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A New Livelihood Sustainability Index for Rural Revitalization Assessment—A Modelling Study on Smart Tourism Specialization in China

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Abstract: In our rapidly urbanizing world, the problem of rurality versus urbanization is becoming a source of concern. Rural tourism development may become a new important stimulus for promoting a sustainable transformation of the farmers' livelihood. This calls for a smart specialization in rural tourism where the focus is on a balanced rural revitalization strategy. As part of the empirical research, this paper introduces a livelihood sustainability index. This index helps to construct a balanced system for the evaluation of livelihood sustainability achievements in rural tourism destinations. It is based on livelihood capital, livelihood strategy, and the interlinkage between livelihood and environment, in order to dynamically assess the livelihood sustainability of rural households. Taking Huangpi District of the Wuhan area in China as our applied case study, the livelihood sustainability index appears to show over the past years a significant rise, based on a comprehensive index method, an entropy method, and a coupling coordination model. Our findings show that the development of rural tourism has clearly promoted livelihood sustainability. This has inter alia resulted in the accumulation of livelihood capital, an asset of which both social and cultural capital have benefitted greatly; livelihood strategies have also improved, and therefore so have livelihood diversity and stability; and finally, the interlinkage and coordination degree between livelihood and the environment has also changed positively from a primary to intermediate balanced development. However, the livelihood sustainability index in the area concerned is still relatively low, and has not yet reached its possible optimal level. Hence, there is still much room for improvement. Various approaches can be proposed to achieve a more sustainable livelihood, such as enhancing livelihood capital; narrowing the economic gap between farmers by participating in professional tourism activity; establishing the mechanism of industrial integration and the development of rural eco-tourism; and coordinating a balanced development of livelihood and environmental quality.

Keywords: sustainable livelihoods; rural ecological environment; rural tourism; smart specialization; livelihood sustainability index; rural revitalization strategy

1. Rural Revitalization and Smart Specialization: New Opportunities for Rural Tourism

The rapid urbanization of our world has started already more than half a century ago. Nowadays, cities—and in a more general sense, urban agglomerations—accommodate already more than half of the world's population. From this perspective, the UN is even speaking of the “urban century” as a new epoch in human history. This rising urbanization is not only a simple geographic and demographic phenomenon of spatial movements of people. The new map of our planet, called the “New Urban World” by Kourtit, mirrors also a change in economic–political power positions of modern

cities [1]. In the “urban century” we observe a fundamental transformation in the roles of urban agglomerations and mega-cities (cities with more than 10 million inhabitants), which may be generally described as “urban empires” [2]: cities and urban areas tend to become economic–political magnets, which attract a significant part of global socio-economic activity (e.g., business, visitors, culture, science and technology) and become the smart leaders of world economic forces.

The above sketch of global megatrends prompts two broad categories of policy challenges, viz. (i) an effective management of the multi-faceted constellation of large-scale urban areas (e.g., housing, mobility, poverty, environmental quality, human health); and (ii) sufficient care for a balanced socio-economic position of the rural population, which is nowadays gradually turning into a minority, at least from a geographic–demographic perspective. In the present study we will focus our attention on the development of new opportunities for the rural population in the urban world. In particular, we will address here novel perspectives offered by rural tourism to the agricultural sector where we will use China as a case study.

Rural development strategies have been advocated worldwide as a policy intervention aiming at supporting a healthy livelihood for the rural population, often oriented towards agriculture, handicraft, small-scale informal activities, wellness, nature, and ecology [3]. In recent decades, eco-tourism—inspired by an environmentally benign orientation of less urbanized areas—has become a new focal point of rural development opportunities. There is a growing set of studies on rural transitions in the context of regional resilience. An interesting case study on the attractiveness of rural landscapes and nature in small-scale tourism can be found in a Japanese case study on rural wellness by Romao et al. [4].

It is clear that a re-orientation of a local economy towards rural tourism is a major challenge, from both an economic and sustainability point of view. This calls for a long-range strategic policy, which will ensure economic livelihood, entrepreneurial vitality, and environmental awareness of all stakeholders involved. The framing of the present research on a smart, sound, and sustainable development of rural areas in China will be based on a so-called “smart specialization” policy [5]. Smart specialization has in recent years become a popular policy strategy for supporting less privileged areas. Given the territory-specific assets in a given area that is in need of public assistance, new public stimuli aiming at innovative behavior by all actors have to be provided in a tailor-made way that support specific and novel development opportunities of the area concerned. Generic policies (e.g., general infrastructure, education) do not adequately address the weaknesses of a given area; a “one size fits all” strategy is not sufficient for a significant upgrading of a certain less developed region [6]. Smart specialization calls for a case-specific approach that exploits all forms of local or regional capital and balances emerging discrepancies or disparities by a carefully harmonized supply of public resources aiming at strengthening local opportunities and eliminating local bottlenecks. Various scientific studies on smart specialization as promising forms of new regional development policy can be found *inter alia* in Boschma [7], Capello and Kroll [8], Foray [9], and Romao and Nijkamp [10].

In addition to research and policy interest in the impact of tourism strategies, it should be noted that sustainable development of rural tourism has a far-reaching impact on village residents. In villages located in mountainous areas, the contribution of sustainable development of agricultural tourism activities to economic improvement and demographic trends cannot be ignored either [11]. In post-socialist rural areas, sustainable development of tourism has diversified the rural economy towards ecological, economic, and social sustainable development, especially in terms of improving the quality of life of the local people, reducing poverty, as well as mitigating social and environmental degradation [12]. It is noteworthy that the sustainability of rural tourism is based on the idea of combining the social and economic interests of rural areas and the interests of the natural environment. Combining rural and local resources and traditional products that are unique to rural areas with tourism activities can facilitate the current trend of sustainable development [13].

In our analysis of the potential of—and bottlenecks for—a sound rural tourist development, we will take the region of Wuhan in China as an example. The rapid urbanization of China has exerted

a deep impact on China's rural areas, with lagging public facilities, a declining population, and less prosperous local economic perspectives. A clear orientation of rural areas towards small-scale rural tourism may be an interesting form of smart specialization for agriculture in these areas. However, before such a smart rural tourism policy can be implemented more generally, it is necessary to profoundly analyze the strengths and weaknesses of rural tourism in the appropriate, dedicated target areas to be tested. In our approach, we will put the emerging Chinese Rural Revitalization Strategy in the context of a more general Smart Specialization Policy by zooming in on rural tourism development opportunities in the Wuhan region. We aim to identify the critical success factors of such a strategy, based on a wealth of statistical data. Using a quantitative analysis of evidence-based facts, we also will distil useful policy lessons.

This paper is organized as follows. After this introductory section, we will offer a sketch of China's Rural Revitalization Strategy (Section 2), followed by a presentation of the empirical data base (Section 3). The research methodology is outlined in Section 4, while the research results are presented in Section 5. Conclusions and policy lessons are given in Section 6.

2. Sustainable Livelihoods for China's Farmers

In recent years, China's economic development policy has increasingly focused on the improvement of the growth potential of rural areas. The report of the 19th National Congress of the Communist Party of China put forward the implementation of the new Rural Revitalization Strategy. The livelihood of farmers is an important factor affecting the prosperity of both industry and human life in general. Before analyzing the concept of sustainable livelihoods, we pay attention to the meaning of sustainable tourism development, which usually refers to meeting the needs of local residents and foreign tourists, while protecting the resources they rely on so as to ensure future opportunities and possibilities for tourism development (World Tourism Organization, 1993) [14]. In analyzing sustainable tourism, in addition to the study of the impact of tourism development, researchers will also focus on the excessive development of tourism and on the sustainable development of tourism companies. Over-exploitation of tourist destinations will increase interference with local lifestyles and cause residents to develop a feeling of exclusion, thereby affecting their sustainable tourism development [15]. For tourism enterprises, tourism SMEs and tourism clusters can foster new sustainable development narratives and maintain sustainable ecotourism through absorption, innovation, and adaptability [16].

We know that residents' attitudes towards tourism are the key to ensuring the success and long-term sustainable development of tourism destinations, and are also important factors in favoring tourism products and protecting the sustainable development of local communities [17]. Compared with urban tourism destinations, the seasonality of tourism will have a greater impact on the sustainable development of rural tourism destinations. The seasonality of the tourism industry will further affect the attitude of the residents towards the tourism industry by affecting the composition of the residents' livelihood capital [18]. At the same time, it is pertinent to consider the typical conflicts of interest in rural areas. In the planning process, one should prioritize the sustainability of protection and the development goals [16]. Therefore, it is without doubt necessary to study the sustainability of rural households' livelihoods in rural areas.

A sustainable livelihood is an important goal of the Rural Revitalization Strategy. "Livelihood" refers to the way people can make a living, which affects the ecological environment depending on their capabilities and assets. Livelihoods are sustainable when people can cope with changes in fragile environments and can recover from external shocks, as well as maintain or strengthen capacities and assets for the benefit of future generations without damaging natural resources [19]. Sustainable livelihoods also include livelihoods that are independent of external support and do not destroy others [20]. In this context, the Sustainable Livelihoods Framework (SLF) proposed by the UK's Department for International Development (DfID) provides a systematic approach to conduct research on poverty governance and rural development [21]. The SLF reveals the nature of livelihoods, demonstrates the relationship between development and poverty, helps people identify their own

livelihood capital and adaptations to the external environment, and leverages their strengths and external environmental support in order to achieve sustainable livelihoods. Being a holistic and people-centered approach to sustainability, SLF has proved to be a useful analytical tool for the examination of tourism and community relations, particularly in a rural context [22,23].

As a balanced tourism development causes less damage to natural resources than other types of development, China has regarded tourism as one of the most effective approaches for rural area development. Rural tourism has become more popular since the 1990s in China [24]. The development of rural tourism is an important driving force for the transformation of the livelihood of rural households [25]. The livelihood value of tourism is mainly reflected in livelihood capital, livelihood strategy, and livelihood outcomes, and should be sustainable from generation to generation [26]. Tourism development affects the reserves, quality, and allocation of livelihood capital, while the combination, flow, and transformation of capital may become more flexible, which may increase the ability of farmers to reduce risks to a considerable extent [27–29]. The development of rural tourism has promoted the reconstruction and change of the farmers' livelihoods. The traditional single livelihood approaches tend to be diversified, which helps to spread risks and reduce livelihood vulnerability [25]. Livelihood outcomes include increased household income, greater welfare, lower livelihood vulnerability, improved food security, and a sustainable use of natural resources. In addition, factors such as household income and expenditure, mental health, physical health, and the social and natural environment are usually included in the evaluation of sustainable livelihood outcomes [30–32]. The development of rural tourism has an important impact on the farmers' livelihood. The tourism-oriented specialized livelihood model is of great significance for achieving the sustainability of farmers' livelihood [29]. However, insufficient accumulation of livelihood capital, lack of professional organizational guidance, and residents' own myopic perspectives have sometimes prevented farmers from benefiting from tourism development [33,34].

In general, farmer poverty is closely related to the vulnerability of their livelihood. Consequently, important questions are: Does the development of rural tourism improve the sustainability of farmers' livelihood? What are its limiting factors? Clearly, how farmers can be helped to build a sustainable livelihood is related to the realization of the general goal of poverty alleviation in China. At present, tourism and livelihood have gradually become an attractive topic of academic research, and most of this is horizontal or comparative, based on static or multiple livelihood methods [35], with only a few dynamic and longitudinal research studies. Taking the Huangpi District of Wuhan as an example, this paper aims to (i) construct a sustainable evaluation index system for assessing rural households' livelihood; (ii) dynamically assess the sustainable livelihood of farmers before and after they participate in tourism; (iii) uncover its constraints; and (iv) explore novel ways to improve the farmers' sustainable livelihood. Finally, this paper provides a guide for the implementation of the strategy for Rural Revitalization in China and the alleviation of rural poverty through tourism.

3. Overview of Research Area and Data Sources

3.1. Overview of the Study Area

Our study area, Huangpi District, is located in the northern part of the province of Wuhan, with a land area of 2261 km² and a population of 1.13 million. Huangpi District was selected as the site of the case study in this paper, mainly because of the following considerations: 1) Rural tourism in Huangpi District has a promising socio-economic foundation and the farmers' driving effect is clearly visible. In recent years, Huangpi District, relying on landscape resources, has created the Mulan eco-cultural tourism brand and is vigorously developing rural tourism. At present, there is 1 AAAAA (5A)-level tourist scenic spot; five AAAA (4A)-level tourist scenic spots; and more than 600 star-rated farmhouses. In 2018, the number of tourists in the region reached 24.043 million, and the total tourism income reached 14.31 billion yuan, assisting about 100,000 farmers in the region to benefit from tourism development. 2) The rural tourism development model in Huangpi District is typical. In

2016, Huangpi District was included in China's first batch of global tourism demonstration zones, and implemented a project that involves "citizens going to the countryside, capable people returning to the countryside, and enterprises revitalizing the countryside", according to the official local government. This initiative gradually generated a favorable development trend in driving the promotion of scenic areas, helping enterprises and the participating farmers. In view of this, our study takes the Huangpi Mulan eco-cultural tourist area as the main research area; the scenic spots at different development stages and with high popularity were selected as the empirical research case. According to the ranking of strength of the surrounding villages, the bottom eight villages were selected as the research sites. The basic situation, location, and participation mode of the surveyed villages are shown in Appendix A (Table A1 and Figure 1). Farmers in Huangpi District appear to participate in various forms of tourism, mainly tourism business activities, including catering, accommodation, tourist shops, and fruit picking on farms. Some farmers also obtain tourism income through land transfer, vacant farmhouse rentals or investment, scenic spots or hotel activity, and ticket bonus sharing. Some tourist enterprises at scenic spots got a great deal of revenue from selling entrance tickets, and gave a proportion of this revenue (e.g., 10%–30%) to the local people, who supply land, forests, and other resources used by tourists.

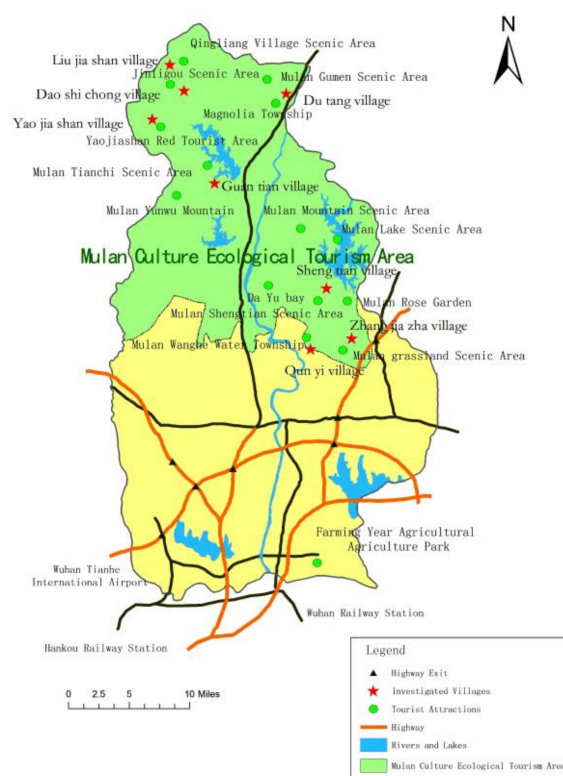


Figure 1. Locations of the investigated villages in Huangpi District.

3.2. Data Sources

Many data in our research stem from field investigations and surveys. Using the participatory rural assessment method, the authors conducted field research in Huangpi District in July 2018. First, the authors conducted in-depth interviews with village authorities and scenic area managers to acquire data on the development of rural tourism, the livelihood of the farmers, and the changes in the rural ecological environment. Secondly, using random sampling, 103 farmers who participated in the tourism were selected from eight villages; the investigation was conducted in the form of one-on-one in-depth interviews. The survey time for each household was about 60 minutes. The survey included: 1) basic information of family members (gender, age, education level, health status, etc.); 2) the status of household livelihood capital before and after participating in tourism (natural capital, physical capital,

financial capital, social capital, and cultural capital) and livelihood strategies (means of livelihood and livelihood stability); and 3) farmers' evaluation of the rural ecological environment before and after tourism development. The basic situation of the surveyed farmers is shown in Appendix A (Table A2). The gender, age, and participation time of the survey participants appear to be quite evenly distributed. Most of the interviewees were educated up to the junior high school level, while their overall education level is low. The family size is mostly 3–5 members. After the presentation of our database, we will sketch out in Section 4 the research methodology applied for our study.

4. Research Methods

4.1. Composition of the Indicators System

This paper combines the sustainable livelihood framework of the abovementioned DfID with the current research information [35], in order to construct the sustainable livelihood evaluation index of farmers in rural tourism destinations. The indicators system includes livelihood capital, livelihood strategy, and the linkage (coupling) and coordination degree between farmers' livelihood and ecology. All indicators are given in Appendix A (Table A3).

Livelihood capital is at the core of the sustainable livelihood framework, including natural capital, material capital, human capital, financial capital, and social capital (for a broader overview of the different forms of capital for regional development, see Capello 2019 [36]). Rural culture is an important attraction for rural tourism [37], while scholars such as Gale introduce cultural capital [38]. Livelihood capital is an important basis for farmers to carry out livelihood activities and is also an important barrier against livelihood risk [35]. A lack of livelihood capital is an important factor in restricting the benefit people obtain from tourism development. Therefore, livelihood capital is an important part of evaluating the sustainability of farmers' livelihood [39]. Livelihood strategies are the ways in which farmers can combine and use their own livelihood assets in order to pursue positive livelihood outputs or achieve their livelihood goals [40].

Livelihood diversification is an important indicator of livelihood strategies, which can diversify livelihood, facilitate risk spreading, and reduce vulnerability [25]. The stability of livelihood is an important goal of sustainable livelihoods, and is mainly expressed by the annual change in household income [40,41].

The transformation and upgrading of the farmers' livelihood and the improvement of the ecological environment are important elements of rural revitalization; they are an important guarantee for the sustainable development of rural tourism. The relationship between livelihood and the ecological environment is complex, since they mutually promote and restrict each other. The rural ecological environment is the basis for maintaining the livelihood of farmers, while ecological governance also offers the possibility of improving livelihood [42]. It should be noted here that farmers are often both the destroyers of the ecological environment and its defenders. The improvement of the farmers' sustainable livelihood is an important force in promoting environmental protection [43]. Tourism development clearly plays a vital role in realizing the improvement of the farmers' livelihood and ecological protection [44]. The sustainable and balanced development of livelihoods and the ecological environment is an important condition for farmers to achieve a sustainable livelihood. Therefore, the coupling and coordination degree between the farmers' livelihood and the rural ecological environment is an important indicator for evaluating the sustainable development of the farmers' livelihood. Referring to the coupling coordination model [45], the coupling degree between livelihood and the ecological environment includes the two systems of livelihood and the ecological environment. The standard PSR (Pressure–State–Response) model is then constructed according to the way in which the rural-tourism–ecological–environmental index system is constructed [46,47].

4.2. Data Processing

The study mainly compares the livelihood sustainability index of farmers before and after participating in tourism through the calculation of comprehensive values, the degree of coordination of livelihood and ecosystem coupling, and the livelihood sustainability index, so as to evaluate the impact of rural tourism development on the sustainable livelihoods of farmers.

During the calculation, livelihood capital, livelihood strategy, livelihood system, and the ecosystem lead to a comprehensive value of livelihood by using a weighted summation. The data is processed dimensionless by the method of extreme difference normalization. In order to avoid a bias caused by subjective factors, the weight of the index is calculated by the entropy method of objective weighting [45].

In order to calculate the comprehensive value of each system, the following formula was used:

$$f = \sum_{j=1}^n \omega_j X_j \quad (1)$$

where: f represents the comprehensive value ($0 \leq f \leq 1$); n represents the n th indicator of criteria on j ($j = 1, 2, 3, \dots, n$); ω_j represents the weight of each indicator; X_j represents the mean value of each indicator.

Next, we may calculate the degree of coupling between the livelihood system and the ecosystem by

$$C = \left\{ \frac{f(L) \cdot f(E)}{\left[\frac{f(L) + f(E)}{2} \right]^2} \right\}^k \quad (2)$$

where: C is the degree of coupling (the larger the value, the better the coupling); $f(L)$ and $f(E)$ are the comprehensive value of the livelihood system and the ecosystem (its value is calculated by Formula (1)); k ($n \geq 2$) is the regulation coefficient, and k is set as 2.

Now, to increase the discrimination capacity of the coupling degree, we may calculate the coupling coordination degree of the two systems by

$$T = \alpha f(L) + \beta f(E) \quad (3)$$

$$D = \sqrt{C \cdot T} \quad (4)$$

where: α and β represent the weights of the livelihood system and the ecosystem (in this study, both are equally important, so both are set to 0.5); D represents the degree of coupling coordination.

Subsequently, the livelihood sustainability index was derived as follows:

$$S = \omega_1 X_{LC} + \omega_2 X_{LS} + \omega_3 X_{LEC} \quad (5)$$

where: S represents the livelihood sustainability index; ω represents the weight including ω_1 , ω_2 , ω_3 ; X_{LC} , X_{LS} and X_{LEC} represent the combined value of livelihood capital, livelihood strategy, and the coupling degree between livelihood and the ecological environment. The above equations will now be used in our empirical analysis.

5. Empirical Research Results

Our empirical results are presented in Figure 2 and Table 1, respectively. They will now concisely be described.

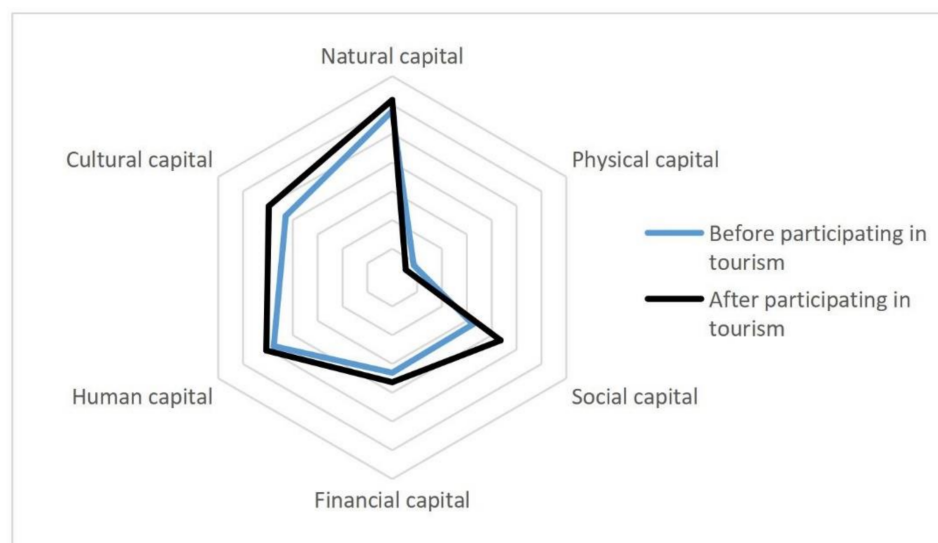


Figure 2. The change in sustainable livelihoods in 2018.

Table 1. The change in weight and value of livelihood capital.

Subject	Previous Weight	Posterior Weight	Previous Value	Posterior Value
Natural capital	0.1785	0.1601	0.1158	0.1235
Land capital	0.0450	0.0327	0.0068	0.0029
Family location	0.0693	0.0650	0.0620	0.0607
Drinking water quality	0.0641	0.0624	0.0470	0.0600
Physical capital	0.1199	0.1139	0.0109	0.0172
Housing capital	0.0609	0.0546	0.0077	0.0080
Durable goods value	0.0479	0.0506	0.0030	0.0091
Livestock value	0.0111	0.0087	0.0001	0.0002
Financial capital	0.1956	0.1903	0.0661	0.0727
Family savings	0.0576	0.0531	0.0125	0.0163
Borrowing, loans, subsidies, etc.	0.0089	0.0180	0.0001	0.0014
Ease of borrowing	0.0644	0.0600	0.0275	0.0287
Ease of loan	0.0647	0.0592	0.0259	0.0263
Human capital	0.1977	0.2012	0.0953	0.1013
Labor force	0.0648	0.0604	0.0297	0.0277
Labor education	0.0689	0.0641	0.0437	0.0406
Cognitive ability	0.0630	0.0604	0.0219	0.0312
Skill training time	0.0010	0.0163	0.0000	0.0018
Social capital	0.1539	0.1777	0.0649	0.0872
Human expenditure	0.0496	0.0484	0.0075	0.0135
Telephone bill	0.0371	0.0476	0.0055	0.0133
Social network support	0.0007	0.0179	0.0001	0.0049
Welcome to tourists	0.0664	0.0638	0.0518	0.0555
Cultural capital	0.1545	0.1569	0.0857	0.0993
The level of understanding of folk customs	0.0659	0.0629	0.0397	0.0434
Willingness to inherit folk customs	0.0657	0.0630	0.0391	0.0436
Want to retain traditional manual skills	0.0229	0.0310	0.0069	0.0123

(Note: Since the decimal value is retained to the fourth digit, the value of the skill training indicator before participation is 0).

5.1. Livelihood Capital

The development of rural tourism has clearly promoted the improvement of the farmers' livelihood capital, the changes in livelihood capital reserves, and its portfolio allocation, among which social capital and cultural capital show the greatest increase. The changes in livelihood capital before and after farmers participate in tourism are shown in Table 1. The development of rural tourism has prompted some farmers to move closer to the scenic spot, which is conducive to tourism management, while the livelihood value of the family location has increased in several aspects: 1) the drinking water

conditions have improved. The quality of the drinking water of a few farmers has changed from the previous pond and well water to tap water, benefiting from the improvement of rural infrastructure construction; 2) material capital has also significantly increased. After participating in rural tourism, some farmers have independently renovated their old houses, built new houses, and even purchased other houses in order to provide tourist accommodations and catering facilities, so their housing capital value has risen. The capital value of the households' durable goods has also increased substantially, and so has the number of TVs and air conditioners. Some farmers have even bought small cars; 3) financial capital has been effectively upgraded. After participating in tourism, the farmers' income and savings have increased. As a result of the large investment required at an early stage and the increase in the amount of loans and borrowing, the government has decided to give appropriate subsidies to the farmers who manage accommodation and catering. Consequently, the enthusiasm of farmers to participate in tourism has grown, the government support has increased, and farmers believe that borrowing finance is easier; 4) the human capital of farmers has increased. Mainly after participating in tourism, their degree of cognitive ability and the extent of skill training has increased significantly, especially for employees at scenic spots and in hotels. The amount of training carried out by enterprises has increased, which has improved the professional skills and knowledge base of the farmers; 5) the relationship between people has intensified, and their expenditure on personal expenses and telephone calls has increased significantly. The value of social network support has increased. Whether a relative or friend is in the public village domain or is a scenic spot manager is very important for farmers in their decision to participate in tourism. Farmers are increasingly welcoming tourists, and it is generally believed that more tourists will generate more benefits; and 6) the value of cultural capital has increased. Rural culture is an important part of rural tourism resources. Folk customs in rural areas are the basis of rural authenticity. In order to attract more tourists, farmers pay more attention to rural culture and are willing to actively understand and inherit traditional culture.

Notwithstanding the overall success, the accumulation of the farmers' livelihood capital is still not at its maximum, while the difference in livelihood capital among farmers is large. After participating in tourism, the family livelihood mode has often changed from farming to tourism management; thus, the dependence on land becomes lower, so that land capital was greatly reduced. Most farmers who are willing to participate lack opportunities to conduct tourism operations because of a poor family situation. Housing capital and household durable goods are the basis for the farmers' production and life, but material capital is still at a low level. Financial capital is still low, especially for farmers who run farmhouses. Due to the large investment required for tourism development, household savings are small or even zero. The existence of human capital is generally characterized by a low level of education, and the number of farmers receiving skills training is also low. Such training mainly happens on the job. Most farmers lack social network support and social capital. Although farmers have an understanding of local folk customs and are willing to inherit them, the cultural characteristics of rural tourism products are still insufficient, and the cultural capital is relatively low.

5.2. Livelihood Strategy

The development of rural tourism has promoted the reconstruction and change of farmers' livelihoods; nowadays their livelihoods tend to be more diversified. After the completion of the construction of new tourist attractions, the number of non-tourist livelihood farmers has decreased significantly. Before farmers participated in tourism, there were more farmers who had a single way of livelihood, and they were mainly migrant workers. The proportion of farmers who participated in two or more livelihoods after tourism has increased, but only slightly. More farmers are participating in catering and accommodation, followed by working in tourism enterprises. More than 50% of the farmers participate in one type of tourism, mostly accommodation and catering, and family members are almost all involved in tourism management, while tourist shops, tourism enterprises, and rentals require less labor, and are usually performed by other members of the family. Clearly, other livelihood options can be chosen as well.

The stability of livelihood in this area has certainly improved, and rural tourism has a definite role in promoting the stability of the farmers' livelihoods. In addition to being affected by the macroeconomic environment, livelihood stability is also related to the level of education, work skills, and engaging in specific livelihood strategies. Before participating in tourism, the farmers' livelihood stability was poor, the frequency of their work changes was large, and their annual income was unstable. After participating in tourism, however, the overall livelihood stability of farmers has slightly improved, and the work situation became relatively fixed. In particular, the annual income of employees who rent out houses, land, and tourism enterprises is relatively stable now.

Consequently, after participating in tourism, the number of farmers with only one source of income has not fallen sharply. The single way of farming and working has now changed into a single way of tourism livelihood. Most farmers have a higher dependence on tourism. Although the tourism livelihood is more stable than the livelihoods based on farming and labor, the farmers involved in tourism management are highly dependent on the level of development at scenic spots, especially those farmers participating in catering, accommodation, and tourist shops, whose income depends on the tourists who visit the scenic spot. Quantity, and thus overall stability, is not high. At the same time, as more and more farmers participate in the operation of catering, accommodation, and tourist shops, the need for product homogeneity is serious and competition is fierce, resulting in low tourism income for some farmers. Here, a single way of tourism livelihood and low livelihood stability are both factors that restrict the sustainability of farmers' livelihood.

5.3. Coupling Degree between Livelihood and Ecology

Farmers appear to believe that rural tourism has improved the rural ecological environment, including the water environment, the atmospheric environment, the soil environment, and animal and plant resources. Compared with the natural environment, the improvement of the rural human environment has been greatly improved, especially in terms of physical and mental health. Tourism companies help to upgrade the villages' infrastructure and enhance the rural environment. Governments, scenic spots, and communities have also improved their policies, funds, and facilities for the improvement of the rural ecological environment. As a direct beneficiary of tourism development, farmers are paying more attention to the protection of the rural ecological environment and can actively participate in village governance and ecological protection. Tourism has had a definite positive effect on the improvement of the rural environment, and its ecological function is remarkable, as is shown in Table 2.

Table 2. The change of weight and value of the ecological system.

Subject		Before Weight	After Weight	Before Value	After Value
Pressure		0.2530	0.2309	0.1493	0.0833
Resource utilization	Domestic water usage	0.0628	0.0543	0.0351	0.0158
	Household electricity	0.0628	0.0558	0.0355	0.0160
Material discharge	Household refuse	0.0637	0.0588	0.0365	0.0213
	Noise pollution	0.0637	0.0620	0.0422	0.0302
Natural ecological Environment	State	0.4366	0.4489	0.2744	0.3246
	Water environment	0.0618	0.0621	0.0386	0.0396
	Air environment	0.0617	0.0649	0.0448	0.0490
	Soil environment	0.0626	0.0635	0.0394	0.0412
	Animal and plant	0.0634	0.0642	0.0417	0.0464
Social environment	Social security	0.0631	0.0644	0.0415	0.0480
	Sanitation status	0.0615	0.0646	0.0337	0.0492
	Physical and mental health	0.0625	0.0652	0.0347	0.0511
Response		0.3102	0.3202	0.1544	0.2336
Government-community Enterprise	Remediation policy	0.0627	0.0645	0.0323	0.0467
	Remediation funds	0.0619	0.0648	0.0306	0.0466
Personal	Remediation facility	0.0621	0.0646	0.0312	0.0472
	Farmers	0.0621	0.0644	0.0303	0.0469
	Tourists	0.0614	0.0619	0.0300	0.0463

The coupling degree reflects the interaction between the livelihood and the ecosystem. Before and after the introduction of tourism, the coupling in terms of correlation between livelihood and the ecosystem is very high, 0.95 and 0.96, respectively, which is close to 1, indicating that the coupling of the two systems is significant. The two are mutually restrained and have strong synergies. Achieving a win–win situation between the two systems plays an important role in promoting the harmonious development of human–land relations. The coordination degree of coupling measures the level of overall coordinated development of these relations. According to the type of coordination and the development of coupling and coordination, before and after tourism, the coupling degree of farmers' livelihood and the ecosystem is 0.69 and 0.74, respectively, from primary to intermediate. However, although rural tourism has a definite role in promoting the coupling and coordination of livelihood and the ecosystem, the improvement appears to be relatively small, and the livelihood and the ecosystem are not coordinated very successfully, which restricts the sustainability of the farmers' livelihood.

Tourism development has resulted in the improvement of the rural tourism ecological environment, but nevertheless, the ecological pressure has increased significantly. Most of the farmers who are involved in catering and accommodation have significantly increased their use of water and electricity, but also the volume of garbage, while the ecological pressure has increased. Some farmers believe that rural noise pollution will increase, which will have a definite adverse impact on daily life. Even after the development of rural tourism, the level of coupling and coordination of livelihood and the ecosystem is still low, and the relationship between humans and the land has not yet reached its optimal state. It is, therefore, necessary to further adjust the smart specialization development model of rural tourism, to improve the ecological environment of rural tourism, and to achieve a win–win situation between livelihood and the ecosystem.

5.4. Livelihood Sustainability Index

According to the entropy method and Formula (1), the values of ω_1 , ω_2 , and ω_3 before the residents participated in tourism are respectively, 0.3268, 0.2923, and 0.3809, while after participation the values are 0.3429, 0.3150, and 0.3421. The index weights have not changed greatly. X_{LC} , X_{LS} , and X_{LEC} have contributed, respectively, to the tourism values with 0.4636, 0.3613, and 0.3421, while the participation values were 0.5980, 0.4141, and 0.6867. After the farmers participated in the tourism, the coupling of livelihood capital, livelihood strategy, and livelihood and the ecosystem were improved.

According to Formula (5), the farmer's livelihood sustainability index increased from 0.4143 to 0.5704. Tourism thus has a definite role in promoting the sustainability of farmers' livelihoods, but there is insufficient accumulation of livelihood capital, and a poor livelihood diversity, stability, and ecology. As a result of the impact of the poor level of coordinated development and other constraints, the tourism livelihood sustainability index is still at a relatively low level. Figure 3 clearly shows the difference in the livelihood sustainability index between farmers before and after participating in tourism.

To examine the effects of the independent variables, such as family characteristics and livelihood characteristics, on the livelihood sustainability index, a one-way variance analysis was used in our research (see Table 3). The number of those engaged in household labor, the highest level of education, and the number of livelihoods all have a significant impact on the livelihood sustainability index. The livelihood sustainability index does not increase with the number of family members and the number of family laborers. The households with a household labor force of four family members have the highest index of livelihood sustainability, while families with fewer or many family members might require more help and support. The level of education and the number of livelihoods are positively correlated with the livelihood sustainability index. From the perspective of the increase in that index, it appears that Guantian Village has the largest increase (0.2198) and Qunyi Village (0.1359) has the smallest, mainly because the development cycle of the scenic spots is different. The Mulan Tianchi Scenic Area appears to be relatively mature and attracts more tourists. The farmers' livelihood in this village is relatively sustainable.

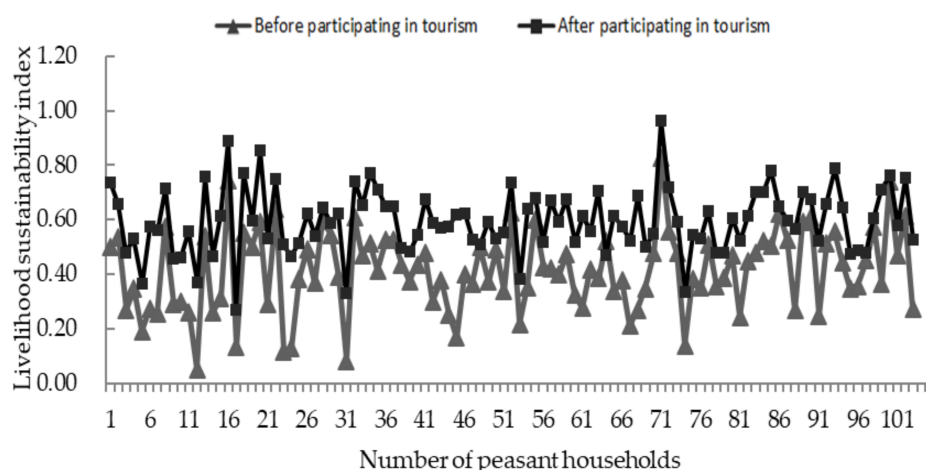


Figure 3. The change in the livelihood sustainability index.

Table 3. Analysis of variance of the livelihood sustainability index.

Dimension	Variable	F	Sig.
Before participating in tourism Farmers' livelihood sustainability index	Number of family members	3.195	0.007
	Number of household labor	3.576	0.009
	Family members with the highest level	3.607	0.005
	Number of livelihood methods	8.023	0.001
After participating in tourism Farmers' livelihood sustainability index	Number of family members	2.656	0.020
	Number of household labor	5.478	0.001
	Number of family members with the	2.675	0.026
	Number of livelihood methods	11.726	0.000

6. Conclusions and Recommendations

6.1. Conclusions

This study has positioned rural tourism strategies in the broader context of smart specialization as a vehicle for effective regional development. The Chinese case study has highlighted the importance of sustainability objectives in regional smart specialization policy.

According to the sustainable livelihood concept, the present paper has developed a livelihood sustainability index. Next, this index was applied and tested in order to dynamically assess the sustainability of farmers' livelihood before and after tourism. The study found that, after farmers participate in tourism, the livelihood sustainability index improves, and so does the coupling of livelihood capital, livelihood strategies, and the linkage of livelihoods and ecology. The number of those engaged in household labor, the highest level of education of family members, and the number of different livelihoods all have a significant impact on the livelihood sustainability index. Nevertheless, the farmers' livelihood strategies are still relatively simple, and they are still vulnerable. The livelihood of farmers has not yet reached its optimal state (in comparison to opportunities elsewhere), and there is still much room for improvement. The factors that restrict the sustainability of farmers' livelihood include insufficient accumulation of livelihood capital, a single livelihood, poor stability, and high ecological pressure, while the coupling of livelihoods and the ecological environment are of a relatively poor quality and lack a coordinated development.

6.2. Recommendations

The transition from traditional farming to more modern rural tourism activities calls for effective resilience of all actors involved. Farmers are in a favorable position in the development of rural tourism, which guarantees benefits to farmers. In fact, a sustainable development of farmers' livelihoods

may be the end-result of a sustainable development of rural tourism and of the underlying Rural Revitalization Strategy, as a specific case of smart specialization. In order to continuously increase the value of tourism for livelihood, the following implementation path seems plausible and realistic: 1) enhancing the degree of specialization of tourism livelihood capital, strengthening education and skills training, encouraging skilled workers to go to the countryside, establishing interest in protection and benefit-sharing mechanisms, and ensuring that farmers have equal opportunities for development; 2) guiding farmers to participate professionally in tourism according to their own conditions, choosing appropriate tourism livelihood methods, exploring industrial integration mechanisms, implementing an integration of the agriculture, tourism and culture industry, and promoting the integration of tourism livelihoods and other livelihood methods in order to achieve livelihood diversification; 3) innovating the development model of eco-tourism, avoiding ecologically destructive development, maintaining ecological balance, rationally arranging regional environmental capacity, and guiding farmers to adopt green development in order to save resources and reduce ecological pressure. Clearly, sustainable tourism development—as part of a smart specialization strategy—needs a balanced and well-orchestrated regional development policy.

Rural tourism destinations have a wide range of perspectives for sustainable development policy and research. This study has focused on a quantitative livelihood indicators evaluation for farmers in transition. Smart specialization appears to be a good strategy for successful resilience. Clearly, the article also has certain shortcomings. Due to the different roles of managers in rural tourism destinations and the differences in farmers' perceptions of tourism in different livelihood strategies, the tourism sustainability assessment system based on farmers' livelihoods needs to be further improved. At the same time, there is a lack of long-term, dynamic follow-up research on farmer livelihood long-run perspectives. Therefore, building a dynamic evaluation database for sustainable tourism livelihoods and dynamically revealing the long-term evolution of sustainable tourism livelihoods and their driving mechanisms will be one of the key points for future research.

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Appendix A Database and Descriptors

Table A1. Situation of the investigated villages.

Villages	Situations	Patterns of Participating in Tourism	Villages	Situations	Patterns of Participating in Tourism
Guan- tian Village	238 households, 938 people; Mulan Tianchi Scenic Area, opened in 2002	Land transfer, Enterprise employees, Farmhouse management, organic farms, Tourist shops, etc.	Dao shi chong Village	356 households, 1284 people; Jinli Valley Scenic Area, opened in 2010	Operating tourism, Enterprise employees, Ticket bonus sharing
Liu jia-shan Village	107 households, 478 people; Qingliang Village Scenic Area, opened in 2006	Operating tourism, Enterprise employees, Ticket bonus sharing	Yaojia Mountain	213 households, 866 people; Yaojiashan Red Tourist Area, opened in 2015	Operating tourism, Enterprise employees, Ticket bonus sharing
Zhangjia-zha Village	536 households 1603 people; Mulan grassland Scenic Area, opened in 2007	Operating tourism, Enterprise employees	Du tang Village	471 households, 1748 people; Magnolia Township, opened in 2017	Land transfer, Enterprise employees, Vacant farmhouse rental, Shareholding cooperative dividends
Sheng- tian Village	316 households, 1136 people; Mulan Shengtian Scenic Area, opened in 2007; Mulan Rose Garden, opened in 2014	Land transfer, Enterprise employees, vacant farmhouse rental, Operating tourism	Qun yi Village	95 households, 1612 people; Mulan Water Township Scenic Area, opened in 2018	Operating tourism

Table A2. Situation of the investigated peasant households.

Subject	Variable	Frequency	Subject	Variable	Frequency
Gender	Male	53	Age	18–35 years old	24
	Female	50		36–45 years old	21
Education level	Illiteracy	5		46–55 years old	36
	Junior high school and below	71		56–65 years old	17
	High school or secondary school	20		66 years old or older	5
	College	6	Family population	1–2	15
	Bachelor's degree or above	1		3–5	81
Years participating in tourism	0–1year	23	Years participating in tourism	6–7	7
	2–3years	32		6–9 years	16
	4–5years	16		10–13 years	16

Table A3. Evaluation index system of livelihood sustainability in rural destinations.

First Indicator	Second Indicator	Third Indicator	Description of Indicators
Livelihood capital	Natural capital	Land capital [25,30,32,37]	Land quality * land area Land quality assignment: 1. Very poor 2. Poor 3. General 4. Fertile 5. Very fertile
		Family location [30,32]	Distance to the nearest scenic spot
		Drinking water quality [27]	Assignment: 1. Pond River 2. Well Water 3. Tap Water
	Physical capital	Housing capital [27,28,32,37]	Housing quality * housing area Housing quality assignment: 1. Villa, 2. Multi-story building, 3. One-story bungalow, 4. Soil embryo room
		Durable goods value [27,28,32,37]	The sum of the quantity and unit price of household durable goods such as beds, air conditioner, washing machine, TV, computer, refrigerator, bicycle, electric car, motorcycle, car, mobile phone, etc.
		Livestock value [28]	Number of livestock * market unit price
	Financial capital	Family savings [32,33]	Assignment: 0. No 1.10–50 thousand 2.50–100 thousand 3.100–200 thousand 4.200–300 thousand 5.300 thousand or more
		Borrowing, loans, subsidies, etc. [27,28,32,37]	(Unit: 10,000 yuan)
		Difficulty in borrowing [37]	Assignment: 1. Very difficult 2. Not easy 3. General 4. Easy 5. Very easy
		Loan difficulty [37]	Assignment: 1. Very difficult 2. Not easy 3. General 4. Easy 5. Very easy
	Human capital	Labor force [25,27,28,37]	Number of family laborers (labor workers aged 18–65 who are not in school and are healthy)
		Labor education [25,37]	Average length of education of the labor force
		Cognitive ability [48]	The degree of understanding of tourism development, assignment: 1. Do not understand at all 2. Do not understand very much 3. General 4. Understand 5. Very understand
		Skill training times [27,28,32,38,49]	Family skill training times per year (unit: times)
	Social capital	Human expenditure [28,32]	Family annual expenditure (unit: yuan)
		Telephone bill [27,28,32]	Family annual telephone bill (unit: 10,000 yuan)
		Social network support [30,49]	Relatives/friends are village cadres or in government agencies or enterprises, scenic areas management departments, assignments: 0. None 1. Yes
		Welcome to tourists [49]	Assignment: 1. Very unwelcome 2. Not welcome 3. General 4. Welcome 5. Very welcome
	Cultural capital	The level of understanding of folk customs [37]	Assignment: 1. Completely unknown 2. Don't understand 3. General 4. Understand 5. Understand very well
		Willingness to inherit folk customs [37]	Assignment: 1. Very unwilling 2. Unwilling 3. General 4. Willing 5. Very willing
		Whether to retain traditional manual skills [37]	Assignment: 0. No 1. Yes

Table A3. Cont.

First Indicator	Second Indicator	Third Indicator	Description of Indicators
Livelihood strategy	Livelihood diversification [39]		Number of household livelihoods
	Livelihood stability [40,41]		The annual change in household income, the value of the assignment: 1. Very large 2. Large 3. General 4. Small 5. Very small
Coordination degree of livelihood and the ecological environment	Livelihood system	Livelihood capital	As above
		Livelihood strategy	As above
	Ecosystem	Pressure [47]	resource utilization: Domestic water usage/Household electricity situation
			Material discharge: household refuse/noise pollution Assignment: 1. Very much 2. More 3. General 4. Less 5. Very little
		Status [46,47]	Natural ecological environment: water environment, atmospheric environment, soil environment, animal and plant resources
			Humanities and social environment: social security, physical health status, mental health Assignment: 1. Very bad 2. Not good 3. Normal 4. Good 5. Very good
		Response [46,47]	Government-Community: Remediation Policy, Remediation Funds, Remediation Facilities
			Individual: farmers, tourists, ecological protection awareness and behavior Assignment: 1. Very bad 2. Not good 3. Normal 4. Good 5. Very good

Table A4. Coupling and Coordination Development Type Classification and Evaluation Criteria.

Range	0.00–0.39	0.40–0.49	0.50–0.59	0.60–0.69	0.70–0.79	0.80–0.89	0.90–1.00
Development Type	Severe Disorder Decline Type	Imbalance decay type	Barely coordinated development types	Primary Coordinated Development Type	Intermediate Coordinated Development Type	Well-coordinated development types	Quality Coordinated Development Type

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