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Analysis on Change Trend and Influencing Factors of Natural Resource Utilization of Community Farmers around the Habitat of Giant Pandas

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Abstract

The habitat of giant pandas borders the living areas of farmers in surrounding communities. Due to the low level of economic development and resource used method, the life of community farmers depends on the natural resources of the habitat of giant pandas. Analyzing the natural resource utilization of farmers in communities around the habitat of giant pandas is conducive to formulating more reasonable management policies and protecting the habitat of giant pandas more effectively. Based on the field survey data, this paper classifies the main ways of community farmers using the natural resources of the habitat of giant pandas, counts the quantity of resources used and analyzes their change trends. On this basis, this paper selects indicators, constructs a model and analyzes the main influencing factors affecting the natural resources utilization of community farmers from three aspects: the individual characteristics of household heads, the family characteristics of community farmers and the residence characteristics of community farmers.

Keywords

Natural Resource, Method of Utilization, Change Trend, Influencing Factors, The Habitat of Giant Pandas

1. Introduction

The habitat of giant pandas is rich in forest and species resources. Due to the limitations of resource development mode and economic development stage, the livelihood of surrounding communities depends on natural resources [1] [2]. Due to the interference of human economic activities such as resource development and land occupation, the habitat of giant pandas is seriously fragmented and the ecosystem balance is threatened [3] [4]. Establishing the Giant Panda National Park and improving the management system of nature reserves are important measures to solve the contradictions and conflicts between the development of communities around habitats and the protection of biodiversity. How to coordinate the contradiction between community development and giant panda protection is not only the key to the construction of a nature reserve management system and improving the effectiveness of giant panda protection, but also the focus of academic research.

Scholars have carried out many studies on the utilization of natural resources in habitats. Jiaoting Peng [5] studied the utilization of resources by community farmers around the forest. Changhai Wang [6] studied the economic dependence of communities around the Giant Panda Nature Reserve on natural resources. Hui Pan [7] studied the utilization of resources in Zhangjiangkou Mangrove National Nature Reserve by beach contractors, fish pond farmers and community farmers. Mingping Zhan [8] studied salary collection, illegal logging, grazing and collection of nonwood forest products in the Xipo community of Gaoligong Mountain Nature Reserve. Other scholars have analyzed the influencing factors of the method of natural resource utilization. Xiaoxia He [9] analyzed the impact of different types of communities and the degree of poverty of communities on the utilization of natural resources. Sha Song (2016) [10] analyzed the impact of location factors and family population on the utilization of natural resources. Feng Han [11] analyzed the impact of years of education, source and structure of income on the utilization of natural resources.

From the perspective of community residents' behavior, this paper classifies the methods of natural resource utilization in the communities around the habitat of giant pandas, and analyzes their main influencing factors. This has important theoretical and practical significance for effectively protecting the habitat of giant pandas, coordinating the contradiction between protection and development, and realizing sustainable development. The research idea of this paper is: firstly, using the field survey data to classify the main methods of community farmers using the natural resources of the habitat of giant pandas, and then analyze their change trends. On this basis, this paper constructs Probit and Tobit models to analyze the main factors affecting community farmers' choice of natural resource utilization methods. It is mainly analyzed from three aspects: the individual characteristics of the head of household, the characteristics of the community family and the characteristics of farmers' residence location.

2. Study Area

2.1. Main Utilization Modes of Natural Resources and Change Trends in Nature Reserves by Community Farmers

The habitat of giant pandas is rich in natural resources and the community borders it. Community farmers use the natural resources of the habitat to obtain income and maintain their lives. Referring to the statistical yearbook of each county and the data of the third and fourth national giant panda survey, community farmers usually cut bamboo and wood (for building houses), dig bamboo shoots and traditional medicine, collect potherb, dible fungi, and firewood. For the needs of continuous follow-up research, the questionnaire survey mainly focuses on seven types of natural resource utilization. This paper analyzes the data of 25 typical counties with the habitat of giant pandas surveyed in 2014 and 2019, and counts the quantity of natural resources as shown in Table 1.

It can be seen from Table 1 that: the collection of firewood in 25 counties was mostly in a downward trend from 2014 to 2019. The quantities of wood collected in several counties of Qinling, Daxiangling and Xiaoxiangling are in the downward trend. But farmers of other counties collected more wood in the past five years. The quantities of bamboo collected in several counties of Qionglai, Daxiangling and Xiaoxiangling are in the upward trend from 2014 to 2019. But farmers of other counties collected less bamboo in the past five years. The quantities of bamboo shoots and potherb collected in all counties are in a downward trend in the past five years. The quantities of edible fungi collected in several counties of Qinling, Qionglai and Liangshan are in the downward trend in the past five years. But farmers of other counties collected more edible fungi from 2014 to 2019. The quantities of traditional medicine collected in several counties of Qinling, Minshan and Qionglai are in the upward trend from 2014 to 2019. But farmers of other counties collected less traditional medicine in the past five years.

Table 1. The average annual quantity of natural resources collected.

Mountain	Firewood (t)		Wood (m^3)		Bamboo (t)		Bamboo shoots(kg)		Potherb (kg)		Edible fungi (kg)		Traditional Medicine (kg)	
	2014	2019	2014	2019	2014	2019	2014	2019	2014	2019	2014	2019	2014	2019
Qinling	2.11	1.83	0.89	0.71	1.03	0.90	139.79	132.52	56.32	54.13	71.45	67.27	19.85	21.08
Minshan	2.28	2.14	1.10	1.15	1.34	1.33	163.11	155.80	72.21	68.36	79.09	82.76	22.75	25.10
Qionglai	3.43	3.22	1.13	1.29	1.25	1.28	69.85	66.12	80.06	77.58	73.98	70.33	18.56	21.19
Daxiangling	2.39	2.27	0.55	0.52	2.57	2.59	188.98	182.13	63.53	60.79	68.19	72.32	31.25	28.63
Xiaoxiangling	1.65	1.46	0.69	0.55	2.36	2.50	36.11	32.23	57.08	51.55	73.66	77.13	25.10	22.31
Liangshan	1.17	1.13	0.32	0.38	2.81	2.77	105.09	95.80	68.06	63.25	113.58	108.97	33.16	29.75

Source of Data: The data in the table are calculated and sorted out according to the field survey data of the research group in 2014 and 2019.

2.2. Quantity of Usage and Change Trends of Natural Resources

Comparing the two survey results of this study, it is found that the quantity of natural resources utilization of community farmers shows a downward trend, but it is still at a high level. Among them, the quantity of wood has decreased more, and the quantity of bamboo shoots, traditional medicine and edible fungi are still relatively high. Digging bamboo shoots and picking potherb usually cause great damage to the habitat of giant pandas. Bamboo shoots are popular food in the market, but they are also the main food for giant pandas. The collection of bamboo shoots not only interferes with the survival of giant pandas, but also causes the food competition between humans and giant pandas. Some farmers collect 100 kg of bamboo shoots a day, which is a great consumption of bamboo shoots in the mountains. A large number of bamboo shoots have been collected, which has led to a decline in the output of bamboo shoots in recent years. In order to increase income, community farmers went to further areas to look for bamboo shoots, which also led to the degradation of vegetation in deep forests.

Compared with digging bamboo shoots, picking potherb has greater destructive power on forest vegetation. With the improvement of living conditions, people's demand for health preservation is rising, and the price of traditional medicine is increasing sharply. Driven by interests, the number of traditional medicine collected by community farmers has also increased significantly. According to the survey, the income of community farmers in some counties from collecting traditional medicine for 1 - 2 months in the peak season exceeds the family's crop planting income for one year. Therefore, many community farmers go to the mountains to collect medicine, and there is fewer and fewer traditional medicine in areas close to home. Some secretly enter the reserve to collect medicine, which seriously threatens the habitat of giant pandas. Collecting traditional medicine will destroy the vegetation of giant panda habitat. The noise of farmers affects the normal residence of giant pandas and is easy to cause forest fires.

In recent years, due to the implementation of major ecological projects, the publicity of protection and management departments, and the popularization of electricity, the collection of firewood and wood is in a downward trend in most areas. In the past, the farming was mainly land reclamation. Now, because more and more young people choose to work in cities, most community households are not inclined to open up wasteland. The collection amount of potherb is small in other mountains except Qionglai Mountain. Compared with other mountain systems, Qionglai Mountain has superior natural environment and convenient transportation. Many community farmers here are engaged in tourism and catering industry to provide tourists with potherb, so the collection amount of potherb is high.

2.3. Characteristics of the Typical Habitat for Giant Pandas in the 25 Countries

Compared with the data of the third and fourth national giant panda surveys,

the habitat area of giant pandas increased by 535.29% in Lixian, followed by 344.21% in Leibo. It shows that the ecological environment of these counties has improved in past years. The habitat of giant pandas in Mabian decreased by 37.27% and that in Jiuzhaigou by 11.38% (Table 2). It may be because farmers of these counties used more natural resources and damaged the environment.

Table 2. The area of habitat for giant pandas in the 25 countries.

Mountain	County	The area of habitat for giant pandas (hm^2)	
		The third national giant panda survey	The fourth national giant panda survey
Qinling	Foping	60,959	64,977
	Yangxian	54,328	51,689
	Ningshan	67,019	60,940
	Taibai	79,679	93,375
	Zhouzhi	67,716	61,743
Minshan	Qingchuan	32,256	51,002
	Jiuzhaigou	106,275	94,178
	Pingwu	277,071	288,322
	Songpan	111,361	100,303
	Beichuan	88,951	95,691
	Anxian	9150	16,275
	Dujiangyan	34,508	38,347
Qionglai	Wenchuan	166,582	148,339
	Lixian	3825	24,300
	Baoxing	200,032	192,824
	Tianquan	130,835	142,633
Daxiangling	Yingjing	61,265	85,433
	Hongya	19,761	42,732
Xiaoxiangling	Luding	6,286	21,718
	Shimian	43,694	66,006
	Mianning	32,977	34,627
Liangshan	Ebian	94,299	113,057
	Meigu	37,798	40,532
	Mabian	50,712	31,811
	Leibo	8209	36,465

Source of data: The 4th National Survey Report on Giant Panda in China.

3. Method

3.1. Index

According to the theory of behavioral economics, scholars empirically analyze that the age characteristics and education level of the head of household, resource endowment and location characteristics of the family have significant impact on the choice of natural resource utilization mode [11] [12]. This paper analyzes the main factors affecting the utilization of natural resources from three aspects:the individual characteristics of the head of household, the characteristics of farmers' families and the characteristics of place of home (Table 3).

3.2. Model

In order to judge and analyze the factors affecting the use of natural resources, the measurement model is set as follows:

$$Y = \alpha + l_1(X_1) + \cdots + l_n(X_n) + e \quad (1)$$

Y is the total annual utilization of natural resources of farmers, including bamboo shoots, bamboo, traditional medicine, potherb, fungi, firewood, wood, *etc.* W_{1-n} is the dependent variable and, e is the residual term.

Table 3. Definition of variables.

Types of index	Independent variable	Index
Individual index	X1	Age of head of household (year)
	X2	Education level of head of household (year)
Family index	X3	Family members who have lived at home for more than 6 months within one year (person)
	X4	Number of non-agricultural members of the family (person)
	X5	Area of cultivated land owned by the family (hm^2)
	X6	Area of forest land owned by the family (hm^2)
	X7	Housing area of the family (m^2)
	X8	Livestock in the family (LU*)
	X9	Per capita income of the family in one year (yuan)
	X10	Annual household income from non-agricultural jobs (yuan)
	X11	Have family members participated in publicity activities in the reserve (1 = Yes; 0 = No)
Place of home index	X12	Altitude of place of home (km)
	X13	Distance of place of home from the nearest market (km)
	X14	Is there a road from the place of home to the village? (km)
	X15	Is the place of home in a poor county? (1 = Yes; 0 = No)
	X16	Is the place of home within the protected area? (1 = Yes; 0 = No)

*LU (Livestock Units), 1 cattle = 1 LU, 1 pig = 0.5 LU, 1 sheep = 0.3 LU [13].

Because farmers may or may not use the natural resources represented by the dependent variable, there are a large number of zero observations, that is, the deleted data do not meet the normal distribution, so the least square method cannot be used. In this study, Tobit model is adopted, and a latent variable is used to represent the observed corresponding Y:

$$y^* = \beta_0 + X\beta + u, u \mid X \sim Normal\left(0, \delta^2\right) \tag{2}$$

$$y = \max\left(0, y^*\right)$$

y^* obeys the normal homovariance distribution with linear conditional mean. If $y^* \geq 0, y = y^*$; if $y < y^*, y = 0$. X is the independent variable affecting the used quantity of natural resource, β is the parameter to be estimated, u is the random disturbance term, and obeys the standard normal distribution.

4. Main Influencing Factors of Community Farmers' Utilization of Natural Resources

According to the preliminary survey data, as shown in Table 4, the education level of the head of household is mainly at the primary school level, and some farmers have reached the junior middle school level. Generally, there are 3 - 5 permanent residents in the family, mainly the elderly and children. On average, young farmers go out to work for about 5 months every year. The cultivated land area of the surveyed community farmers is small and seriously fragmented. Community woodlands are mostly collectively owned. From the standard deviation of each variable, the survey data is stable.

Table 4. Descriptive statistics of data.

Independent variable	Mean value	Standard deviation	Maximum value	Minimum value
X1 (year)	43.12	18.90	85	21
X2 (year)	2.55	1.21	13	0
X3 (person)	3.97	2.15	11	1
X4 (person)	1.32	0.60	5	0
X5 (hm^2)	0.211	0.135	1.589	0
X6 (hm^2)	0.576	0.680	7.546	0
X7 (m^2)	131.23	19.31	220	46
X8 (LU)	5.90	24.63	200	0
X9 (yuan)	6010.32	1543.12	17563.21	1098.86
X10 (yuan)	533.81	352.36	16597.20	0
X11 (1 = Yes; 0 = No)	0.39	0.25	1	0
X12 (km)	1189.19	525.57	3500	750
X13 (km)	55.31	42.50	150	0
X14 (1 = Yes; 0 = No)	0.48	0.16	1	0
X15 (1 = Yes; 0 = No)	0.20	0.27	1	0
X16 (1 = Yes; 0 = No)	0.23	0.18	1	0

4.1. Individual Characteristics of the Head of Household

Among the community farmers around the habitat of giant pandas, the older households have a more traditional lifestyle and prefer to use firewood as energy [14] [15]. The amount of bamboo collected by farmers for construction purposes has gradually decreased in recent ten years. The main reason may be that more and more young workers enter cities and towns to work, and the elderly and children stay in the village. The old man collects a small amount of bamboo for making bamboo baskets and other living utensils containing grain or feed. Young people have changed their way of life because of their exposure to external information. It is rare to cut down a large amount of bamboo for building houses. Cutting down and selling bamboo requires a lot of labor. However, because most people go out to work for income, they give up cutting bamboo.

Generally speaking, the heads of households around the habitat of giant pandas have a higher education level and can use electricity, so the collection of firewood will be reduced [16]. The education level of the head of household has a significant 5% negative impact on the collection of firewood. The higher the education level of the head of household is, the stronger the awareness of environmental protection is. However, families with high education level of household head also have a higher tendency to collect medicine in the field. It can be seen from **Table 5** that the education level has a significant positive impact of 1% on traditional medicine collection. The reason may be that the high level of education makes the farmers' heads of households obtain more external information and better understand the market demand. In recent years, the prices of all kinds of precious traditional medicine have been rising. These traditional medicines generally grow in deep mountains, which are also the habitat for giant pandas. Collecting traditional medicine in the mountains has great destructive power on vegetation. Noise is one of the interference factors for wild animals [17]. Dujiangyan City, Songpan County, Pingwu County, Meigu county and Leibo County have a large collection of traditional medicine. Giant pandas generally avoid areas where human activities are frequent, so collecting traditional medicine in the mountains will affect the life of giant pandas.

4.2. Family Characteristics of Community Farmers

If there is a large permanent population in the family, the demand for residential housing is naturally higher [18]. Community farmers use wood mainly to build houses. Because the terrain around the giant panda habitat is not conducive to the transportation of cement and steel, community farmers use wood to build houses. At the same time, with a large permanent population, the demand for cooking, heating and lighting is naturally high, and the collection of firewood is also rising. A large number of permanent farmers at home mean more labor force, and the collecting traditional medicine probability increases accordingly. It can be seen from **Table 5** that the household farmer population has a significant 1% positive impact on the quantity of traditional medicine. In Pingwu

Table 5. The main influencing factors of the way of resource utilization.

Independent variable	Dependent variable						
	Firewood	Wood	Bamboo	Bamboo shoots	Potherb	Edible fungi	Traditional medicine
X1	3.17***	5.19	1.12*	43.25*	34.19	50.23**	60.51**
	(1.43)	(4.02)	(0.78)	(25.76)	(28.35)	(26.12)	(33.30)
X2	−0.26**	−1.59**	−0.68**	−183.62	89.58***	−41.32*	−42.60*
	(0.15)	(0.85)	(0.43)	(155.74)	(43.69)	(22.19)	(26.42)
X3	1.35**	3.98**	1.56	63.81	42.77	45.49***	49.67**
	(0.81)	(2.05)	(1.07)	(43.25)	(36.12)	(15.32)	(23.35)
X4	−1.72*	−2.12*	−1.41*	(159.11)	−95.12	−36.69	−46.43
	(0.85)	(1.75)	(0.82)	(132.29)	(73.41)	(20.45)	(30.31)
X5	4.59	4.10	3.21*	−310.65	−243.31	−50.31**	55.42**
	(3.25)	(2.96)	(1.98)	(290.52)	(175.89)	(26.18)	(27.25)
X6	3.99	3.08	2.71	211.65***	80.18***	47.57	−50.61
	(2.68)	(2.57)	(1.92)	(105.33)	(36.77)	(30.43)	(35.39)
X7	−1.78**	2.65*	0.89	80.37	−45.38**	30.31	41.35
	(1.01)	(1.42)	(1.06)	(49.25)	(27.15)	(21.24)	(29.21)
X8	2.30*	1.02	0.89*	83.16	−64.21**	39.45***	56.42***
	(1.25)	(0.76)	(0.51)	(65.29)	(37.03)	(20.18)	(25.19)
X9	−2.23***	−3.78	−2.43*	−92.15	−63.87*	−61.39*	−42.41
	(0.75)	(2.59)	(1.35)	(75.62)	(41.03)	(40.28)	(31.30)
X10	2.59	3.17	2.31	−23.72**	31.59	62.37	−48.43*
	(1.76)	(1.85)	(1.72)	(15.33)	(25.18)	(50.28)	(30.27)
X11	−2.66*	−3.27***	−2.53*	−35.21*	−26.85*	−68.28**	−43.42**
	(1.35)	(1.41)	(1.36)	(23.18)	(17.19)	(36.15)	(21.18)
X12	2.83*	2.79**	1.27	−38.21**	37.21**	51.32*	−40.29*
	(1.65)	(1.31)	(1.05)	(25.61)	(19.59)	(30.21)	(23.16)
X13	−2.19	−2.23	−1.05	−31.52**	−21.52**	−60.21	−43.27
	(1.67)	(1.51)	(0.76)	(20.61)	(12.27)	(45.15)	(29.18)
X14	−2.78*	3.20	0.73*	51.78	41.32	71.27	40.25
	(1.66)	(2.15)	(0.45)	(48.33)	(35.16)	(59.18)	(25.14)
X15	2.33	3.57	0.87	45.02***	35.65*	55.19	36.22*
	(1.78)	(2.27)	(1.19)	(19.48)	(21.38)	(43.12)	(20.13)
X16	2.31	2.28**	0.59	36.18**	28.72**	39.29	30.30
	(1.52)	(1.19)	(0.42)	(21.19)	(16.43)	(22.17)	(19.22)

*, ** and *** mean significant at the level of 0.1, 0.05 and 0.01.

County, Songpan County, Meigu county and Mabian County, traditional medicine is the main economic source of community farmers around the giant panda habitat. Because the cost of collecting traditional medicine is low and the income is high. The survey found that the number of non-agricultural employees in the family is large, and the demand for wood, firewood and bamboo is low. Because some family members work in cities, they do not have enough time and labor to cultivate, and there is less cultivated land.

Community farmers have more cultivated land, which makes it easier to obtain family income through farming, so the quantity of natural resources will be reduced accordingly [19]. If community farmers have more woodlands, they are more likely to collect traditional medicine and dig bamboo shoots. The forest area owned by families had a significant 1% positive impact on the quantity of traditional medicine and bamboo shoots. If the family's house area is large, the quantity of wood cutting is also large. Because the houses of community farmers are mainly wood structures, large houses need more wood. However, such families have higher income, use more commercial energy such as electricity, and use less firewood. House area has a significant 5% negative impact on the number of firewood. The per capita income of migrant families is high, and such families rarely use natural resources. Family income and the quantity of traditional medicine probability have a significant negative effect of 10%. Because there have been many publicity activities in the reserve in recent years, less farmers who have participated in ecological protection publicity cut down wood, collect firewood, dig bamboo shoots or traditional medicine.

4.3. Characteristics of Farmers' Residence Location

The habitat of giant pandas is mostly in the western mountainous area of Sichuan Province, and the surrounding communities live at a high altitude. Because it is close to the forest area, the collection of wood and firewood here is high [20]. Because it is far from the market and the transportation cost of fresh bamboo shoots is high, farmers here rarely dig bamboo shoots.

Where there are roads to the village, residents gradually replace firewood with electricity [21]. The economic level of poor counties is low. The residents here have single survival skills and tend to dig bamboo shoots and collect traditional medicine for income. Farmers living around the reserve have reduced the use of natural resources due to the publicity of the reserve. At the same time, because the reserve has carried out green agricultural technology training, the collection of bamboo shoots, traditional medicine and firewood has been reduced.

5. Conclusion

The farmers of communities around the habitat of giant pandas mainly use natural resources by collecting bamboo shoots, traditional medicine, or firewood. Obtaining natural resources from the habitat of giant pandas in exchange for income through the above methods is the main way for community residents to

maintain their livelihood. Community farmers with older heads of household and low education are more inclined to use natural resources, and these families also collect a large number of firewood and bamboo shoots, because they use resources in a more primitive way and lack the skills to go out to work. Community farmers with more cultivated land carry out green agriculture under the guidance of the government, which reduces the probability of using natural resources in the mountains. However, a large number of community farmers have less cultivated land and live in deep mountains with high altitudes and inconvenient transportation. Their cultivated land is seriously fragmented, and they can't use mechanical farming, and their income is very low. Because they live in forest areas, selling livestock products and medicinal materials are important ways of livelihood. The primitive utilization of natural resources by community farmers interferes with the survival of giant pandas. The government and relevant administrative departments should take various measures to help community farmers find alternative livelihoods and reduce the use of natural resources.

Authors' Contributions

Qing Qin drafted the manuscript. Shuo Wang, Shuihua Cai and Yan Dong collected the data. Xiao Zhou analyzed the data. Jian Qiu supervised the work. All authors contributed to the writing of the manuscript.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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