425) in Prathi Township.

4.3. Two Different Scenarios of Rural Shrinkage and Expansion

The composite shrinkage index analysis shows that there is rural shrinkage in Gongshan County under the influence of the Gaoligong Mountain Nature Reserve and the Three Rivers World Heritage Site. The data reflected the shrinkage transmission at the township and administrative village levels (Table 1). Among the towns that are part of the rural shrinkage are the towns of Cikai and Prati, including five administrative villages in Cikai Town, Shuangla Village (−0.1830) in Bingzhongluo, Masidang Village (−0.0699) in Pengdang Township, Xianjiudang Village (−0.9602) and Kongdang Village (−0.0268) in Dulongjiang Township, and Lazan Village (2.5397), Litoudi Village (1.3373), Qida Village (−0.9775), and Hebo Village (−2.2887) in Prati Township. One of the anomalies is Jiasheng Village in Bingzhongluo Town. Its population is shrinking, but its land expansion is relatively large. The main reason is that Jiasheng Village is close to the tourist area of Bingzhongluo, and more tourist hotels have been built, resulting in outliers and a larger amount of land per capita. In addition, ten other administrative villages are also in a state of expansion.

The institutional construction of the Gaoligong Mountain Nature Reserve and the Three Rivers World Heritage Site has resulted in a series of ecological management and land-use restriction policies. Under this institutional spatial force, the scale of land use has in turn influenced and regulated population movement, thus creating a phenomenon of internal adjustment between townships and villages in Gongshan County. The construction of the Gaoligong Mountain Nature Reserve has to some extent limited the traditional use of natural ecological resources (logging, forest planting, aquaculture, etc.); on the other hand, because the World Heritage Site encourages the development of ecotourism industry, it has also opened another new development path for local people in the development model for a modern service industry led by tourism.

To further verify the correctness of the above results, we selected the shrinking and expanding villages with large changes for a comparison and verification of remote sensing images. Among them, Cikai Village, Danzhu Village, and Qiunatong Village were selected as tokens of the shrinkage type, and Jiasheng Village and Longyuan Village were selected as tokens of the expansion type. Comparing the remote sensing image data for these villages for 2010 and 2020 (Figure 5), it can be found that the measurement results are consistent with the increases and decreases in rural land.

Among them, the land-use shrinkage indexes for Cikai Village and Danzhu Village were −0.8364 and −0.5211, respectively. From 2010 to 2020, the spatial growth of residential land was not obvious in actual performance. The main reason for this situation is the renovation of old urban areas and the demolition and renovation of houses, resulting in a relatively high cost of living in the county, which leads to differences in the choices of different people. People with higher incomes will choose to live in the central city of Gongshan County to enjoy the convenient life and school education; people with lower incomes will not choose Cikai Village in order to reduce the cost of entry but go to nearby tourist towns with better land conditions and strong employment vitality.

The main reason for the shrinking land in Danju Village is that it is located on the left side of the river. The available flat land belongs to a north–south strip, but most of it is cultivated land where changes in the nature of use are prohibited. Therefore, there is also a lack of land for construction. With the loss of population, the shrinking houses are gradually turned into woodland and cultivated land for ecological conservation. Qiunatong Village is a very representative traditional village in the study area. On the one hand, the government wants to protect the original residential architectural landscape and prohibits arbitrary demolition and relocation [68,69]. However, public services and educational shortcomings are prominent, population loss is serious, and residential land is gradually shrinking.

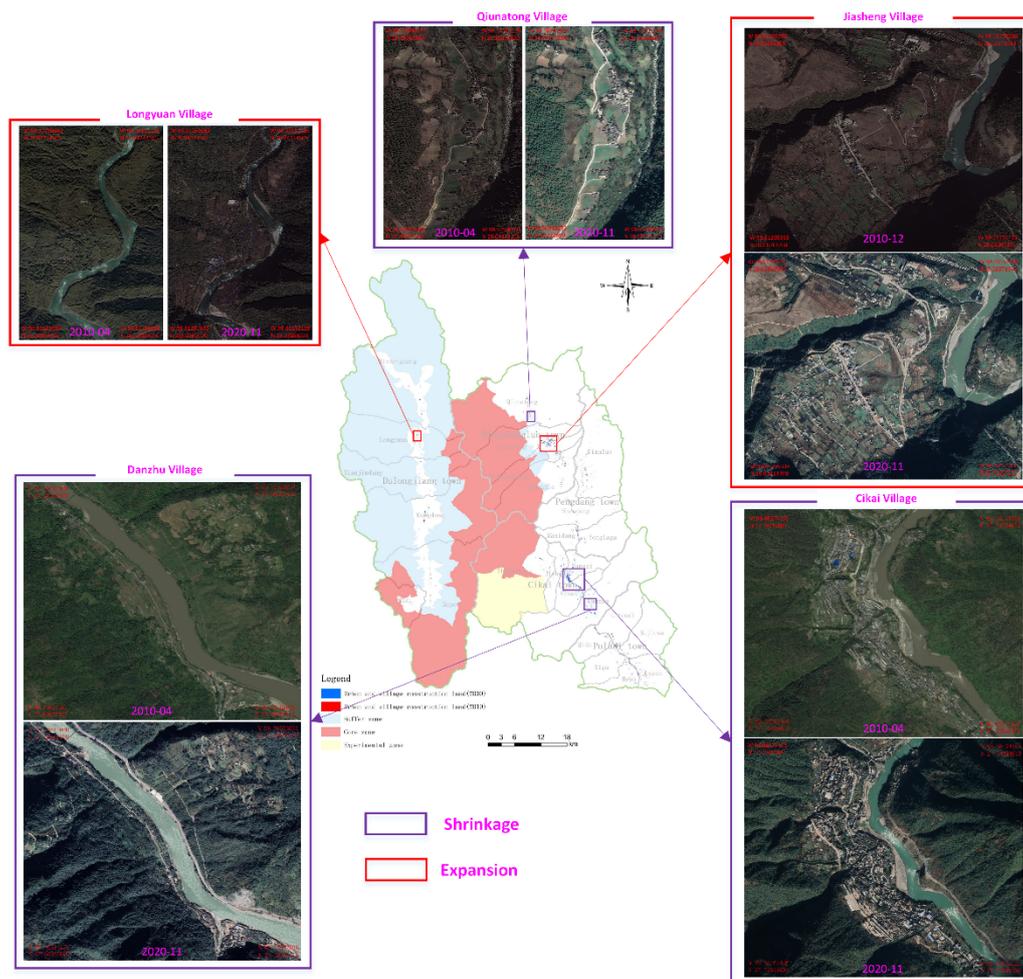


Figure 5. Remote sensing image validation of shrinking and expanding villages undergoing large changes.

Among these two expanding and developing villages, Jiasheng Village, near Bingzhongluo Town, has the most beautiful natural landscape resources and assumes the supporting service function of tourist reception. As a result, many tourist hotels and restaurants have been built in Jiasheng Village. The study found that although the population of Jiasheng Village has decreased, the scale of land use has increased. Longyuan Village is a key area for the development of Dulongjiang cultural tourism in Dulongjiang Township. The land here is flat and open and located on both sides of the main traffic. As a result, the local government started to build a centralized poverty-alleviation village in Longyuan Village in 2015, which affected the ecological environment. The concentration of families relocated from the Gaoligong Mountain Nature Reserve and the construction of more functional facilities in the tourism landscape to promote tourism services also led to expansion in the scale of land use, which is also more evident in Figure 5.

5. Discussion

5.1. Reconfiguration of Rural Development Factors under the Influence of Multiple Institutional Spaces

As seen from the above analysis, once PAs intervene in the administrative system, a double spatial force is generated, forcing population flows from areas subject to strict restrictions to new areas of tourism development activated by heritage sites, thus leading to a reconfiguration of various development factors at the regional level and changing urban-rural spatial relations and evolutionary paths. This phenomenon is consistent with the

findings of Canavire-Bacarreza et al. (2013) on the impact of PAs on poverty in Bolivia [48]. Hospers' research on rural shrinkage in Europe also found that imperfect urban policies will have negative impacts on rural changes [70].

However, multiple factors affect rural shrinkage. In Romania, the spatial reorganization of industries due to institutional reforms will affect employment opportunities, triggering a shift from growth to shrinkage [71]. Some countries that allow recreational opportunities in nature reserves, such as the Philippines, where tourism facilities can be built and where indigenous people are not forced to move out of nature reserves, will show different patterns of aggregation [49]. Institutional spaces and demographic thresholds are the key variables affecting rural shrinkage. Rural shrinkage analyses for Central Europe and the United States may not be applicable in Northern Europe and Southeast Asia. In this study, the spatial division of nature reserves, World Heritage Sites, and administrative areas in Gongshan County led to the identification of three institutional forces and two mechanisms (constraints and incentives) (Figure 6). Administrative areas and nature reserves mainly bring constraint mechanisms. As an external deterrent, administrative regions influence employment, education, and housing purchases through China's household registration system, which effectively creates a high barrier to entry for many foreign household-registration holders. The majority of the population consists of local people living in Gongzaga County who are employed.

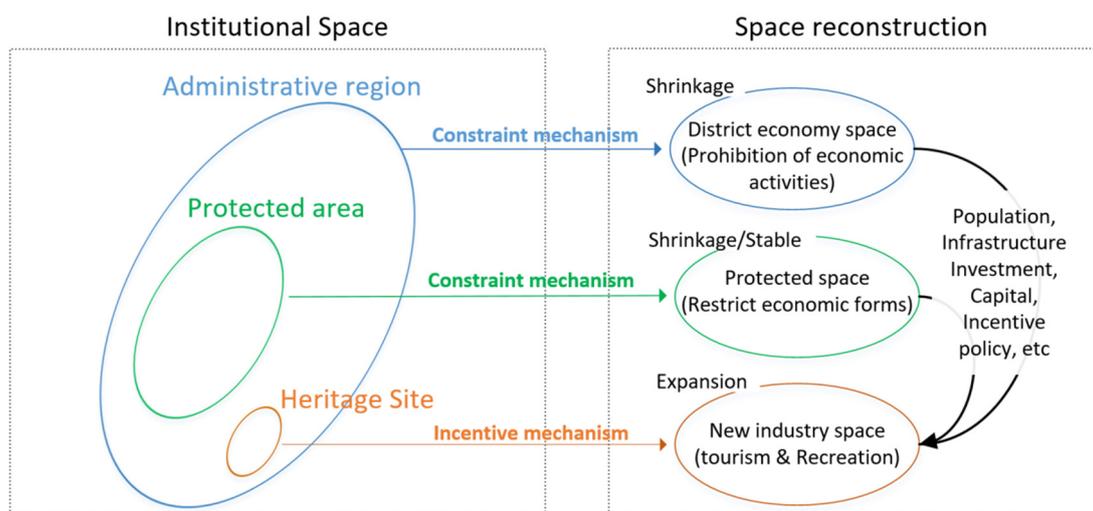


Figure 6. Spatial reconstruction under the guidance of institutional space.

At the same time, due to the establishment of the Gaoligong Mountain Nature Reserve, economic activities within the area are strictly prohibited, and only industries closely related to ecological protection can be developed. This results in insufficient regional economic and social vitality in the townships within the nature reserves and leads to the shrinkage of some townships and villages with poor land conditions and few development opportunities. For example, Danzhu Village and Qiu Natong Village are relatively disadvantaged geographically, with relatively limited radiation from the urban economy and a large shortfall in basic education and medical services, making it difficult to avoid population exodus.

On the contrary, those villages whose ecotourism development has been promoted by the construction of the Three Rivers World Heritage Site have been given incentives for tourism economic development by the government, such as Jiasheng Village, Bingzhonglou Village, Longyuan Village, etc. They have continued to receive external tourism investment, public service implementation has gradually improved, employment opportunities have increased, population absorption capacity has been strengthened, and the scale of residential land has also expanded.

5.2. Uneven Changed Villages inside and outside the Protected Area

The intervention of the institutional space of nature reserves and World Heritage Sites has changed the path-dependence of the original regional evolution of Gongshan County and created a new institutional, economic, and social environment. Along with the administrative institutional space, rural shrinkage and expansion coexist under the three institutional spatial forces described above. PAs generate vertical-scale differentiation effects and horizontal differentiation effects, shaping pressure surfaces and constraint mechanisms. Vertical-scale differentiation effects refer to the impacts of PAs on urban systems, while horizontal differentiation effects refer to the impacts on the development of different townships. Pressure surfaces refer to the fact that different PAs, due to their different degrees of restricting industrial development, are equivalent to upper-level pressures being put on the areas in which they are located, forcing them to develop in directions stipulated by the protected areas. Vertical-scale differentiation effects act on the vertical system of towns–townships–villages [38]. The constraint mechanism of nature reserves and the tourism incentive mechanism of World Heritage Sites have jointly changed population movement patterns, promoting spatial differentiation and population migration, manifested in patterns of agglomeration and evacuation.

Under the restrictions of the nature reserve, the county has no choice but to develop ecological industries, resulting in a lack of economic diversity and vitality, forcing the indigenous people of the townships covered by the nature reserve to go out in search of subsistence resources or to obtain resources through illegal production methods [72]. Villages that are a potential threat to the nature reserves are gradually withdrawn from the scope of the reserves under the policy constraints of ecological restoration and ecological compensation. The horizontal differentiation effect is mainly reflected at the township level. As different townships face different pressures and have different endowments of tourism resources, those villages and towns that have lost their development advantages will be at a disadvantage in the above demographic change process and will only be able to maintain the status quo or succumb to shrinkage.

Compared with the rural development paths in general areas, the development of villages within the nature reserve will reduce the original path-dependence. As can be seen in Figure 7, under normal conditions, rural population movements will be clustered into two types of villages and towns. In the case of nature reserves, China's nature reserve law requires that people in the core area and experimental area must be relocated out of the nature reserve because of its potential threats to the ecosystem. The local government hopes that this spatial relocation and clustering will facilitate the subsequent centralized supply of administrative and public services.

5.3. Tourism Development Based on Heritage Sites as a Dampener for Rural Shrinkage

In this study, the development and utilization of tourism resources in the Three Rivers World Heritage Site has reduced the adverse effects of rural shrinkage in Gongshan County at the aggregate level as a whole. The root causes of rural shrinkage are population loss, hollowing out, and loss of land for construction.

Similarly, rural expansion is driven by the need to maintain ongoing economic vitality. Whether in developed, developing, or underdeveloped countries, the construction of PAs affect local communities to varying degrees, their effects including the loss of traditional economies, dispossession of livelihoods, loss of well-being, and the psychological and political disenfranchisement of communities [73,74]. At this point, a novel economic development force is needed to provide better options for secondary development opportunities for the rural shrinking subjects [75]. Undoubtedly, tourism development led by Three Rivers World Heritage Site provides a shelter and acts as a damper for rural shrinkage.

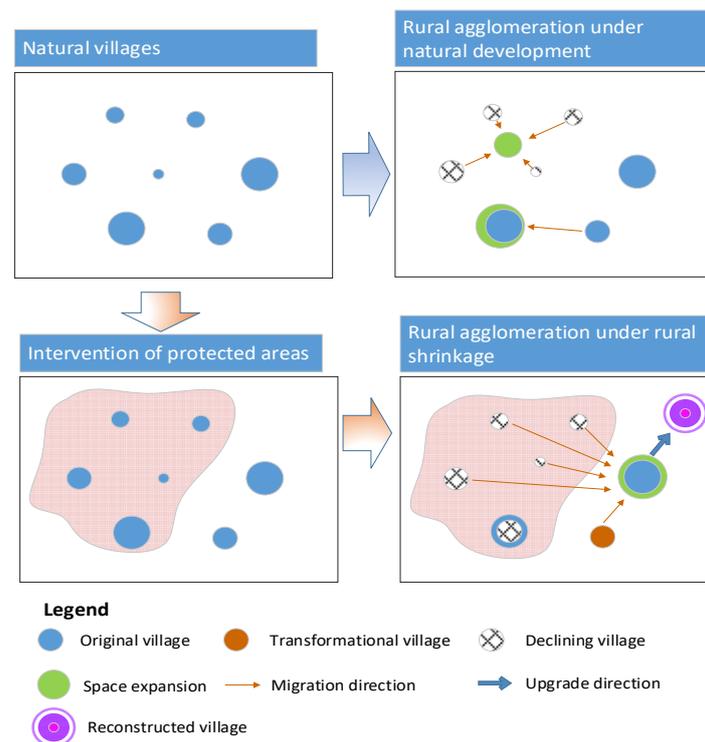


Figure 7. Comparison of rural shrinkage scenarios under natural development and protected land intervention.

In this paper, Bengzhongluo Town, Dulongjiang Township, and Pengdang Township are all areas with relatively concentrated natural and cultural resources in the Three Rivers World Heritage Site that have attracted the migration of populations from other townships in Gongshan County. These people migrate to these tourist townships or tourist characteristic villages to gather and engage in temporary or seasonal tourist service industries, as a result of which the rural settlements in Gongshan County present both shrinkage and expansion.

However, the lack of good planning for these tourist villages and towns has left rural expansion in a disorderly state. For example, too many tourist hotels and other reception facilities have been built in Bingzhongluo Town, so that many traditional agricultural-production populations have been converted to tourist workers and few are engaged in low-income traditional agricultural cultivation, which has caused the most attractive agricultural production landscape to gradually disappear.

The loss of traditional farming landscape assets due to the forced displacement of populations brought about by nature reserves and the disorderly development of tourism in World Heritage Sites are hidden in the process of rural shrinkage and expansion. The embedding of nature reserves and World Heritage Sites has actually broken the original pattern of benefit distribution in Gongshan County; both population migration and traditional farming landscape destruction are external manifestations of this systemic change.

6. Conclusions

Previous studies on this topic have emphasized unidimensional studies of rural shrinkage from top to bottom at the macro-level [76]. They have framed their hypotheses in terms of patterns of shrinkage due to external economic attraction, without considering the constraints and incentives brought about by the construction of nature reserves and World Heritage Sites within administrative districts [38,77]. Clearly, it is these subtle factors that directly affect the fates of rural populations and the process of sustainable development. However, our study is unique in proposing a more explicit theoretical framework and

has tested it through a case study of Southwest China. The analysis of rural shrinkage in terms of the interaction of three different systems of nature reserves, World Heritage Sites, and administrative divisions is more conducive to enhancing the understanding of new pathways for rural development in China from a political-economy perspective. Rural shrinkage and restructuring in such areas occur relatively slowly and are more decisively influenced by policy than in areas profoundly affected by globalization and urbanized economies.

PAs are institutional tools that represent political visions and their embedding marks the inclusion of local stakeholders in a new spatial governance framework, the alteration of regional development paths through the constraints and incentives of nature reserves, and the alteration of pre-existing town systems and interests through the reorganization of rural systems. While such nature reserve systems are embedded in a way that wipes out some development opportunities and causes villages to shrink, they also innovatively promote the expansion of villages in other regions. Therefore, when planning for nature reserves, local livelihoods should be fully considered, especially when delineating the boundaries of the reserves; the government should assess the positive or negative impacts of construction on rural development and consider the effect of reconfiguring town systems at the regional level.

The case study of Gongshan County in this paper is a microcosm of the reform of environmental protection policies in developing countries and the reconstruction of urban–rural spatial relations in this process. How to achieve a balance of government effects? Smart decline requires recognizing and respecting the reality of shrinking populations; it does not deny growthism altogether but emphasizes confronting the problem of recession [28]. If the construction of PAs does not better address the balance between shrinkage and expansion, there will be a high probability of loss of natural assets and the emergence of a general recession.

So, in this case, how to establish a positive model for the coordinated development and multi-objective of PA? It is proposed to establish “conservation coordination zones” in the peripheral areas of nature reserves. That is, while strengthening the protection of natural authenticity, the scale of the tourism industry should be moderately controlled, a unique “concession” system should be adopted, and a series of technical audits, such as architectural designs, should be constructed to form a certification system. On the other hand, with a long-term vision of community cooperation, a high-quality development strategy should be adopted to prevent negative growth with respect to short-term goals and maximize the curb on the negative impact of low-cost competition on the long-term development of new industrial spaces.

The current residential building has changed from a traditional one-story building to a multi-story building. This may decrease the proportion of plots and may not fully reflect changes in land-use structure [78]. The next step will include a more detailed questionnaire examination of both rural shrinkage and expansion involving designers, planners, and communities at the policy and planning levels, as well as suggestions for effective measures to improve sustainable rural development pathways.

Author Contributions: H.Y.: conceptualization, writing—original draft preparation, writing—review and editing, supervision, funding acquisition. L.X.: methodology. S.L.: field surveys, writing—original draft preparation. Y.L.: writing—review and editing; J.L.: conceptualization, writing—review and editing. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A

Table A1. Chinese and English names of administrative villages and population size table.

Chinese Name	English Name	Code	2010	2020	Change
茨开镇	Cikai Town	1	7440	7220	−220
茨开村	Cikai Village	101	2115	2258	143
芒孜村	Mangzi Village	102	1533	1462	−71
吉束底村	Jishudi Village	103	779	876	97
双拉娃村	Shuanglawa Village	104	717	726	9
丹朱村	Danzhu Village	105	2296	1898	−398
丙中洛镇	Bingzhongluo	2	5875	6396	521
秋那桶村	Qiunatong Village	201	1237	1215	−22
甲生村	Jiasheng Village	202	1298	1217	−81
丙中洛村	Bingzhongluo Village	203	1781	2376	595
双拉村	Shuangla Village	204	1559	1588	29
捧当乡	Pengdang	3	5512	5678	166
迪麻洛村	Dimangluo Village	301	2109	2181	72
闪当村	Shangdang Village	302	1429	1432	3
马西当村	Masidang Village	303	519	484	−35
永拉嘎村	Yonglaga Village	304	1455	1581	126
独龙江乡	Dulongjiang	4	3972	4259	287
迪正当村	Dizhengdang Village	401	632	658	26
龙元村	Longyuan Village	402	556	575	19
献九当村	Xianjiudang Village	403	709	756	47
孔当村	Kongdang Village	404	1030	1006	−24
巴坡村	Bapo Village	405	762	947	185
马库村	Maku Village	406	283	317	34
普拉底乡	Prati	5	5769	6583	814
力透底村	Litoudi Village	501	1140	1343	203
其达村	Qida Village	502	723	793	70
咪谷村	Migu Village	503	524	541	17
禾波村	Hebo Village	504	1101	1175	74
腊咱村	Lazan Village	505	1473	1942	469
补久娃村	Bujiuwa Village	506	808	789	−19

Appendix B

Table A2. Comparison of classified categories for China's second and third land-use survey data.

Paper Classification		The Second National Land Survey			The Third National Land Survey			
						0303	Mangrove forest	
						0304	Forest swamp	
						0306	Shrub swamp	
				00	Wetland	0402	Everglade	
						0603	Saltern	
						1105	Coastal beach	
						1106	Inland beach	
						1108	Swale	
Cultivated land (01)	01	Cultivated land	011	Paddy field	01	Cultivated land	0101	Paddy field
			012	Irrigated land			0102	Irrigated land
			013	Dry land			0103	Dry land
Garden land (02)	02	Garden Plot	021	Orchard	02	Plantation land	0201	Orchard
			022	Tea garden			0202	Tea garden
			023	Other garden			0203	Rubber estate
							0204	Other garden
Woodland (03)	03	Woodland	031	Forestland	03	Woodland	0301	Arboreal lands
			032	Shrubland			0302	Bamboo forest land
			033	Other woodland			0305	Shrubland
							0307	Other woodland
Grassland (04)	04	Grassland	041	Natural pasture	04	Grassland	0401	Natural pasture
			042	Cultivated pasture			0403	Cultivated pasture
			043	Other grass			0404	Other grass
Commercial service land (05)	05	Commercial service land	051	Wholesale and retail land	05	Commercial service land	05H1	Commercial service facilities land
			052	Accommodation and catering land				
			053	Commercial and financial land			0508	Land for logistics and warehousing
			054	Other commercial land				
Industrial and mining storage land (06)	06	Industrial and mining storage land	061	Industrial land	06	Land for mining and industry	0601	Industrial land
			062	Land for mining			0602	Land for mining
			063	Land for warehouse				
Urban land (07A)	07	Residential land	071	Urban residential land	07	Residential land	0701	Urban residential land
Rural residential land (07B)			072	Rural homestead			0702	Rural homestead

Table A2. Cont.

Paper Classification		The Second National Land Survey		The Third National Land Survey				
Public management and public service land (08)	08	Public management and public service land	081	Organization land	08	Public management and public service land	08H1	Land for press and publication of government organizations
			082	Press and publication land			08H2	Land for science, education, culture, and health
			083	Land for science and education			0809	Public facilities
			084	Medical and health charity land			0810	Parks and green spaces
			086	Public facilities				
			087	Parks and green Spaces				
			088	Land for scenic facilities				
			Special use land (09)	09			Special use area	091
092	Diplomatic and consular land							
093	Land used for prison							
094	Religious land							
095	Land for the funeral							
Transportation Land (10)	10	Land for transportation	101	Land for railway	10	Transportation Land	1001	Land for railway
			102	Highway land			1002	Land for rail transit
			103	Street land			1003	Highway land
			104	Country road			1004	Town and village
			105	Land for the airport			1005	Transportation service station land
			106	Port land			1006	Country road
			107	Land for pipeline transportation			1007	Land for the airport
			1008	Port land				
1009	Land for pipeline transportation							
Water area and water conservancy facility land (11)	11	Water area and water conservancy facility land	111	Water surface of river	11	Water area and water conservancy facility land	1101	Water surface of river
			112	Water surface of lakes			1102	Water surface of lakes
			113	Water surface of reservoir			1103	Water surface of reservoir
			114	Water surface of swag			1104	Water surface of swag
			115	Coastal beach			1107	Ditch
			116	Inland tidal flats			1109	Hydraulic construction land
			117	Ditch			1110	Glaciers and permanent snow cover
			118	Hydraulic construction land				
			119	Glaciers and permanent snow cover				
Other land (12)	12	Other land	121	Leisure area	12	Other land	1201	Leisure area
			122	Facility agricultural land			1202	Facility agricultural land
			123	Footpath in a field			1203	Footpath in a field
			124	Alkaline land			1204	Alkaline land
			125	Wetland			1205	Sand
			126	Sand			1206	Bare land
			127	Nudation			1207	Area of bare rock and gravel

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