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How Does Rural Resilience Affect Return Migration: Evidence from Frontier Regions in China

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Abstract: An important way to realize urban–rural integration and regional coordinated development is to attract labor forces back to rural areas. Most of the existing studies consider the impact of individual factors on population migration, they lack a systematic framework to analyze the combined impact of different factors on rural return migration. Furthermore, in practice, the interaction within the rural social ecosystem as an important driver of return migration is always ignored. Using data from 131 villages in 14 cities in Guangxi, China, combined with the Coupled Infrastructure System framework and the sustainable livelihoods framework, this paper analyzes the comprehensive impact of internal components of the rural social ecosystem on return migration. Qualitative comparative analysis is used to identify four condition combinations that can effectively promote return migration and five condition combinations that make return migration vulnerable. The main conclusions are as follows. First, high-level public infrastructure providers are an important driving factor for labor return to rural areas, and a substitution effect exists between them and livelihood capitals. Second, sufficient human capital and social capital are crucial for return migration, highlighting the importance of the structure of rural members and the collective atmosphere. Third, natural capital and economic capital emphasized by previous research are not key conditions for forming a high level of return migration. Fourth, the vulnerability of return migration is mainly caused by the decline of social capital, the loss of public infrastructure providers, and excessive dependence on economic or physical capital input. To attract return migration, rural areas need to pay attention to the integration and synergy of multi-dimensional capital and public infrastructure providers, and special emphasis should be placed on the cultivation of public leadership to promote the enhancement of human capital and social capital. This paper provides a more comprehensive and instrumental analytical perspective for understanding and promoting rural return migration. While deepening the understanding of the dynamic relationship between rural social ecosystem and labor mobility, it also offers policy insights for developing countries to achieve integrated urban–rural development.

Keywords: rural social ecosystem; rural resilience; return migration; configuration analysis; rural areas

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1. Introduction

With the promotion of global urbanization and modernization, large-scale population movements from rural to urban areas and from less developed to more developed regions

have fostered rapid development in the global economy. For instance, prior to the pandemic outbreak, in 2019, China's migrant worker population reached 290.77 million, including 174.25 million workers, marking an increase of 28.92 million compared with 2009, which represents a 19.9% increase over the decade [1,2]. In recent years, due to the impact of COVID-19 [3], the global economic downturn, and the government's emphasis on rural construction, there has been a gradual decline in both the scale and speed of population flow, and significant changes in the spatial pattern of population movement. By way of example, in China, the proportion of inter-provincial migration is decreasing, while intra-provincial and intra-city migration is on the rise, and the trend of the floating population returning to their home provinces or even counties is becoming increasingly prevalent. Data from the 2018 China Labor Dynamics Survey (CLDS) indicate that 22.1% of the country's rural population has experience working outside their home county, and a 2023 survey of western mountainous counties reveals that returnees make up 35.6% of the rural population. As a key element of rural development, return migration will undoubtedly have a profound impact on both the inflow and residential areas [4]. Analyzing the intentions and factors influencing return will not only deepen our understanding of population flow dynamics but also inform policies aimed at optimizing the distribution of regional human resources and fostering urban–rural integration and coordinated regional development.

As a key phenomenon in the process of urbanization, population flow has always been the focus of social science research. The current research on population flow can be roughly divided into two main areas. The first area includes the spatial pattern of population flow [5,6] and the demographic characteristics of population mobility, that is, the factual characteristics [7,8]. Most of these studies focus on intra-urban mobility (i.e., city-to-city mobility). Conversely, as an important part of population mobility, the anti-urbanization mobility of Chinese labor from cities to rural areas has received little attention in existing studies. The second area focuses on the driving factors of population flow, namely explanatory factors [9–11]. Various influential theories have emerged within this research domain, among which "push and pull theory" provides the basic explanatory framework for population migration [12,13]. This theory posits that the push factors from the outflow area and the pull factors from the inflow area significantly influence the decision to return [14,15]. Neoclassical economics, based on the premise of expected income maximization, posits that the return decision is the outcome of migrants weighing the costs and benefits of migration [16,17]. The new migration economics focuses on the family and believes that labor migration is a decision based on the overall interests of the family [18]. Structuralism and social network theory emphasize the role of institutional environment and social connections with the hometown on labor return [19]. Although existing studies have discussed the influencing factors of labor return from the perspectives of individuals, families, places of inflow and places of outflow, etc., most of these studies focus on the impact of individual factors on population migration and lack a systematic framework to analyze the combined influence of dynamic combinations of different factors on labor return. Furthermore, insufficient attention has been paid to the role of rural governance systems in assessing the return of labor.

In addition, in this kind of framework discussion on population mobility, there is no consensus conclusion from existing research on the impact of population mobility on the economy and society. Specifically, on the one hand, development economics views labor migration as a tool for development, and from this perspective, the return of migrants to their home areas is not conducive to development, i.e., it does not effectively contribute to the development of the migrants' families and the areas of inflow, and in severe cases, it may even affect the stability of the society. Hirvonen and Helene Bie Lilleør (2015) [20] found that return migrants do not present themselves as different from non-migrants in their

home regions in any positive way; for example, they do not seem to have higher levels of consumption and asset holdings than non-migrants, and they are not more entrepreneurial than non-migrants. Li and Liang (2024) [21] found that return migration has a detrimental effect on the cognitive development of rural migrant children, which also implies that return migration may widen the gap between urban and rural children. Bai and He (2002) [22] argued that the return migration will lead to increasing employment problems in rural areas, and that, in this case, return migration will not only be a passive choice of the "losers", but will also lead to "developmental failure" in the place of departure. For example, when return migrants are merely a rather homogeneous factor supply shock to the local labor supply market, it only makes the local competition for labor employment more intense [23]. On the other hand, studies on rural development have shown that the return migration plays a positive role in the development of labor households and rural areas. By using data from China's Household Finance Survey, Zhou et al. [24] found that the return migration is conducive to strengthening rural entrepreneurial activities, which leads to the conscious return of human and financial capital as the key drivers of rural economic growth and has a great potential to promoting rural economic development. Bosworth and Glasgow [25] also argued that the entrepreneurial activities of rural migrants are conducive to promoting a new process of rural development. Luo et al. [26] found that the return of outgoing labors can significantly mitigate rural income inequality and is more conducive to the mitigation of inequality of wage and property incomes. This mitigation effect is particularly pronounced in lower-middle income, farming- and labor-type rural households. Hausmann and Nedelkoska [27] argued that return labors have acquired complex and advanced knowledge and technology in the cities to which they originally flowed, and that their return not only compensates for the demand for labors in the outflow areas but also complements the productivity of the local labor [28], which, in turn, has spillover effects on the economic development of the entire village and even neighboring villages. Böhme's [29] study based on Mexican panel data pointed out that international mobility of rural labor can significantly increase investment in agricultural assets.

The countryside is a complex social ecosystem, comprising the intricate interplay of cultural, economic, resource, and environmental factors, characterized by openness, nonlinearity, instability, and continuous fluctuation [30]. Alterations in any system element can precipitate corresponding changes in others, triggering a chain reaction that leads to a shift in the system state. Resilience, as one of the system's attributes, encompasses the system's capacity to withstand and recover from external shocks, ensuring the continuity of its core functions during crises [31]. In essence, resilience represents a proactive adjustment strategy enabling the system to learn from, adapt to, and integrate internal and external environmental perturbations. Currently, amidst China's rural revitalization efforts, the integrated development of urban and rural areas is being actively fostered. In this process, numerous agriculture-supporting and agriculture-benefit policies are being implemented in rural areas, fostering increased exchange and interaction among various elements and subsystems within the rural social ecosystem and with the external environment, including human, capital, and cultural flows, thereby enhancing the resilience of the rural social ecosystem [32]. Li et al. [33] noted that the resilience of a rural social ecosystem is most critically reflected in the willingness of people to reside within it and contribute to its bottom-up revitalization. Hence, empirical evidence suggests that labor outflow or return can either undermine or bolster the resilience of rural social ecosystems [34]. However, a realm that remains underexplored in current research is whether the resilience of rural social ecosystems can also influence labor mobility in turn. Consequently, it is seldom considered in practice whether the interaction between the internal elements of the rural social ecosystem can catalyze the return of the labor force. As a result, this analysis

frequently overlooks the significant motivation stemming from the internal dynamics of the rural social ecosystem.

One of the best frameworks for measuring rural resilience and analyzing the interactions between components within rural social ecosystems is the Coupled Infrastructure System (CIS) framework. The CIS framework provides a systematic analytical perspective and constructs the interactive relationship among the four subsystems of resource, resource users, public infrastructure providers, and public infrastructure, which enables a more scientific and comprehensive understanding of rural return migration and the ability to diagnose key problems [35]. Based on this, this paper first analyzes return migration through the CIS framework, using the existing evaluation system for return migration as a foundation and combining it with the sustainable livelihoods framework as a secondary evaluation index to evaluate the impact of the rural social ecosystem on return migration. This comprehensive evaluation system provides a more comprehensive understanding of the complex mechanisms behind return migration. Additionally, to test the validity of the theoretical framework, this paper conducts an in-depth analysis of 131 village-level data from 14 cities in Guangxi, providing a rich empirical basis for understanding return migration and revealing the internal logic and dynamic changes in the rural social ecosystem. Ultimately, starting from the construction of rural resilience, this paper offers a new perspective and strategy to alter the current urbanization process characterized by the massive outflow of rural labor and provides valuable insights for achieving rural sustainable development and economic revitalization.

There are two notable innovations in this paper. On the one hand, existing studies introduce the institutional analysis framework when discussing the impact of rural labor migration on the rural social ecosystem, whereas studies on resilience commonly employ the sustainable livelihoods framework. This paper aims to explore the relationship between rural resilience and labor mobility in the rural social ecosystem, offering the potential to integrate the institutional analysis framework with the sustainable livelihoods framework. On the other hand, through the method of configuration analysis, this paper identifies the mutual substitution between rural public infrastructure providers and rural livelihood capitals, challenging the traditional single-factor research that emphasizes the dominant role of natural capital, economic capital, and material capital on return migration. This offers a novel theoretical perspective for overcoming the constraints imposed by natural capital, economic capital, and material capital on rural return migration in practice.

2. Theoretical Analysis and Research Framework

The rural area is a complex social ecosystem, which is connected with the ecosystem and influenced by various social systems [36]. This paper employs the CIS framework, which is suitable for analyzing the interactions among internal components of rural social ecosystem, in conjunction with the sustainable livelihood capitals, to assess how rural social ecosystem impact return migration. The CIS framework (Figure 1), evolved from the combination of the Institutional Analysis and Development (IAD) framework and the Social–Ecological System (SES) framework, constructs the interaction between the four subsystems of resource, resource users, public infrastructure providers, and public infrastructure. The resource refers to the natural conditions of a village, such as climate, water resource, and topography. Resource users are reflected in the demographic characteristics of the village, such as population size, population density and population quality. Public infrastructure providers are manifested in the governance attributes of the village, including the number and caliber of village officials, the presence of support units, and the extent of support from higher governance levels. Public infrastructure is an important part of the CIS framework. As Anderies et al. [37] detail, the infrastructure composing the CIS framework

is primarily divided into two types. The first type is hard infrastructure, which pertains to artificial service facilities such as roads, farmland water conservancy, water supply, and power supply. The second type is soft infrastructure, which encompasses intangible tools that can be utilized alongside other types of infrastructure, such as village regulations and local policies. In comparison to the IAD framework, which focuses on single-action situations, and the SES framework that emphasizes variables within hierarchical structures, the CIS framework highlights the fundamental interactions within social–ecological systems. It adds eight interconnections between the internal components of the system, establishing links between different elements to form multiple action situations, with a particular focus on the dynamic combinatorial relationships between elements [38].

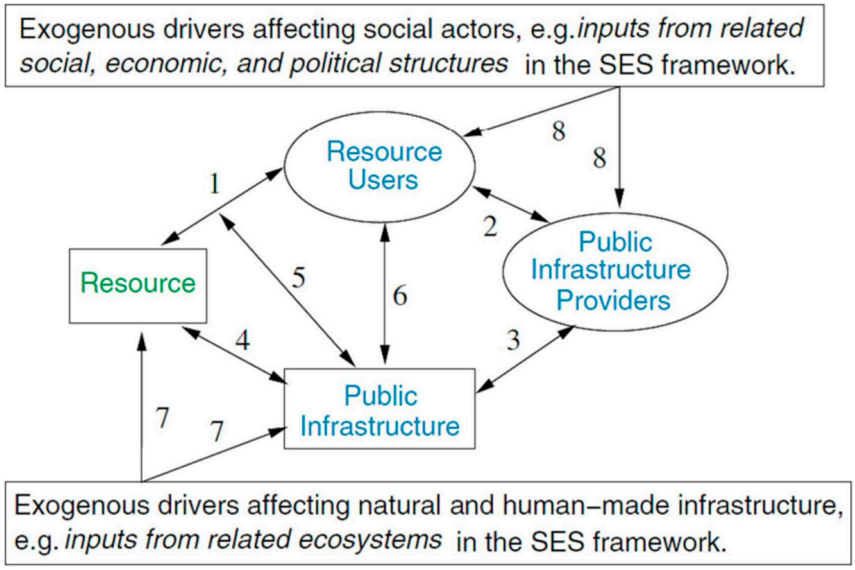


Figure 1. Coupled Infrastructure System (CIS) framework (Source: Anderies and Janssen [39]).

The CIS framework provides a systematic analytical perspective to explore the complex factors of return migration. The framework emphasizes that the abundance of resources is a key factor affecting the economic development potential and living environment of a region. Proper development and utilization of natural infrastructure can attract labor back to sectors like agriculture, forestry, and services, and foster a congenial living environment that entices migrant workers to return. The number, health conditions, and education level of resource users, that is, residents in rural areas, will affect the development of rural areas and further affect the decision of the out-migrated labor to return to their villages. In the realm of public infrastructure, the enhancement of hard infrastructure significantly improves transportation conditions and living facilities, and elevates the level of communication and information technology. Meanwhile, the improvement of soft infrastructure is instrumental in refining the institutional and economic environments for rural development. Together, these improvements foster rural return migration. Rural public infrastructure providers positively influence return migration by formulating policies, directing infrastructure investments, and enhancing public services.

At the same time, sustainable livelihood capital is included in the CIS framework as a secondary indicator to analyze and evaluate rural return migration. Sustainable livelihood capital is a multi-dimensional analytical tool widely used to explore how individuals, families, or communities use various resources and strategies to maintain and enhance their livelihoods. Sustainable livelihood capital is divided into five categories, namely natural capital, economic capital, physical capital, human capital, and social capital. Using sustainable livelihood capital as a theoretical analysis tool to explore the causes and

influencing factors of rural return migration has significant advantages and broad applicability. First, the comprehensiveness of the livelihood capitals enables it to consider multiple factors influencing return migration, such as economic opportunities, social networks, educational resources, natural resources, and financial conditions, thereby providing a multidimensional analytical perspective. Secondly, the systemic perspective emphasizes the interaction and interdependence among various factors, which aids in unraveling the complex systemic issues behind return migration, such as how to promote the growth of economic capital by improving social capital, so as to attract labor back to rural areas.

Natural capital refers to the natural resources utilized for rural development, including water, soil, minerals, timber, and other resources, as well as ecosystems such as forests and grasslands. As a vital form of capital for rural development, the better the quality and the larger the area of land, and the more abundant the water resources, the more conducive it is for villages to develop agricultural crops, increase farmers' income [40], and enhance the resilience of rural areas to external shocks [41]. Economic capital pertains to the financial assets available to the village for achieving its livelihood objectives, primarily sourced from collective management projects, land leases, expropriation compensation, investment returns, financial transfers, and similar activities. From the perspective of the "rational actor" model, we posit that the more economic capital a village possesses, the stronger its ability to withstand current external shocks and potential future risks. Physical capital comprises the production facilities and infrastructure essential for village sustenance, including healthcare, education, road construction, and agricultural infrastructure. The means of production and infrastructure are closely related to the production and life of villages, which greatly affect the modernization of rural areas. Research indicates that irrigation canals are critical for assessing the robustness of rural social ecosystems [42]. Human capital encompasses the knowledge, skills, labor capacity, and health of individuals, directly influencing the village's ability to cope with and recover from external shocks. Villages with ample labor can maintain daily operations through self-sustaining endeavors and have the potential to generate higher collective income and bolster economic capital. The educational attainment of village officials is crucial for enhancing collective scientific decision-making, fostering endogenous village development, and equipping the village to better manage sudden crises and external shocks. Social capital refers to the networks, trust, and norms in villages that can improve economic efficiency through coordinated action. Extensive contact networks signify a higher degree of efficiency and cohesion in village collective action, facilitating improved access to livelihood information, diversification of livelihood choices, and bolstering villages' resilience to risks. Furthermore, villages with robust social capital garner greater external support, aiding in risk management and sustaining rural livelihoods.

In the framework integration depicted in Figure 2, resource and natural capital both pertain to critical natural resources within the ecosystem, fulfilling human needs in production and life and aligning on two core dimensions: resource categorization and service functionality. Individuals within the village, constituting human capital, are the primary agents utilizing resources for production and daily life. Essentially, they parallel the resource users identified within the CIS framework as subjects of resource utilization. Hard infrastructure within the CIS framework and physical capital within the sustainable livelihood capitals are both tangible assets that exist to ensure the normal functioning of socio-economic activities in villages. They exhibit a strong congruence in terms of functionality and the nature of the assets. Soft infrastructure in CIS framework and economic and social capital in sustainable livelihood capitals refer to invisible tools that can be used by villages in production and development, and there is a close corresponding relationship between them. The public infrastructure providers, associated with the village's governance system,

remain a distinct and autonomous component. Consequently, the fundamental analytical logic of rural return migration in this paper is formulated as follows. Under the external shock of urbanization, how do rural ecosystems mobilize the five types of livelihood capital through the interaction of internal elements to achieve adaptation to external shocks? This adaptation process is specifically manifested in rural return migration.

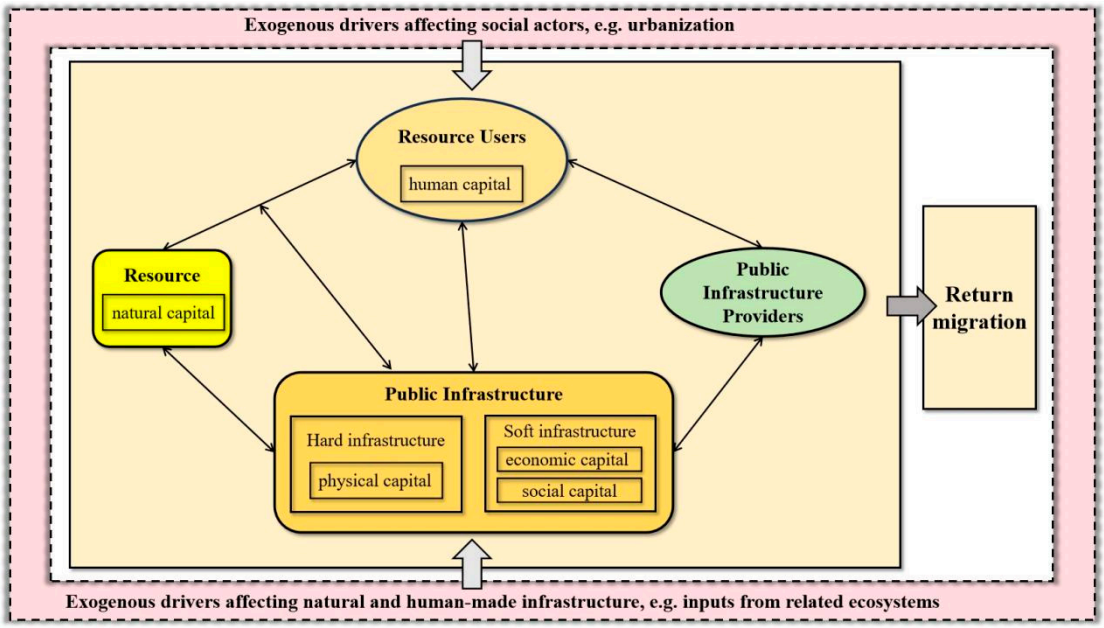


Figure 2. Theoretical framework diagram.

3. Data Sources and Methods

3.1. Data Sources

This paper's research is anchored in the Guangxi Zhuang Autonomous Region, situated in the southwest border of China, governing 14 prefecture-level cities, 70 counties, and 1118 townships. It is a coastal, border, and riverine ethnic minority autonomous region. Guangxi, in comparison to other provinces, has a later developmental onset, a weaker economic base, and is situated in the western region, making it one of China's less developed areas. Over the past two decades, Guangxi has emerged as a significant source of labor outflow, predominantly directed towards Guangdong and other eastern coastal regions. Statistics indicate that 9.22 million migrant workers emigrated from Guangxi in 2017 [43]. In the past five years, under the auspices of national agricultural support policies and the Western Development Strategy, there has been a marked enhancement in rural infrastructure and public services. Concurrently, the impact of the COVID-19 pandemic has led to a downturn in urban economies, resulting in a reduction in job opportunities. Consequently, a segment of labor that had previously migrated across provinces and regions has gradually returned to rural areas. Data indicate that in 2022, Guangxi's migrant worker population stood at 8.88 million, marking a reduction of 340,000 from 2017 levels and a 3.7% decrease over the five-year period [44].

This paper uses data from the "100 villages and 1000 households" questionnaire survey, conducted by 79 carefully recruited and trained investigators across 14 cities in Guangxi from September 2023 to February 2024. The questionnaire comprises two sections, namely a village-level questionnaire and a household-level questionnaire. The survey primarily assessed the basic conditions of villages and farmers, land use, infrastructure, digital technology application, rural tourism, natural disasters, social capital, rural governance, education, and environmental management over the past three years. To enhance the survey

samples' comprehensiveness and representativeness, this study adheres to a stratified sampling method, starting with city–county–township (town)–village–household selection, detailed as follows. The process commences with the selection of 14 cities in Guangxi, followed by the random selection of 1–2 counties from each city, 6–8 towns and townships from each county, 2–3 villages from each township, and 7–11 farmers from each village. Ultimately, a delegate from each village's "two committees" familiar with local affairs participates in the village-level survey, while a household member represents each home in the household-level survey. Finally, a total of 131 village-level samples and 988 household-level samples from 14 cities across the Guangxi region were selected as the subjects of this study. Figure 3 shows the distribution of villages studied in this paper.

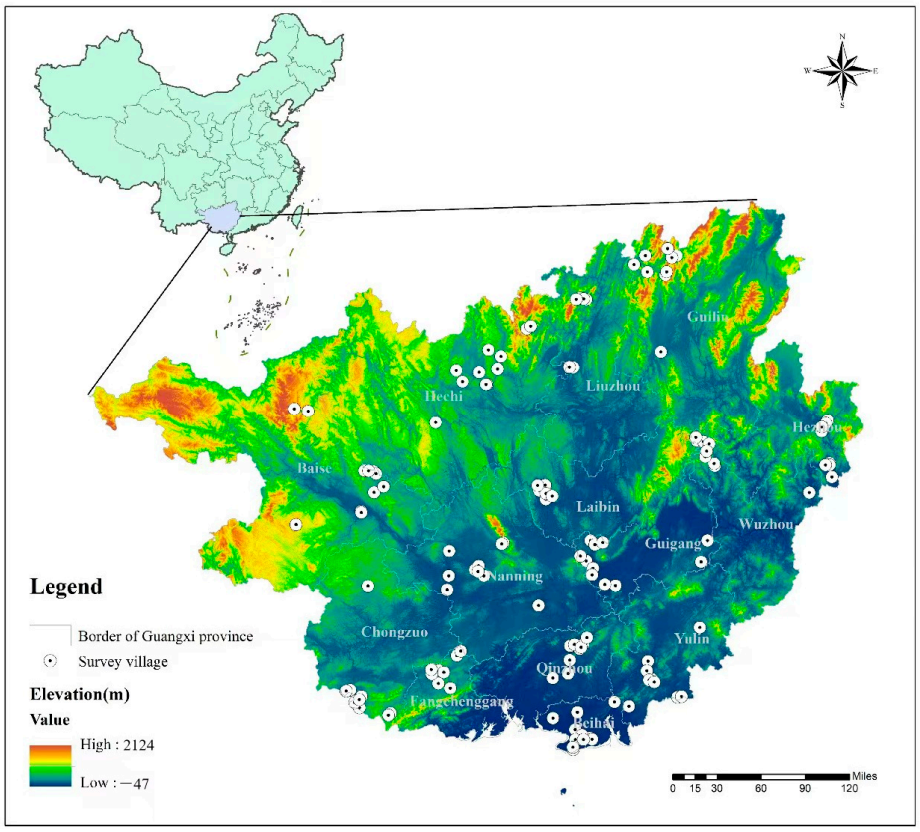


Figure 3. Research zoning map.

3.2. Variable Selection and Index System

To quantify rural return migration, this paper employs the ratio of returning labor to the total labor in the village since 2022 as an indicator. In this study, resources are principally assessed through natural capital, with specific indicators including the area of agricultural land and the sufficiency of water resources. Resource users are primarily reflected through the human capital of rural labor, with detailed indicators encompassing population density, demographic scale, educational attainment, and health status. Public infrastructure is measured through the village's social, economic, and physical capital, with specific indicators such as neighborhood relationships, cadre–mass relations, economic strength, collective economic income, number of clinics, and internet connectivity. The public infrastructure providers are characterized by attributes of the rural governance system, including the number of village committee members, the degree of recognition for the first secretary's work, and the role of the village council. Specific indicators are shown in Appendix A.1.

3.3. Methods and Models

3.3.1. Index System Construction

To deal with the multi-indicator variables that include both continuous and categorical data, this paper employed a scaling technique to normalize all indicators onto a uniform scale ranging from 0 to 1, ensuring the precision of the analysis. Specifically, based on the original score (X_j) for each indicator, we calculate the standardized score (Xj') through the normalization process. Subsequently, we determine the weight (W_j) of each indicator using the entropy method, which is based on the concept of information entropy; indicators with higher entropy have lower weights and vice versa. Finally, we calculate the comprehensive score of the variable (S) by multiplying the standardized score of each indicator with its weight and summing them. The formula is as follows:

$$S = \sum_{k=0}^{n} Xj'*W_j$$

where X_j denotes the original indicator score, Xj' represents the standardized score after normalization processing, and W_j signifies the weight of the indicator, ascertained through entropy measurement. This method helps ensure that the relative importance of different indicators in the comprehensive score is reasonably reflected and reduces the bias that may arise from different units of measurement of the indicators.

3.3.2. Variable Calibration

Adhering to the Fuzzy-set Qualitative Comparative Analysis (fsQCA) research protocols, this study utilizes FSQCA 3.0 software to transform raw data into fuzzy set membership scores. Referencing Fiss [45], this study establishes the calibration thresholds for full membership, crossover, and non-membership at 75%, 50%, and 25% of the case sample descriptive statistics, respectively. The calibration for non-high return migration rates is derived from the complement set of high return migration rates.

3.3.3. Application of NCA and fsQCA

Return migration decisions encompass considerations at the individual and familial levels and are influenced by an array of social and economic factors, which are interdependent and together constitute a complex combination of conditions affecting return migration. Traditional statistical techniques, which presuppose the independence of independent variables, unidirectional linear relationships, and symmetry of causality, are limited in their ability to capture the complexity of multiple factors interacting with one another. Such methods, which analyze the marginal "net effect" of independent variables on the dependent variable while controlling for other factors, do not sufficiently address the intricate causal relationships that arise from interdependencies among independent variables [46]. The configurational perspective and fsQCA embrace a holistic analytical approach, viewing the research subject as an amalgamation of various conditional variable combinations and uncovering the set relationships between these configurations and outcomes through set-theoretic analysis, effectively addressing causal complexity issues such as concurrent causality, causal asymmetry, and multiple causal pathways.

A necessary condition refers to a prerequisite for the occurrence of a specific outcome; without it, the corresponding result cannot materialize. Necessary Condition Analysis (NCA) focuses on analyzing factors that can produce or contribute to a particular outcome, which are crucial for organizational decision-making and often constitute the necessary conditions for the emergence of certain specific outcomes within an organization. Unlike the necessary condition tests in fsQCA, NCA not only establishes the categorical necessity but also the degree of necessity [47].

Consequently, this study employs the NCA method in conjunction with the fsQCA method to dissect the joint impact of the CIS framework and livelihood capitals on return migration from an integrated and systematic perspective. The CIS framework delineates the rural social ecosystem into its core subsystems, including resource, resource users, public infrastructure providers, and public infrastructure, whereas livelihood capitals encompass natural capital, economic capital, physical capital, human capital, and social capital. This study leverages the complementary strengths of NCA and fsQCA methods to identify the influence of various condition combinations on return migration and to uncover multiple concurrent causal relationships, thereby enhancing the scientific and comprehensive understanding of the underlying mechanisms of rural return migration.

3.3.4. Analysis of Necessary Conditions

During analysis, NCA can not only identify whether a certain antecedent condition is a necessary condition for a certain result but also calculate the effect size (d) and *p*-values of the antecedent condition by employing ceiling regression (CR) and ceiling envelopment (CE) techniques. Effect size refers to the minimum threshold of necessary conditions required to produce a specific result, with values ranging from 0 to 1. A value approaching 1 indicates a larger effect size, while a value less than 0.1 indicates a small effect size. Based on Dul et al. [48], necessary conditions are considered to have an effect size (d) greater than 0.1, and the Monte Carlo simulation displacement test indicates a significant effect ($p < 0.01$).

In Appendix A.2, the results of the NCA are reported, including the effect sizes obtained using two different estimation methods, CR and CE. In summary, although social capital ($p = 0.032$) is significant, its effect size is too small to be considered as a necessary condition for return migration rate. Additionally, the results of natural capital ($p = 1.0$), economic capital ($p = 1.0$), physical capital ($p = 1.0$), human capital ($p = 1.0$), and public infrastructure providers ($p = 1.0$) are not significant, indicating that they are not necessary conditions for return migration rate. This indicates that rural return migration behavior is influenced by a constellation of antecedent conditions, and relying on any single factor is insufficient to achieve a high return migration rate. Achieving the desired outcome requires a synergistic combination of natural capital, economic capital, physical capital, human capital, social capital, and public infrastructure providers.

In Appendix A.3, which presents the bottleneck levels, further reports on the results of the bottleneck analysis are provided. The term "bottleneck level" refers to the percentage level of the antecedent condition variables that must be met to achieve the maximum observed range level value (%) of the outcome variable, aiding in the understanding of the conditions under which the antecedent conditions exert the most critical impact on the outcome. As illustrated in Appendix A.3, to attain a 100% return migration rate, a 1% level of social capital is required, while no bottleneck levels are observed for the other five antecedent conditions.

This paper further employs the fsQCA method to test the necessary conditions. Within fsQCA, a condition with a consistency level exceeding 0.9 is deemed a necessary condition for the result variable [49]. As shown in Appendix A.4, the consistency levels for all antecedent conditions fall below 0.9. This result aligns with the NCA findings, implying that no individual rural socio-ecological environmental condition is sufficient on its own to drive a high return migration rate.

4. Results

4.1. Configuration Analysis

In this paper, fsQCA 3.0 software is utilized to investigate the influence mechanism of return migration rate. To mitigate the issue of paradoxical configurations, this paper

establishes the PRI consistency threshold at 0.7 [50], retains the RAW consistency threshold at the default value of 0.8 [45], and sets the case frequency value to 1 [51], ultimately yielding solutions of varying complexity. These solutions are categorized into three types, namely complex, intermediate, and simple. Upon comparing the intermediate and simple solutions, conditions present in both are deemed core conditions, while those unique to the intermediate solutions are considered edge conditions. Table 1 presents the condition configurations corresponding to the return migration.

Table 1. Configurations that achieve high and non-high return migration rate in fsQCA.

Antecedent Conditions	High Return Migration Rate				Non-High Return Migration Rate				
	H1	H2	H3	H4	S1	S2	S3	S4	S5
Natural capital	⊗	⊗	⊗	●	●		⊗	⊗	●
Economic capital	⊗	⊗	⊗	●	•	•	⊗	●	●
Physical capital	⊗	⊗	●	•	⊗	⊗	●	⊗	●
Human capital	⊗	●	●	●	⊗	⊗	⊗	●	●
Social capital	⊗	●	⊗	●	⊗	⊗	⊗	⊗	⊗
Public infrastructure providers	●	⊗	●	⊗		•	⊗	⊗	⊗
Consistency	0.851	0.840	0.864	0.858	0.859	0.883	0.834	0.839	0.813
Raw coverage	0.067	0.070	0.073	0.055	0.103	0.071	0.084	0.062	0.054
Unique coverage	0.039	0.039	0.038	0.030	0.039	0.004	0.054	0.034	0.029
Solution consistency	0.836				0.841				
Solution coverage	0.189				0.246				

Note: ● = core condition exists; ⊗ = core condition does not exist; • = marginal condition exists;⊗ = marginal condition does not exist; Blank = condition dispensable.

4.1.1. The Social–Ecological System Configurations Resulting in High Rural Return Migration Rate

As can be seen from Table 1, there are four distinct configurations of influence on the high rural return migration rate. Among the four configurations, the consistency levels for both individual and overall solutions exceed 0.8, satisfying the requirement of being no lower than 0.75, among which the individual solution consistency results are H3 (0.864) > H4 (0.858) > H1 (0.851) > H2 (0.840). The minor differences in consistency among all configurations suggest equivalence and substitutability among the four configurations in generating the expected results, with configuration H3 being the most effective path for achieving a high rural return migration rate. The consistency of the overall solution is 0.836, which suggests a robust explanatory strength for achieving a high rural return migration rate within the case set that satisfies the configural expression; the coverage of the overall solution is 0.189, indicating that the outcome of achieving a high rural return migration rate covers more than 18% of the case set.

Configuration H1 is dominated by public infrastructure providers. Configuration H1 shows that high rural return migration rate can be generated by using non-high physical capital, non-high human capital, non-high social capital, and high public infrastructure providers as core conditions, combined with non-high natural capital and non-high economic capital as marginal conditions. This suggests that the role of public infrastructure providers on rural return migration is more prominent compared to other conditions and can constitute a sufficient condition to explain the generation of results. When the level of public infrastructure providers is high, it can effectively break the constraints imposed by the insufficiency of natural capital, physical capital, economic capital, human capital and social capital, and promote the increase in rural return migration and resilience. The consistency of this configuration is 0.851, and the results of the coverage indicate that

this configuration is able to explain about 6.7% of the cases, of which about 3.9% can be explained by this configuration only.

Configuration H2 belongs to the two-wheel drive path of talent cultivation and social network. Configuration H2 suggests that a rural social–ecological environment with non-high physical capital, high human capital, high social capital and non-high public infrastructure providers as the core conditions, complementing non-high natural capital and non-high economic capital as the marginal conditions, can achieve the desired outcome of a high return migration rate. In villages deficient in physical, natural, and economic capital, and where public infrastructure providers are lacking, the same goal of high return migration rate can be achieved with sufficient human and social capital. This configuration has a consistency score of 0.84, and coverage results indicate that this configuration accounts for approximately 7% of the cases, of which about 3.9% are uniquely explained by this configuration.

Configuration H3 has the characteristics of multi-element integration drive. Configuration H3 demonstrates that high physical capital, high human capital, high public infrastructure providers, non-high economic capital and non-high social capital as the core conditions, and non-high natural capital as the marginal conditions, can effectively bolster the rural return migration rate. In this scenario, if the countryside possesses ample physical and human capital along with a robust level of public infrastructure providers, the return migration rate can be enhanced even in the absence of economic and social capital, thereby strengthening the resilience of rural development. The consistency of this configuration is 0.864, and the original and unique coverage are 0.073 and 0.038, respectively, indicating that this configuration is able to explain about 7.3% of the cases in the set of cases of realizing a high return migration rate in the countryside, and that about 3.8% of the cases can be explained by this pathway only. It has the highest original coverage, indicating that the generalizability is higher than the other three configurations, and that high levels of physical capital, human capital, and high-quality public infrastructure providers in the countryside can play a reinforcing role in generating high return migration rate.

Configuration H4 belongs to the collaborative drive of livelihood capitals. Configuration H4 indicates that high natural capital, high economic capital, high human capital, high social capital and non-high public infrastructure providers as the core conditions and complementary high physical capital as the marginal conditions can generate high labor return rate in the countryside. This path reveals that the synergistic alignment of rural natural capital, economic capital, physical capital, human capital, and social capital can overcome the constraints imposed by the low level of public infrastructure providers and enhance the return migration rate. The consistency of this configuration is 0.858, with the lowest original coverage of 0.055, suggesting that this configuration is able to explain about 5.5% of the cases in the set of cases that achieve a high return migration rate to the countryside, which is related to the difficulty of the countryside in meeting the high level of all the five major livelihood capitals. The unique coverage of this configuration is 0.03, indicating that about 3% of the cases can be explained by this path only.

4.1.2. The Social–Ecological System Configurations Resulting in Non-High Rural Return Migration Rate

This paper also tests the rural social–ecological environment that produces non-high rural return migration rate, and there are five configurations that produce non-high rural return migration rate. First, configuration S1 indicates that in a socio-ecological environment deficient in physical capital, human capital, and social capital, abundant natural capital and economic capital alone cannot ensure a high rural return migration rate. Second, configuration S2 shows that in a social–ecological environment lacking in physical capital, human capital, and social capital, the rural return migration rate will not be high even if

there is sufficient economic capital and high level of public infrastructure providers. Third, configuration S3 reveals that even with ample physical capital, a socio-ecological environment deficient across natural capital, economic capital, human capital, social capital, and public infrastructure providers will not achieve a high rural return migration rate. Fourth, configuration S4 shows that in a socio-ecological environment deficient in natural capital, physical capital, social capital, and public infrastructure providers, abundant economic capital and human capital alone are insufficient to ensure a high rural return migration rate. Finally, configuration S5 shows that in a socio-ecological environment deficient in social capital and public infrastructure providers, sufficient natural capital, economic capital, physical capital, and human capital are not enough to achieve a high rural return migration rate. In this paper, we find that configurations S1, S2, S3, S4, and S5 all indicate that in the absence of social capital, the result will be a non-high return migration rate, regardless of changes in other antecedent conditions.

Further, this paper conducts a robustness test of the antecedent grouping states for high return migration rates [52]. First, the number of cases threshold was raised from 1 to 2 to produce 2 groupings, and groupings H1′ and H3′ are true subsets of groupings H1 and H3 (Appendix A.5.). Second, the RAW consistency threshold is raised from 0.80 to 0.85, where the grouping state H1′ is identical to H1, and the grouping states H3′ and H4′ are true subsets of the grouping states H3 and H4 (Appendix A.6.). Finally, the PRI consistency threshold was increased from 0.70 to 0.74, where the histomorphic H1′ is fully consistent with H1, and the histomorphic H3′ and H4′ are true subsets of the histomorphic H3 and H4 (Appendix A.7.). The robustness test shows robust results.

5. Discussion

5.1. Longitudinal Comparison of High Return Migration Rate Configurations

5.1.1. High Return Migration Rate Configurations Dominated by Public Infrastructure Providers

Configuration H1 represents a pathway to a high return migration rate, markedly influenced by public infrastructure providers. The configuration indicates that the emergence of public infrastructure providers reduces the necessity for villages to amass the livelihood capitals, and the role of these providers, including the first secretary, village elders, councils, and cooperatives, can significantly enhance village attractiveness and promote the return of a large number of labor forces to their hometowns for development. Li et al. [53] assert that successful village development relies on the participation and coordination of village elites. The field survey also revealed that rural elites, as public infrastructure providers, can accurately align the development trends of rural areas with the needs of returning labor, leveraging their deep policy knowledge, robust organizational skills, and close ties with the community to achieve a convenient rural transportation network, comprehensive communication coverage, and modern living facilities through scientifically sound development plans and incentives. Through the implementation of well-crafted development plans and incentives, the government has fostered a convenient transportation network, comprehensive communication coverage, and modern living facilities in the countryside. These efforts significantly bolster rural transformation and development, effectively encouraging the return of skilled and high-caliber labor, thereby infusing the rural economy with renewed vitality and momentum.

Configuration H3, compared to H1, increases the demand for physical capital and social capital, demonstrating that the interplay of multiple elements can generate synergistic effects. With the premise of having public infrastructure providers, the support of physical capital and social capital makes it possible to broaden and deepen village development, enhancing the village's risk-bearing capacity for development. Our research team found in the investigation that investment in physical capital means more funds are available

for the development of village public infrastructure and industries. Concurrently, existing literature indicates that an abundance of social capital means that returning labor can not only have more resource support [54] but also increased employment and entrepreneurship opportunities [55]. Moreover, they can also quickly integrate into village life through social networks, reducing their concerns when making the choice to return and being willing to take root in rural areas for the long term [56].

5.1.2. High Return Migration Rate Configurations Dominated by Human Capital and Social Capital

Configuration H2 reflects that the synergy between human capital and social capital in villages can exert a strong attraction to out-migrating labor, achieving a high level of return migration. The role of the village committee and the implementation of skills training can make out-migrating labor realize the development potential of their hometown. A tight-knit social network and strong social support can provide emotional support and social resources for returning labor [57]. Under this synergistic effect, labor is willing to return to their hometown and can more smoothly integrate into the local society and realize their self-worth. For example, in terms of innovation and entrepreneurship, returning labor, in the context of abundant human capital accumulation in the village, can share their technology and knowledge with local villagers and also learn new technologies and knowledge from the villagers, achieving two-way communication and learning and inducing the emergence of innovative ideas [58]. Meanwhile, close interpersonal networks and an atmosphere of trust and mutual assistance within the village can greatly stimulate the entrepreneurial enthusiasm and creativity of returning talents [59,60], increasing the probability of entrepreneurial success [61].

5.1.3. Substitution Between Public Infrastructure Providers and Livelihood Capitals

Configuration H4 reflects the fact that under the given scenario of the lack of public infrastructure providers, for a village to achieve a high level of return migration, its natural, economic, physical, human, and social capital must all be abundant. The research team found that ample physical capital meets the villagers' daily production and living needs, while robust human capital fosters talent and energizes village development. The existing literature indicates that sufficient economic capital promotes the diversification of village industries, offering villagers a multitude of employment opportunities and higher income levels [62]. Thus, only with all five capitals at a high level can a village compensate for the absence of public infrastructure providers and exert a strong pull for labor to return to rural areas.

Comparison reveals a mutual substitution between configuration H1, led by public infrastructure providers, and configuration H4, led by livelihood capitals, in the pathways to foster high levels of return migration. In rural areas where public infrastructure providers are lacking, the government can bolster livelihood capitals through various means to complement and replace, including enhancing vocational skills training for labor, improving public services like education and healthcare, and offering entrepreneurial support. Conversely, when all livelihood capitals are insufficient in the countryside, efforts to attract public infrastructure providers or enhance the capabilities of existing ones become crucial for enticing labor back to rural areas. In this context, the government must actively attract external capital for rural infrastructure development through financial incentives and tax relief, while also expanding avenues to channel talent into rural areas and encouraging local talent to return to their roots post-education, thereby fueling rural revitalization.

5.2. Lateral Comparison of High Return Migration Rate Configurations

5.2.1. Natural Capital Is Not a Key Condition for Realizing a High Level of Return Migration

Natural capital, as a valuable resource endowed by nature, is widely seen as a key factor in attracting return migration [63]. Contrary to prevailing views, the configurational results of this paper show that natural capital is not the core element driving a high level of return migration. The abundance of natural capital, while providing the necessary conditions for rural development, does not consistently invigorate rural areas or foster return migration [64]. In other words, return migration from urban to rural areas transcends constraints of specific regional locations and geographical features. Therefore, in formulating policies aimed at promoting return migration and rural development, the government should not tailor policies to individual villages based solely on natural and geographical disparities. Instead, policies should prioritize enhancing the overall attractiveness of villages, including, but not limited to, improving infrastructure, optimizing public services, promoting industrial upgrading, protecting the ecological environment, and strengthening village cohesion.

5.2.2. Economic Capital Is Likewise Not a Key Condition for Achieving a High Level of Return Migration

Economic capital usually plays an important role in driving village economic development and promoting villagers' employment [65]; however, it is not a key condition for achieving a high level of return migration. The configuration results reveal villages with high return migration rate even amidst suboptimal economic capital, challenging the traditional view of economic capital as the primary driver of return migration. This insight suggests a novel approach for policymakers, indicating that in pursuing effective strategies to promote return migration, it is not mandatory to rely on large-scale economic capital inputs; instead, they should explore support policies that are lower in cost, higher in efficiency, and more targeted. Consequently, the government and society can focus on enhancing the employment environment, elevating public service standards, bolstering vocational training, adopting flexible work arrangements, and offering entrepreneurial assistance and tax relief, thereby increasing the local area's attractiveness to labor, reducing financial strain, and fostering sustainable economic and social development.

5.2.3. Human Capital as a Key Condition for Achieving a High Level of Return Migration

Human capital, encompassing the labor composition, health status, skill proficiency, and other factors in rural areas, is an indispensable and key condition for realizing a high level of rural return migration. In the context of the in-depth implementation of the rural revitalization strategy, the rural economy and social progress are increasingly reliant on high-quality labor [66]. Enhancing human capital not only bolsters the market competitiveness and employment quality of rural labor, improving their income levels [67,68] but also ensures a robust talent pool for industrial upgrading, technological innovation, and social governance in rural areas [69]. Therefore, to realize a high level of rural return migration, investing in and nurturing human capital must be prioritized. Achieving this goal requires a concerted effort from the government, society, and enterprises to continuously enhance the comprehensive quality and employability of the rural labor through measures such as strengthening rural education, vocational training, talent introduction, and support for innovation and entrepreneurship. It is equally important to develop and refine incentive mechanisms and support systems for rural talents, ensuring stable expectations and guarantees for return migration.

5.3. Low-Level Return Migration Configurations Analysis

The occurrence of low-level return migration in rural areas, which refers to the lack of sufficient scale, quality, and sustained support for labor mobility from urban to rural areas, will make the positive process of return migration, which should promote rural development, exceptionally fragile. This fragility could result in a shortfall of returning labor, failing to meet the basic needs of rural economic development and impacting the efficiency of agricultural production and the overall vitality of villages. It could also result in a dearth of labor skills among the existing rural labor, hindering the effective promotion of rural industrial upgrading and transformation, and limiting the diversification of rural economic development. Furthermore, the instability and uncertainty of return migration could lead to a reversal at any time, causing villages to confront the dilemma of renewed population loss and forfeiting the support and impetus provided by returning residents in societal, economic, and cultural realms. This section aims to elucidate the factors rendering return migration vulnerable, drawing on the findings from the low-level return migration configurations analysis.

5.3.1. The Decline of Social Capital

Table 1 clearly shows that all five low-level return migration configurations contain suboptimal social capital, underscoring the importance of social capital for villages in attracting labor back to rural areas and bolstering resilience to external shocks [70]. Furthermore, the bottleneck level table indicates that social capital is the primary bottleneck for achieving high rural return migration rate, acting as a constraint that prevents the return migration effect from reaching its optimal state (i.e., achieving a 100% return rate). A decay of social capital, characterized by alienation of interpersonal relationships, lack of trust, decline of village cohesion, and dilution of common values, directly diminishes the village's attractiveness to labor, resulting in a diminished incentive for return migration. Specifically, laborers may face a lack of adequate support networks and struggle to secure necessary development support and resources due to alienated interpersonal relationships; concurrently, eroding village cohesion can undermine residents' confidence in the village's future development, prompting further out-migration of labor.

5.3.2. Loss of Public Infrastructure Providers

It can be derived from Table 1 that three low-level return migration configurations all include the absence of public infrastructure providers, reflecting that public infrastructure providers play a crucial role in attracting labor return to rural areas and enhancing rural developmental resilience. When the capacity of rural public infrastructure providers is limited or there is a significant loss of such providers, the village's ability to retain and attract labor will be greatly diminished. This is specifically manifested in the inability of public infrastructure providers to provide villages with timely and effective infrastructure and high-quality public services, which greatly reduces the livability and attractiveness of the village, causing potential returning labor to be deterred, and making it difficult to prevent the outflow of current residents. Therefore, enhancing the professional level and service quality of rural public infrastructure providers has an undeniable strategic significance for promoting the effective return migration and strengthening the village's capacity for sustainable development.

5.3.3. Inputs of Economic Capital Cannot Reverse the Trend of Return Migration Towards Vulnerability

The investment in economic capital, while considered an important factor in promoting regional development to some extent [71], is not a panacea [72], especially when facing the complex and variable patterns of return migration. Upon in-depth analysis of the

configuration results, it is not difficult to find that relying solely on the injection of economic capital cannot fundamentally reverse the overall trend of return migration becoming fragile. Some villages, even with a high accumulation of economic capital, such as having strong economic strength, higher per capita net income, more investment opportunities, or receiving certain external financial support, still face the dilemma of a non-high return migration rate. The reasons behind this are diverse, possibly due to the slow progress of these villages in providing employment opportunities, improving living conditions, and enhancing the level of public services, failing to effectively attract out-migrating labor to return to rural areas.

5.3.4. A Single Input of Physical Capital Does Not Create a Stable Trend of Return Migration

From configuration S3, it can be concluded that an emphasis on physical capital alone, while it may stimulate economic growth and increase employment opportunities in the short term, fails to establish a stable trend of return migration in the long term. Return migration is a complex process influenced by a multitude of factors, including but not limited to economic development, industrial structure, educational resources, social security systems, and living environments. Focusing exclusively on physical capital inputs, such as infrastructure development and the introduction of big data and the Internet of Things into rural areas, while overlooking the need to enhance labor quality, refine employment environment, and safeguard labor rights and interests, makes it challenging to consistently attract and retain rural labor, particularly high-skilled talent.

6. Conclusions, Implications, and Limitations

By coupling the CIS framework with the sustainable livelihoods framework, and employing NCA and fsQCA methods, this paper offers an in-depth discussion on the impact of rural social–ecological systems on return migration and pinpoints key condition combinations affecting return migration, based on village-level data from 14 cities in Guangxi, China. It is found that return migration is a complex phenomenon involving multiple factors and pathways, and no single condition within the rural social–ecological system is solely sufficient to determine return migration. To elaborate, this paper identifies four configurations, all of which can effectively promote return migration, albeit with varying degrees of importance and mechanisms of action. First, a robust presence of public infrastructure providers is essential and sufficient for driving return migration, with a substitutable relationship existing between them and livelihood capitals. Second, adequate human capital and social capital are pivotal factors influencing return migration, underscoring the significance of the membership structure and collective atmosphere within rural society for fostering population mobility and redistribution. Once again, natural capital and economic capital are not the key conditions for promoting rural development and realizing high-level return migration. Finally, based on the five configurations of non-high return migration rate, it is found that the causes of low-level return migration are mainly the decay of social capital, the loss of public infrastructure providers, and the over-emphasis on the single input of economic capital or physical capital.

The existing literature on the drivers of return migration is mainly from a single perspective, such as emphasizing economic-related reasons [73], land-related reasons [74], and so on. In contrast, by combining the CIS framework and the sustainable livelihoods framework, this paper explores the role of the five major livelihood capitals and public infrastructure providers in influencing return migration from the perspective of rural resilience, providing a more systematic and comprehensive analytical framework for understanding the return migration process.

There are two main views in the existing research on the factors affecting the return of outgoing laborers. One view suggests that events such as economic downturns and epidemics lead to a reduction in urban employment opportunities [75] and that it becomes difficult for the outgoing laborers to earn a living in the city. Another view suggests that the rising urban cost of living is the main factor. The high cost of living has gradually increased the pressure on outgoing laborers to survive in cities, so more and more outgoing laborers return to work in counties or townships [76]. It can be seen that most of the existing studies approach the issue of return migration from the perspective of external factors in the countryside, while few of them have systematically explored whether or how the developmental changes within the countryside can promote the return migration. In this paper, we discuss the relationship between the interactions between the internal elements of the rural social–ecological system and the choice of return migration and provide a new explanation for the promotion of return migration from the perspective of mobilizing the internal mechanisms of the rural social–ecological system.

The existing research mostly reflects the single-factor and single-effect nature of rural resilience [77,78], and there is limited research on the systematic strategies that need to be adopted to enhance rural resilience to withstand external shocks. From the perspective of social–ecological systems, this paper identifies four sets of condition combinations that enhance rural resilience through systematic pathways to promote return migration and summarizes the pathways and modes of systematic enhancement of rural resilience.

The five major capitals of rural social–ecological systems and public infrastructure providers play an indispensable role in promoting the return migration and enhancing the resilience of the countryside. Based on the above conclusions, we give the following recommendations for rural development. First, strengthen the public leadership of rural cadres by combining internal and external factors. On the one hand, it is to improve the business level of the existing providers, namely village cadres. As village cadres are of great significance to rural development, more efforts should be made to train them so that they can have the advantages of deep policy understanding, strong organizational and coordinating ability, and close contact with the public. On the other hand, it is the introduction of high-level providers: it is necessary to broaden the channels for attracting talents to villages, attract local talents to return to their hometowns, strengthen the investment guarantee for talent revitalization, and promote the return of talents. Second, increase investment in rural public infrastructure construction. On the one hand, it is to strengthen infrastructure construction, focusing on roads, water supply, logistics and the rural living environment, and accelerate making up for shortcomings and weaknesses in development. On the other hand, it is to improve the supporting public service facilities in the countryside on the basis of the existing facilities and raise the level of public services. Thirdly, human capital and social capital should become more important directions in future policy making, and the government should emphasize the enhancement of human capital and the cultivation of social capital. On the one hand, through strengthening rural education, vocational training and talent introduction and other measures, it should improve the comprehensive quality and employability of the rural labor and enhance the endogenous power of rural development. On the other hand, it is to focus on building a harmonious rural social relationship network, enhance rural cohesion and sense of belonging, and provide stable social support for the return migration. Fourth, optimize employment services by combining soft and hard skills. On the one hand, villages should provide efficient and convenient job-seeking services for returning villagers, offering one-stop services such as employment policy consultation and job information query through the combination of offline service sites and online digital service platforms. On the other hand, to provide rural vocational education and training that, as much as possible, meets the needs of villagers,

with on-site teaching, and to cultivate a group of high-quality rural talents who are skilled in technology, good management, and capable of handling the task. Fifth, strengthen the policy protection for the returning masses. On the one hand, safeguard the rights and interests of the masses in labor protection, ensuring their labor remuneration and other rights and interests are protected in accordance with the law. On the other hand, strengthen the medical protection for the returning masses, improve and perfect the rural medical and healthcare system, and ensure that the returning masses receive basic, safe, convenient, and affordable medical and healthcare services that reflect social equity and are in line with economic and social development.

Although this study has yielded significant findings in exploring the relationship between rural development and return migration, there are still some shortcomings. On the one hand, the study's sample, comprising 132 villages across 14 municipalities in Guangxi, is constrained by a limited number of villages per municipality and an overall small sample size, which may limit the general applicability and extrapolation of the study's conclusions. Future research should aim to expand the sample size and geographical scope and consider comparative analyses across various regions to assess the influence of the characteristics of social–ecological systems in various regions and villages on return migration. On the other hand, further studies must clarify the existence of different rural return migrations, which affect the role of the different capitals. This requires future research to further develop richer analytical means to deepen the conclusions of this paper.

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Appendix A.

Appendix A.1. Construction of Variables and Index System

CIS Framework	Livelihood Capitals	Specific Indicators
Resource	Natural capital	Landform
		Characteristic natural resources
		Water availability
		Cultivated area
		Fragmentation of cultivated land
		Forest area
		Soil fertility
Resource Users	Human capital	Proportion of population under 12 and over 60
		Labor proportion
		Labor structure
		Role of village committee
		Number of skills training sessions conducted
		Have a secondary vocational school

CIS Framework	Livelihood Capitals	Specific Indicators
Public Infrastructure	Physical capital	Whether there is an e-commerce point of sale or service
		Number of households with broadband network installed
		Cultivated land transfer quantity
		Diversity of public space
		Number of supermarkets or small shops
		Frequency of use of agricultural machinery
		Number of clinics
		Whether it is equipped with suitable aging facilities
	Economic capital	Hierarchy of economic power
		Per capita net income
		Collective economic income
		Contact frequency with enterprises or market entities outside the village
		Characteristic industry type
		Average price of land transfer
		Whether it is located on the outskirts of the city
	Social capital	Neighborhood relationship
		Relationship between cadres and masses
		Frequency of contact with other villages
		Number of inspections by superior leaders
		Frequency of cultural and sports activities
Public infrastructure providers	—	Number of village committee members
		First secretary job recognition
		Role of villagers' council
		Number of economically active cooperatives
		Frequency of obtaining higher government policy or financial support in the past three years
		Whether there are university graduates among the officers and cadres of public organizations
		Party membership

Appendix A.2. Results of the Analysis of the Necessary Conditions for the NCA Method

Antecedent Condition [a]	Method	Precision	Ceiling Zone	Scope	Effect Size (d) [b]	*p*-Value
Natural capital	CR	100%	0.000	0.99	0.000	1.000
	CE	100%	0.000	0.99	0.000	1.000
Economic capital	CR	100%	0.000	0.99	0.000	1.000
	CE	100%	0.000	0.99	0.000	1.000
Physical capital	CR	100%	0.000	0.99	0.000	1.000
	CE	100%	0.000	0.99	0.000	1.000
Human capital	CR	100%	0.000	0.99	0.000	1.000
	CE	100%	0.000	0.99	0.000	1.000
Social capital	CR	100%	0.000	0.99	0.000	0.032
	CE	100%	0.000	0.99	0.000	0.032
Public infrastructure providers	CR	100%	0.000	0.99	0.000	1.000
	CE	100%	0.000	0.99	0.000	1.000

Note: a. Calibrated fuzzy set affiliation value. b. $0.0 \leq d < 0.1$: "small effect"; $0.1 \leq d < 0.3$: "medium effect"; $0.3 \leq d < 0.5$: "large effect"; $0.5 \leq d$: "very large effect".

Appendix A.3. NCA Method Bottleneck Level (%) Analysis Results [a]

Returning Activity	Natural Capital	Economic Capital	Physical Capital	Human Capital	Social Capital	Public Infrastructure Providers
0	NN	NN	NN	NN	NN	NN
10	NN	NN	NN	NN	NN	NN
20	NN	NN	NN	NN	NN	NN
30	NN	NN	NN	NN	NN	NN
40	NN	NN	NN	NN	NN	NN
50	NN	NN	NN	NN	NN	NN
60	NN	NN	NN	NN	NN	NN
70	NN	NN	NN	NN	NN	NN
80	NN	NN	NN	NN	NN	NN
90	NN	NN	NN	NN	NN	NN
100	NN	NN	NN	NN	1.0	NN

Note: NN = not necessary.

Appendix A.4. Necessity Test for Individual Conditions of the QCA Method

Antecedent Variables	Outcome Variables	
	High Return Migration Rate	Non-High Return Migration Rate
Natural capital	0.512	0.568
~Natural capital	0.587	0.526
Economic capital	0.517	0.573
~Economic capital	0.577	0.517
Physical capital	0.545	0.531
~Physical capital	0.529	0.539
Human capital	0.553	0.537
~Human capital	0.553	0.564
Social capital	0.574	0.492
~Social capital	0.505	0.583
Public infrastructure providers	0.589	0.503
~Public infrastructure providers	0.508	0.590

Note: "~" means logic negation (i.e., non-high).

Appendix A.5. Robustness Tests for Increasing Frequency Thresholds

Antecedent Condition	High Return Migration Rate (The Frequency Threshold Is 1)				High Return Migration Rate (The Frequency Threshold Is 2)	
	H1	H2	H3	H4	H1′	H3′
Natural capital	⊗	⊗	⊗	●	⊗	⊗
Economic capital	⊗	⊗	⊗	●	⊗	⊗
Physical capital	⊗	⊗	●	●	⊗	●
Human capital	⊗	●	●	●	⊗	•
Social capital	⊗	●	⊗	●	⊗	⊗
Public infrastructure providers	●	⊗	●	⊗	●	●
Consistency	0.851	0.840	0.864	0.858	0.851	0.864
Raw coverage	0.067	0.070	0.073	0.055	0.067	0.073
Unique coverage	0.039	0.039	0.038	0.030	0.042	0.049
Solution consistency	0.836				0.849	
Solution coverage	0.189				0.116	

Note: ● = core condition exists; ⊗ = core condition does not exist; • = marginal condition exists; ⊗ = marginal condition does not exist.

Appendix A.6. Robustness Tests for Increasing RAW Consistency Thresholds

Antecedent Condition	High Return Migration Rate (The RAW Consistency is 0.80)				High Return Migration Rate (The RAW Consistency is Increased to 0.85)		
	H1	**H2**	**H3**	**H4**	**H1′**	**H3′**	**H4′**
Natural capital	⊗	⊗	⊗	●	⊗	⊗	●
Economic capital	⊗	⊗	⊗	●	⊗	⊗	●
Physical capital	⊗	⊗	●	●	⊗	●	•
Human capital	⊗	●	●	●	⊗	●	●
Social capital	⊗	●	⊗	●	⊗	⊗	●
Public infrastructure providers	●	⊗	●	⊗	●	●	⊗
consistency	0.851	0.840	0.864	0.858	0.851	0.864	0.858
raw coverage	0.067	0.070	0.073	0.055	0.067	0.073	0.055
unique coverage	0.039	0.039	0.038	0.030	0.042	0.040	0.035
solution consistency			0.836			0.851	
solution coverage			0.189			0.150	

Note: ● = core condition exists; ⊗ = core condition does not exist; • = marginal condition exists; ⊗ = marginal condition does not exist.

Appendix A.7. Robustness Tests for Increasing PRI Consistency Thresholds

Antecedent Condition	High Return Migration Rate (The PRI Consistency Is 0.70)				High Return Migration Rate (The PRI Consistency Is Increased to 0.74)		
	H1	**H2**	**H3**	**H4**	**H1′**	**H3′**	**H4′**
Natural capital	⊗	⊗	⊗	●	⊗	⊗	●
Economic capital	⊗	⊗	⊗	●	⊗	⊗	●
Physical capital	⊗	⊗	●	●	⊗	●	•
Human capital	⊗	●	●	●	⊗	●	●
Social capital	⊗	●	⊗	●	⊗	⊗	●
Public infrastructure providers	●	⊗	●	⊗	●	●	⊗
Consistency	0.851	0.840	0.864	0.858	0.851	0.864	0.858
Raw coverage	0.067	0.070	0.073	0.055	0.067	0.073	0.055
Unique coverage	0.039	0.039	0.038	0.030	0.042	0.040	0.035
Solution consistency			0.836			0.851	
Solution coverage			0.189			0.150	

Note: ● = core condition exists; ⊗ = core condition does not exist; • = marginal condition exists; ⊗ = marginal condition does not exist.

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