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Abandoned Tibetan and Qiang Villages Cause Analysis: A Case Study of Li County

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ABSTRACT

This paper takes Li County, Aba Tibetan and Qiang Autonomous Prefecture, Sichuan Province, China as an example in order to study the phenomenon and causes of village abandonment from a multi-ethnic perspective. Oblique photogrammetry and semi-structured interviews were used to collect spatial and abandonment data in 219 villages. The characteristics of the abandoned villages of the Qiang and Tibetans were compared and analyzed through site selection indicators such as altitude, spatial indicators such as scale, and abandonment indicators such as abandonment rate. The main factors affecting village abandonment were screened by Pearson correlation analysis and linear regression analysis. The results show that the site selection of Qiang villages is gentle, and the villages are larger in scale, more compact in shape, and more concentrated in distribution. The abandonment phenomenon in Tibetan villages is more serious, and the abandonment rate, relocation distance, and relocation height difference are greater. The main influencing factors of Qiang and Tibetan village abandonment are different, but the most influencing factors are the same. The main factor affecting the abandonment of Qiang villages is terrain, and the main factor affecting the abandonment of Tibetan villages is terrain, resources, economy. Terrain is the most factor affecting the abandonment of Tibetan and Qiang villages.

Keywords: Abandoned villages, Cause analysis, Qiang villages, Tibetan villages

INTRODUCTION

Villages are one of the earliest forms of production and life organization formed in human society, and they are precious natural wealth and cultural resources. However, with the process of urbanization and industrialization, the phenomenon of vacant and abandoned villages is common in all countries in the world. About 6000 villages were abandoned in Italy (Gorgo and Riggi, 2018), about 20000 uninhabited settlements in Russia (Rumjancev et al., 2019), about 1000 villages disappeared in the Czech Republic (Bartolomucci, 2020), about 800 villages have disappeared in Ukraine over the past three decades (Roman and Andriy, 2022). In the past 20 years, more than 600000 villages in China have disappeared. Abandoned villages have caused multiple problems, including waste of land resources (Long et al., 2009), decreased community cohesion (May, 2016), and loss of village history (Latocha, 2020).

Existing studies have focused on issues such as the causes, development mechanisms, and revitalization methods of village abandonment. In the study of causes, the phenomenon of village abandonment is related to resource factors such as natural resource depletion (Duhaime et al., 2005), natural disasters (McLeman, 2011),economic factors such as agricultural production reduction (Rumjancev et al., 2019), demographic factors such as population reduced size (Bartolomucci, 2020), and social factors such as war and violence (Sela, 2009). Fewer studies have compared village abandonment across multiple ethnic groups. This paper takes Li County, Aba Tibetan and Qiang Autonomous Prefecture, Sichuan Province, China as an example, to study the phenomenon and causes of village abandonment from a cross-cultural perspective.

METHODOLOGY

Study Area

The geographical location of Li County is 30°54′N-31°12′N, 102°32′E-103°30′E (Figure 1), located in the southeast of Aba Tibetan and Qiang Autonomous Prefecture in Sichuan Province, 200km away from Chengdu, the capital of Sichuan Province. The total area of Li County is about 4318km^2. Located on the southeast edge of the Qinghai-Tibet Plateau, it is rich in natural resources but complex in landform types; it is located in the Longmenshan earthquake fault zone, and natural disasters frequently occur in Li County; belonging to the Tibetan-Yi Corridor, the cultures of various ethnic groups in Li County collide fiercely, Tibetan and Qiang are the main ethnic groups in Li County.

Sample and Data Collection

The study selects 219 Tibetan and Qiang villages in Li County as the research sample. Based on the old place names recorded in the Li County Gazetteer in

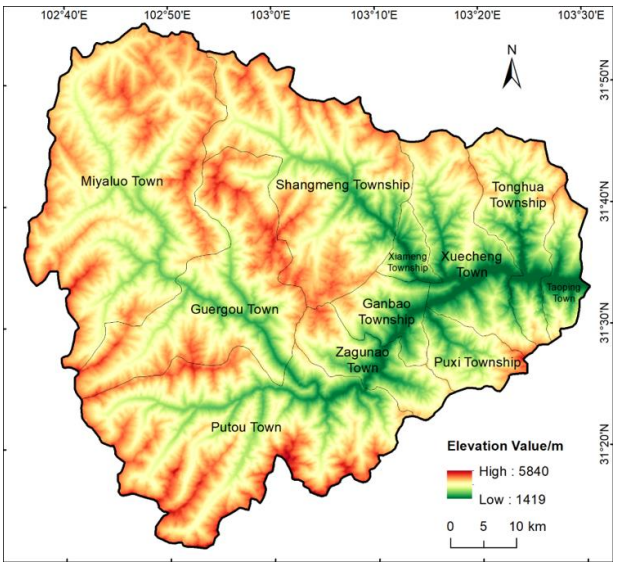

Figure 1: Geographical location and elevation map of Li County.

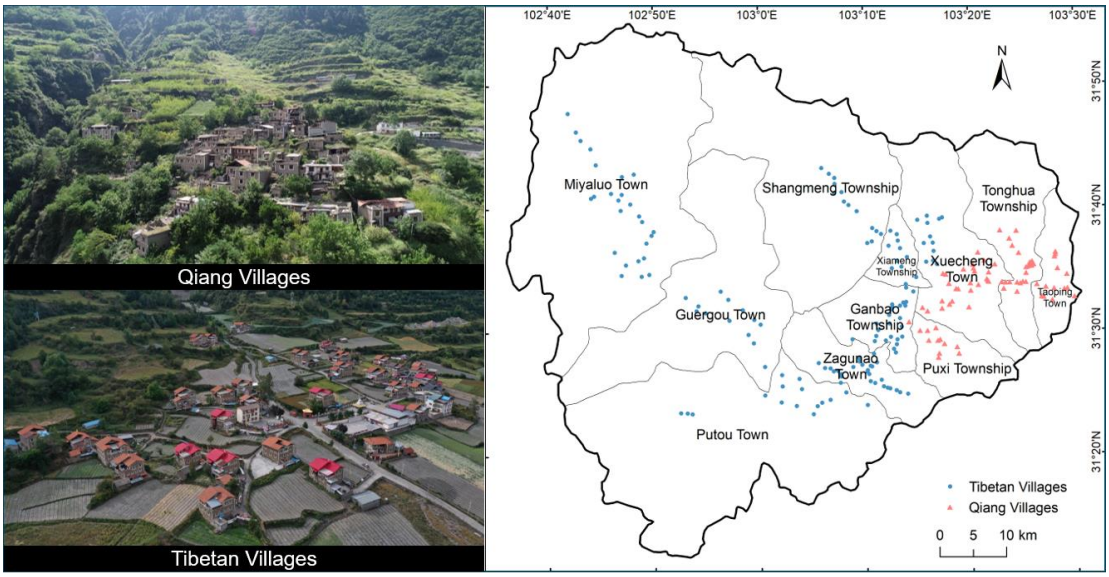

Figure 2: Research sample location.

1980, the research sample consisted of 219 Tibetan and Qiang villages after screening, including 145 Tibetan villages and 74 Qiang villages (Figure 2).

The data collected for the study include village abandonment data, terrain data, resource data, and economic data. The data sources are as follows (Figure 3): (1) Village abandonment data include village spatial images collected by Oblique photogrammetry and abandoned situations collected by survey interviews. (2) Terrain data include altitude, relief amplitude, and slope, and the source is ASTER GDEM V2 provided by Geospatial Data Cloud (http://www.gscloud.cn/). The source of administrative division data is the 1:1 million national basic geographic database provided by the National Catalogue Service For Geographic Information (http://www.webmap.cn). (3) Resource data include reference data and self-collection data. Meteorological elements, NDVI, Agricultural production potential, and Ecosystem service value data come from the Resource and Environment Science Data Center (http://www.resdc.cn/DOI). The data source of water distance is ASTER GDEM V2. Distance to the township center, elevation difference to the township center, distance to the county center, elevation difference to the

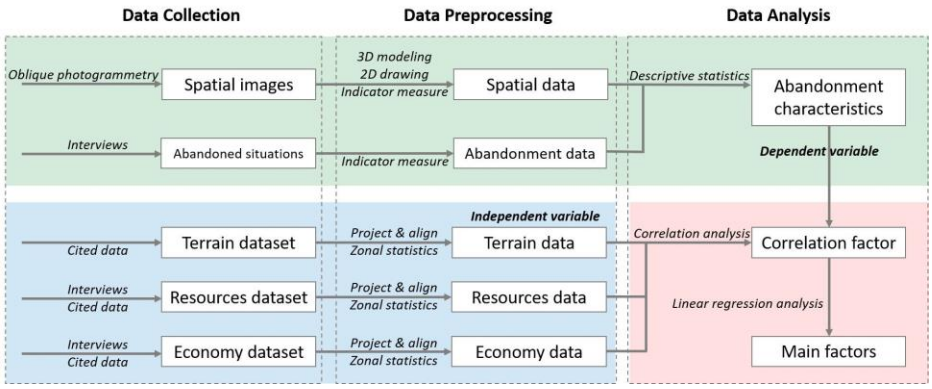

Figure 3: Research flow analysis diagram.

county center, and whether geological disasters have occurred come from survey interviews. (4) Economic data include cited data and self-collected data. The GDP and population density data come from the Resource and Environment Science Data Center (http://www.resdc.cn/DOI). The data of annual per capita income and the proportion of agricultural income come from survey interviews.

Data Preprocessing

Data preprocessing methods are as follows: (1) Process village spatial data (Figure 4). Firstly, based on Metashape, the village aerial image is built into a 3D model. Second, export the general floor plan of the village. Then, based on Rhino, the general plan of the village was drawn, and the Alpha Shape algorithm (Wilson et al., 2009) was used to calculate the village boundary. Finally, indicators are used to measure the spatial form of villages. *The sum of projected areas of residential buildings* (S) is used to measure the village scale (Formula 1), *the BC index*(BC) (Boyce and Clark, 1964) is used to measure the boundary shape (Formula 2), and *the distribution density of residential buildings* (D) is used to measure the degree of agglomeration (Formula 3). (2) Process village abandonment data. *Abandonment rate* (AR) is uesd to measure the degree of village abandonment (Formula 4). Houses that are unoccupied for more than half a year are considered abandoned. Calculate the relocation distance and relocation height difference between the new and old villages after the villages are abandoned to represent the separation degree of the new and old villages after abandonedment. (3) Based on ArcGIS, the CGCS2000 3 Degree GK CM 102E Projected Coordinate System was used to project and align terrain, resource, and economy data sets, and zonal statistics of village values.

$$S = \sum_{i=1}^{n} S_i \tag{1}$$

In the formula, S is the scale of the village, n is the number of houses in the village, and S_i is the projected area of the i-th house.

$$BC = \sum_{i=1}^{n} \frac{r_i}{\frac{1}{n}\sum_{i=1}^{n} r_i} \times 100 - \frac{100}{n} \tag{2}$$

In the formula, BC is the Boyce-Clark shape index, n is the number of radiation lines emitted from the centroid in a certain contour, and r_i is the i-th radius length from the centroid of the surface to the edge of the figure.

Figure 4: Preprocessing of village spatial data.

$$D = \frac{S}{S_0} \tag{3}$$

In the formula, D is the degree of agglomeration, S is the scale of the village, and S_0 *is* the area of Alphashape.

$$AR = \frac{N}{N_0} \tag{4}$$

In the formula, AR is the abandonment rate, N is the number of abandoned houses, and N_0 is the number of village houses.

Data Analysis

The research carried out the following analysis: (1) Analysis of the abandoned phenomenon of Tibetan and Qiang villages, including village site selection characteristics, spatial characteristics, and abandoned characteristics. The study uses altitude, relief amplitude, and slope to measure site selection characteristics, uses scale, shape, and agglomeration to measure spatial characteristics, and uses abandonment rate, relocation distance, and relocation elevation difference to measure abandonment characteristics. (2) Based on the results of existing literature, research and interviews, 24 terrain, resources and economic factors (Table 1) were selected for causal analysis, and Pearson correlation was used to analyze the factors that were significantly related to the abandonment rate of Tibetan and Qiang villages. (3) Carry out stepwise

Table 1. Explanatory variables and assumed direction of influence.

Variable group	Variable	Abbr.	Hypothesized influence
Terrain	Altitude (km)	ALT.	+
	Relief amplitude (km)	RA	+
	Slope (°)	SL.	+
Resources	Annual average ground temperature (°C)	GST	-
	Annual average air temperature (°C)	TEM	-
	Annual average air pressure (hPa)	PRS	-
	Annual average wind speed (m/s)	WIN	+
	Annual average sunshine duration (h)	SSD	-
	Annual average precipitation (mm)	PRE	-
	Annual average evaporation (mm)	EVP	+
	Annual average relative humidity (%)	RHU	-
	Normalized difference vegetation index	NDVI	-
	Distance to water source (km)	DTW	+
	Agricultural production potential (kg/ha)	APP	-
	Ecosystem service value (10000 yuan/km^2)	ESV	-
	Distance to town center (km)	DTC	+
	Elevation difference to town center (km)	EDTC	+
	Distance to county center (km)	DCC	+
	Elevation difference to county center (km)	EDCC	+
	Whether geological disasters have occurred (yes = 1, no = 0)	WGDO	+
Economy	Annual per capita income (10000 yuan)	APCI	-
	Proportion of agricultural income (%)	PAI	-
	Gross Domestic Product (10000 yuan/km^2)	GDP	-
	Population density (people/km^2)	PD	-

regression analysis and hierarchical regression analysis on the factors with significant correlation, and screen out the main influencing factors and the most influencing factors.

RESULTS

Descriptive Statistics Results of Abandonment Phenomenon

The results of elevation data analysis show that there are significant differences in the site selection of Tibetan and Qiang villages. Compared with Tibetan villages, Qiang villages are located at lower altitude, with higher relief amplitude and steeper slope (Figure 5 a-c). Specifically, the median elevation of Qiang ethnic villages is 2249m, which is lower than the median elevation of Tibetan ethnic villages at 2430m. The undulation height of Qiang ethnic villages is 529m, which is higher than the 473m of Tibetan ethnic villages. The slope of Qiang ethnic villages is 19.09°, which is steeper than the 18.61° of Tibetan ethnic villages.

The results of oblique photogrammetry show that the spatial characteristics of Tibetan and Qiang villages is significantly different. Compared with Tibetan villages, Qiang villages have a larger scale, more compact boundary shape, and denser distribution of dwellings (Figure 5 d-f). The data shows that the median size of Qiang villages is 0.70 km^2, which is larger than

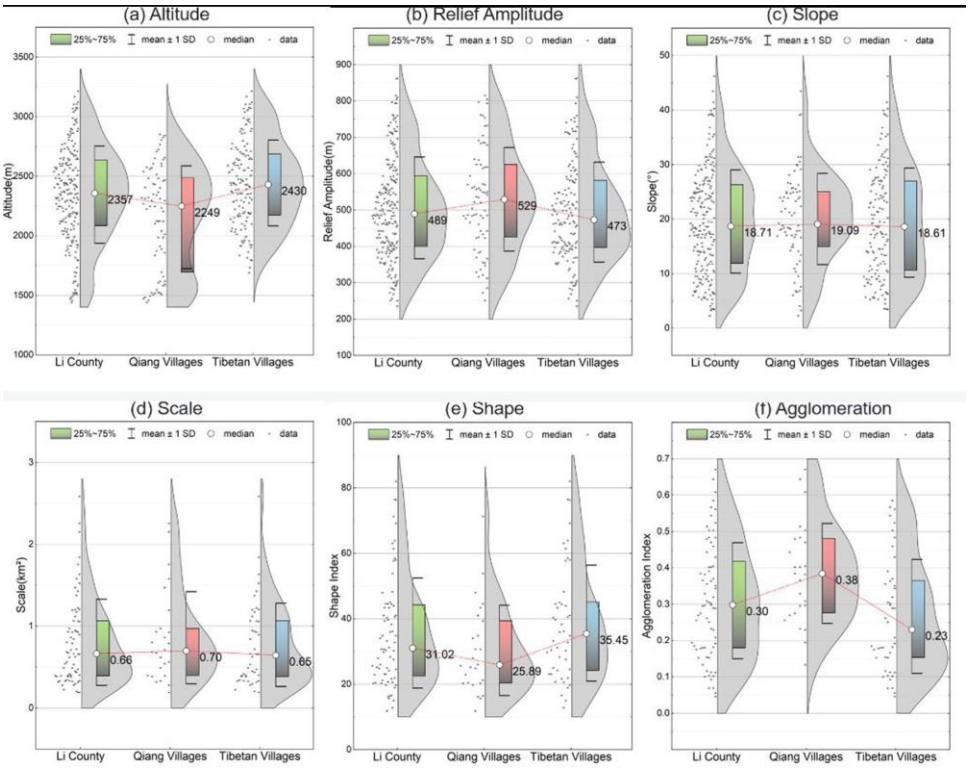

Figure 5: The descriptive statistics of the site selection and spatial characteristics of Tibetan and Qiang villages.

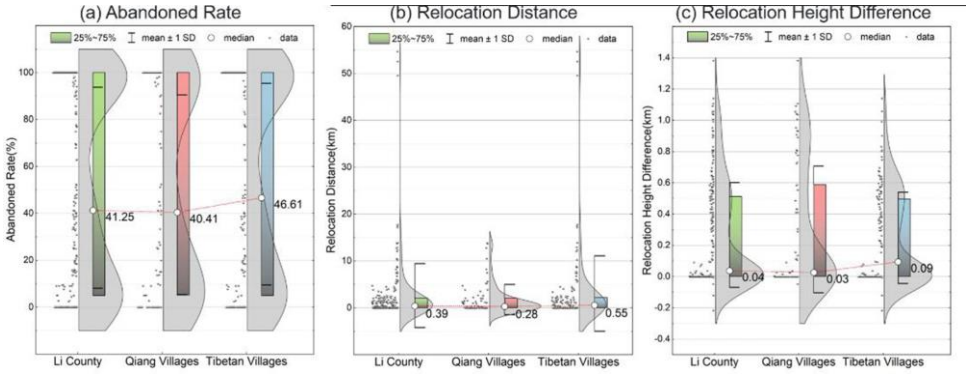

Figure 6: The descriptive statistics of abandoned characteristics of Tibetan and Qiang villages.

that of Tibetan villages (0.65 km^2); the BC shape index of Qiang villages is 25.89, which is smaller than that of Tibetan villages (35.45). When the BC index is closer to 0, the boundary shape is closer to a circle, so the boundary shape of Qiang villages is more compact; the density of Qiang villages is 0.38, which is about twice the density of Tibetan villages (0.23).

Combining the above-mentioned fieldwork and semi-structured interviews, the research further analyzes the abandoned characteristics of Qiang and Tibetan villages. It can be seen that the phenomenon of abandonment in Tibetan villages is more serious. Compared with the Qiang villages, the abandonment rate, the relocation distance of the new and old villages, and the relocation height difference of the Tibetan villages are larger (Figure 6). The data show that the median abandonment rate of Tibetan villages is 46.61%, which is higher than that of Qiang villages (40.41%); the relocation distance of Tibetan villages after abandonment is 0.55km, about twice that of Qiang villages (0.28km); The height difference of relocation of Tibetan villages is 0.09 km, which is about three times that of Qiang villages (0.03km).

Correlation Analysis Results of Abandonment Rate

Abandonment rate and 24 factors were selected for correlation analysis. The results show that the composition of factors significantly correlated with the village abandonment rate of Tibetan and Qiang people is similar. The same thing is that the eight factors of altitude, relief amplitude, slope, distance to water, elevation difference to town center, elevation difference to county center, annual per capita income, and proportion of agricultural income are significantly related to the abandonment rate of Qiang and Tibetan villages. Among them, terrain factors, resource factors and abandonment rate were significantly positively correlated, and economic factors were significantly negatively correlated with abandonment rate. The difference is that the distance to the township center is significantly positively correlated with the abandonment of Qiang villages (Figure 7 a), whether geological disasters have occurred is significantly positively correlated with the abandonment of Tibetan villages (Figure 7 b).

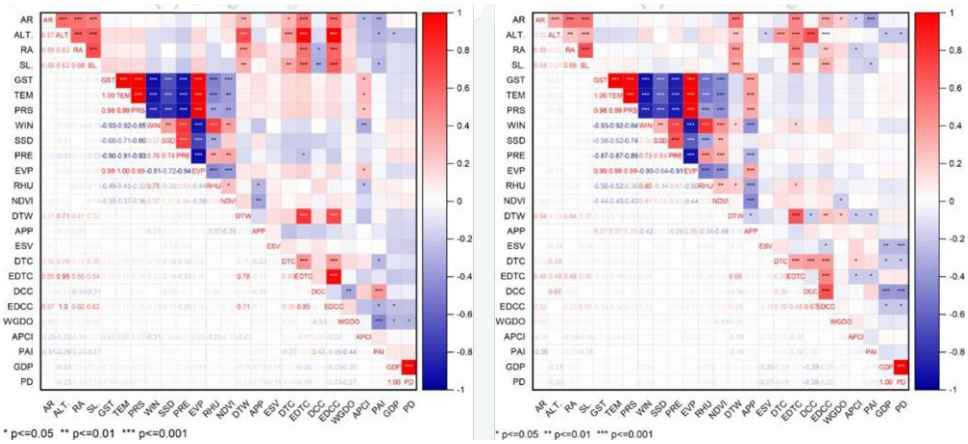

Figure 7: Correlation analysis results of abandonment rate.

Regression Analysis Results of Abandonment Rate

The stepwise regression results show that the main factors affecting the abandonment rate of Qiang and Tibetan villages are different. The main factors affecting the abandonment rate of Qiang villages are terrain, and the main factors affecting the abandonment rate of Tibetan villages are terrain, resources, and economy. Altitude and relief amplitude were the best predictors of abandonment rates in Qiang villages (Table 2), explaining 36.7% of the variability. Altitude, relief amplitude, slope, distance to water source, and proportion of agricultural income are the best predictors of the abandonment rate of Tibetan villages (Table 3), explaining 49.6% of the variability of the abandonment rate.

Hierarchical regression results show that terrain is the most factor affecting the abandonment rate of Tibetan and Qiang villages. The variation of R^2 in the terrain group is the largest (Table 4), indicating that terrain factors have the greatest impact on the abandonment rate of Tibetan villages. The main influencing factors of the Qiang villages are only the terrain group, that is, the terrain has the greatest impact on the abandonment of the Qiang villages.

Table 2. The best predictor variables affecting the abandonment rate of Qiang villages.

Variable	Unstandardized coefficients	VIF
Altitude	0.365**	1.621
Relief amplitude	0.952**	1.621
Constant	-0.811	/
Adjust R^2	0.367	
DW	1.619	
P	0.000	

Note: * p<=0.05, ** p<=0.01, *** p<=0.001

Table 3. The best predictor variables affecting the abandonment rate of Tibetan villages.

Variable	Unstandardized coefficients	VIF
Altitude	0.156*	1.129
Relief amplitude	0.698**	2.015
Slope	0.009*	1.984
Distance to water source	0.211***	1.306
Proportion of agricultural income	-0.414***	1.057
Constant	-0.301	/
Adjust R^2	0.496	
DW	1.525	
P	0.000	

Note: * p<=0.05, ** p<=0.01, *** p<=0.001

Table 4. L'/R^2 after the input of variable groups affecting the abandonment rate of Tibetan villages.

Variable group	L'/R^2	F
Terrain	0.157	29.314***
Resources	0.063	29.314***
Economy	0.052	29.314***

Note: * p<=0.05, ** p<=0.01, *** p<=0.001

DISCUSSION

The spatial differences of Tibetan and Qiang villages are obvious, and the phenomenon of abandonment is common. The villages of the Qiang people are flat, large in scale and compact in layout, while the Tibetan villages are the opposite. This difference is related to history. During the Qin Dynasty, the Qiang people moved from the northwest to Lixian County and other places to escape the war (Ji, 2000), and built compact and adjacent villages to resist the enemy. Tibetans have a large population, and for the convenience of life, residential buildings are mostly scattered. Although villages are generally abandoned, the relocation distance and height difference of Qiang villages are small, making it easy to use old villages. However, the degree of separation between old and new Tibetan villages is high, which is not conducive to the revitalization of old villages.

The composition of factors significantly correlated with the village abandonment rate of Tibetan and Qiang people is similar. The distance to township was significantly positively correlated with the abandonment rate of Qiang villages, but not with the abandonment rate of Tibetan villages. This difference was caused by the reconstruction policy after the Wenchuan earthquake in 2008. The construction assistance policy requires the use of reinforced concrete materials. To facilitate construction, some Qiang villagers build new houses in the town center. At the same time, whether geological disasters have occurred was significantly positively correlated with the abandonment rate of Tibetan villages, but not with the abandonment rate of Qiang villages. The protection of Qiang culture led to this difference. In order to

protect the Qiang culture, the Qiang villages in geological disaster areas such as Puxi Township have not been relocated.

The main influencing factors of the abandonment rate of Tibetan and Qiang villages are different, but the largest influencing factors are the same. The topographical environment that is convenient for production and living (Di Figlia, 2016), water and education and other resources, and competitive wages in industry and service industries (Long et al., 2009) promote the abandonment of Tibetan villages. The difference is that the cherries planting industry in the Qiang villages has developed well, which has alleviated the impact of economic and resource factors. Moreover, the Qiang people believe in the worship of nature, and their reverence for nature makes terrain factors prominently affect the Qiang people's relocation decisions. At the same time, as the primary feature that distinguishes mountain villages from plain villages, terrain is the most factor affecting the abandonment rate of Tibetan and Qiang villages.

CONCLUSION

This study analyzes the abandonment phenomenon and causes of Qiang and Tibetan villages, obtains and analyzes the spatial characteristics of Qiang and Tibetan villages, compares the abandoned characteristics of Qiang and Tibetan villages, and analyzes how terrain, resources, and economic factors affect village abandonment. The results show that the Qiang villages in the study area are located in a flatter area than the Tibetan villages, and the Qiang villages are larger in scale, with tighter boundaries and denser dwellings. The abandonment phenomenon of Tibetan villages is more serious, and the village abandonment rate, relocation distance, and relocation height difference are higher than those of Qiang villages. The main influencing factors of Qiang and Tibetan village abandonment are different, but the most influencing factors are the same. The abandonment of Qiang villages is significantly affected by terrain factors, and the abandonment of Tibetan villages is affected by terrain, resources, and economic factors, and terrain has the greatest impact on the abandonment of Tibetan and Qiang villages.

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