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Measurements and Influencing Factors of New Rural Collective Economies' Resilience toward Mountain Disasters in Indigent Areas: A Case Study of Liangshan Yi Autonomous Prefecture, China

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Abstract: Economic activities in disaster-prone areas are significantly susceptible to mountain disasters, and enhancing the resilience of new rural collective economies (RRCEs) is a pressing challenge that needs to be overcome in the areas of disaster risk management and sustainable development. The target research area comprises 48 representative villages in Liangshan Yi Autonomous Prefecture (LP). An assessment framework based on the Resilience Index Measurement Analysis (RIMA) model is established to evaluate the RRCEs in the face of mountain disasters, and the influencing factors regarding the RRCEs are examined. The results show that (1) typical villages in the new rural collective economies (NRCE) have a low level of resilience. (2) Transformational capacity is the key to improving RRCEs. (3) Off-farm villages exhibit the highest level of collective economic resilience, followed by diversified villages, while the lowest resilience level is observed in purely agricultural villages. (4) Talent security and institutional security are important for achieving a high level of resilience. Both of these factors significantly influence RRCEs. (5) The combined influence of talent, financical, institutional, technological, and business security contributes to the diverse factors that shape RRCEs. In other words, the path to achieving resilience in the new rural collective economies is characterized by multiple routes that lead to a common goal. Building on this, we propose recommendations in five key areas, namely, encouraging scientific research and innovation, improving disaster insurance coverage, strengthening the emergency protection system, facilitating collective economic development, and selecting suitable strategies to enhance resilience based on local conditions. The aim is to offer valuable insights for disaster-prone areas to enhance RRCEs and realize sustainable development and rural revitalization.

Keywords: new rural collective economies (NRCE); rural revitalization; mountain disasters; resilience; Resilience Index Measurement Analysis (RIMA)

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1. Introduction

Due to climate change, there has been a rise in mountain disasters for mountainous areas, including flash floods, mudslides, landslides, and avalanches [1]. Mountainous areas comprise approximately 20% of the total global land area, with China alone accounting for approximately two-thirds of this area, leading to a significant exposure to mountain disasters [2]. Mountain disasters pose a multifaceted threat, as they are capable of washing away towns and rural settlements, which can result in casualties and economic losses. Such disasters can also block critical infrastructure such as highways, bridges, and power systems [3]. Additionally, these disasters cause sedimentation in natural resources, such as arable lands and forests, reroute rivers, and cause ecological damage, thereby hindering

the high-speed and sustainable development of rural economies in mountainous areas [4]. This phenomenon besets resource-rich mountainous regions with topographic challenges and economic setbacks, exacerbating the issue of rural residents falling into poverty or returning to poverty as a result of these disasters [5].

Resilience, as a nonengineered approach in disaster management, has gained prominence in recent years [6,7]. Originating from the field of ecology, resilience refers to the capacity of a system to restore equilibrium after a disturbance [8]. With rural areas worldwide facing economic uncertainty and ecological crises that pose significant threats to the livelihoods and sustainable development of rural residents, there has been a growing emphasis on rural revitalization and increased attention toward rural resilience [9,10], which has been employed to analyze the coping capacities and strategies of rural households following the financial crisis [11], the sustainability of farmers' livelihoods [12], the stability of family farm operations [13], and the capacity for sustainable rural development [14]. Several studies have identified the factors influencing rural resilience, including the sense of responsibility and belonging among villagers [9,15], land ownership [16], and the level of digital network infrastructure [17]. Natural disasters such as floods, earthquakes, and mudslides that surpass rural resilience thresholds within a short period can also severely damage rural infrastructure, economies, and human security [18,19].

Maintaining the dynamism of rural economic development is essential to increasing rural resilience and promoting sustainable rural development [20]. The focus of rural economic development varies according to the global stage of social and economic development [21]. In developed countries, the rural economy is dominated by commodity-based agricultural production [22]. The promotion of integrated rural development is one of the primary objectives of the EU Common Agricultural Policy (CAP) [23]. In developing countries, rural economies are predominantly characterized by smallholder economies. Nevertheless, the structure of the rural economy in these countries is undergoing significant transformations due to industrialization, urbanization, globalization, a gradual shift away from agriculture by farmers [24], and the progressive mechanization of agricultural production. Based on the experience of developed countries, bottom-up initiatives, such as rural revitalization, can assist rural economies in maintaining dynamism, adapting to change, and achieving sustainable development [25].

The rural collective economy is a unique economic form under the socialist system of public ownership [26] and has transitioned from primary cooperatives to advanced cooperatives, from people's communes to a two-tier management system, and from adapting to market-oriented reforms to exploring diverse approaches for economic realization. This evolution is further emphasized in the No. 1 central document for 2023, which calls for the exploration of various avenues for developing the new rural collective economies (NRCE) that includes resource contracting, property renting, intermediary services, and participations in asset shareholding. New rural collective economies are forms of rural public economic systems that are based on rural collective economic organizations. They encompass collective assets allocated to collective members, a robust internal governance structure, economic strength, and governance efficiency. Their scope includes the collective economies inherited from the people's commune system, along with new forms of the collective economy, such as farmers' professional cooperative economies, joint-stock cooperative economies, and the economic associations that have emerged in the new era [27]. As NRCEs develop under the leadership of township party committees and grassroots party organizations, human factors are being incorporated into the management of the collective economies. This emphasizes the comprehensive development of spatial and ecological resources, the equitable sharing of benefits generated through systematic development among village members, and the promotion of increased wealth and income for the general rural population. Consequently, NRCEs play a significant role in consolidating and expanding the achievements obtained in regard to poverty alleviation and ensuring the common prosperity of all people at the present stage [28].

Numerous studies have been conducted to explore the factors, paths, and models of the new rural collective economic development. Li et al. created an integrated framework that linked urban-rural development and rural economic resilience and highlighted the fact that continuous investments in infrastructure, public services, and industries can enhance the resilience of rural economies [29]. Cui et al. examined 338 impoverished villages and discovered that China's precise poverty alleviation policy succeeded in stimulating endogenous development in rural areas. This policy improved production factors, optimized economic structures, enriched functional roles, and significantly enhanced the level of rural economic resilience [30]. Natural disasters can damage crops, farmland water conservancy projects, and infrastructure in disaster-prone areas. This damage adversely affects the transportation of agricultural materials and the sale of agricultural products, thus posing a significant threat to the development of the rural collective economies. Furthermore, the development of the rural collective economy is constrained by various factors. These include natural factors such as unfavorable geographic locations, inadequate transportation conditions [31], and limited natural resources [32]. Additionally, social factors, such as the long-standing two-tier management system that emphasizes division over unification [33], low human quality for management and innovation [28], and a weak awareness of collective action among members, and economic factors, such as excessive collective debt [34] and the lack of a political and economic separation between rural collective economic organizations and village committees [35], have limited the development of the rural collective economies. Different scholars have proposed various models based on different classifications. For instance, Gao et al. categorized models into operating, joint venture, leasing, service, and party-building models based on their respective modes of operation [26]. A systematic review of the existing studies both at home and abroad reveals that few scholars have considered the resilience of new rural collective economies (RRCEs), particularly in the context of mountainous areas that are prone to natural disasters. Given the significant impact of the stable development of NRCEs on both the national economy and on people's livelihoods, there is a need to address the quantitative evaluation and spatial differentiation research that regards its resilience.

Liangshan Yi Autonomous Prefecture (LP), which is located in China, is known for its high levels of poverty. While significant progress has been made in poverty eradication, consolidating these achievements and preventing the resurgence of widespread poverty remains critical. Recognizing its significance in facilitating the stable transition of impoverished villages, the local government places great emphasis on the development of village-level collective economies as a key measure for uplifting communities and assisting individuals in escaping poverty. LP is susceptible to frequent mountain disasters and has a limited community disaster defense capacity. Mountain disasters pose significant environmental constraints on poverty-reduction efforts, increase the risk of people falling back into poverty, and hinder the development of the rural collective economies. Building upon these circumstances, LP is used as a case study, and the region's specific conditions are incorporated in the analysis. This serves to enhance the existing Resilience Index Measurement Analysis (RIMA) model that was developed by the Food and Agriculture Organization of the United Nations (FAO) [36–38], which we use to analyze RRCEs in coping with mountain disasters. In this study, the characteristics of its subdimensions are further examined as well as the factors influencing RRCEs. Furthermore, this study can serve as a valuable case study for informing the economic development strategies of other rural communities worldwide that are prone to natural disasters. This paper is aimed at making the following potential contributions: (1) An analytical framework is established to evaluate RRCEs in poverty-eradication areas under the coercive impact of mountain disasters. (2) Recommendations are provided to enhance RRCEs by addressing the existing challenges they face in coping with mountain disasters. These insights can serve as a valuable reference for promoting sustainable economic development in rural communities, both within China and globally.

2. Methodology and Data Sources

2.1. Overview of the Study Area

LP is located in the southwestern part of Sichuan Province, and it serves as a transition zone between the Sichuan Basin and the Yunnan–Guizhou Plateau as well as the Qinghai–Tibetan Plateau. It spans from 26°02′–29°18′ N, 100°03′–103°52′ E. The topography steadily descends from northeast to southwest, featuring a maximum elevation of 5904 m and a minimum elevation of 310 m, resulting in a substantial height difference of 5594 m (Figure 1). The region is situated in the Western Rift Valley of Panxi, which is characterized by complex geological formations and an exceptional climate that renders its natural environment highly fragile [39]. The area undergoes frequent occurrences of mountain disasters, including flash floods, mudslides, and landslides [40]. LP encompasses 17 counties and cities in its jurisdiction, covering an area of 60,423 square kilometers. The region is rich in labour resources, providing sufficient human capital for the development of NRCEs, and is home to a resident population of 4,858,400 individuals. It is characterized by the presence of 14 hereditary ethnic groups, including Han, Yi, Tibetan, Mongolian, and Naxi. LP is renowned as China's largest Yi settlement, with a Yi household population of 2,936,500 as of the end of 2021, constituting of 54.56% of the total household population.

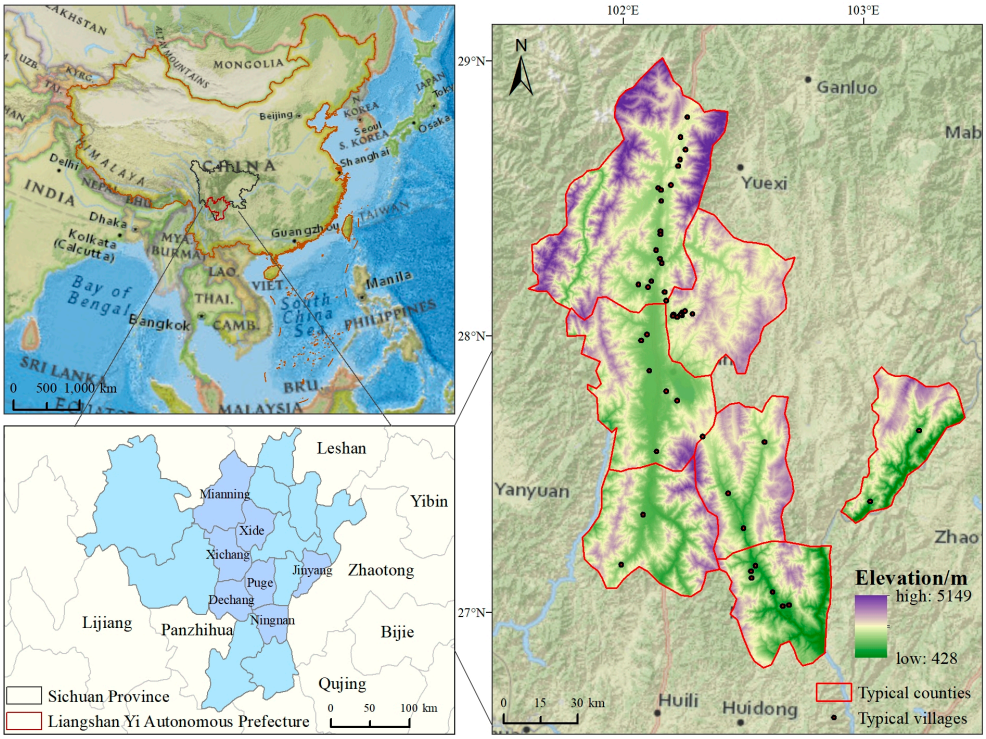

Figure 1. Geographic location of the study area.

2.2. Data Sources

Combined with the recommendation of local government departments, after several on-site surveys and a comprehensive consideration of the disaster characteristics, topography and geomorphology, the population density, socioeconomic development and farmers' income levels of each area, and seven counties and cities, namely, Mianning, Xichang, Xide, Dechang, Jinyang, Puge, and Ningnan, were selected for inclusion in this study as typical counties and cities of the region, and the basic information of each county and city is shown in Table 1. Typical counties and cities were selected on the basis of (1) strong mountain disaster interferences. Most of the mountain disasters in LP occur on the banks of river valleys and are distributed along the water system network. (2) The level of socio-economic development has a gradient. Jinyang County, Xide County, and Puge County are the key counties for national rural revitalization, with strong policy inclinations, while Mianning

County, Xichang City, Dechang County, and Ningnan County belong to the Anning River Basin, which is an important growth pole for economic development in LP. The basic principles followed in the selection of typical villages are the following: (1) there have been mountain disasters or there are hidden spots of mountain disasters and (2) NRCEs have different stages of development.

The survey process used the participatory rural appraisal (PRA) method to conduct one-on-one interviews with 51 local village leaders, and each questionnaire took approximately two hours. The content of the interviews included the basic situation of the administrative village, the development of the rural collective economies, and the level of the disaster's threat or loss. Finally, 48 valid questionnaires were obtained. The geographic information data came from the National Science and Technology Infrastructure Platform, the National Earth System Science Data Center (http://www.geodata.cn, accessed on 10 April 2023), and the Geospatial Data Cloud (http://www.gscloud.cn, accessed on 10 April 2023). The socio-economic data are from the statistical yearbook in 2019 for LP.

Table 1. Basic information on the selected counties and cities in 2019.

Name	Area (km^2)	Average Altitude (m)	Landform	Population Density (Person/km^2)	GDP per Capita/CNY	Per Capita Disposable Income of Rural Residents/CNY
Mianning	4422	2744.14	semi-high mountainous areas	91.6	31,842	16,136
Xichang	2657	2170.91	river valley	257.7	61,120	19,656
Xide	2202	2613.55	semi-high mountainous areas	102.6	18,700	9736
Dechang	2300	2258.35	river valley	94.6	34,701	19,052
Jinyang	1587	2146.06	semi-high mountainous areas	134.2	22,773	9745
Puge	1905	2493.45	semi-high mountainous areas	114.7	18,128	11,417
Ningnan	1672	1881.45	semi-high mountainous areas	119.6	34,349	17,186

2.3. Methodology

2.3.1. Evaluation of the Indicator System

Building upon the theory of complex adaptive systems, Martin defined economic resilience as the regional economic system's ability to adapt and restructure its industrial, technological, and institutional frameworks in response to market, competitive, and environmental shocks [41]. This adaptive capacity is aimed at mitigating the impacts of such shocks, sustaining the system's ongoing development, or even leveraging such shocks to facilitate the system's renewal. Martin categorizes economic resilience into four interconnected dimensions: preventive capacity (PVC), coping capacity (CPC), adaptive capacity (ADC), and transformational capacity (TFC). On this basis the RRCEs is defined in this study as the internal conditions of the rural collective economic system in the absence of a mountain disaster or in the stable state of the rural collective economic system that transitions into a new and higher level through the reorganization of elements and structural adjustments after the impact of a mountain disaster. The resilience of rural collective economic system is measured from four dimensions, namely, the PVC, CPC, ADC, and TFC (see Table 2).

PVC refers to the proactive measures taken prior to a disaster to mitigate the losses inflicted upon the rural collective economies. Disaster insurance coverage serves as an objective reflection of farmers' awareness of disaster prevention and mitigation and acts as an effective mechanism for mitigating losses. It leads young people to exhibit a heightened

understanding of disaster prevention and mitigation activities, including emergency drills and village-wide awareness campaigns. Through their influential role, young laborers can effectively disseminate their understanding of disasters to their older and younger relatives and friends within their social circles. CPC is defined as the ability of the rural collective economic system to withstand shocks and maintain its normal functioning in the event of a disaster. Maintaining well-defined monitoring systems and assigned responsibilities for disaster sites are crucial for villages to effectively gather disaster information and promptly respond by issuing early warnings. The number of emergency shelters indicates the accessibility and convenience of emergency shelters for rural residents. At the same time, capacity characterizes the inventory of the available equipment that can withstand the impacts of disasters [19]. ADC is defined as the remedial measure that the rural collective economy can provide after a disaster occurs and the series of changes in the economy, society, and farmers' lives that occur in the face of the disaster process. Per capita income characterizes the average economic level of farming households, and higher economic conditions empower such households with greater adaptability, thereby reducing the pressure on the village. Those individuals receiving the minimum subsistence allowance represent a vulnerable group, and village collectives prioritize their development by providing them with assistance. The higher the proportion of low-income individuals is, the more challenging it becomes to advance the collective economies [42]. An adequately developed health care system can strengthen the rural social security capacity and mitigate the impact of uncertainties [43]. TFC is evident in the efforts undertaken by the government, village collectives, or farm households to maintain, repair, or support the development of the rural collective economies. The per capita cultivated land area reflects the level of resource endowment in rural areas. A higher per capita cultivated land area signifies a more abundant foundation for the development of the primary industry [29]. The number of agricultural technicians signifies the extent of the local government's support for agricultural science and technological development. Higher levels of technological progress can foster new dynamics for economic development [44]. The per capita village collective economic organization book capital reflects the level of financial capital within the village collective. Areas with a strong economic base can promptly adapt to mountain disaster shocks, thereby enhancing the stability of economic development [45]. The distance of an area from the county core reflects its level of infrastructure development. Smaller distances indicate a stronger spillover effect of urban development, resulting in increased employment and educational opportunities for the residents of those areas and their children [30].

Table 2. Variable system for assessing RRCEs.

Dimension	Indicator	Variable	Definition	Unit
PVC	Disaster prevention awareness	Disaster insurance coverage (X_1)	Ratio of the number of farmers who purchased disaster insurance to the total number	%
	Human capital	Percentage of labor force (X_2)	Ratio of the population in the 15–64 age group to the total population	%
CPC	Emergency response	Number of persons with clear responsibilities (X_3)	Number of specialized disaster site monitors and responsible persons	person
		Number of emergency shelters (X_4)	Number of emergency shelters in the village	number
		Emergency shelter capacity (X_5)	Ratio of the number of people who can be accommodated in emergency shelters to the total household population	/

Table 2. *Cont.*

Dimension	Indicator	Variable	Definition	Unit
ADC	Economic foundation	Per capita income (X_6)	Income level of the rural population	CNY
	Social security	Proportion of underinsured persons (X_7)	Ratio of the number of underinsured persons to the total household population	%
		Number of doctors and sanitarians (X_8)	Number of doctors and sanitarians in village health care facilities	person
TFC	Production conditions	Cultivated land area per capita (X_9)	Ratio of the cultivated land area to the total household population in the village	hm^2
	Technological advancement	Number of agricultural technicians (X_{10})	Number of agricultural technicians in the village	person
	Industrial development	Per capita funds from village collective economic organizations (X_{11})	Ratio of the book capital of the village collective economic organizations to the total population	CNY
	Transportation accessibility	Distance from the county core (X_{12})	Village distance from the nearest county core area	km

2.3.2. Assessment Methodology

Since resilience is the result of multiple factors that are difficult to directly measure [46], a latent variable model is constructed to measure RRCEs based on the RIMA model. The RIMA model was first proposed in 2008 [36] to measure the resilience of farm households to food security risks. It has been updated over many iterations and developed into the latest RIMA-II model [38]. The RIMA series model considers each dimension as a latent variable and comprehensively measures the resilience index based on factor analysis and the multiple indicators–multiple causes (MIMICs) model, which is an approach that better avoids the limitations of subjectivity that exist in conventional resilience assessment methods, and it is widely used in the field of resilience assessment [37] (Figure 2).

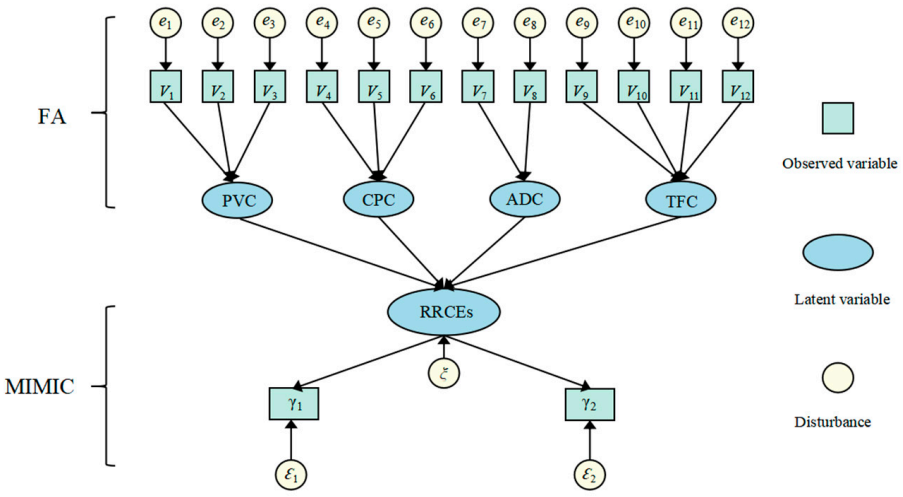

Figure 2. RIMA model framework.

(1) Constructing a matrix of raw indicators

With n villages and h evaluation indicators, the original indicator matrix is established as $X = \{X_{ij}\}n*h$ ($1 \leq i \leq n$, $1 \leq j \leq h$), where X_{ij} is the value of the j indicator for the i village.

(2) Dimensionless treatment

The original indicators in the indicator system were converted to dimensionless indicators using the following formula from the polarity standardization method:

$$P_{ij} = (X_{ij} - X_{min})/(X_{max} - X_{min}) \quad (1)$$

where P_{ij} is the value of the j dimensionless indicator for the i village, X_{ij} is the value of the j raw indicator for the i village, X_{min} is the minimum value of the j raw indicator, and X_{max} is the maximum value of the j raw indicator.

(3) Factor analysis

Due to the correlation between variables in the evaluation index system, factor analysis can be used to replace the original indicators by selecting four independent public factors that contain most of the information of the original indicators in accordance with the idea of dimensionality reduction to simplify the relationship between complex variables without losing the original information. The results of KMO and Bartlett's test of sphericity show that the KMO test coefficient (0.640) was greater than 0.5 and the Bartlett's test coefficient (Sig.) was 0, which, being less than 0.05, indicated that the original data were suitable for factor analysis. According to the correlation size between the public factors and the evaluation indices, the first public factor mainly describes the TFC of the rural collective economic system, the second public factor mainly expresses the ADC, the third public factor mainly expresses the CPC, and the fourth public factor mainly expresses the PVC. The cumulative variance contribution rate of these 4 public factors reaches 68.30%, which constitutes a reasonable degree of explanation.

(4) Constructing the MIMICs model

The MIMICs model is a form of structural equation used to estimate unobservable variables. In order to solve the model, it is necessary to estimate a set of joint equations, introducing cause and indicator variables, establishing a relationship between unobservable and observable variables, and making it suitable to estimate unobservable resilience [47–49]. In the MIMICs model, the RRCEs is considered a latent variable that is related to a set of causal variables that are used to determine economic resilience on the one hand and that affect a set of observable indicator variables on the other. Thus, the MIMICs model consists of two parts, the measurement model and the structural model, which portray the impact of the PVC, CPC, ADC, and TFC on the RRCEs and the extent to which the RRCEs responds to the indicator variables, respectively.

Thus, the MIMICs model consists of two parts, the measurement model and the structural model, which reflect the relationship between the new rural collective economic resilience and the indicator and cause variables, respectively. The measurement model is expressed as follows:

$$\gamma_1 = \lambda_1 \text{ RRCEs} + \varepsilon_1 \quad (2)$$

$$\gamma_2 = \lambda_2 \text{ RRCEs} + \varepsilon_1 \quad (3)$$

$$\gamma_3 = \lambda_3 \text{ RRCEs} + \varepsilon_3 \quad (4)$$

$$\gamma_4 = \lambda_4 \text{ RRCEs} + \varepsilon_4 \quad (5)$$

where RRCEs denotes the resilience level of the rural collective economies, γ_1 and γ_2 denote indicator variables related to RRCEs, λ_1 and λ_2 denote the parameters of the measurement model, and ε denotes the measurement error vector.

The structural model is expressed as follows:

$$\text{RRCEs} = \beta_{\text{PVC}} \text{ PVC} + \beta_{\text{CPC}} \text{ CPC} + \beta_{\text{ADC}} \text{ ADC} + \beta_{\text{TFC}} \text{ TFC} + \xi \quad (6)$$

where PVC, CPC, ADC, and TFC denote the cause variables' levels of preventive capacity, coping capacity, adaptive capacity, and transformational capacity, respectively; β_{PVC}, β_{CPC}, β_{ADC}, and β_{TFC} denote the parameters of the structural model; and ξ denotes the random perturbation term. RRCEs is a relative concept rather than an absolute unit of measurement, and the larger its value is, the stronger the ability to combat risk and the more stable the development of the NRCE.

The four dimensions of rural collective economic resilience proposed in this study, i.e., PVC, CPC, ADC, and TFC, serve as the MIMICs model's four causal variables. In addition, four indicator variables, namely, per capita collective economic income, the number of cooperatives, the number of agribusinesses, and the number of family farms and large-scale farmers, were selected in this study for use in the MIMICs model analysis, and the indicators were selected on the following basis. The resilience of the rural collective economy directly determines the income and distribution of the collective economies such that the more robust the resilience is, the stronger the sustainability of the collective economic development and the higher the income; thus, the per capita collective economic income indicator was selected. A stable natural and social environment is conducive to the growth and expansion of new agricultural business entities, so the number of cooperatives, the number of agricultural enterprises, and the number of family farms and large farming households were selected to characterize the stable development of the NRCE (Table 3).

Table 3. MIMICs model construction for the evaluation of the RRCEs.

Variable Type	Variable Name	Definition	Unit
Causal variables	PVC	Based on the four common factors extracted from the factor analysis (latent variables)	/
	CPC		/
	ADC		/
	TFC		/
Indicator variables	Per capita collective economic income	Ratio of the village collective economic income to the total household population in 2022	CNY
	Number of cooperatives	The number of shareholding economic cooperatives and specialized cooperatives	number
	Number of agricultural enterprises	The number of leading agricultural industrialized enterprises	number
	Number of family farms and large-scale farmers	The number of family farms and large-scale farmers	number

2.3.3. Analysis Methodology for the Factors Influencing RRCEs Based on Qualitative Comparisons

Due to the village-scale nature of this study, obtaining a large sample size is challenging, making traditional statistical or econometric analysis methods unsuitable for attribution analysis. Qualitative comparative analysis (QCA) is a comparative analytical method that is focused on cases, where each case is seen as a combination of conditions. By comparing the differences among cases, QCA is used to identify the causal relationships between condition groups and outcomes, thus addressing the following research question: 'Which groups of conditions lead to the occurrence or nonoccurrence of the desired outcome?' This approach is particularly suitable for attribution studies with small sample sizes [50]. In this paper, the intention is to use QCA, which is based on set theory, to analyze the multiple and complex mechanisms that contribute to the RRCEs from a group state perspective. This is because, unlike the traditional statistical analysis of binary relationships, QCA recognizes the fact that the interdependence and diverse combinations of causal conditions form multiple and concurrent relationships. This approach facilitates a more comprehensive understanding of the distinct driving mechanisms underlying the resilience of village domains. Hence, QCA is better suited for investigating the interplay

of multiple factors that influence the RRCEs from a holistic perspective. Furthermore, the paths for enhancing the RRCEs in each village domain are diverse. Multiple causal pathways can lead to the same equivalent outcome, and the QCA method can effectively identify the complete the equivalence of different antecedent condition groups that are not mutually contradictory but do contribute to the interpreted outcome.

The QCA analysis comprises two main stages. The first stage involves testing whether a single condition (including its nonsets) is a necessary condition for the RRCEs. If a condition is consistently present when the focal outcome occurs, then it is considered necessary for the outcome. Consistency is used as the criterion to evaluate necessary conditions, and a consistency value that exceeds 0.9 indicates that the condition is necessary for the outcome. The second stage involves conducting a conditional grouping analysis to assess the sufficiency of different groups, based on multiple conditions, to cause the outcome [51]. Consistency is also employed to assess the adequacy of the configuration, with a minimum acceptable standard of 0.75 [51].

The new endogenous development theory integrates endogenous and exogenous theories, emphasizing the combined influence of internal and external resources and promoting sustainable development. It aligns with the current mainstream rural development theory used in developed European countries [52]. This study incorporates both existing research findings and current realities [53–55]. The stable development of the rural collective economy requires a combination of internal and external resources, including (1) human resources, (2) financial resources, (3) institutional supply, (4) technical conditions, and (5) natural resources. Accordingly, the factors that influence the RRCEs are analyzed using QCA, and the selected conditional variables are outlined in Table 4. (1) Talent security: This study reveals a strong correlation between elite talent and the stable development of the rural collective economies. Villages led by individuals with overall capabilities such as returnees, university students, and businessmen are assigned a value of 1 while others receive a value of 0. (2) Financial security: the development of the rural collective economy cannot be separated from government support, especially in disaster-prone areas where economic development is threatened by the multiple threats of mountain disasters, which require the government to invest large amounts of money to help. (3) Institutional security: The reform of the rural property rights system is essential for the development of the rural collective economies. The analysis is used to assess the impact of institutional safeguards based on the extent and effectiveness of the reform. (4) Technological security: the adoption of advanced agricultural technologies, such as drip irrigation, are denoted by a value of 1 if the technological conditions adequately support the long-term development of the rural collective economy and of 0 otherwise. (5) Business security: Business assets represent the resource endowment of the village. A more favorable business environment correlates with greater income, reflecting the resource base of the collective economy.

Table 4. Variable definitions.

Variable Name	Definition and Assignment
RRCEs	Based on the results of the previous analysis of the natural breakpoint method, villages with a low resilience level in the 3-class hierarchy were assigned a value of 0, and villages with a medium-high resilience level were assigned a value of 1.
Talent security	Villages with returning entrepreneurs, college students, businessmen, and other entrepreneurial leaders are assigned a value of 1, and 0 is assigned otherwise.
Financial security	Set to 1 if there is a financial allocation and to 0 otherwise.
Institutional security	Set to 1 for a thorough reform of the rural property rights system and to 0 otherwise.
Technological security	Set to 1 for the adoption of advanced agricultural technologies and to 0 otherwise.
Business security	Set to 1 for having a business income and to 0 otherwise.

3. Results

3.1. The Evaluation of the RRCE toward Mountain Disasters

The MIMICs model constructed above was empirically analyzed through the use of the AMOS software 24, and the fitting results are shown in Table 5. For the test index of goodness of fit, it is generally believed that a model fits well when $1 < \chi^2/df < 3$, RMSEA < 0.08, and CFI > 0.95, indicating that the model fits well. The model $\chi^2/df = 1.097$, RMSEA = 0.045, and CFI = 0.952 indicates a good model fit [56]. All four causal variables significantly and positively affect the RRCEs. The resilience level increases by 0.029, 0.029, 0.037, and 0.075 units for each unit increase in the PVC, CPC, ADC, and TFC, respectively. The unstandardized coefficient of the TFC is the largest, indicating that by enhancing the value of the capacity by 1 unit, the TFC obtains a utility of 2–3 times higher than that of the PVC, CPC, and ADC; thus, the TFC is the key to enhancing the resilience level of the rural collective economic system in the study area. For every 1 unit increase in the level of resilience of new rural collective economies, the number of cooperatives increases by 0.944 units, the number of agribusinesses increases by 1.178 units, and the number of family farms and large-scale farmers increases by 0.894 units. Accordingly, an assessment model for the RRCEs can be obtained:

$$\text{RRCEs} = 0.029\ \text{PVC} + 0.029\ \text{CPC} + 0.037\ \text{ADC} + 0.075\ \text{TFC} \quad (7)$$

Table 5. Results of the MIMICs model for the evaluation of RRCEs.

Variable Type	Variable Name	Non Standardized Coefficients	Standard Errors	T Value	*p*-Value
Causal variables	PVC	0.029 *	0.017	1.691	0.091
	CPC	0.029 *	0.017	1.648	0.099
	ADC	0.037 *	0.020	1.832	0.067
	TFC	0.075 ***	0.024	3.080	0.002
Indicator variables	Per capita collective economic income	1.000			
	Number of cooperatives	0.944 **	0.409	2.311	0.021
	Number of agricultural enterprises	1.178 ***	0.401	2.935	0.003
	Number of family farms and large-scale farmers	0.894 **	0.374	2.392	0.017

Notes: *, **, and *** denote 10%, 5%, and 1% significance levels, respectively. Collective economic income per capita is a predetermined scale indicator for the model, and it has a parameter of one.

3.2. Spatial Distribution Pattern of the RRCEs in Regard to Mountain Disasters

The distribution of the RRCEs in the sample villages ranges from −0.166 to 0.410. The level of rural collective economic resilience is divided into three categories according to the natural discontinuity point method, which shows that the resilience of typical villages is dominated by medium and low levels, accounting for 45.84% and 39.58% of the total, respectively, and that these villages are mainly located in the northern region. Only seven villages have a high level of resilience, and they are concentrated in Ningnan County, Mianning County, and Xide County. The level of resilience of the rural collective economy in the study area is not high, and it generally shows a spatial pattern that is slightly higher in the south than in the north (Figure 3).

The range of the PVC values in typical villages is −1.331–2.866, and the PVC of villages in the northern region exhibits a significantly higher value than those in the southern region (Figure 4). Villages were categorized into low, medium, and high levels of PVC, accounting for 43.75%, 33.33%, and 22.92% of the total, respectively. This expands the range of villages with a high PVC, which differs from villages with high rural collective economic resilience levels. The range of the CPC varies from −1.300 to 3.997, showing spatial characteristics similar to those of the rural collective economic resilience, with

higher values observed in the south and lower values in the north. The ADC ranges from −1.412 to 4.240. The majority of villages (52.08%) exhibit a medium level of ADC, followed by those exhibiting a low level (43.75%), with only two villages at the high level. This pattern forms an olive-shaped structure, with lower values observed in the north and higher values in the south. The TFC spans from −1.491 to 3.741, and villages with low, medium, and high levels account for 45.83%, 37.50%, and 16.67% of the total, respectively. A concave central section with prominent north and south ends characterizes the spatial distribution of the target area.

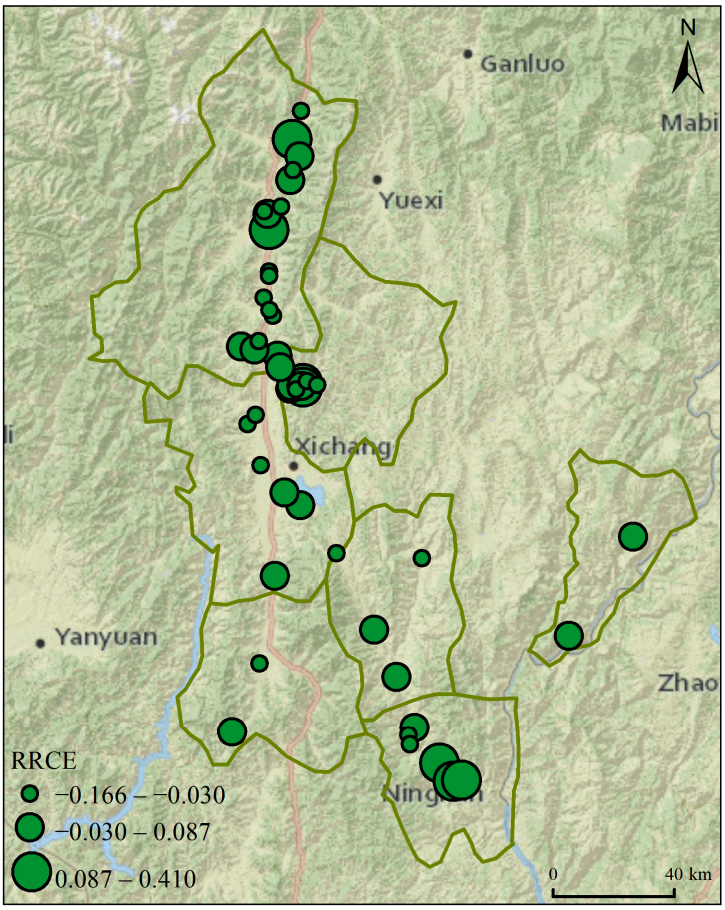

Figure 3. Spatial distribution pattern of RRCEs.

3.3. Comparison of Different Types of RRCEs

Based on the variations in nonfarming and income diversification seen within the new rural collective economies and considering the findings of previous research [57], rural collective economic development is classified into three categories: purely agricultural, diversified, and off-farm. Villages without a non-farm income from the NRCE are classified as purely agricultural, while those with a nonagricultural income share in excess of 95% are categorized as off-farm. Those villages falling between these extremes are considered diversified. Out of the total sample of 48 villages, 12 were classified as purely agricultural, 24 as diversified, and 12 as off-farm, accounting for 25.00%, 50.00%, and 25.00% of the sample, respectively.

Regarding the RRCEs, off-farm villages exhibit the highest level of resilience (mean value of 0.013), followed by diversified villages (mean value of 0.002) and purely agricultural villages with the lowest level (mean value of −0.011). These findings suggest that the variations in these three industrial structures in the new rural collective economies contribute to the differences in resilience levels. In terms of the PVC, the ranking of the development types is as follows: diversified (mean value of 0.274) > purely agricultural (mean

value of −0.240) > off-farm (mean value of −0.336). Additionally, the standard deviation of off-farm villages is the highest (1.079), indicating significant variations in this category. These results suggest that off-farm villages need to address their limitations and work toward reducing internal disparities. In terms of the CPC, the ranking of the development types proceeds as follows: off-farm (mean 0.315) > diversified (mean −0.011) > purely agricultural (mean −0.335). This indicator reveals the most substantial difference in capacity among the different development types, with a deviation of 0.650, a fact that highlights that the disparity in resilience among villages primarily manifests in their CPC. Regarding the ADC, the ranking of the development types is as follows: diversified (mean 0.097) > purely agricultural (mean −0.059) > off-farm (mean −0.230). This capacity indicator shows the least variation among the different types of villages. In terms of the TFC, the ranking of the development types is as follows: off-farm (mean 0.299) > purely agricultural (mean 0.042) > diversified (mean −0.127) (Figure 5).

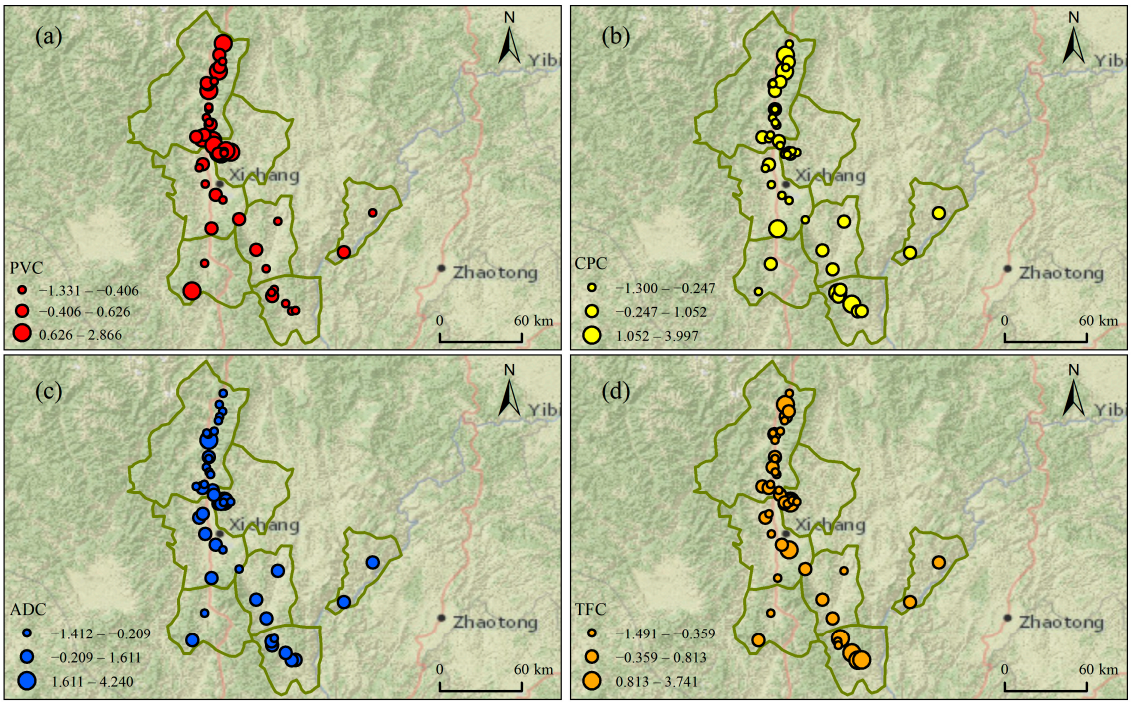

Figure 4. Spatial distribution pattern: (**a**) PVC, (**b**) CPC, (**c**) ADC, and (**d**) TFC.

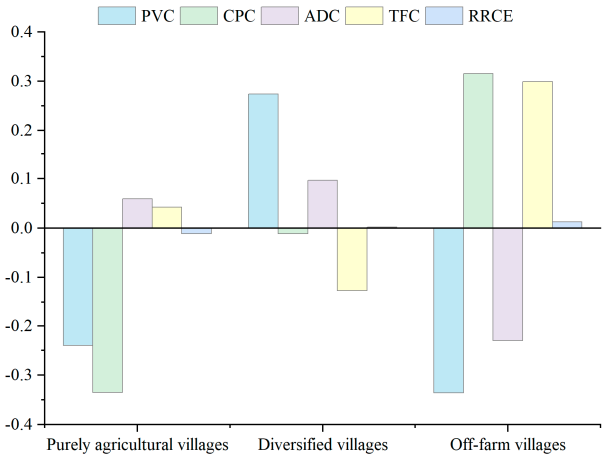

Figure 5. Comparison of PVC, CPC, ADC, TFC, and RRCEs in purely agricultural, diversified, and off-farm villages.

3.4. Factors Influencing the RRCEs in Regard to Mountain Disasters

3.4.1. Necessity Analysis of Individual Conditions

According to the analysis results of the natural breakpoint method conducted in the previous section, villages with low resilience levels were assigned a value of 0, and villages with medium-high resilience were assigned a value of 1. First, whether a single condition (including its nonset) constitutes a necessary condition for the RRCEs was tested. According to the test results, the consistency of talent security is 0.962; thus, it can be regarded as a necessary condition for the focal outcome, and further, through the coverage rate, we know that it can be used to explain more than 59.5% of the cases; that is, 59.5% of the total rural collective economic development is dominated by elite capacity. Therefore, talent security can be seen as an important influence on the RRCEs (Table 6).

Table 6. Analysis of necessary conditions.

Conditional Variables	High Resilience Level of RRCEs		Low Resilience Level of RRCEs	
	Consistency	Coverage	Consistency	Coverage
Talent security	0.962	0.595	0.773	0.405
~Talent security	0.038	0.167	0.227	0.833
Financial security	0.692	0.692	0.364	0.308
~Financial security	0.308	0.364	0.636	0.636
Institutional security	0.577	0.625	0.409	0.375
~Institutional security	0.423	0.458	0.591	0.542
Technological security	0.731	0.559	0.682	0.441
~Technological security	0.269	0.500	0.318	0.500
Business security	0.654	0.515	0.727	0.485
~Business security	0.346	0.600	0.273	0.400

3.4.2. Sufficiency Analysis of Conditional Groups

The above factors affecting the RRCEs yielded a total of 32 (2^5 = 32) groups. Consistency is also used as a measure of group adequacy, but the minimum acceptable standard is 0.75, and the frequency threshold is 1. The final group results are shown in Table 7. The six optimal forms of conditional combinations constituted by the five conditional variables, with a coverage of 0.808, show strong explanatory power, whereas S2a and S2b share the same core conditions; thus, they are second-order equivalent groups.

Table 7. Group analysis of high levels of RRCEs.

Conditional Combination	Number of Shared Cases	Talent Security	Financial Security	Institutional Security	Technological Security	Business Security	Raw Coverage	Unique Coverage	Consistency
S1	3	•	⊗		⊗	⊗	0.115	0.038	1
S2a	3		□	•	□	⊗	0.115	0.038	1
S2b	3	■		•	■	⊗	0.115	0.038	1
S3	3	•	⊗	•	⊗		0.115	0.038	1
S4	10	■	•	⊗		•	0.308	0.308	0.8
S5	8	■	•	•	•		0.269	0.192	0.875
				Solution coverage				0.808	
				Solution consistency				0.875	

Notes: ■ or • indicate that the condition exists, □ or ⊗ indicate that the condition does not exist, • or ⊗ indicate a core condition, and ■ or □ indicate an edge condition. A blank space indicates that the condition may or may not exist.

(1) Talent security type (S1): For Group S1, when talent security is present, other conditions become irrelevant in realizing high levels of rural collective economic resilience. Therefore, talent security is considered both a necessary and sufficient condition for achieving high levels of resilience.

(2) Institutional security type (S2a): The presence and centrality of institutional security within Group S2a indicates that institutional security, compared to other conditions, plays a significant role in achieving high levels of resilience. Therefore, institutional

security itself can be considered a sufficient condition for explaining the results and represents another critical factor that influences the RRCEs.

(3) Talent-technological-driven with institutional security type (S2b): For Group S2b, institutional security serves as the fundamental condition, complemented by human resources and technical security, needed to generate a high level of rural collective economic resilience. This indicates that even villages without significant business assets can achieve a high level of rural collective economic resilience when operating within a robust institutional security framework supported by adequate human resources and technical assistance.

(4) Institutional and talent dual-security type (S3): In Group S3, talent security, nonfinancial security, institutional security, and nontechnological security emerge as the core conditions, indicating that the presence of abundant human resources and comprehensive institutional reforms can effectively address financial and technical challenges and lead to a high level of rural collective economic resilience. For instance, on the basis of the prevention and treatment of potential disasters, the Echigeze village, leveraging its advantageous geographic location, has achieved a high level of rural collective economic resilience through strategic measures. These measures include implementing collective membership identifications, conducting asset verifications, holding elections for a supervisory board or council, generating rental income from vacant factory buildings, and appointing a dedicated individual to oversee the management of the collective economies. Notably, the Ochi Geze Village has accomplished this feat despite facing a severe shortage of agricultural technicians to support their arable land resources.

(5) Talent-driven under the duality of financial and business security type (S4): In Group S4, financial security, noninstitutional security, and business security constitute the core conditions, with talent security playing a secondary role. This suggests that villages with imperfect institutions can still attain high levels of resilience in their rural collective economies, given that the local government provides financial support for industrial development and brings in talented individuals for effective management. The original coverage of this group is 0.308, and its unique coverage is also 0.308, signifying that this is the path with the highest explanatory power.

(6) Talent-driven under the triad of financial, institutional, and technological security type (S5): For Group S5, financial, institutional, and technological security occupy central roles, while human security plays a complementary role. The role of business assets in fostering rural collective economies with high levels of resilience is discretionary within this environment.

4. Discussion

4.1. Characterization of the RRCEs in Regard to Mountain Disasters

In the context of global warming, southwest China has experienced an increase in the frequency and intensity of extremely heavy rainfall [58], which has led to frequent mountain disasters [59] that have significantly impacted human economic and social systems [60]. These challenges are particularly pronounced in rural areas with limited infrastructure and public services [61]. Exogenous rural development policies have proven effective in enhancing the capacity of villages to withstand and recover from external shocks [62], leading to an increased economic resilience that relies on greater support being provided to villages [30]. However, it is essential for these policies to account for the unique characteristics of diverse rural areas, as their outcomes have been mixed [21]. Endogenous rural collective economies achieve sustainable development by strengthening the supportive role of grassroots rural organizations and harnessing the internal dynamics of rural development, thereby delivering sustained benefits to farmers. The frequent incidence of mountain disasters in the southwestern region has impeded the progress of the rural collective economies. Current engineering-based measures are limited in adequately addressing the requirements of rural-community disaster management, including legal and regulatory

frameworks, disaster-prevention awareness and education, disaster insurance, and emergency response plans. Assessing the rural collective economic system in disaster-prone areas from a resilience standpoint underscores that the countryside functions as a spatial–territorial system [63]. This perspective acknowledges the significance of physical space, geographic characteristics, population density, cultural values, and other factors within the rural context [64]. Moreover, it recognizes the importance of natural environmental elements in the southwestern mountainous areas in shaping the overall rural system.

In this study, the crucial role of the rural collective economies' ability to adapt to mountain disasters in building resilience is highlighted. Enhancing the TFC is key to improving resilience levels. Mountain disasters and meteorological events pose a significant risk to crops, farmland water conservancy projects, roads, communication equipment, and other infrastructures in the impoverished mountainous areas of southwest China. Restoring damaged infrastructures necessitates substantial inputs of skilled personnel, materials, and financial resources. This inevitably impacts industrial inputs in the short or even long term, imposing heightened demands on the development of the already-fragile rural collective economies. In light of this, the central government and local authorities have allocated significant financial resources to promote the growth of the rural collective economies, beginning with its nascent stages and progressively strengthening it. These "shell villages" and weak villages can choose appropriate development methods under the guidance of local governments. However, there is a lack of awareness among villagers regarding collective action [65], and the prevalence of 'free-riding' behavior in the operation of cooperatives represents a common challenge [66]. Moreover, the limited penetration of local governments at the grassroots level has led to the convergence of rural industry types and the lack of product competitiveness [67], thus impeding the progress of the rural collective economy in its early stages. To achieve significant developmental progress, fostering innovation and devising tailored approaches that align with local conditions is crucial. For instance, the success of Japan's 'one village, one product' movement, which has been adopted in various Asian and developing countries [68–70], can be attributed to administrative support for self-governance which allows for the expression of rural social autonomy, thereby harnessing local potential [71].

Considering the varying resilience of different industry types in addressing mountain disasters, rural collective economic development in LP is classified into three categories in this study: purely agricultural, diversified, and off-farm. The findings indicate that off-farm villages exhibit the highest level of resilience, followed by diversified villages, while purely agricultural villages demonstrate the lowest level of resilience. These results suggest that the agricultural industry is particularly susceptible to natural disasters, making it the most fragile industry type. As early as the 1940s, Japan implemented the Agricultural Disaster Compensation Law, which has played a significant role in supporting the development of the agricultural industry in impoverished areas [72]. Additionally, there is a consensus on the use of agricultural insurance as a preventive measure [73]. To achieve the healthy and sustainable development of rural specialty industries in poverty-stricken areas, establishing a comprehensive industrial chain is crucial. In addition to agriculture, the agricultural-product-processing industry can significantly increase farmers' incomes by enhancing the added value of agricultural products. To safeguard the interests of village collectives and farmers, establishing a rights protection system based on farmers' professional cooperatives and shareholding economic cooperatives is essential. This ensures that more of the added value of agriculture remains within rural areas and prevents the encroachment of external capital on rural collective resources, which can be detrimental [74,75]. Tourism built upon local cultural and natural resources can also yield economic benefits for village collectives and farm households, albeit only after substantial upfront investments in infrastructure development. For instance, in the anti-poverty initiative undertaken in the Appalachian region of the United States, significant government investments in road construction played a pivotal role in enhancing transportation in mountainous areas and

reducing isolation from the outside world. This, in turn, created the necessary conditions for poverty eradication [76].

4.2. Factors Influencing the RRCEs

The study results show that talent security significantly influences the RRCEs. Higher cultural quality, greater professional competence, and broader horizons among business managers enable the exploration of new approaches in the collective economic system to address the challenges posed by mountain disasters. These findings align with previous studies [29]. While the presence or absence of financial security does not consistently impact the level of the RRCEs, Cui et al. argued that government support plays a critical role in driving collective economic developments in developing countries [30]. Moreover, they highlight the fact that government support has a more pronounced effect in areas with deeper poverty levels. The observed disparity can be attributed to the presence of distinct coercive variables in each study area. For instance, Cui et al. examined Lankao County in Henan Province, a key county for national poverty alleviation efforts, to explore the resilience of rural economic system in addressing external economic fluctuations, macro-controls, industry competitions, and other disruptions. In contrast, the primary threat to LP is mountainous disasters, for which basic disaster-resilience measures, such as disaster prevention and mitigation awareness, and disaster-escape skills among rural residents are required [30]. These measures cannot be solely achieved through financial support but rather also require publicity and education by village cadres or schools, as well as emergency drill training. Institutional security is a prerequisite for the development of the rural collective economies. At the same time, technology serves as a safeguard, while business assets form its foundation. Incomplete institutional reform [35], the insufficient promotion of agricultural and animal husbandry technology [77], and a lack of business assets [33] hinder the stable development of the rural collective economies. This, in turn, impacts the collective income of villages and the individual incomes of rural residents. Consequently, rural collective economies become unable to bear the burden of disaster reconstruction funds and subsidies for residents affected by disasters, which leads to a reduction in the level of resilience.

4.3. Remaining Issues, Prospects, and Policy Implications

This paper utilizes the RIMA model to assess an RRCEs. The advantage of this model lies in its ability to overcome the subjective biases often associated with conventional resilience-assessment methods. Moreover, the incorporation of structural equation modeling allows for greater flexibility in capturing the four capacity dimensions. However, one limitation of this method is the inability to observe the specific contribution of each evaluation index to the resilience level. To address this, establishing a matrix of component score coefficients in factor analysis and cause variable coefficients in the MIMICs model is recommended. This approach can help to uncover the importance ranking of the evaluation indicators. Furthermore, considering the existence of various types of mountain disasters, recognizing that the RRCEs may differ under different types of mountain-disaster coercions is crucial. Therefore, conducting future in-depth analyses to explore the resilience differences and commonalities among different disaster types is recommended. LP is an area inhabited by ethnic minorities, where residents have developed a unique disaster culture through their interactions with nature [78]. This includes practices such as nature worship and ancestor worship, which reflect the Yi people's understanding of disasters, their perception of the relationship between human beings and nature, and their ethical view of nature in harmony with the sky and human beings. In the future, further exploration of the impact of this local knowledge on the RRCEs regarding mountainous disasters is recommended.

Combined with the results of the current study, the following policy recommendations are presented to enhance the RRCEs in the face of mountain disasters: (1) Improve the coverage rate of disaster insurance and enhance the PVC. Given the high vulnerability

of the agricultural industry, it is essential to increase the coverage rate of agricultural insurance. This can be achieved by leveraging the public service capacity of the rural collective economies. The village's collective economic organization should further engage in negotiations with insurance companies to determine the types of insurance and compensation standards. (2) Improve the emergency protection system and enhance the CPC. Comprehensive disaster-relief programs that encompass assistance for vulnerable groups and affected industries need to be developed. Additionally, clear working guidelines or standard systems for various phases of disaster management, including prevention and preparedness, monitoring and early warning, emergency response, and recovery and reconstruction, need to be established. (3) Rural collective economies should be grown, and the ADC should be enhanced. The rural governance system of "government and society" is prone to the loss of collective assets and revenues. Attempts should be made to divest the functions of basic self-governing organizations and to appoint full-time accountants for the dynamic management of the resources, assets, and funds of the collective economies and the distribution of revenues in the village to unleash the vitality of the collective economies and keep the revenues in the village to the greatest extent possible rather than being encroached upon by external capital. To further bridge the income gap between farmers in the village, a special help fund for low-income groups can be set up to provide additional subsidy funds for poverty-stricken, marginalized, and low-income households. (4) Scientific research and innovation should be promoted to enhance the TFC. The establishment of a human resource development mechanism that combines academic education, skills training, and practical exercises should be actively explored to provide specialized talent for rural development and disaster prevention and mitigation. Several agricultural high-tech industrial demonstration zones and agricultural science and technology parks should be built in villages with a good foundation for industrial development; ecological agriculture, leisure and tourism agriculture, creative agriculture, etc., should be vigorously developed; the deep integration of agriculture with secondary and tertiary industries such as cultural tourism, leisure and recreation, and e-commerce and logistics should be promoted; and an industry–academia-research cooperation mechanism oriented toward the market should be promoted along with the synergistic innovation of enterprises, colleges and universities, and scientific research institutes to revitalize the countryside to form a diversified and stable industrial structure. (5) Context-specific approaches should be adopted. Villages should select appropriate paths and targeted measures based on their economic development level and the characteristics of their natural environments. These paths can include talent security, institutional security, talent-technological-driven with institutional security, institutional and talent dual-security, talent-driven under the duality of financial and business security, and talent-driven under the triad of financial, institutional, and technological security. The development of disaster prevention and mitigation and that of the collective economies should be considered while promoting a stable increase in farmers' incomes. The government should also prioritize efforts to promote sustainable rural development.

5. Conclusions

Considering the vulnerability to mountain disasters of the rural collective economic development in the mountainous areas of southwest China, the RIMA model is enhanced in this study to establish an assessment index system for measuring an RRCEs. The index system encompasses four dimensions, PVC, CPC, ADC, and TFC, and takes 48 typical villages in LP as the research object to analyze the spatial differentiation characteristics of rural collective economic resilience and explains the factors that influence the resilience of rural areas. In this study, the spatial differentiation characteristics of rural collective economic resilience are examined and the factors that influence its level are identified. This study finds that the RRCEs is generally low, and the TFC is the key to improving the resilience level. Considering the variations in nonfarming activities and income diversification within the rural collective economies, the villages were classified into purely agricultural, diversified,

and off-farm types. It was found that the agricultural industry is highly vulnerable in the face of mountain disasters and that the RRCEs in off-farm villages is significantly higher than that of the other two. Drawing upon the new endogenous development theory and employing QCA, this study reveals that talent security functions as a significant factor in cultivating a high level of resilience in the rural collective economies. Additionally, institutional security emerges as another crucial factor contributing to a high level of resilience in the rural collective economies. These two factors constitute an important influence on the high resilience level of rural collective economies. Six pathways toward achieving a highly resilient rural collective economy are identified in this study. These pathways include the talent security type, institutional security, talent-technological-driven with institutional security, institutional and talent dual security, talent-driven under the duality of financial and business security, and talent-driven under the triad of financial, institutional, and technological security. Behind the RRCEs lies the result of the synergistic effect of multiple factors. The level of resilience can be enhanced through an effective combination of factors, even when different paths lead to the same destination. Villages should consider their economic development level and resource background conditions and choose the appropriate path based on their local conditions. By implementing targeted measures that coordinate disaster mitigation and development, the RRCEs can be enhanced.

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References

1. Borga, M.; Stoffel, M.; Marchi, L.; Marra, F.; Jakob, M. Hydrogeomorphic response to extreme rainfall in headwater systems: Flash floods and debris flows. *J. Hydrol.* **2014**, *518*, 194–205. [CrossRef]
2. Gan, B.-R.; Liu, X.-N.; Yang, X.-G.; Wang, X.-K.; Zhou, J.-W. The impact of human activities on the occurrence of mountain flood hazards: Lessons from the 17 August 2015 flash flood/debris flow event in Xuyong County, south-western China. *Geomat. Nat. Hazards Risk* **2018**, *9*, 816–840. [CrossRef]
3. Wang, Y.; Chen, C.; Wang, J.; Baldick, R. Research on Resilience of Power Systems Under Natural Disasters—A Review. *IEEE Trans. Power Syst.* **2016**, *31*, 1604–1613. [CrossRef]
4. Terzi, S.; Torresan, S.; Schneiderbauer, S.; Critto, A.; Zebisch, M.; Marcomini, A. Multi-risk assessment in mountain regions: A review of modelling approaches for climate change adaptation. *J. Environ. Manag.* **2019**, *232*, 759–771. [CrossRef] [PubMed]
5. Rodriguez-Oreggia, E.; De La Fuente, A.; De La Torre, R.; Moreno, H.A. Natural Disasters, Human Development and Poverty at the Municipal Level in Mexico. *J. Dev. Stud.* **2013**, *49*, 442–455. [CrossRef]
6. Wang, Y.; Zhang, C.; Chen, A.S.; Wang, G.; Fu, G. Exploring the relationship between urban flood risk and resilience at a high-resolution grid cell scale. *Sci. Total Environ.* **2023**, *893*, 164852. [CrossRef]
7. McClymont, K.; Morrison, D.; Beevers, L.; Carmen, E. Flood resilience: A systematic review. *J. Environ. Plan. Manag.* **2020**, *63*, 1151–1176. [CrossRef]
8. Holling, C.S. Resilience and Stability of Ecological Systems. *Annu. Rev. Ecol. Syst.* **1973**, *4*, 1–23. [CrossRef]
9. McManus, P.; Walmsley, J.; Argent, N.; Baum, S.; Bourke, L.; Martin, J.; Pritchard, B.; Sorensen, T. Rural Community and Rural Resilience: What is important to farmers in keeping their country towns alive? *J. Rural Stud.* **2012**, *28*, 20–29. [CrossRef]

10. Scott, M. Resilience: A Conceptual Lens for Rural Studies? *Geogr. Compass* **2013**, *7*, 597–610. [CrossRef]
11. Faulkner, J.-P.; Murphy, E.; Scott, M. Rural household vulnerability a decade after the great financial crisis. *J. Rural Stud.* **2019**, *72*, 240–251. [CrossRef]
12. Wang, Y.; Zhang, Q.; Li, Q.; Wang, J.; Sannigrahi, S.; Bilsborrow, R.; Bellingrath-Kimura, S.D.; Li, J.; Song, C. Role of social networks in building household livelihood resilience under payments for ecosystem services programs in a poor rural community in China. *J. Rural Stud.* **2021**, *86*, 208–225. [CrossRef]
13. Borychowski, M.; Stępień, S.; Polcyn, J.; Tošović-Stevanović, A.; Ćalović, D.; Lalić, G.; Žuža, M. Socio-Economic Determinants of Small Family Farms' Resilience in Selected Central and Eastern European Countries. *Sustainability* **2020**, *12*, 10362. [CrossRef]
14. Wilson, G.A.; Hu, Z.; Rahman, S. Community resilience in rural China: The case of Hu Village, Sichuan Province. *J. Rural Stud.* **2018**, *60*, 130–140. [CrossRef]
15. Keogh, D.U.; Apan, A.; Mushtaq, S.; King, D.; Thomas, M. Resilience, vulnerability and adaptive capacity of an inland rural town prone to flooding: A climate change adaptation case study of Charleville, Queensland, Australia. *Nat. Hazards* **2011**, *59*, 699–723. [CrossRef]
16. Sarah, S. Enhancing the analysis of rural community resilience: Evidence from community land ownership. *J. Rural Stud.* **2013**, *31*, 36–46. [CrossRef]
17. Marshall, A.; Wilson, C.-A.; Dale, A. Telecommunications and natural disasters in rural Australia: The role of digital capability in building disaster resilience. *J. Rural Stud.* **2023**, *100*, 102996. [CrossRef]
18. Parsons, M.; Reeve, I.; McGregor, J.; Hastings, P.; Marshall, G.R.; McNeill, J.; Stayner, R.; Glavac, S. Disaster resilience in Australia: A geographic assessment using an index of coping and adaptive capacity. *Int. J. Disaster Risk Reduct.* **2021**, *62*, 102422. [CrossRef]
19. Li, Y.; Huang, H.Q.; Song, C.Y. Rural resilience in impoverished areas of southwest China: A case study of chongqing. *Hum. Geogr.* **2022**, *37*, 97–105. [CrossRef]
20. McAreavey, R. Finding rural community resilience: Understanding the role of anchor institutions. *J. Rural Stud.* **2022**, *96*, 227–236. [CrossRef]
21. Liu, Y.; Li, Y. Revitalize the world's countryside. *Nature* **2017**, *548*, 275–277. [CrossRef]
22. Zang, Y.; Hu, S.; Zhou, B.-B.; Lv, L.; Sui, X. Entrepreneurship and the formation mechanism of Taobao Villages: Implications for sustainable development in rural areas. *J. Rural Stud.* **2023**, *100*, 103030. [CrossRef]
23. Lillemets, J.; Fertő, I.; Viira, A.-H. The socioeconomic impacts of the CAP: Systematic literature review. *Land Use Policy* **2022**, *114*, 105968. [CrossRef]
24. Reardon, T.; Stamoulis, K.; Pingali, P. Rural Non-farm Employment in Developing Countries in an Era of Globalization. *Agric. Econ.* **2007**, *37*, 173–183. [CrossRef]
25. Li, Y.; Westlund, H.; Zheng, X.; Liu, Y. Bottom-up initiatives and revival in the face of rural decline: Case studies from China and Sweden. *J. Rural Stud.* **2016**, *47*, 506–513. [CrossRef]
26. Gao, M.; Wei, J.; Song, H. Strategic conception and policy optimization of innovative development of new rural collective economy. *Reform* **2021**, *9*, 121–133.
27. Kong, X. The Development and Innovation of Rural Economic Collectives in China (1978–2018). *J. Nanjing Agric. Univ. (Soc. Sci. Ed.)* **2018**, *18*, 1–10+157. [CrossRef]
28. Gao, M.; Li, Z.; Lei, Z. Talent supporting new rural collective economy: Mode exploration, realistic dilemma, and optimization path. *Res. Agric. Mod.* **2022**, *43*, 568–577.
29. Li, Y.; Huang, H.; Wang, S. Path of Urban-Rural Integrated Development in Traditional Agricultural Zones Based on Rural Economic Resilience: The Study of Typical Counties of Hebei Province. *Econ. Geogr.* **2021**, *41*, 28.
30. Cui, Z.; Li, E.; Li, Y.; Deng, Q.; Shahtahmassebi, A. The impact of poverty alleviation policies on rural economic resilience in impoverished areas: A case study of Lankao County, China. *J. Rural Stud.* **2023**, *99*, 92–106. [CrossRef]
31. Liu, W.; Li, J.; Ren, L.J.; Xu, J.; Li, C.; Li, S.Z. Exploring Livelihood Resilience and Its Impact on Livelihood Strategy in Rural China. *Soc. Indic. Res.* **2020**, *150*, 977–998. [CrossRef]
32. Sisneros-Kidd, A.M.; Monz, C.; Hausner, V.; Schmidt, J.; Clark, D. Nature-based tourism, resource dependence, and resilience of Arctic communities: Framing complex issues in a changing environment. *J. Sustain. Tour.* **2019**, *27*, 1259–1276. [CrossRef]
33. Zhou, L.; Xi, Y.X.; Ma, H.; Fang, P. How to Develop New Collective Economy in Resource-poor Villages? A Case Study of Yuanjiacun in Shaanxi Province Based on the Theory of Public Governance. *Chin. Rural Econ.* **2021**, 91–111.
34. Liang, H. The Development of Rural Collective Economy in China: Problems and Countermeasures. *Public Financ. Rev.* **2016**, 68–76. [CrossRef]
35. Xu, G.C. Zhanfeng From "Integration of Politics and Economy" to "Separation of Politics and Economy": A New Logic of Rural Collective Economic Governance. *Agric. Econ. Manag.* **2021**, 26–37.
36. Alinovi, L.; Mane, E.; Romano, D. Towards the Measurement of Household Resilience to Food Insecurity: An Application to Palestinian Households. 2008. Available online: http://www.stats.gov.cn/english/ICAS/papers/P020071017475481721768.pdf (accessed on 10 April 2023).
37. d'Errico, M.; Romano, D.; Pietrelli, R. Household resilience to food insecurity: Evidence from Tanzania and Uganda. *Food Secur.* **2018**, *10*, 1033–1054. [CrossRef]
38. Sibrian, R.; d'Errico, M.; Fulladolsa, P.; Benedetti-Michelangeli, F. Household Resilience to Food and Nutrition Insecurity in Central America and the Caribbean. *Sustainability* **2021**, *13*, 9086. [CrossRef]

39. Cao, M.; Xu, D.; Xie, F.; Liu, E.; Liu, S. The influence factors analysis of households' poverty vulnerability in southwest ethnic areas of China based on the hierarchical linear model: A case study of Liangshan Yi autonomous prefecture. *Appl. Geogr.* **2016**, *66*, 144–152. [CrossRef]
40. Hu, S.-y.; Yu, M.; Que, T.; Fan, G.; Xing, H.-g. Individual willingness to prepare for disasters in a geological hazard risk area: An empirical study based on the protection motivation theory. *Nat. Hazards* **2022**, *110*, 2087–2111. [CrossRef]
41. Martin, R. Regional economic resilience, hysteresis and recessionary shocks. *J. Econ. Geogr.* **2012**, *12*, 1–32. [CrossRef]
42. Kalogiannidis, S.; Papadopoulou, C.-I.; Loizou, E.; Chatzitheodoridis, F. Risk, Vulnerability, and Resilience in Agriculture and Their Impact on Sustainable Rural Economy Development: A Case Study of Greece. *Agriculture* **2023**, *13*, 1222. [CrossRef]
43. Dewa, O.; Makoka, D.; Ayo-Yusuf, O.A. Measuring community flood resilience and associated factors in rural Malawi. *J. Flood Risk Manag.* **2023**, *16*, e12874. [CrossRef]
44. Guo, C.Y.; Zhang, Y.J.; Liu, Z.Q.; Li, N. A Coupling Mechanism and the Measurement of Science and Technology Innovation and Rural Revitalization Systems. *Sustainability* **2022**, *14*, 10343. [CrossRef]
45. Zhang, M.H.L. Spatial disparities and identification of influencing factors on agricultural economic resilience in China. *World Agric.* **2022**, 36–50. [CrossRef]
46. Morkūnas, M.; Volkov, A.; Bilan, Y.; Raisiene, A. The role of government in forming agricultural policy: Economic resilience measuring index exploited. *Adm. Manag. Public* **2018**, *31*, 111–131.
47. Dreher, A.; Kotsogiannis, C.; McCorriston, S. Corruption around the world: Evidence from a structural model. *J. Comp. Econ.* **2007**, *35*, 443–466. [CrossRef]
48. Dell'Anno, R.; Dollery, B.; Volkswirtschaftliche Fakultät, L.-M.-U.M. Comparative Fiscal Illusion: A Fiscal Illusion Index for the European Union. *Empir. Econ.* **2014**, *46*, 937–960. [CrossRef]
49. Medina, L.; Schneider, F. Shadow Economies Around the World: New Results for 158 Countries Over 1991–2015. *SSRN Electron. J.* **2017**. [CrossRef]
50. Ragin, C.C.; Fiss, P. Net effects analysis versus configurational analysis: An empirical demonstration. In *Redesigning Social Inquiry: Fuzzy Sets and Beyond*; University of Chicago Press: Chicago, IL, USA, 2008; pp. 190–212.
51. Cooper, B.; Glaesser, J. Qualitative Comparative Analysis, Necessary Conditions, and Limited Diversity: Some Problematic Consequences of Schneider and Wagemann's Enhanced Standard Analysis. *Field Methods* **2015**, *28*, 300–315. [CrossRef]
52. Bosworth, G.; Annibal, I.; Carroll, T.; Price, L.; Sellick, J.; Shepherd, J. Empowering Local Action through Neo-Endogenous Development; The Case of LEADER in England. *Sociol. Rural.* **2016**, *56*, 427–449. [CrossRef]
53. Hong, R.L.; Zhan, M.L.; Wang, F.X. What determines the development of a rural collective economy? A fuzzy set qualitative comparative analysis (fsQCA) approach. *China Agric. Econ. Rev.* **2023**, *15*, 506–533. [CrossRef]
54. Peng, Y.; Peng, X.B.; Li, X.; Lu, M.Y.; Yin, M.Z. Effectiveness in Rural Governance: Influencing Factors and Driving Pathways-Based on 20 Typical Cases of Rural Governance in China. *Land* **2023**, *12*, 1452. [CrossRef]
55. Hu, X.; Liu, X.J. The Practice of Endogenous Development Theory in Rural Revitalization: Evidence from Ohnan Town in Shimane Prefecture of Japan. *Contemp. Econ. Jpn.* **2022**, *41*, 58–77. [CrossRef]
56. Wu, W.J.; Yang, X.; Jia, H.F. An Analysis of Impact Factors to the Propensity of Car Sharing in the "Post-Epidemic Era" Based on an Extended UTAUT Model. *J. Transp. Inf. Saf.* **2023**, *41*, 112–120.
57. Yan, J.; Zhuo, R.; Xie, D.; Zhang, Y. Land Use Characters of Farmers of Different Livelihood Strategies: Cases in Three Gorges Reservoir Area. *Acta Geogr. Sin.* **2010**, *65*, 1401–1410.
58. Xu, C.; Fu, H.; Yang, J.; Wang, L. Assessment of the Relationship between Land Use and Flood Risk Based on a Coupled Hydrological–Hydraulic Model: A Case Study of Zhaojue River Basin in Southwestern China. *Land* **2022**, *11*, 1182. [CrossRef]
59. Chan, E.Y.Y.; Man, A.Y.T.; Lam, H.C.Y. Scientific evidence on natural disasters and health emergency and disaster risk management in Asian rural-based area. *Br. Med. Bull.* **2019**, *129*, 91–105. [CrossRef]
60. Bi, P.; Parton, K.A. Effect of climate change on Australian rural and remote regions: What do we know and what do we need to know? *Aust. J. Rural Health* **2008**, *16*, 2–4. [CrossRef] [PubMed]
61. Hu, J.X.; Chen, C.; Kuai, T.T. Improvement of Emergency Management Mechanism of Public Health Crisis in Rural China: A Review Article. *Iran. J. Public Health* **2018**, *47*, 156–165.
62. Gilling, J.; Jones, S.; Duncan, A. Sector Approaches, Sustainable Livelihoods and Rural Poverty Reduction. *Dev. Policy Rev.* **2001**, *19*, 303–319. [CrossRef]
63. Li, Y.; Yan, J.; Wu, W.; Liu, Y. The process of rural transformation in the world and prospects of sustainable development. *Prog. Geogr.* **2018**, *37*, 627–635.
64. Bell, M.M. The Fruit of Difference: The Rural-Urban Continuum as a System of Identity1. *Rural Sociol.* **1992**, *57*, 65–82. [CrossRef]
65. Wang, Y.H.; Chen, C.L.; Araral, E. The Effects of Migration on Collective Action in the Commons: Evidence from Rural China. *World Dev.* **2016**, *88*, 79–93. [CrossRef]
66. Zang, L.; Wang, Y.; Su, Y. Does Farmland Scale Management Promote Rural Collective Action? An Empirical Study of Canal Irrigation Systems in China. *Land* **2021**, *10*, 1263. [CrossRef]
67. Zeng, G.; Zhang, C.; Li, S.; Sun, H. The Dynamic Impact of Agricultural Fiscal Expenditures and Gross Agricultural Output on Poverty Reduction: A VAR Model Analysis. *Sustainability* **2021**, *13*, 5766. [CrossRef]
68. Li, N.; Schumann, F. The one village one product (ovop) model and economic development on guam. *J. Econ. Econ. Educ. Res.* **2013**, *14*, 21–34.

69. Natsuda, K.; Igusa, K.; Wiboonpongse, A.; Thoburn, J. One Village One Product—Rural development strategy in Asia: The case of OTOP in Thailand. *Can. J. Dev. Stud./Rev. Can. D'études Développement* **2012**, *33*, 369–385. [CrossRef]
70. Nyamu, G.; Wagah, G.; Obala, L. The role of productive processes on the implementation of differential advantage approach in Kenya OVOP projects. *J. Geogr. Reg. Plan.* **2018**, *11*, 95–101. [CrossRef]
71. Hoang Thanh, L.; Ta Nhat, L.; Nguyen Dang, H.; Ho, T.M.H.; Lebailly, P. One Village One Product (OVOP)—A Rural Development Strategy and the Early Adaption in Vietnam, the Case of Quang Ninh Province. *Sustainability* **2018**, *10*, 4485. [CrossRef]
72. Chen, C.; Chen, J.; Tao, J. Industry Poverty Alleviation: Foreign Experience and Its Policy Implications. *Econ. Geogr.* **2018**, *38*, 127–134.
73. Wang, M.; Liao, C.; Yang, S.; Zhao, W.; Liu, M.; Shi, P. Are People Willing to Buy Natural Disaster Insurance in China? Risk Awareness, Insurance Acceptance, and Willingness to Pay. *Risk Anal.* **2012**, *32*, 1717–1740. [CrossRef] [PubMed]
74. Suh, J. Communitarian cooperative organic rice farming in Hongdong District, South Korea. *J. Rural Stud.* **2015**, *37*, 29–37. [CrossRef]
75. Zhong, Z.; Jiang, W.; Li, Y. Bridging the gap between smallholders and modern agriculture: Full insight into China's agricultural cooperatives. *J. Rural Stud.* **2023**, *101*, 103037. [CrossRef]
76. Lein, J.K.; Day, K.L. Assessing the growth-inducing impact of the Appalachian Development Highway System in southern Ohio: Did policy promote change? *Land Use Policy* **2008**, *25*, 523–532. [CrossRef]
77. Wang, W.; Zhao, X.; Cao, J.; Li, H.; Zhang, Q. Barriers and requirements to climate change adaptation of mountainous rural communities in developing countries: The case of the eastern Qinghai-Tibetan Plateau of China. *Land Use Policy* **2020**, *95*, 104354. [CrossRef]
78. Melore, T.; Nel, V. Resilience of informal settlements to climate change in the mountainous areas of Konso, Ethiopia and QwaQwa, South Africa. *Jàmbá J. Disaster Risk Stud.* **2020**, *12*, 9. [CrossRef] [PubMed]