The impact of ecotourism on local rural households' livelihood around Wolong Nature Reserve

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Abstract

Purpose – The development of tourism around Wolong Nature Reserve changes the local communities' ways of life. This study discusses how ecotourism affects the households' use of their capitals, the livelihood strategies as well as illustrates the impact on the habitats in the reserve through Department for International Development's (DFID) Sustainable Livelihood Framework (SLF) with data collected during fieldwork.

Design/methodology/approach – The study focuses on (1) Calculating Livelihood Capital Index. (2) The effects of livelihood capitals on livelihood strategy were calculated by multinomial logistic regression.

Findings – The study has yielded the following results: (1) In general, tourism promotes people's livelihood capitals. The growth in different types of households under tourism settings is ranked as full-time tourism operators > part-time tourism operators > traditional living households. (2) Tourism development mainly shifts livelihood strategies in two ways. Firstly, travel operating replaces some traditional practices that make livings; secondly, increased needs for potherbs and herbs from tourists let households enter into the hills to pick the plants more actively, which intensifies the destruction of giant panda's habitats. (3) Nine types of livelihood capitals indicators, namely farmland quality, distance between house and roads, number of laborers, average housing area, average income per person, whether family members being village cadres, and ever having received skills training shape livelihood strategies in different levels.

Originality/value – Three discussions are drawn from the study: (1) Enhancing the exploit for tourism resources to form a diversified competition. (2) Introducing herb growing to fulfill tourists' needs and improve people's livelihood in the meantime. (3) Optimizing the tourism surveillance and management system and improving the rules and regulations.

Keywords Ecotourism development, Sustainable livelihood framework, Wolong Nature Reserve, Livelihood capitals

Paper type Research paper

1. Introduction

With the continuous development and progress of human civilization, the standard of human life and the requirements for the quality of life are constantly improving. People pay more attention to ecology and tourism (Lu, 1996). Therefore, in recent years, ecotourism, based on good ecological environment, has developed rapidly in the world (Deng and Liu, 2020). And the protected areas have become the main carrier of ecotourism because of their rich tourism resources (Costa *et al.*, 2016). According to the estimates of the International Ecotourism Association, the world's Natural Ecotourism revenue grows at the rate of 10–12% every year, which has become an important direction of tourism in the 21st century. For example, in Nepal (Regmi and Walter, 2017), India (Ghosh-Harihar *et al.*, 2019), Kenya (Cheung, 2015) and

other countries and regions with good ecological foundation and rich biodiversity, but relatively poor economy, ecotourism is the main protection measure of the reserve and one of the main income increasing ways for surrounding farmers. In China, only forest tourism accounted for 1.6 billion tourists, about 30% of the total domestic tourists, creating a comprehensive social output value of about 1.5 trillion yuan, in 2018, greatly stimulating the local economic development.

Although scholars still have different views on ecotourism, it is generally believed that the place of ecotourism should be the relatively primitive and simple areas, especially the nature reserves which are of great significance to the ecological environment (Ross and Wall, 1999). The community farmers around the nature reserve are one of the most important subjects to protect biodiversity (Ma and Wen, 2016). However, the establishment of the nature reserve has changed the famers' traditional natural lifestyle (Mao *et al.*, 2018), and intensified the contradiction between ecological protection and the sustainable livelihood of community farmers. The development of ecotourism, in order to reduce the unreasonable interference and dependence of farmers on nature resources, puts forward a sustainable alternative way of livelihood (Cu *et al.*, 2017). However, in the process of ecotourism development, if the interests of the surrounding farmers cannot be guaranteed, the farmers may not be able to provide relevant support for the ecological protection, resulting in a certain degree of ecological damage. Therefore, the key to the development of ecotourism lies in whether the interests of local residents can be taken into account, so as to achieve a win-win situation of ecological protection and farmers' livelihood (Zhou *et al.*, 2021).

With the development of tourism, the traditional way of livelihood of the farmers around the reserve has changed greatly (Mbaiwa, 2011). The farmers began to turn the way of livelihood from the traditional way which was based on the breeding and planting industry, to the diversified way of livelihood involved in tourism management. The development of ecotourism in the reserve has improved the ability of farmers to cope with the fragile natural economic environment, and also has played a positive role in alleviating the contradiction between traditional livelihood and ecological protection of farmers in the reserve (Bi *et al.*, 2020). Therefore, how to promote the healthy development of tourism, making it possible to improve the livelihood level of residents, while reducing the interference of local residents in habitat is an important proposition of balanced development and protection.

Most of the foreign studies related to impacts of tourism development on farmers' livelihoods have been conducted for a specific research area, with qualitative and quantitative analyses on changes of farmers' livelihoods before and after tourism development even at each stage of tourism development in the region. Fujun *et al.* proposed the concept of sustainable tourism livelihoods in their study "the impact of tourism on farmers' livelihoods", and completed the construction of a "sustainable livelihoods analysis framework", which provides innovative ideas for other scholars to carry out their research work (Shen *et al.*, 2008). Ozcatalbas's study illustrated the relationship between developments of rural tourism and lifestyles as well as survival modes of local people according to the Turkey region (Ozcatalbas *et al.*, 2010). Based on a qualitative research approach, Monica found that a positive impact can be made by rural tourism development on economy as well as lifestyles, which presents an uneven representation from the perspective of space (Iorio and Corsale, 2010). Josep's empirical study was conducted with three rural tourism sites in the Botts Delta, USA, he drew the conclusion that tourism development had led to changes in the traditional livelihoods of local farmers (KC *et al.*, 2015). Wei Liu qualitatively analyzed the impact of different developmental periods of tourism development on Wolong Nature Reserve over the past thirty years–the exploration period, the participation period and the development stage on social, economic and environmental aspects through combining the theory of Tourism Area Life Cycle (TALC), and pointed that

"As tourism develops, the promoting role of tourism on economic and social development is becoming more and more obvious." (Liu *et al.*, 2016).

Research studies on impacts of tourism development on farm household livelihoods have started late in China, and the existing studies mostly analyzed the changes taken place in farm household livelihoods before and after the development of tourism in those selected samples, meanwhile farm household livelihood vulnerability was also explored. During the research process of farm household livelihood changes, tourism scenic areas in Shanxi were selected as a sample by Kong *et al.* to explain the differences appeared in the impact of rural tourism before and after on farm households' survival styles (Kong *et al.*, 2008). From the perspective of tourism-social system theory, Yu *et al.* analyzed the impact of tourism development on farmers' livelihoods in the Qinling Jinshixia watershed area and the constraints (Yu *et al.*, 2013). Yao *et al.* put forward corresponding initiatives to promote tourism-participating herders to reach sustainable livelihood development mainly based on the study of ecotourism sites in Kanas, Xinjiang (Yao *et al.*, 2012); He *et al.* adopted a comparative approach to investigate the role of tourism development in changing the livelihoods of farm households in a rural tourism site of the northern Qinling Mountains (He *et al.*, 2014). Maben and Wen Yali *et al.* analyzed impacts of ecotourism on changes in farm household income through the propensity score matching method (Ma and Wen, 2016).

From domestic and international studies, it is easy to find that most of the existing studies on the impact of tourism development on farmers' livelihoods have constructed a systemic analysis framework from a macro perspective by constructing specific systemic links between tourism and society, economy and culture. To expand selection region as samples, the surrounding communities of giant panda habitat are covered from a micro perspective can be the innovative point of this paper, which explores the livelihood transformation of farmers around the habitat caused by tourism development from two aspects: the change of farmers' livelihood capital accumulation and strategy selection of livelihood. Besides, the framework of sustainable livelihood analysis proposed in *the guide of sustainable livelihood* of 2000 by the Department for International Development (DFID) is considered to analyze the impact of ecotourism on Farmers' livelihood in Wolong area, which makes and tourism development, farmers' livelihood and habitat protection be organically linked.

Giant panda is the symbolic and endemic species of China, therefore, the research on the livelihood of farmers around the giant panda nature reserve can be provided as a reference and theoretical basis, which is not only for impact of tourism on the livelihood of farmers around specific wildlife habitats in the future, but also for cooperative relationship among the sustainable development of tourism, farmers' livelihood and habitat protection. Both of them are of the greatest significance in this paper.

2. Methods
2.1 Study site
The communities chosen for data collection locate around Wolong Nature Reserve. Wolong reserve is located in the southeast of Qionglai Mountian, 130 km from Chengdu, bordered by Wenchuan county in the east, Xiaojin county and Baoxing county in the west, Li county in the north, and Chongzhou, Dayi county and Lushan county in the south. The reserve covers an area of 200,000 hectares with a length of 60 km from east to west and 63 km from north to south.

Wolong Nature Reserve is one of the first group conservations that were approved by the government at national level. Founded in 1963 by the government and wildlife protection organizations, it considered giant panda as the key protected animal. In 1980, the reserve was recognized as one of the World Network of Biosphere Reserves in the UNESCO's Man and Biosphere (MAB) program further and established National Giant Panda Center along with

World Wildlife Foundation (WWF). Since then, the "center" has been carrying out scientific research on captive breeding, rewilding and protection of giant panda. According to the Fourth National Giant Panda Survey, there are 180 wild individuals distributed in the reserve, about 10% of total population, which is the highest among all nature reserves. By the end of 2018, the center has successfully bred 334 cubs, accounting for nearly 60% of total captive population around the world. Moreover, the forest's ecosystem and other rare species of animals and plants such as snub-nosed golden monkeys and Davidia involucrate (or dove-tree) have been receiving special attention since the reserve was taken into the MAB program in 1983. In 2006, the reserve was inscribed on the World Heritage list and the samples collected here are of typicality.

By far, 520 households within Wolong Special Administrative Region have participated in tourism operation, accounting for 35.6% of total. Nearly a hundred households have been planning to start new tourism business or enlarge the scale of their business. Gengda and Wolong, two counties inside the special administrative region, have different geographical and climate characters. This leads to different patterns of their tourism development. The distance between Gengda county and the giant panda tourist area is within 1 km. During wintertime, Gengda county is warmer that Wolong county. The number of tourists in Gengda county has increased over the years and tourism business here enjoys a positive trend. By the end of 2018, 460 households in Gengda have been running farmhouses for touring, hostels, or inns. Among them, 51 households' investment was in the range of 200,000–500,000 RMB, 215 in the range of 500,000–800,000 RMB and 194 households invested more than 800,000; by comparison, much fewer households in Wolong county were involved in tourism. Only 60 households provided accommodation service to tourism, taking up 8% of total households in Wolong county and consisting about 150 people.

Overall, in the ten year's development, tourism in Wolong Special Administration Region has grown from stagnation to a boom. Local people are presenting greater enthusiasm in tourism than ever before. Thus, to figure out the replacement effect of traditional farming, possible improvement of collecting activities, influences on households' livelihood capitals, livelihood strategies and habitats protection by tourism development is of practical and theoretical importance (see Table 1).

2.2 Date collection and variables selection
Preliminary investigation and interview of 1,459 local households started from November 2018, with a design of 20% of total number being re-visited, namely a sample size of $1,459 \times 20\% = 292$ households.

We combined random and stratified random sampling. In counties of Gengda and Wolong, households were stratified into participators and non-participators of tourism operation, and proportional amounts of households were randomly selected to confirm the final samples. As the result shows, 292 households were surveyed. After removing 8 invalid questionnaires, the number of valid samples remained at 284, a validity rate of 94.67%.

County	Villages	Village groups	Total population	Total households	Households running tourism business	Proportion of households running tourism business
Wolong	3	9	2,290	704	60	8%
Gengda	3	17	2,497	751	460	62%
Total	6	26	4,787	1,459	520	35.6%

Table 1.
Overview of villagers
in Wolong Nature
Reserve

The average age of the householders is 46 years old, number of family members is 5.2, and number of long-time migrant workers is 1.6. Major family activities for livelihood consists of farming, animal husbandry, forestry management, tourism operation, going out to work and collecting activities.

By referring to the Sustainable Livelihood Framework (SLF) proposed by the UK's DFID and methods used in previous researches, rural households' livelihood capitals are divided into 5 parts, namely natural capital, physical capital, human capital, financial capital and social capital. Detailed indicators under each type are to be measured (Zhang et al., 2019).

Natural capital refers to all the nature resources that are owned by the household for production activities, such as a farmland (He, 2015). Human capital consists of health, knowledge and skills, which directly influences the use of other forms of assets (Su and Li, 2014). Physical capital refers to infrastructure and materials owned by the household to pursue farm-based life such as buildings and machinery (Tang et al., 2013). Financial capital refers to the financial resources that are used for production activities such as annual income, loan opportunities and amount (Feng et al., 2018). Social capital refers to a set of social relationships and networking with relatives, neighbors and others (Wang et al., 2019). Table 2 shows the detailed indicators of livelihood capitals.

2.3 Descriptive analysis

When the proportion of tourism income to total income is zero, the household is defined as traditional; when the proportion of tourism income to total income does not exceed 50 percent, the household is defined as part-time; when the proportion of tourism income to total income exceeds 50 percent, the household is defined as full-time (see Tables 3–5).

There were 146 valid questionnaires in Gengda village, of which 42 were traditional, 42 were part-time and 62 were full-time. In Wolong village, there were 138 valid questionnaires, of which 106 were traditional, 18 were part-time and 16 were full-time.

Descriptive statistics of the 284 samples in the study area based on the type of farming households show that in terms of natural capital, traditional households have a significantly larger area of cultivated land and better quality of cultivated land than part-time and full-time households, but full-time households have a shorter average distance from the road.

In terms of human capital, full-time households have the highest average level of education, part-time households have the highest total population and household labor force and traditional households have the lowest total population and household labor force.

In terms of physical capital, traditional type households have the least amount of space per capita in their houses, and full-time households have only 0.18 square meters more space per capita in their houses than part-time households on average. Part-time households have the most amount of material allowance, traditional types the second most and main-employed types the least. The number of livestock was the highest on average for traditional-type households and the lowest for full-time type households.

In terms of financial capital, the average annual household income per capita and the average access to household bank loans are the highest for full-time type, second highest for the part-time type, and lowest for the traditional type. The part-time type has the widest sources of income access.

In terms of social capital, part-time households have a greater proportion of members with village leaders. Full-time households have more people receiving skills training, and traditional households have a greater amount of spending on favors.

2.4 Analysis methodology
2.4.1 Calculating Livelihood Capital Index. The entropy method is used to determine weights and calculate Livelihood Capital Index (LCI). It integrates data and decides weights of each

Livelihood capitals	Detailed indicators	Symbol	Positive/ negative	Variables descriptions
Natural capital	Farmland area	N1	Positive	Mu (a unit of area)
	Farmland quality	N2	Positive	1 = bad 2 = normal 3 = good
	Distance between home and roads	N3	Negative	km
Human capital	Education level	H1	Positive	1 = primary school or below 2 = middle school 3 = secondary school 4 = higher education
	Number of family members	H2	Positive	Count individuals
	Number of laborers	H3	Positive	Count individuals
Physical capital	Average housing area	P1	Positive	Total housing area/H2
	Material subsidies	P2	Positive	Agricultural and forestry Material subsidies received in 2017 (RMB yuan)
	Number of livestock	P3	Positive	Number of livestock = the number of cows *1 + the number of pigs *0.25+ the number of goats*0.25 + total number of poultry*0.005
Financial capital	Average annual income per person	F1	Positive	Total annual income in 2017/H2
	Opportunity to get loans	F2	Positive	No = 0 Yes = 1
	Ways of income	F3	Positive	Count types of livelihood activities bring incomes
Social capital	Family members being village cadre	S1	Positive	No = 0 Yes = 1
	Skills training	S2	Positive	No = 0 Yes = 1
	Expense for social relations	S3	Positive	Household expenses as gift-money in 2017 (RMB yuan)

Note(s): A "positive" indicator means that the larger the value is, the higher the livelihood capital value is; reversely, as to a "negative" indicator, the larger the value is, the lower the livelihood capital value is

Table 2.
Value of livelihood
capitals indicator

Location	Livelihood type	Number of people
Gengda village	Traditional type (the proportion of tourism income to total income = 0)	42
	Part-time type (0 < the proportion of tourism income to total income ≤ 50%)	42
	Full-time type (the proportion of tourism income to total income > 50%)	62
Wolong village	Traditional type (the proportion of tourism income to total income = 0)	106
	Part-time type (0 < the proportion of tourism income to total income ≤ 50%)	18
	Full-time type (the proportion of tourism income to total income > 50%)	14

Table 3.
Classification of farm
households by
livelihood type

indicator according to measures of dispersion, which is represented by the entropy value. When evaluating the value of an indicator, the indicator with higher entropy value provides more information and has larger weights; vice versa, the one with lower value provides less information and has smaller weights.

This method removes subjective factors and determines the weights objectively.

Variable	Traditional living				Part-time			
	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max
Farmland area	2.97	3.08	0	20	2.06	2.20	0	12
Farmland quality	2.08	0.72	1	3	1.79	0.66	1	3
Distance between home and roads	0.80	0.46	0.1	2.5	0.52	0.26	0.1	1
Education level	1.78	0.89	0	4	1.71	0.86	1	4
Number of family members	4.45	1.58	1	10	5.48	1.72	3	13
Number of laborers	2.33	1.18	0	7	3.17	1.29	1	8
Average housing area	22.28	9.31	8	60	35.52	9.84	20	65
Material subsidies	3904.03	1438.87	890	8,900	4816.04	1549.84	2,670	11,570
Number of livestock	6.24	18.08	0	200	3.95	8.04	0	44
Average annual income per person	15877.05	9923.58	1,140	60890.1	21500.41	9748.46	7,390	50,890
Opportunity to get loans	0.34	0.43	0	1	0.58	0.44	0	1
Ways of income	2.98	0.86	1	5	3.77	0.89	1	6
Family members being village cadre	0.13	0.30	0	1	0.21	0.37	0	1
Skills training	0.58	0.44	0	1	0.71	0.41	0	1
Expense for social relations	7448.65	1520.94	5,000	10,000	7115.00	1662.94	4,500	10,000

Table 4.
Descriptive statistics of each variable (Traditional living and Part-time)

Variable	Full-time			
	Mean	Std. Dev	Min	Max
Farmland area	0.97	1.36	0	9
Farmland quality	1.62	0.56	1	3
Distance between home and roads	0.47	0.26	0.1	1
Education level	1.92	0.76	1	4
Number of family members	5.00	1.25	2	10
Number of laborers	2.85	0.97	1	6
Average housing area	35.74	7.43	15	60
Material subsidies	3,618.36	652.86	1780	5,340
Number of livestock	1.23	4.96	0	45.5
Average annual income per person	27047.71	17082.13	2,890	110,742
Opportunity to get loans	0.64	0.41	0	1
Ways of income	2.87	0.82	1	6
Family members being village cadre	0.18	0.33	0	1
Skills training	0.77	0.36	0	1
Expense for social relations	5296.512	1497.72	3,000	7,900

Table 5.
Descriptive statistics of each variable (full-time)

The process of calculation is as follows:

Step 1 Normalize the indicators to rescale them.

Normalization of positive indicators: $Y_{ij} = \frac{X_{ij} - \min(X_i)}{\max(X_i) - \min(X_i)}$.

Normalization of negative indicators: $Y_{ij} = \frac{\max(X_i) - X_{ij}}{\max(X_i) - \min(X_i)}$.

Step 2 Determine weights by the entropy method. Equations for entropy method are as follows:

$$C_{ij} = Y_{ij} \bigg/ \sum_{i=1}^{n} Y_{ij}$$

$$e_j = -1/\ln n * \sum_{i=1}^{n} C_{ij} \ln C_{ij}$$

$$W_j = (1 - e_j) \bigg/ \sum_{j=1}^{m} (1 - e_j)$$

Step 3 Calculate the total value of livelihood capitals and every households' livelihood capitals value of each types of capital according to the weights. For three types of households with different participatory levels (full-time operator, part-time operator and traditional living households), their total and respective index value of each capitals equal to the average value of correspondent indicators for each household types.

Equations for LCI are as follows:

$$\text{LCI}_i = \sum_{j=1}^{n} W_j Y_{ij}$$

In above equations, Y_{ij} refers to the normalized value of indicator j in sample i. X_{ij} refers to the initial value of indicator j in sample i. $\min(X_i)$ and $\max(X_i)$ are the minimum and maximum value in the indicator j. C_{ij} refers to the weight assigned to indicator j in sample i. e_j refers to entropy value of indicator j, W_j is the weights of indicator j obtained through entropy method. Y_{ij} is the standardization of X_{ij} (see Table 6).

2.4.2 The influence of livelihood capitals on livelihood strategies. Multinomial logistic regression is used when there are three or more unordered dependent variables. It assigns one category of dependent variable as reference and examines the influence of independent variables on dependent variables of other categories.

Ω is the occurrence ratio, which is the ratio of the probability of an event to the probability of nonoccurrence. P_1 represents the traditional living household type, P_2 represents the full-time living household type, P_3 represents the part-time living household type.

$$\Omega = P_j/P_r$$

The model of Multinomial Logistic Regression is as follows:

$$\text{Logit}(\Omega) = \beta_{0j} + \beta_{1j}N_1 + \beta_{2j}N_2 \ldots + \beta_{pj}S_3$$

where β_{ij} is the regression coefficient, and $x_i(x = N, H, P, F, S; i = 1, 2, 3)$ represents the independent variable.

On the basis of this model, three types of household are analyzed to see influence of each independent variable. The traditional living household (P_1) type is chosen as the reference dependent variable, and other two types, full-time operator (P_2) and part-time operator (P_3) are modeled to produce regression respectively. When the coefficient β remains positive, the household is more likely to choose full-time or part-time tourism operating as livelihood strategy along with the increase of the independent variable; when β is negative, the household is more likely to choose traditional living as livelihood strategy with the increase of the independent variable.

$$\Omega_2 = P_2/P_1 \quad \text{Logit}(\Omega_2) = \beta_{02} + \beta_{1j}N_1 + \beta_{2j}N_2 \ldots + \beta_{pj}S_3$$
$$\Omega_3 = P_3/P_1 \quad \text{Logit}(\Omega_3) = \beta_{03} + \beta_{1j}N_1 + \beta_{2j}N_2 \ldots + \beta_{pj}S_3$$

Livelihood capitals	Detailed indicators	Weights (by entropy method)	LCI
Natural capital	Farmland area N1	0.08	N1*0.08 + N2*0.06 + N3*0.04
	Farmland quality N2	0.06	
	Distance between home and roads N3	0.04	
Human capital	Education level H1	0.07	H1*0.07 + H2*0.06 + H3*0.17
	Number of family members H2	0.06	
	Number of laborers H3	0.17	
Physical capital	Average housing area P1	0.16	P1*0.16 + P2*0.05 + P3*0.10
	Material subsidies P2	0.05	
	Number of livestock P3	0.10	
Financial capital	Average annual income per person F1	0.03	F1*0.03 + F2*0.10 + F3*0.02
	Opportunity to get loans F2	0.10	
	Ways of income F3	0.02	
Social capital	Family members being village cadre S1	0.08	S1*0.08 + S2*0.05 + S3*0.05
	Skills training S2	0.05	
	Expense for social relations S3	0.05	

Table 6.
Weights and calculation of LCI

3. Results

3.1 The influence of tourism development on rural household livelihoods

Tables 7 and 8 shows levels of engagement in tourism operating and livelihood capitals of sample households from different villages in two counties.

Overall, all types of households have seen an increase of their livelihood capitals after tourism development. A drop from 0.0614 to 0.0602 of Social Capital Index is the only capital decreases, which shows that tourism development has generally weakened the households' accumulation of social capital. This is mainly because the households tend to manage farmhouses in a similar way without obvious differentiation. Consequently, they compete over natural resources and public resources (such as parking lots and public infrastructure) more intensely, which may draw disruption and deteriorate the relationship between neighbors (Park and Stokowski, 2009), and therefore reduce the expense for social relations.

The rest four capitals all get improved (namely index score increased) to some extent, among which physical capital (from 0.0779 to 0.0812) and financial capital (from 0.0656 to 0.0692) enjoy the largest increase. Through tourism operation, the households have substantially increased household income, generated more sources of income and enriched household manageable capitals. Because of this, they are more easily to get loans from banks, laying the foundation to further enlarge the size of tourism operations. However, natural capital only undergoes a slight increase (from 0.0637 to 0.0644). On the one hand, better public service infrastructure makes transportation more convenient. On the other hand, along with increased visitors, improper behaviors such as littering, spitting, or talking loudly in public places occurred, degrading rural surroundings for a living. Furthermore, landscape construction occupies large areas of farmland. As a result, the farmland owned by rural households has dropped dramatically, limiting their ability to accumulate the natural capital.

Judging from the location of the households, Village 1 in Gengda ranks first in both LCI and all capitals except for social capital after tourism development, followed by Village 3 in Gengda, Village 2 in Gengda and Village 1 in Wolong. Village 2 and Village 3 in Wolong scores the second lowest and lowest respectively. The ranking shows that Village 1 in Gengda has benefited the most from the tourism development. This can attribute to the fact that the village can fulfill the needs of sightseeing and convenient transportation with being nearest

	Household type	Sample size	N	H	P	F	S	LCI
				Livelihood capitals				
Before tourism development	Full-time	76	0.0632	0.0648	0.0839	0.0648	0.0681	0.3488
	Part-time	60	0.0527	0.0630	0.0856	0.0755	0.0613	0.3441
	Traditional living	148	0.0749	0.0622	0.0543	0.0447	0.0471	0.2832
	Total tourism participators	136	0.0586	0.0639	0.0847	0.0695	0.0651	0.3467
	Difference between participators and non-participators	–	−0.0163	0.0017	0.0304	0.0248	0.0180	0.0635
After tourism development	Full-time	76	0.0650	0.0741	0.0976	0.0778	0.0654	0.3799
	Part-time	60	0.0564	0.0735	0.0913	0.0821	0.0661	0.3692
	Traditional living	148	0.0727	0.0650	0.0573	0.0481	0.0487	0.2917
	Total tourism participators	136	0.0601	0.0738	0.0940	0.0802	0.0658	0.3739
	Difference between participators and non-participators	–	−0.0125	0.0088	0.0367	0.0321	0.0171	0.0822

Table 7.
Comparison of household livelihood capitals of different types

	Location	Sample size	N	H	P	F	S	LCI
				Livelihood capitals				
Before tourism development	Village 1, Gengda	71	0.0601	0.0683	0.0834	0.0729	0.0669	0.3516
	Village 2, Gengda	45	0.0633	0.0701	0.0820	0.0655	0.0622	0.3431
	Village 3, Gengda	38	0.0622	0.0712	0.0838	0.0719	0.0606	0.3497
	Village 1, Wolong	36	0.0664	0.0680	0.0712	0.0599	0.0632	0.3287
	Village 2, Wolong	49	0.0652	0.0667	0.0719	0.0622	0.0568	0.3228
	Village 3, Wolong	45	0.0670	0.0688	0.0721	0.0573	0.0559	0.3211
	Total	284	0.0637	0.0687	0.0779	0.0656	0.0614	0.3373
After tourism development	Village 1, Gengda	71	0.0611	0.0731	0.0889	0.0774	0.0624	0.3629
	Village 2, Gengda	45	0.0641	0.0724	0.0838	0.0699	0.0588	0.3490
	Village 3, Gengda	38	0.0627	0.0721	0.0856	0.0737	0.0599	0.3541
	Village 1, Wolong	36	0.0667	0.0693	0.0746	0.0637	0.0668	0.3312
	Village 2, Wolong	49	0.0668	0.0692	0.0750	0.0637	0.0568	0.3316
	Village 3, Wolong	45	0.0670	0.0701	0.0748	0.0624	0.0565	0.3308
	Total	284	0.0644	0.0712	0.0812	0.0692	0.0602	0.3462

Table 8.
Comparison of household livelihood capitals of different location

to the giant panda tourist area and close to main roads. The village also has the highest participation and largest scale of tourism operation on average. In general, Gengda's three villages have enjoyed better improvement than that of three villages in Wolong.

Although tourism development is generally beneficial to the rural households around the habitats, households participated in tourism benefits more. All households with different levels of participation in tourism have seen an improvement of LCI more or less. Livelihood capitals are ranked as full-time tourism operators > part-time tourism operators > traditional living households both before and after the development. However, the difference of livelihood capitals between participators and non-participators (or traditional living households) becomes larger after the development. For all capitals expect for natural capital, participators' scores are much higher than non-participator's, while the differences between full-time and part-time households are relatively small.

The largest improvement of difference reflects in human capital. Taking the figure from Table 7, difference between participators and non-participators in human capitals has risen from 0.0017 to 0.0088. This difference comes from the fact that participating households have more chances to get skill training in the field of food hygiene, cooking and hotel management apart from being employed in tourism industry. They also become aware of the competitive market when tourists are picking services and facilitates, and then try to improve their competitiveness. The difference has not improved a lot in terms of financial capital, physical capital and natural capital, because better rural environment, public transportation and infrastructure brought by tourism development have covered almost every household. The reason why participators benefit more is that their farmlands take a larger proportion. In addition, compared with part-time operators, full-time operators get higher scores in physical capital, financial capital and human capital, but lower scores in natural and social capital.

3.2 The influence of livelihood capitals on tourism participators' livelihood strategies
When natural, social and economic environment change, rural households as "economic man" will constantly shift the lifestyles and behaviors to adapt changes and gain profits (materially or psychologically) at best. The shifting and adaption are in line with rural households' transformation of livelihood. Under the government's macro-economic control, shifts of natural environment and tourism development, they attempt to transform from unsustainable livelihood to sustainable livelihood by choosing livelihood strategies corresponding with their capitals and goals.

Since 2016, tourism around Wolong Nature Reserve has got rid of the influence from 2008 Sichuan Earthquake and become vitalized. The households in Wolong county prefer traditional living as the county locates highly and far from the tourist area but owns rich natural resources, while the households in Gengda county tend to tourism operation, because their land has been taken for building the giant panda center, which reduces the natural resources but setup foundations for tourism. The choosing between different livelihood strategies comes from lack of natural resources caused by tourism, households economic or social rational preference based on livelihood capitals.

Table 9 shows the output of logistics regression analysis from STATA 13. The model has a 0.05 significance level with a pseudo R^2 of 0.6493, indicating the model has a good fit. By stepwise regression, farmland quality, distance between home and roads, number of laborers, average housing area, average annual income per person, family members being village cadre and skills training are selected as significant variables. Ways of income affects part-time operator households significantly, but does not affect full-time operators very much. The number of family members and material subsidies affect full-time operators significantly, while they do not affect part-time operators significantly.

Looking into each livelihood capitals, as to natural capital, when a standardized unit of farmland quality increases, the probability of choosing part-time tourism operation drops to $1/(1 + 0.138) = 87.9\%$ of conventional one, and that of full-time operation to $1/(1 + 0.201) = 83.3\%$ compared to traditional living. This indicates that when the

Independent variables	Part-time operators			Full-time operators		
	Coefficient β_{i2}	Occurrence ratio Ω_{i2}	Significance level P_{i2}	Coefficient β_{i3}	Occurrence ratio Ω_{i3}	Significance level P_{i3}
N_1	−0.007	0.993	0.961	−0.146	0.865	0.364
N_2	−1.979	0.138	0.004***	−1.606	0.201	0.014**
N_3	−1.744	0.175	0.071*	−3.150	0.043	0.005***
H_1	0.216	1.241	0.594	0.089	1.093	0.821
H_2	1.091	2.977	0.125	2.303	10.008	0.000***
H_3	1.075	2.931	0.016**	1.162	3.197	0.011**
P_1	0.386	1.472	0.000***	0.324	1.382	0.000***
P_2	0.000	1.000	0.681	−0.002	0.998	0.003***
P_3	−0.011	0.989	0.588	−0.058	0.944	0.167
F_1	0.000	1.001	0.007***	0.000	1.001	0.002***
F_2	0.695	2.004	0.370	0.713	2.040	0.348
F_3	1.373	3.946	0.003***	0.275	1.316	0.505
S_1	−1.695	0.184	0.02**	−1.382	0.251	0.048**
S_2	2.778	16.081	0.003***	2.376	10.766	0.009***
S_3	−0.021	0.382	0.267	−0.015	0.291	0.252

Table 9.
Multinomial Logistic
Regression outcomes
of factors that influence
households' livelihood
strategies

households own farmland in good quality, they prefer farming and husbandry as main ways of living. Since good-quality farmland can yield agriculture products of large quantity and high quality, offering stable income and little risk. The distance between home and roads has a 10% significance level to part-time operator and 1% to full-time operator, and their beta coefficients are negative, which indicates that the closer the distance is, the households are more likely to choose part-time or full-time tourism operation. This is because the distance represents the accessibility of a house. Houses with closer distance are usually companied with more convenient transportation, more attractive to tourists and therefore a larger amount of predictable income. The prominent location of the house can be a natural advantage to tourism.

As to human capital, the number of laborers in a household has a 5% significance level to both part-time and full-time operator. One laborer increase would increase the household's willing of choosing part-time tourism operation to 2.931 times, and that of full-time tourism to 3.197 times compared to traditional living. For each number of family members increase, the choice of full-time operation rises to 10.008 times as much. Drawing the results, it can be seen that the households with more family members are more likely to run a tourism business. Along with the increase of the size of tourism operation, more people are needed to do management and arrangement. If family members are not enough, extra expense will be spent in hiring. A huge rise in the cost results in deduction of net profits. Thus, the sufficiency of laborers in a household is also one of the conditions for choosing the type of tourism operation.

When it comes to physical indicator, average housing area has a positive correlation with the livelihood strategy transformation from traditional living to tourism participation with a significance level of 1%. The probability of transforming to part-time tourism operation becomes 1.472 times as much as before, while that of full-time tourism 1.382 times. The households with a larger housing area are more willing to participate in tourism , for as more tourists come as a result of the development (1) the room size, structure and setup are one of the most important selling points to attract customers. The housing area decides the capacity of accommodation service the household can provide to a certain extent: the larger the area is, the more tourism it can receive. (2) The area and structure of house are determined by the households' economic strength, and households with stronger economy have stronger ability

to fend off risks and more possibility to choose tourism as a way of living. Farm and forestry subsidies, however, may have a negative correlation with the transformation. Each unit of material subsidies' increase would cause the probability of transforming to full-time tourism operation decreases to 99.8% of the original one, which shows that the material subsidies do not the transformation so much. Although theoretically material subsidies can encourage the households to engage in farming, animal husbandry or forestry, Wolong's policy stimulates that annual material subsidy per Mu is merely 260 yuan. The money cannot make a difference to the household income, and consequently does not support households' tendency toward traditional living.

As to financial capital, each unit increase of average annual income per person, the probability of choosing part-time and full-time tourism operation both increase by 0.1%, and both have a significance level of 1%, indicating that the higher average annual income per person is, the households are more likely to participate in tourism. Tourism operation requires a large amount of financial investment. Only households with sufficient income can sustain their business. Meanwhile, ways of income shows a positive correlation with the transformation to part-time tourism operation, whereas it does not affect the transformation to full-time operation. This may be that part-time operators take part in various kinds of livelihood practices. Most households do not abandon all traditional ways while operating the tourism business. The investment to tourism accounts for less than 50% of total investment.

For social capital indicator, the family member receiving skills training and being village cadre promote the chance of choosing tourism operation. During the field study, we learned that government of Wolong Special Administrative Region provided regular trainings related to cooking, hotel management and tourism management to local households. The more number of times they take the training courses, they gain more management skills and experience and are more likely to transform to tourism operation. As it is illustrated in Table 9, households with members being village cadre tend to participate in tourism management, as village cadres are the ones most informed by subsidy policies related to tourism and the trade-offs. On the basis of this, they could gain more benefits and reduce risks.

To sum up, all five types of livelihood capitals have detailed indicators that influence the choosing of livelihood strategies significantly. Via the outcomes from the model of multinominal logistic regression, it is known that farmland quality, distance between home and roads, number of laborers, average housing area, average annual income per person, family members being village cadre, skills training, ways of income, number of family members and material subsidies are ten significant variables that influence the household's choice between different strategies, though each variable influences in different levels or ways.

3.3 Limitations and perspectives
Firstly, roles of other factors in addition to the impact of ecotourism on Farmers' livelihood are not discussed here. Secondly, it is not clear about the internal mechanism of ecotourism on ecological environment during the process of farmers' livelihood changes. Research output on the relationship between habitat protection and ecotourism development is still insufficient while farmers' livelihood is changing. More investigations might be promoted to explore the impact of other social factors on the livelihood of farmers around the nature reserve, and to explore the relationship between the development of ecotourism and habitat protection in the future.

4. Conclusions and discussions
4.1 A conclusion of the study
Taking Wolong Nature Reserve as research area and the data collected from fieldwork, the study conducts an analysis over the influence of tourism development on the rural

households' livelihood around the area and its relation with habitats conservation under SLF. It is concluded that.

(1) A type of significant positive impact on farmers' LCI can be made by the development of ecotourism. The LCI of the farmers who mainly work on tourism increases most rapidly, otherwise the livelihood index of the traditional farmers changes in the most non-obvious speed at the individual level. From the perspective of various types of capital, both the score values and LCI of the other four types for main and part-time farmers are significantly higher than those which before the development of tourism except that the social capital had decreased after the development of tourism. From the perspective of regional differences, the total livelihood capital of Gengda village with a higher proportion of ecotourism is greater than that of Wolong village.

(2) The impact of tourism on Farmers is reflected off changes of farmers' labor time investment and income source. In view of labor time investment, farmers who participate in tourism management invest the most proportion of time, those who work as traditional farmers invest the least. After they participate in tourism management, only the proportion of time invested in collection activities increases slightly, on the contrary, time for livelihood activities such as aquaculture, planting and forestry decreases significantly. In view of income difference, full-time farmers mainly obtain income of tourism operation, followed by working income and collection income; part-time operators mostly rely on the income from working, followed by tourism operation income; The top three sources of income that traditional farmers depend on are migrant work, aquaculture and planting.

(3) In general, the promotion and development of tourism business activities has a substitution effect on the time investment in aquaculture, planting and forestry, especially on the development of aquaculture. But at the same time, due to the increasing demand of tourists for wild vegetables and medicinal materials, farmers' demands for the collection industry will rise. This aggravated the destruction of the giant panda habitat. Their income from this aspect rose, but the giant panda's habitats suffered severe destruction.

(4) Taking traditional living households as the standard reference to analyze how different livelihood capitals influence households' livelihood strategies, all livelihood capitals have detailed indicators that affect the choosing of strategies significantly, they are farmland quality, distance between home and roads, number of laborers, average housing area, average annual income per person, family members being village cadre, and skills training. Although they show different levels of influence, they are decisive factors for the households to choose whether to run tourism business or decide the scale of the business.

4.2 Disscussions
Tourism around the giant panda's habitats has led to local economic growth and benefits the communities. However, increased scale of tourism and number of tourists are strengthening the interference to the natural habitats. In order to maintain a sustainable development and coordinate the interactive relationship between tourism and conservation, we consult the scenarios and provide suggestions as follow:

(1) New tourism resources should be exploited to make diversified competitions.

The tourism activities in Wolong Nature Reserve are highly homogenous and seasonal. Tourists usually come here for leisure or shelter during summertime. Most tourism operating

households run their business in a way that caters to these requests. Also, since the peak season ranges from June to October, many tourism activities are only carried out during this period. The local government and communities should exploit new types of tourism resources, making salient features for different times of the year, such as red leaves in the fall, and snow mountain in the winter. Households can also cooperate to enlarge the scale, improve the service quality and accommodation conditions of their tourism business. By forming a diversified and healthy competition, tourism can develop in a sustainable way.

(2) Herb growing should be introduced to fulfill tourists' needs and improve local people's livelihood in the meantime.

As the needs for potherbs and herbs as medicine materials increased, the quantity and frequency of collection went up dramatically, destroying the habitat's vegetation. This issue could be mitigated by developing forestry sideline products. By far, a small number of rural households in Wolong Nature Reserve have started growing Chinese herbs such as *Paris polyphylla* (Chong Lou) and Notopterygium (Qiang Huo), and fungi as *Morchella esculenta*. However, due to local household's lack of techniques, experience and financial investment, the survival rate of herb cultivated is low and in small scales. Therefore, the government can introduce research program on herb growing techniques and provide more financial support to the research. Additionally, at the first stage, guidance and technical support from exports in related field should be given to households with farmland of good quality. Traditional living households with sufficient farmland area can also be encouraged to participate in herb growing. The first group of households that receive help from experts can be the lead for those who join later. Herb growing will gradually become mature and can be run in scale, being a new replacement of traditional livelihood strategy. In this way, the income gap can be narrowed as traditional living households get more income by growing herbs. Also, the reliance on natural resources declines.

(3) Tourism surveillance and management system should be further optimized and frequency of patrolling and penalties need to be increased.

Surveillance and management system should be optimized along with the tourism area development. By consulting the analysis results of how much tourism activities the habitat can endure, the number of tourists and vehicles need to be controlled accordingly to reduce the interference to the habitat. In addition, rules and regulations should further improved to avoid tourists and local residents to cross the boundary between tourist area and the conserved habitat. As for the boundary, there should be more patrolling and warning signs to inform or stop people. Heavy penalties on those who enter without permission may need to be added. During our investigation, we found many improper behaviors showed up among tourists: behaviors such as littering, climbing trees and picking flowers are not rare to see. Local government and department of tourism management should better build a team to dissuade tourists from such behaviors and advocate the good ones.

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