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Study on Livelihood Resilience of Rural Residents under the Rural Revitalization Strategy in Ethnic Areas of Western Sichuan, China

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Abstract: Ethnic areas are special in terms of their geographic type, population size, production mode, etc. Scientific assessment of rural residents' livelihood resilience and exploration of its influencing factors are significant for tapping the potential of rural residents' livelihood resilience and promoting sustainable rural development. This research takes the villages in the western Sichuan ethnic area as the study area and, based on the sustainable livelihood framework and the analysis framework of rural residents' livelihood resilience, constructs an evaluation index system of rural residents' livelihood resilience and explores the factors affecting its evolution using the OLS parameter estimation method. The results found that: (1) Annual per capita income and livelihood diversification of key livelihood factors of farm households have improved under the rural revitalization strategy. (2) Skill training opportunities, loan opportunities, living conditions, non-agricultural work experience, and traffic accessibility had the most significant impact on livelihood resilience, and were the dominant forces in enhancing the rural residents' livelihood resilience. (3) There was a divergence of livelihood resilience among different types of rural residents, and those with low altitude, low dependency ratio, strong labor endowment, and high literacy had a higher livelihood resilience; furthermore, the mean value of livelihood resilience of tourism-led rural residents was higher than that of non-tourism-led rural residents under different livelihood strategies.

Keywords: rural residents' livelihood; livelihood resilience; western Sichuan ethnic areas; rural revitalization strategy

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1. Introduction

The countryside is a fundamental political unit that integrates agricultural production, ecological food, and local customs, and is responsible for maintaining the country's overall food, environmental, and cultural security [1,2]. However, with the wave of modernization, industrialization, and urbanization, rural development in many countries around the world is facing problems of high unemployment, the hollowing out of villages, widening income disparities, and the inefficient use of land resources [3–6]. Promoting rural development has become a common goal among countries, and many useful explorations have been carried out, such as Germany's "Village Renewal" campaign, Japan's "One Village, One Product" campaign, South Korea's "New Village Campaign", and the Netherlands' "Multi-System Rural Construction" [7–10]. With the deepening of the rural revitalization movement, rural development has achieved some good results [11–13]. Since the reform and opening up, rural development in China has undergone development strategies, such as new socialist countryside construction, new urbanization, beautiful countryside construction, and precise poverty alleviation [14–17]. Rural areas have achieved historic advancements in industrial

development, ecological environment, and cultural construction [18–20]. The quality of life and livelihood channels of rural residents have also been improved. However, there are still problems in rural areas in terms of livelihood foundation, livelihood pathways, and livelihood strategy selection. Therefore, in order to achieve coordinated and sustainable development of livelihoods, it is necessary to address the vulnerability of livelihoods and shift toward resilience.

Scholars' research on livelihood originated early. Livelihood was first mentioned in the discussion of poverty, referring to the way individuals, families, or groups make a living [21]. In the 1990s, the concept of resilience emerged in the field of social ecology, referring to the ability of a social-ecological system to withstand shocks or disturbances while retaining its original state and regaining stability [22]. Over time, research on resilience expanded into various fields, including the study of livelihoods. Consequently, early research aimed to integrate the principles of resilience and livelihoods to explore livelihood resilience from different perspectives [23,24]. Livelihood resilience reflects the adaptive capacity of livelihoods, indicating their ability to mobilize and utilize resources to diversify or change strategies in response to stress and shocks [25]. This developing theory of livelihood resilience offers a different perspective on the study of rural residents' livelihoods and holds significant importance for optimizing livelihood strategies and ensuring the sustainability of livelihood systems [26]. This theory formed a foundational basis for subsequent research. Based on the clarification of the concept and connotation of livelihood resilience, a variety of livelihood resilience analysis frameworks were established with typical regions and cases. For instance, some frameworks are based on the concept of livelihood capital, drawing connections between capital and the ability to withstand disasters [27]. Other frameworks incorporate dimensions such as adaptive change ability, learning and adaptability, self-organization ability, happiness level, and environmental sustainability. The frameworks laid the foundation for long-term research on how to address livelihood risks in different regions of the world [28,29]. One widely used framework focuses on three dimensions: buffer capacity, self-organization, and capacity for learning. This framework effectively captures the evaluative aspects of livelihood resilience [30]. By employing these various frameworks, researchers have advanced the understanding and assessment of livelihood resilience across different contexts, making significant contributions to the field.

There are also more analytical approaches to livelihood resilience research; for example, categorizing rural households into different types and applying multinomial logistic models to analyze the impact of household livelihood resilience on livelihood strategies [31]. Another approach used a contribution model to identify the main factors contributing to livelihood resilience and to explore livelihood-building pathways for resettled households [32]. A difference-in-difference approach was used to explore the impact of project implementation on livelihood resilience in [33]. In recent years, many scholars have conducted in-depth research on the basis of the livelihood resilience analysis frameworks. For example, the livelihood vulnerability index (LVI) and livelihood impact index (LII) are used to assess livelihood vulnerability in [34]. Sustainable livelihoods are combined with a livelihood resilience framework to explore the relationship between livelihood strategies and livelihood resilience in [35]. Through field research, a livelihood resilience analysis framework was used to calculate the specific regional livelihood vulnerability index in [36]. A number of studies have also been carried out in the areas of livelihood diversification [37], tourism development and assessment [38], land consolidation [39], sudden-onset disasters [40], food security [41], and poverty alleviation and relocation [42]. In recent times, academic research focusing on livelihood resilience has yielded remarkable findings. Nevertheless, the predominant emphasis has been on elucidating the fluctuations in livelihood resilience, while there has been an insufficient examination of the influential factors and underlying mechanisms that drive it.

The western Sichuan ethnic region is located on the southeastern edge of the Qinghai Tibet Plateau, and it has become one of the largest areas of concentrated and deep poverty in China. This is due to the limitations of geography, regional culture, and transport bar-

riers, which have led to the disadvantaged position of farming households in terms of social networks, employment opportunities, and economic resources, and have made their livelihoods more susceptible to instability and vulnerability [43,44]. In recent years, the rural residents' livelihoods based on rural natural resources have shown instability to the external environment due to the impacts of global climate extremes and the restructuring of the urban–rural spatial structure. Changes in the external environment are very likely to affect the sustainability of the livelihoods of rural residents [45]. Therefore, scientifically assessing the level of livelihood resilience in the ethnic areas of western Sichuan and identifying the impact mechanisms, as well as proposing recommendations for improvement, can further help stabilize livelihood development in the ethnic areas. This is of great significance for China's subsequent rural revitalization efforts. At the same time, the Chinese experience and development model formed in relation this can also provide experience and reference for rural development in other countries. Therefore, this research, grounded in Speranza et al.'s livelihood resilience analysis framework and supported by semi-structured questionnaire survey data gathered during the 2017 and 2021 expeditions, seeks to address the ensuing issues: (1) By constructing the evaluation system of rural residents' livelihood resilience, this paper discusses the impact of the implementation of a rural revitalization strategy on rural residents' livelihood resilience in western Sichuan ethnic areas. (2) Using the multiple linear regression model, this paper explores the main factors of the change of rural residents' livelihood resilience in ethnic areas of western Sichuan and compares the differences among various types of rural residents' livelihood resilience and the main reasons for them.

2. Materials and Methods

2.1. Study Area

The ethnic minority region in China refers to the areas where ethnic minorities mainly gather to live. The western Sichuan ethnic region is strategically located at the convergence of Sichuan, Yunnan, and Tibet, encompassing a geographical expanse between 97°20′ E–104°25′ E and 26°02′ N–34°18′ N. It encompasses the administrative areas of Aba Tibetan and Qiang Autonomous Prefecture, Ganzi Tibetan Autonomous Prefecture, Liangshan Yi Autonomous Prefecture, and Panzhihua City and is also home to a concentration of ethnic minorities, including Tibetans, Yi, and Qiang. The total area is about 30×10^4 km^2, accounting for about 60% of the total area of Sichuan Province. The terrain in western Sichuan is high in the northwest and low in the southeast, with an average elevation soaring above 4000 m (Figure 1). The climate showcases a diverse and intricate interplay of subtropical monsoons and cold temperate zones. Average annual temperatures range from −6.6 °C to 16.3 °C. The area boasts numerous rivers that serve as vital water conservation zones for the Yangtze River and the Yellow River.

The population of the western Sichuan region is about 8,006,000 people, with ethnic minorities constituting a significant portion at around 4.4339 million, accounting for 55.42% of the total population. The ethnic areas of western Sichuan are dominated by large families and a small-scale, self-sufficient peasant economy. The plants grown on the land are mainly vegetables and fruits. The grain-planting area is relatively small. Therefore, the self-sufficiency rate of grain is low, and the area relies on an external market supply. Meanwhile, animal husbandry is well developed. The industrial structure here remains relatively simple due to natural constraints. However, the region has a profound accumulation of ethnic culture and unique natural scenery, containing two world natural heritage sites, accounting for 66.7% of the Sichuan average, and some national scenic spots. Tourism has emerged as a key industry in the western Sichuan ethnic areas, with a significant impact on rural revitalization and economic development.

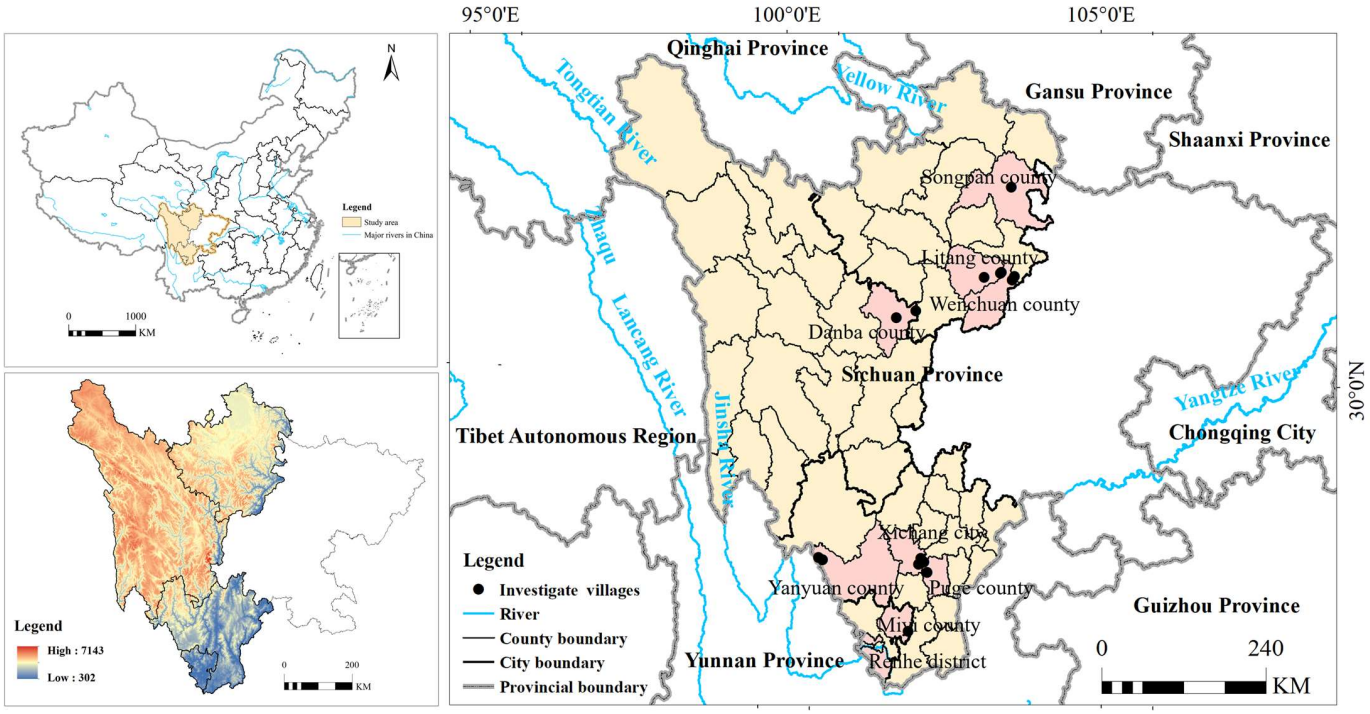

Figure 1. Study area.

2.2. Data Sources

This study primarily used three distinct data types.

(1) Field survey data: These data originated mainly from a semi-structured questionnaire survey conducted among rural residents and from in-depth interviews with personnel closely associated with the village. In preparation for the formal survey, a preliminary trip was undertaken to Taoping Village in May 2017 to gather social and economic information. Building upon the findings of this pre-study, the questionnaire underwent revision and improvement. Subsequently, the research team collaborated with local experts from institutions such as the Tourism Bureau, Poverty Alleviation Bureau, and Transportation Bureau to conduct a preliminary assessment of the villages within the study area. A selection of typical tourist villages and nearby non-tourist villages were sampled for this study. In July 2017, from the 15 identified tourism villages and non-tourism villages, the team randomly selected 10–20 samples from each village and proceeded with the formal survey. Among them, the obtained data represent the overall level of rural households. A follow-up survey was conducted in the same village in January 2021. The average sample size encompassed 958 individuals from 198 rural residents, yielding a recovery rate of 98% after eliminating invalid questionnaires and abnormal data.

(2) Geospatial data: Topographic elevation data (spatial resolution of 90 m) were obtained from the geospatial data cloud (http://www.gscloud.cn/ (accessed on 26 December 2022)). The vector data of administrative boundary and water systems were obtained from the Ministry of Natural Resources of China.

(3) Socio-economic data were obtained from the «Sichuan Statistical Yearbook», «Aba Statistical Yearbook», «Ganzi Statistical Yearbook», «Liangshan Statistical Yearbook», and «Panzhihua Statistical Yearbook».

2.3. Analysis Framework of Rural Revitalization and Rural Residents' Livelihood Resilience

Livelihood behaviors are shaped by the available capabilities and assets within households [46]. The sustainable livelihoods analysis (SLA) framework offers a comprehensive approach to assess the sustainability of livelihoods, encompassing five key dimensions: vulnerability context, livelihood capital, livelihood strategies, process shifts, and livelihood outputs. As the core content of sustainable livelihood research, livelihood resilience has

always been a hot topic in academic research [47]. At present, the analysis framework of livelihood resilience constructed by Speranza et al., including three dimensions of buffer capacity, self-organization, and capacity for learning, is widely used. However, the livelihood resilience of rural residents is not solely influenced by internal structural factors but is also impacted by external contexts of vulnerability, such as natural, social, and political environmental factors. Consequently, in order to gain a comprehensive understanding of the intrinsic value of livelihood resilience changes and the factors influencing them, this study introduces external influencing factors into the analysis framework. This approach is built upon the foundations of Speranza et al.'s livelihood resilience framework, the SLA framework, and the rural revitalization framework used in previous studies. The external influencing factors are introduced to construct the analysis framework of livelihood resilience in this paper.

External influences include the policy environment, vulnerability context, and regional conditions, all of which play pivotal roles in shaping changes in livelihood resilience. In the framework, this paper categorizes external influences into risk factors, policy factors, and regional factors. In 2017, the Chinese Communist Party introduced the "rural revitalization strategy", comprising five specific pillars: industrial revitalization, talent revitalization, cultural revitalization, ecological revitalization, and organizational revitalization. These pillars directly or indirectly impact the buffer capacity, self-organization, and the capacity for learning at different levels. The risk factors refer to the external environment in which rural residents operate and reside, often referred to as the risk environment. For instance, the outbreak of the COVID-19 pandemic in early 2020 had adverse effects on the health and livelihood of residents. In addition, disruptions in the food supply chain, closure of enterprises, and unemployment among rural residents directly affect production and consumption [48–50]. Moreover, regional conditions significantly contribute to changes in the resilience of rural residents' livelihoods. Areas characterized by flat terrain and efficient connectivity are better equipped to meet the livelihood needs of rural residents in terms of infrastructure, thereby fostering increased production and incomes.

Livelihood resilience comprises three fundamental components: buffer capacity, self-organization, and capacity for learning. Buffer capacity refers to the rural residents' ability to maintain their core functions and structures in the face of internal and external disruptions, demonstrating their capacity to withstand unforeseen risks [51]. Self-organization involves the inherent interactions between rural residents and social organizations, empowering rural residents to access resources by fostering internal cohesion and improving communication with the external world [52,53]. The capacity for learning encompasses rural residents' ability to discover, share, and exchange essential skills and knowledge to adapt to external threats or unexpected changes. This enables them to adjust their livelihood strategies and strengthen their connections to the broader system [54,55].

In addition, the confluence of factors, including the policy directives of the rural revitalization strategy, the natural and social conditions of the region, and the inherent livelihood risks, collaboratively contribute to the enhancement of livelihood resilience. In this process, rural residents adapt their livelihood strategies, diversify their livelihood pathways, accumulate livelihood capital, and optimize their livelihood capital structure. As a result, livelihood vulnerability gradually diminishes, and risk resilience increases, thereby invigorating rural residents' internal livelihoods and achieving long-term livelihood sustainability (Figure 2).

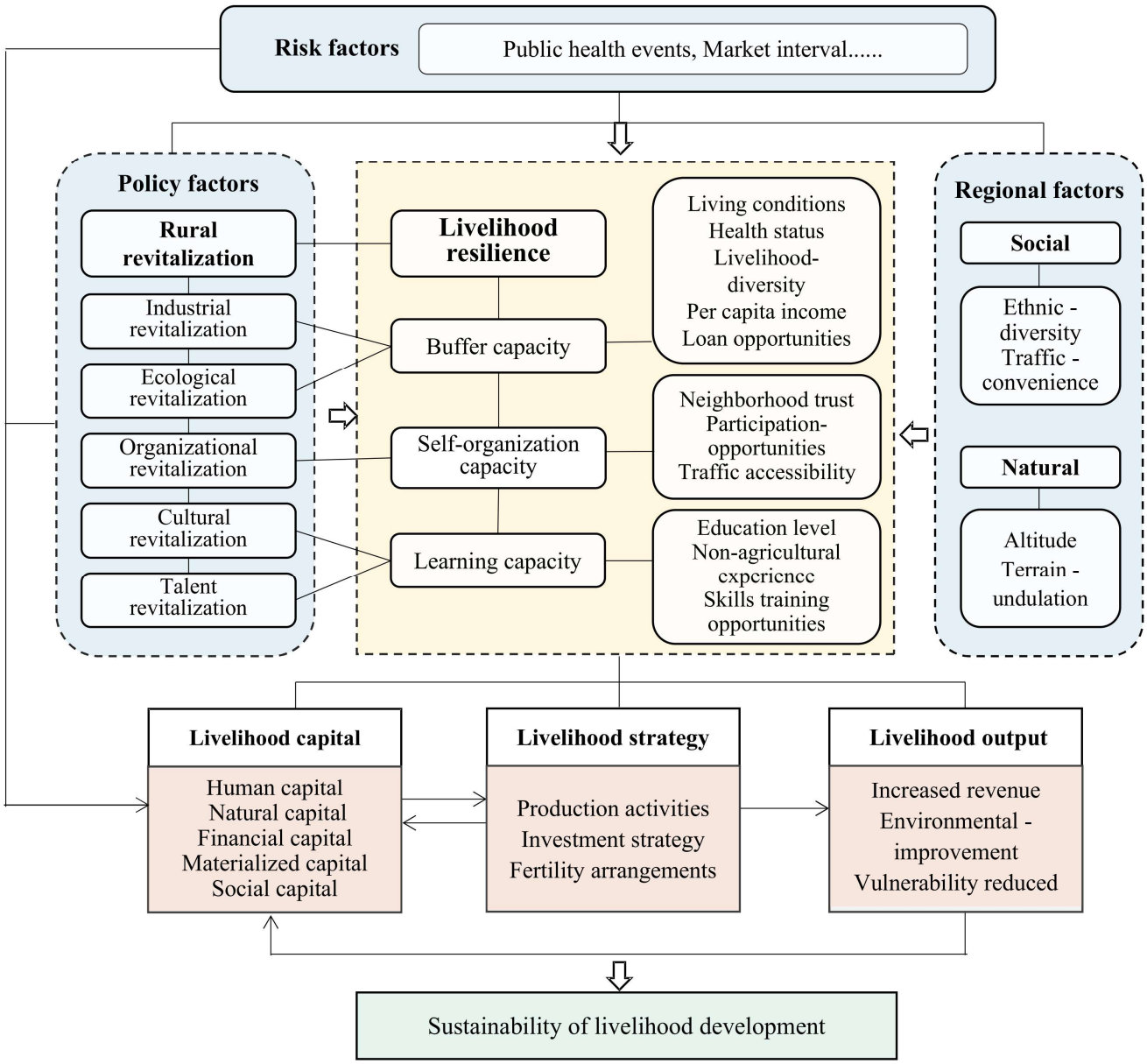

Figure 2. Conceptual framework based on rural revitalization and rural residents' livelihood resilience.

2.4. Indicator System for Evaluating the Livelihood Resilience of Rural Residents

The construction of the indicator system for evaluating the rural residents' livelihood resilience was derived from the framework for analyzing the adaptive capacity of livelihoods, constructed by Speranza et al., and combined with existing studies and questionnaire data of rural residents in the study area. This study selected structured questions from the semi-structured questionnaire and used the 0–1 scoring method to assign scores to each index to carry out dimensionless processing. On the basis of statistical and correlation analyses, the evaluation index system of rural residents' livelihood resilience was constructed from three dimensions: buffer capacity, self-organization, and capacity for learning (Table 1).

Table 1. Evaluation index system for livelihood resilience ability.

Dimension	Indicator	Definition and Interpretation	Weight
Buffer capacity 0.333	Living conditions (X1)	Type of house (0 = thatched, 0.25 = earthwork, 0.5 = clay brick, 0.75 = brick, 1 = concrete)	0.277
	Health status (X2)	Proportion of healthy people in the household to the total number of people (%)	0.153
	Livelihood diversity (X3)	Total number of types of livelihood activities engaged in	0.166
	Per capita income (X4)	Ratio of total annual household income to total number of persons (%)	0.116
	Loan opportunities (X5)	Access to loans from banks (0 = no, 1 = yes)	0.288
Self-organization 0.333	Neighborhood trust (X9)	Level of mutual trust between neighbors (0 = no trust, 0.25 = very little, 0.5 = fair, 0.75 = some trust, 1 = complete trust)	0.234
	Participation opportunities (X10)	Opportunity to participate in village activities (0 = no opportunity, 0.25 = very little, 0.5 = fair, 0.75 = more, 1 = quite a lot)	0.443
	Traffic accessibility (X11)	Type of road (0 = unhardened road, 0.5 = main village road, 1 = township and above road)	0.323
Capacity for learning 0.333	Educational level (X6)	Household educational attainment (0 = illiterate or semi-literate and kindergarten, 0.25 = primary school, 0.5 = junior high school, 0.75 = high school/secondary/vocational high school, 1 = bachelor's degree and above)	0.196
	Skills training opportunities (X7)	Received relevant technical training (0 = no, 1 = yes)	0.378
	Non-agricultural work experience (X8)	Number of non-rural workers as a proportion of the total population (%)	0.426

(Note: X1, X2, . . ., Xn is the independent variable in the regression model).

The buffer capacity dimension encompasses five key indicators: living conditions, health status, livelihood diversity, annual per capita income, and loan opportunities. Physical and housing conditions have a greater impact on the buffer capacity of rural residents. Additionally, the household's labor force and health status signify the human capital status, which plays a critical role in determining the buffer capacity against risk disturbances. Moreover, the diversity of livelihoods and per capita income are vital in enhancing the ability of livelihoods to cope with change, directly influencing the economic well-being of rural residents [56]. It is important to note that a higher household income ensures a more secure quality of life. Furthermore, loan opportunities also plays a crucial role as it affects the household's capacity to maintain essential livelihood functions and structures amidst livelihood risks, leveraging external support [57].

The self-organization dimension comprises three indicators: neighborhood trust, participation opportunities, and traffic accessibility. Firstly, neighborhood trust reflects the extent to which rural residents share resources and support one another. Then, opportunities for participation gauge the rural residents' ability to engage in collective rural affairs, and higher participation levels foster increased social interaction among rural residents [58]. Lastly, transportation reflects the extent of rural residents' connectivity with the outside world, and easy transportation enhances opportunities for rural residents to participate in various social activities.

The capacity for learning dimension encompasses three indicators: educational attainment, skills training opportunities, and non-rural work experience. The household education level importantly contributes to the capacity for learning and influences the liveli-

hood behaviors and learning level of rural residents. Moreover, skills training opportunities provide rural residents with valuable knowledge and skills that they can directly utilize in the face of external changes, thereby reflecting their capacity for learning. Additionally, non-agricultural work experience broadens the horizons of rural residents, increasing their opportunities to learn and interact with the outside world.

2.5. Typology of Rural Residents

In order to better study the livelihood resilience of different types of rural residents, the types of rural residents were classified by combining existing studies and the actual situation in the western Sichuan region. According to the terrain, they can be divided into high- and low-altitude areas; according to the number of laborers, they can be divided into labor shortage ($\leq$2) and labor abundant types of rural residents (>2); according to the household dependency ratio, they can be divided into low ($\leq$0.5), medium (0.5~1), and high dependency ratio households ($\geq$1); according to the average education level of the laborers, they can be divided into high (college and above), medium (primary to high school), and low education (uneducated). In addition, they can be divided into tourism-led and non-tourism-led households based on the local livelihood strategies research.

2.6. Methods

2.6.1. Data Standardization

The indicator system was quantified by classifying and assigning values to the indicators, eliminating differences in the nature of the indicators, the influence of the scale, and the order of magnitude, and standardizing the indicators using the extreme difference method, calculated as:

$$R_{lj} = (R'_{lj} - R_{min})/(R_{max} - R_{min}) \quad (1)$$

In the formula: R'_{lj} is the quantitative value of sample l index j; R_{lj} is the standardized value of sample 1 index j; R_{min} and R_{max} are the minimum and maximum values of the total sample, respectively.

2.6.2. Determination of Indicator Weights

The indicator weights were determined using the mean squared difference decision method, i.e., the coefficients of deviation of the stratified indicators for 2017 and 2021 were calculated and normalized to obtain the indicator weights for each period, which were used to reflect the degree of contribution of each indicator to the overall data. In this study, the three dimensions are considered equally important, so the weights of all three dimensions were assigned a value of 0.333. The indicator stratum weights were calculated as follows:

$$U_{ij} = \frac{1}{n}\sum_{i=1}^{n} R_{ij} \quad (2)$$

$$S_{ij} = \sum_{i=1}^{n} (R_{ij} - U_{ij})^2 \quad (3)$$

$$W_{ij} = S_{ij}/\sum_{i=1}^{m} S_{ij} \quad (4)$$

In the formula, i is the dimension, j is the indicator, R is the indicator value, U is the mean, S is the variance, W is the weight, n is the number of samples, and m is the number of indicators contained in each criterion layer.

2.6.3. Estimation of Livelihood Resilience

Combining existing research with the concept of livelihood resilience, the three dimensions' layer attributes of buffer capacity, self-organization, and capacity for learning were summed to obtain the livelihood resilience, which was calculated as follows [59]:

$$ACI_j = BI_j + LI_j + SI_j = \sum_{j=1}^{m} W_{ij}R_{ij} + \sum_{j=m+1}^{n} W_{ij}R_{ij} + \sum_{j=n+1}^{z} W_{ij}R_{ij} \quad (5)$$

In the formula, ACI_j denotes the adaptive capacity of rural resident j's livelihood, and BI_j, LI_j, and SI_j denote buffer capacity, self-organization, and capacity for learning, respectively. W_{ij} is the weight of each indicator of adaptive capacity, R_{ij} is the normalized adaptive capacity indicator value, and m, n, and z are the numbers of indicators in the buffer capacity, self-organization, and capacity for learning dimensions, respectively.

2.6.4. Regression Model

A regression model is a mathematical model for the quantitative description of statistical relationships, a mathematical method for studying the implied laws of change between relevant variables, and a method for transforming uncertain relationships into definite functional relationships [60]. Regression models have a predictive role. This study analyzed livelihood resilience and selected 11 factors based on a multiple linear regression model, based on the set of explanatory variables. Specifically, livelihood resilience was the dependent variable, and external variables that affect livelihood resilience were the independent variables. The regression model was set up as follows:

$$Y = C + C_1X_1 + C_2X_2 + \ldots + C_iX_j + \varepsilon \quad (6)$$

In the formula, Y is the livelihood resilience, C_i is each intercept term of the regression model, X_j is the explanatory variable, and ε is the random disturbance term. The regression coefficient is a parameter in a regression equation that indicates the magnitude of the effect of the independent variable X on the dependent variable Y. The larger the regression coefficient, the larger the effect of X on Y. A larger regression coefficient indicates that X has a greater effect on Y. A positive regression coefficient indicates that Y increases as X increases, while a negative regression coefficient indicates the opposite.

3. Results

3.1. Changes in Key Livelihood Factors of Rural Residents in the Context of Rural Revitalization

Livelihood capacity is a multifaceted concept, and among its key components, annual income per capita and livelihood diversity are particularly susceptible to changes in external conditions. In 2020, public health events will theoretically affect tourist arrivals and, thus, revenues. This would further lead to a decline in livelihood resilience. However, the questionnaire data show that the per capita income of farmers showed an increasing trend, from 13,609.53 Yuan to 22,082.18 Yuan, with an average annual growth rate of 13%, and there was an upward trend in livelihood resilience. Clearly, the rural revitalization strategy played a positive role. The implementation of the rural revitalization strategy has played a significant role in fostering rural development. Through various initiatives, such as skills training, the expansion of livelihood opportunities, and improvements in regional education, the strategy has gradually increased the household income of rural residents. Skills training has empowered workers and enhanced the stability of their incomes, contributing to a broader range of income sources.

In the context of precise poverty alleviation efforts, the governments in the western Sichuan region have undertaken profound educational poverty alleviation projects, leading to a unique and effective anti-poverty model [61,62]. This has resulted in a transformation in the mindset of rural residents, boosting their motivation and encouraging them to

explore employment opportunities beyond traditional agricultural activities [63]. Evidence from specific villages reflects the positive impact of the rural revitalization strategy.

Comparing data from 2017 and 2021, Taoping Village experienced a two-fold increase in annual income, Shengli Village saw a 1.5 times increase, Deyu Village witnessed a 20.08% rise, and Shannan Village recorded an impressive 58.66% increase. The different levels of growth are related to the buffer capacity between villages, for example, the comparison between Taoping Village (0.68) and Shannan Village (0.61). Taoping Village is a level 4A tourist attraction. It also has very distinct tourism characteristics and good tourism reception services, making the livelihoods of rural residents more diverse. Shannan Village is a non-tourist village, and it has more homogeneous industries, such as growing crops and raising cattle and sheep. The diversity of its rural households' livelihoods is lower than that of Taoping Village. As a result, there is a difference in the level of income growth of rural residents. During the survey, it was observed that some rural residents used to engage solely in agricultural production activities, such as food and fruit tree cultivation or animal husbandry. However, with the support of the precision poverty eradication and rural revitalization strategies, these households have diversified their livelihoods. Many have moved into tourism, utilizing existing resources to offer tourism-related services and earn economic income. Furthermore, during the off-season of tourism, some rural residents have started planting fruits and crops, which they eventually sell across the country using the internet and other platforms. This diversification has enhanced the overall livelihood diversity for rural residents.

3.2. Evaluation of Changes in Rural Residents' Livelihood Resilience

This study focused on 15 villages located in 10 townships within the western Sichuan ethnic region as its research target and tracked and monitored the rural residents' livelihoods before the implementation of the rural revitalization strategy. The study calculated the individual rural residents' livelihood resilience index and quantified the buffer capacity, self-organization, and capacity for learning based on the model presented in Table 2. The results of the analysis indicate that the rural residents' livelihood resilience index in 2021 was 0.622, representing an improvement of 9.7% compared to the index value of 0.567 recorded in 2017. These findings suggest that overall, rural residents' livelihood resilience has shown a positive trend with the implementation of the rural revitalization strategy. The main reasons for this are the gradual enrichment of rural social resources, the rising standard of living of rural residents, and the increasing channels and opportunities for learning about external knowledge.

Table 2. Changes in the livelihood resilience of rural residents before and after the implementation of the rural revitalization strategy.

Indicator	Year		Change Value	Amount of Change/%
	2017	2021		
Buffer capacity	0.177	0.215	0.038	21.47%
Self-organization	0.272	0.279	0.007	2.67%
Capacity for learning	0.118	0.128	0.010	8.47%
Livelihood resilience	0.567	0.622	0.055	9.7%

3.2.1. Buffer Capacity

From 2017 to 2021, there was a significant 21.47% increase in the buffer capacity of rural residents in western Sichuan, rising from 0.177 to 0.215. This change can be attributed to the variations in buffer capacity among different rural residents due to their distinct physical conditions and financial foundations. Western Sichuan ethnic region is situated in the mountainous region of the western plateau in Sichuan Province. Its unfavorable geographical location has historically resulted in limited economic exchanges with the outside world, leading to a closed economic area. Moreover, the livelihood strategies of

residents have been predominantly centered around agriculture, resulting in a low economic base level and a subsequently lower buffer capacity in the initial stages. However, the implementation of the rural revitalization strategy in the same year has played a pivotal role in transforming the region. Leveraging its unique regional and ethnic characteristics, western Sichuan has actively promoted regional development. This includes undertaking supply-side structural reforms in agriculture, with a focus on developing characteristic agricultural production systems and rural tourism management systems [64,65]. Additionally, measures such as "online e-commerce" and "integration of agriculture and tourism" have been employed to ensure the supply and sale of agricultural products, providing rural residents with diverse income opportunities [66–68]. Efforts have also been made to improve the living environment by addressing shortcomings in rural infrastructure and public services [69]. Furthermore, the government's intervention has been instrumental in optimizing the financial and physical capital of rural residents. Initiatives such as issuing poverty alleviation subsidies, renovating dangerous houses, and providing microcredit have collectively contributed to an overall increase in buffer capacity.

3.2.2. Self-Organization

The self-organization index witnessed a marginal increase from 0.272 in 2017 to 0.279 in 2021, representing a modest growth of 2.67%. This subtle change signifies the rural residents' deep appreciation for the efficacy of the rural revitalization strategy in augmenting self-organization. From the vantage point of "talent revitalization and organization revitalization", the government has instituted a novel initiative—the Professional Rural Resident Training Project. Simultaneously, it has endeavored to establish and enhance a comprehensive public service system that spans both urban and rural areas, providing universal coverage. These concerted efforts have paved the way for rural residents to actively partake in training programs, fostering their self-empowerment and development.

However, the outbreak of public health events such as the COVID-19 pandemic has compelled governments to enforce an array of preventive measures, including lockdowns, transportation restrictions, bans on social gatherings, and mandatory quarantines. In response to these circumstances, rural residents have been compelled to recalibrate their behavioral patterns based on their perception of risks and their conscientious adherence to self-prevention and control measures [70]. Consequently, self-isolation and social distancing have imposed constraints on offline activities, leading to a reduction in rural residents' engagement with training opportunities and neighborhood interactions. As a result, there has been a certain weakening of rural residents' self-organization capacity during this challenging period.

3.2.3. Capacity for Learning

The capacity for learning index exhibited a relatively small change, from 0.118 in 2017 to 0.128 in 2021, reflecting an increase of 8.47%. This indicates that majority of rural residents are inclined to improve their capacity for learning. Notably, indicators such as the education level and non-agriculture work experience of rural residents have contributed to this improvement. The dominance of their own ethnic language and mainstream culture has resulted in relatively lower levels of literacy and capacity for learning. However, with the popularization of Chinese teaching and an increasing level of social interactions with the outside world, progress has been made in enhancing learning opportunities. Highly educated rural residents have taken the lead in developing the tourism industry, capitalizing on the region's abundant local resources. They attach importance to tourism management skills training and effectively utilize "Internet+" platforms for tourism promotion and marketing. The transformative effect of their livelihoods, especially the significant income generated from tourism, serves as a powerful demonstration for other rural residents. Consequently, this positively influences the overall improvement of capacity for learning among rural residents in the western Sichuan ethnic region. Moreover, various local governments have launched diverse training programs, focusing on areas such as culture, tourism, sports,

recreation, and agriculture as part of the rural revitalization strategy. These efforts are aimed at empowering rural development and fostering a stronger learning environment.

3.3. Exploration of the Influencing Factors of Rural Residents' Livelihood Resilience Change

The impact factors were analyzed using SPSS, and the results were estimated using the OLS parameter estimation method (Table 3), to explain the extent to which the 11 variables studied were associated with livelihood resilience before and after the rural revitalization strategy. As can be seen from Table 3, the coefficients of the key factors were positive, and the effect was significant at the 1% level, with all other variables held constant. This indicates that they all positively contributed to the rural residents' livelihood resilience. In general, the ranking of the strength of contribution among the influencing factors was in the order of: skills training opportunities (0.561), living conditions (0.339), loan opportunities (0.326), non-agricultural work experience (0.263), and traffic accessibility (0.180), followed by participation opportunities (0.155), livelihood diversity (0.177), education level (0.100), health status (0.098), neighborhood trust (0.093), and finally, per capita income (0.051).

Table 3. Multiple linear regression of rural residents' livelihood resilience.

Dimensional Layers	Livelihood Resilience Indicators	Year				Average	
		2017		2021			
		Coefficient	*p*	Coefficient	*p*	Coefficient	Ranking
Buffer capacity	Living conditions	0.195	0.000	0.483	0.000	0.339	2
	Health status	0.110	0.000	0.085	0.000	0.098	10
	Livelihood diversity	0.120	0.000	0.114	0.000	0.117	6
	Per capita income	0.053	0.000	0.048	0.000	0.051	11
	Loan opportunities	0.373	0.000	0.279	0.000	0.326	3
Self-organization	Neighborhood trust	0.089	0.000	0.097	0.000	0.093	7
	Participation opportunities	0.214	0.000	0.096	0.000	0.155	8
	Traffic accessibility	0.183	0.000	0.176	0.000	0.180	5
Capacity for learning	Educational level	0.110	0.000	0.089	0.000	0.100	9
	Non-agricultural work experience	0.250	0.000	0.276	0.000	0.263	4
	Skills training opportunities	0.551	0.000	0.570	0.000	0.560	1

A key focus of rural revitalization is the promotion of industrial prosperity, and talent plays an indispensable role in driving rural industrial development. Skills training emerges as a critical factor in achieving high-quality employment opportunities. In the western Sichuan ethnic region, active efforts have been made to implement skills training programs tailored to regional realities and aligned with the local industrial structure. This approach not only fosters the development of industries in the region but also enhances the skills of the labor force, expanding the livelihood avenues available to rural residents. Simultaneously, the region continues to deepen the implementation of measures for poverty alleviation and relocation. Through this process, rural residents gain access to improved housing, education, medical care, and other essential services in their new environment. The overall living conditions and quality of life have been enhanced, contributing to an increased ability to withstand risks and challenges. Rural transportation is recognized as a vital prerequisite for rural revitalization. Consequently, the western Sichuan region has been actively promoting the construction of basic rural roads and improving the transportation network. This development enables easier transportation of products and facilitates the influx of tourists. Improved transportation access holds significant implications for the

development of rural characteristic industries, narrowing the urban–rural gap, preserving national culture, and fostering external exchanges. All these factors further strengthen the resilience of rural residents' livelihoods.

4. Discussion

Under the positive promotion of the rural revitalization strategy, the livelihood resilience of rural residents in western Sichuan has improved. However, livelihood resilience showed different results due to differences in regional conditions, rural residents' status, and rural residents' livelihood strategies.

4.1. Differentiation of Rural Residents' Livelihood Resilience

As observed from Figure 3, the rural residents' livelihood resilience in western Sichuan ethnic areas showed significant variation due to differences in the dependency ratios, literacy levels, labor endowments, and livelihood strategies. Furthermore, similar trends in livelihood resilience have emerged among these factors. Specifically, rural residents at higher altitudes exhibited lower livelihood resilience (0.590) compared to those at lower altitudes (0.596), but the difference was not significant. This disparity is attributed to the influence of altitude on topographic relief. Areas with more favorable topographic conditions have easier access to external information and resources. Additionally, the favorable terrain conditions create more favorable external conditions for a higher level of livelihood resilience among rural residents [71]. The results show that tourism development can offset some of the disadvantages caused by the high altitude of the region. For example, data from the Sichuan Provincial Statistical Yearbook indicate that in 2021, Wenchuan and Jiuzhaigou Counties, which are located at high altitudes, accounted for 32.42% of the total tourism revenue of the entire province.

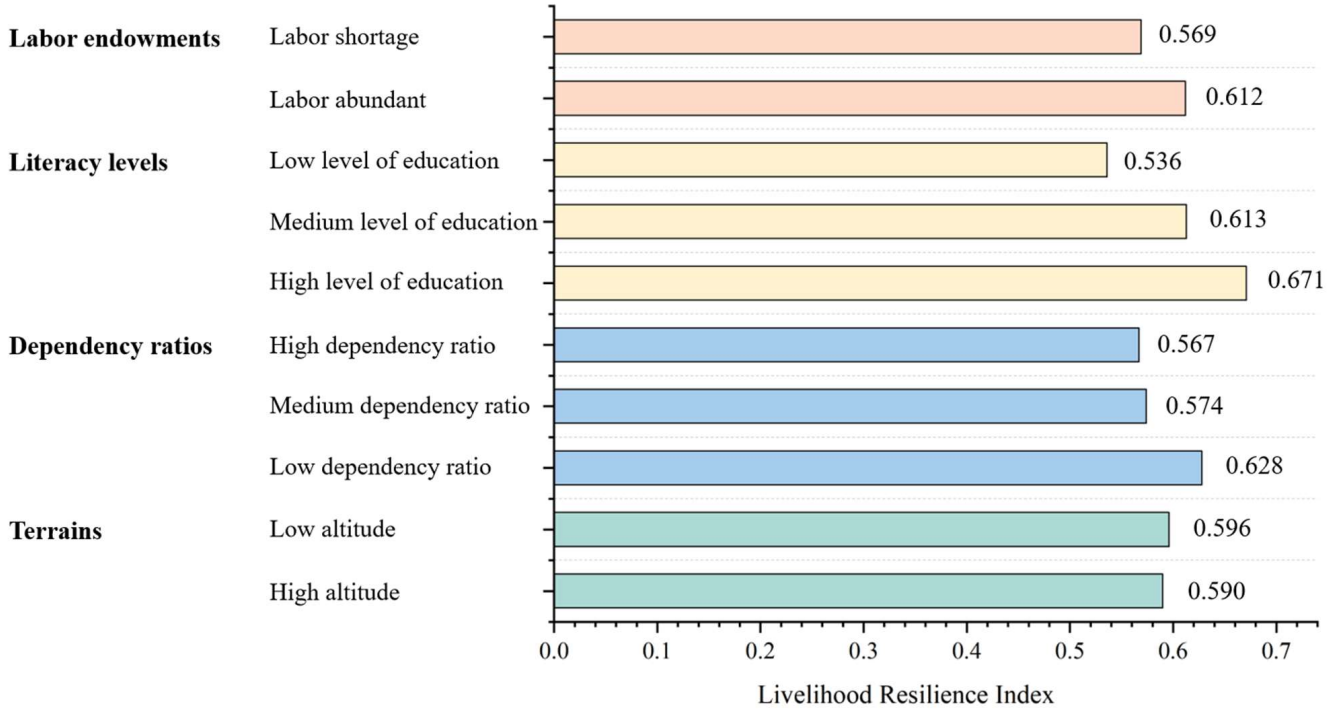

Figure 3. Comparison of livelihood resilience of different types of rural residents in western Sichuan.

Dependency ratios and labor endowments play a crucial role in reflecting the labor force status of rural residents. Research indicates that low dependency ratios and labor-abundant rural residents are better equipped to accumulate financial and physical capital, contributing to higher livelihood resilience. Conversely, rural residents with large dependency ratios and labor shortages experience an increase in the burden of depen-

dency and consumption of household medical care, reducing their ability to withstand risks. As a result, rural residents with low dependency ratios demonstrate significantly higher livelihood resilience compared to those with medium and high dependency ratios. The linear regression results showed that living conditions and loan opportunities have a strong positive contribution to livelihood resilience, while health status and per capita income have a weaker positive contribution. Therefore, the government should strengthen and improve the system of social security levels and care services that cover the whole population, are fair and uniform, and are sustainable and multi-layered, specifically in the form of a maternity support policy system, a medical insurance system, and a pension insurance system, to enhance the well-being of people's livelihoods.

The linear regression results revealed that skill training opportunities had the most substantial positive contribution to the livelihood resilience of rural residents in ethnic areas of western Sichuan, while the contribution of education level was relatively weakened. Figure 3 illustrates the relationship between literacy levels and livelihood resilience, indicating that rural residents with low, medium, and high levels of education experience increasing levels of resilience, in that order. These findings provide valuable insights for guiding educational development and rural revitalization efforts in the region. Simultaneously, the government should play a crucial role in creating more opportunities to attract and retain talent in the region by continuously improving the educational infrastructure. For instance, initiatives such as the "one village, one kindergarten" program, which aims to increase the number and quality of kindergartens, can contribute to building a robust public service system for pre-school education. Additionally, adopting innovative teaching methods, such as the "Internet plus education" approach, can improve the overall efficiency and effectiveness of the modern education system, in order to stimulate the endogenous motivation of rural residents to pursue a better life and achieve high quality through independent learning.

4.2. Impact of Tourism Industry on Rural Residents' Livelihood Resilience in Western Sichuan and Countermeasures

Tourism plays a pivotal role in the rural revitalization of western Sichuan ethnic region. The study's findings revealed that tourism-led rural residents exhibited a higher overall mean value of livelihood resilience (0.604) compared to non-tourism-led rural residents (0.588). This emphasizes the positive impact of tourism development on rural residents' livelihood resilience in the region. Western Sichuan is a multi-ethnic settlement area, with Jiuzhaigou, Huanglong Scenic Spot, and other world natural heritage and high-quality tourism resources. The region's folk culture highlights local characteristics, and the "tourism + ecology" model transforms resource advantages into economic advantages, deeply integrates industrial development with farmers' income, and realizes the long-term development of poverty alleviation and enrichment. Rural residents rely on tourism development, making the family's own material levels higher, with a strong ability to withstand risks.

This study found that changes in the livelihood resilience of tourism-led farm households are directly related to the degree of tourism development, and the higher the degree of tourism development, the greater the likelihood that livelihood resilience will be affected by external influences, while the development of non-tourism-led rural residents has evolved in a relatively stable manner. For example, under the role of the external environment, tourism-led rural residents are directly affected, as their main livelihood mode is blocked, and their income drops significantly, such as in the top ten famous villages in Sichuan, the national civilized villages and towns of Jiaju Village and Ganbao Village, and other tourism villages, whereby the average per capita income decreased by more than 1000 yuan. At the same time, the rural residents' livelihood resilience showed weakness in the dimension of self-organization, and the capacity for learning changes were too large (Figure 4). In recent years, the government has taken many measures to provide impetus for the development of the region. For instance, the government has continued to increase ecological protection

and strengthen rural infrastructure construction, with the aim of making the countryside a beautiful home where people can live and work in peace and contentment [72]. Based on this, the government needs to continue to implement professional skills training in tourism and increase preferential strategies for tourism operations. At the same time, rural revitalization enterprises should play a leading role and provide technical support to individual tourism operators, special support policies for tourism operations should be set up, and residents should make full use of the Internet platform to sell both agricultural and tourism products. For the livelihood resilience of non-tourist rural residents, this is mainly reflected in their capacity for learning. The government should be committed to professional training to give rural residents more financial support, to strengthen the rural residents' own ideological awareness and values, and to inspire positive changes and enthusiasm. Finally, it is also necessary to develop a tourism ecological safety plan that can protect the fragile ecological environment and promote the sustainable development of tourism [73].

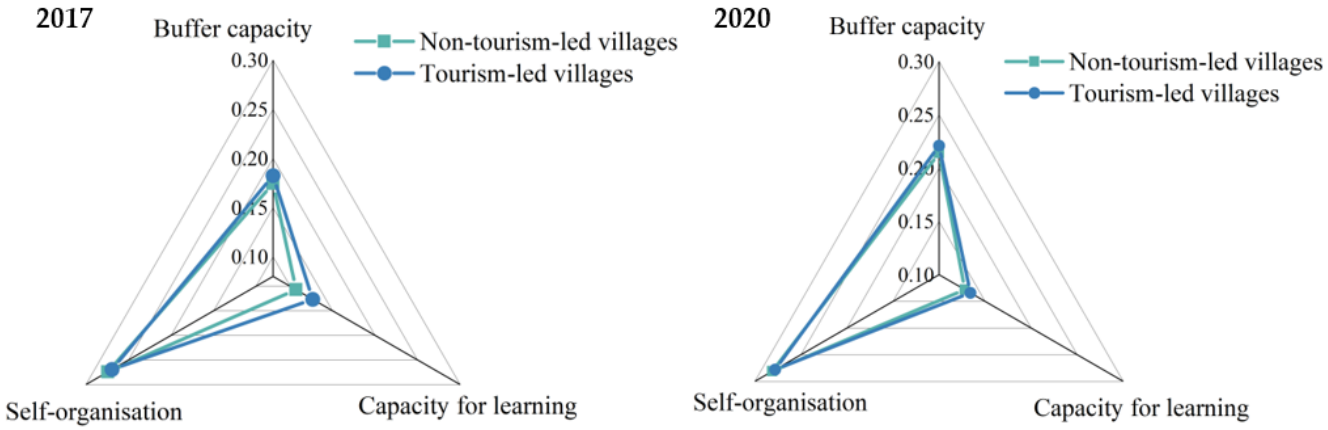

Figure 4. Comparison of various dimensions of abilities between tourism rural residents and non-tourism rural residents.

4.3. Guaranteeing Food Security Is the Cornerstone of National Livelihoods

Guaranteeing food security is the primary task of rural revitalization. It is not only an important foundation for maintaining national security, but also has a bearing on the livelihood and sustainable development of a large group of rural residents [74]. In recent years, the Chinese government has undertaken various activities in maintaining food security, such as carrying out structural reforms on the supply side of agriculture, implementing the return of forests to ploughing, and constructing a whole food industry chain, so as to enhance the food resilience supply in order to cope with food crises arising from unstable economic shocks, climate change, extreme weather, and public health events [75]. This investigation found that ethnic areas in western Sichuan have also deepened the implementation of relevant measures, such as distributing an average of 881 yuan of grain compensation per household to encourage farmers to grow grain, as well as renovation of abandoned land and construction of 151.34 acres (starting from 2019) of high-standard farmland. This has laid the foundation for ensuring food security and restoring grain resilience. However, due to the limitations of the natural conditions, the diversification of agricultural types is insufficient, with 83.3% of rural residents mainly growing livestock, fruits, and vegetables. Meanwhile, the total grain output accounts for only 7.07% of Sichuan Province, with a low grain self-sufficiency rate. These unfavorable factors create a potential crisis for the regional food system and exacerbate the vulnerability of food security.

At present, a better, more sustainable, and equitable food system needs to be established in the ethnic areas of western Sichuan to improve livelihood resilience. It needs to start from three aspects. First, the government needs to enrich and improve the preferential agricultural policies and improve the grain-growing environment, as well as increase rural residents' access to productive resources and technology. Second, rural residents

need to strengthen their capacity for learning and participate in agricultural production technology training. Third, social agents, such as small-scale food producers, need to mobilize agricultural research, finance, and information. At the same time, they should play the role of enterprises in narrowing the market interval and unblocking the sales channels of agricultural products. For example, the government of Yanyuan County has improved the quality of arable land by comprehensively managing rural infrastructure, the rural residents have changed their production and farming methods to improve economic returns, and enterprises and rural residents work together to ensure the sale and supply of agricultural products. Ultimately, the goal of ensuring food security and promoting rural revitalization can be gradually achieved. In collaboration, the food system in the western Sichuan ethnic region should have the ability to produce, protect, and recover at the same time. This mechanism for the joint participation of multiple actors in solving the problems of agriculture and food security is consistent with all regions of the world [76,77]. Therefore, countries around the world need to restore and protect healthy arable land and build resilient agricultural systems to provide food security, ultimately leading to stable and sustainable livelihoods.

5. Conclusions

Guided by the idea of sustainable livelihood development, this study constructed a livelihood resilience evaluation index system for rural residents based on the western Sichuan region. This study analyzed the changes in the rural residents' livelihood resilience in 2017 and 2021, and used a multiple regression model to explore the factors that affect the change of key livelihood factors and livelihood resilience. The following conclusions were drawn:

(1) From the perspective of livelihood resilience composition, under the background of rural revitalization, the rural residents' livelihood resilience index increased from 0.567 in 2017 to 0.622 in 2021, an increase of 9.7%. Rural residents had the highest level of self-organization and the largest amount of change in buffer capacity, with an increase of 21.47%. Although the change in external conditions had a certain impact on rural residents' livelihoods, the level of rural residents' livelihood resilience was still significantly improved under the implementation of the rural revitalization strategy.

(2) From the perspective of key livelihood factors, the household income of rural residents increased, and the diversity of livelihoods also increased. Under the post-targeted poverty alleviation era and the rural revitalization strategy, western Sichuan actively promotes the development of regional economy and society. The livelihood channels of rural residents have been broadened, and the quality of life and the production capacity have been improved. Therefore, the ability to avoid and withstand risks was strengthened, and rural residents' livelihood resilience increased.

(3) From the regression results, in 2021, the buffer capacity layers of health status, livelihood diversity, per capita income, and loan opportunities decreased in influence compared to 2017, and the impact of living conditions largely increased. The degree of influence of the factors in the capacity for learning dimension layer also changed, but in general, the decline was smaller. In terms of the self-organization dimension layer, opportunity to participate was the main influencing factor in 2017 but declined in 2021. The degree of influence of neighborhood trust increased.

Overall, the standard of living of rural residents has also significantly improved, and the rural residents' livelihood resilience has increased, improving their capacity to withstand risks. Therefore, it is important to continue to promote the rural revitalization strategy and to stimulate the internal vitality of rural residents. This is not only conducive to the economic and social prosperity of the villages in the ethnic areas of western Sichuan, but also useful in providing experience and reference for the development of villages all over the world. Ultimately, the goal of high-quality rural development will be realized.

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