The spatial distribution of Buyi villages and landscape patterns change

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Abstract. Buyi nationality is an ethnic group with a long history, living mainly in the southern and southwestern parts of Guizhou Province. The Buyi villages embody the historical crystallization of their own national culture and are an effective carrier for inheriting the national culture. With the rapid development of the social economy, the production and life of the Buyi have also changed. Among them, ethnic villages have an important impact on the adjacent land use structure and landscape spatial pattern. This paper analyzes the spatial distribution of Buyi villages land-use change and landscape pattern in Qianxinan Prefecture and Qiannan Prefecture based on the remote sensing image, DEM field survey data from 1990 to 2020. The research results show that the Buyi villages are mostly distributed in the slope range of 0.83°-12.04° and the elevation range of 783-1362m. The northern slope is the main distribution aspect. From 1990 to 2020, among the land use types of 0-3km around the village site, the largest land use type is forest land, followed by grassland and farmland. Between 1990 and 2020, the area of water and construction land increased by 433.33% and 467.65% respectively, while the area of forest land decreased. In the 0-3km buffer zone of Buyi villages, the agglomeration of patches develops towards decentralization, with complex patch shapes and increased landscape diversity. The 3-6km buffer zone has a high degree of fragmentation. In short, Buyi villages have a high degree of aggregation. The degree of fragmentation is lower than Provincial average. However, with the process of urbanization, the increase in construction land patches will impact the landscape pattern of the village, which should be paid attention to in the future. From the perspective of sustainable development and ethnic cultural diversity, this study explores the influence of the spatial distribution of Buyi villages on the adjacent land use and landscape pattern, which is of great significance for maintaining and promoting the sustainable development of the ecological environment in minority areas.

Keywords: Buyi; Ethnic Villages; Land Use; landscape Change; Spatial Distribution

1 Introduction

The Buyi have a long history. Minority characteristic villages refer to administrative villages or natural villages with a high proportion of minorities, obvious ethnic culture and settlement characteristics, complete production and living functions [1], and the foundation for the inheritance and development of ethnic culture. Therefore, exploring the spatial distribution of the Buyi villages is of great significance to the development of the Buyi group.

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Landscape pattern refers to the spatial arrangement and combination of landscape elements such as patches and corridors of different sizes and shapes [2]. Landscape pattern analysis describes the structural composition characteristics of the landscape and its spatial configuration relationship through text description, graphic description, or landscape index to analyze the temporal and spatial heterogeneity of the landscape pattern and the ecological process [3]. In the context of my country's urbanization, ethnic culture has been impacted, and the ecological environment and landscape pattern of ethnic villages has changed [4]. Therefore, changes in the landscape pattern of ethnic minority villages are of great significance to the development of ethnic minorities. At present, there are many studies on the space of ethnic villages, mainly focusing on the spatial distribution of villages and their driving factors [5-10]. In addition, studies specific to the Miao, Dong and other minority villages, but the lack of research on the Buyi villages [9].

Approximately 97% of the Buyi in China are distributed in southwestern and southern Guizhou. This area has the largest distribution of Buyi villages. In this study, the southwestern and southern regions of Guizhou were used as research areas to analyze the geographical spatial attributes of the Buyi villages and the surrounding land use and landscape pattern changes and explores the influence of the Buyi's special life and production methods on the landscape pattern. This research is of great significance to the sustainable development of my country's ethnic regions.

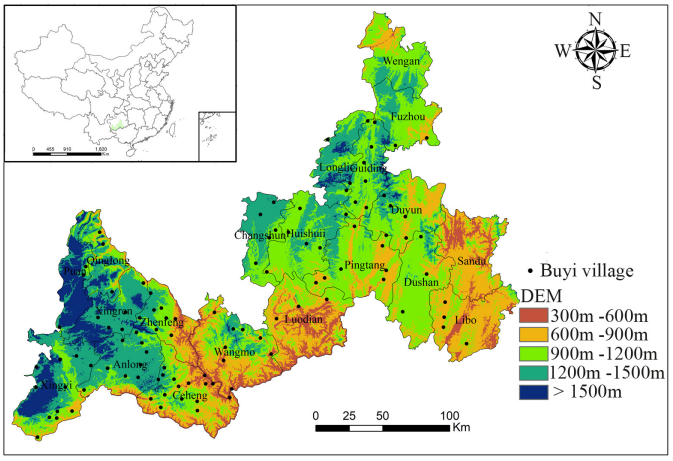

Fig. 1. Research location map and altitude distribution

2 Study area and method

2.1 Study area

Qianxinan Buyi and Miao Autonomous Prefecture (E104°35′~106. 32 7, N24°38′~26°11) and Qiannan Buyi and Miao Autonomous Prefecture (E106°12′-108°18′, N25°04′-27°29′) are located in the southwest and south of Guizhou Province, respectively, as shown in Fig. 1. The

main vein of the mountain extends from west to east, and its branches extend throughout the region. According to the data of the 10th population census, about 97% of China's Buyi live in Guizhou, and most of them live in Qiannan and Qianxinan Buyi and Miao Autonomous Prefectures. Qiannan Autonomous Prefecture and Qianxinan Autonomous Prefecture, which are inhabited by many minorities in Guizhou Province, accounting for 56.60% and 69.98% of the minority population respectively.

2.2 Data and methodology

The land-use data used for the study area was based on Land Use/Land Cover in the years 1990, 1995, 2000, 2005, 2010, and 2015 which comes from the Chinese Academy of Sciences Resource Environmental Data Center (RESDC). The digital elevation model (DEM) data are derived from the National Ge-ographic data cloud. Buyi Ethnic Villages come from villages with ethnic characteristics issued by Guizhou Ethnic and Religious Committee and State Ethnic Affairs Committee.

According to the distribution characteristics of Buyi Villages, taking the altitude of 300 m as the starting point and 300 m as the spacing, the distribution of villages can be divided into five grades: 300-600 m, 600-900 m, 900-1200 m, 1200-1500 m and above 1500 m; 0.5-8.5 ° is flat, 8.5-16.5 ° is gentle, 16.5-20.5 ° is the slope, 20.5 ° and above is steep. Based on the Getis-ord General G function, this paper analyzes the spatial point pattern of Buyi villages.

In ArcGIS, the ethnic villages are merged to establish 0-2km, 3km, and 6km buffer zones. Among them, 0-3km village buffer overlap is low, and the buffer area can completely cover the village, the data has accurate significance. In ArcGIS, 0-3 km and 3-6 km buffer zones were made for all Buyi villages. Based on FRSTATS 4.2, this paper selects Shannon's Diversity Index (SHDI), Shannon's Evenness Index (SHEI), Contagion Index (Contag), Landscape Shape Index (LSI), Aggregation Index (AI), Interspersion and Juxtaposition Index (IJI), Largest Patch Index (LPI) and Patch Density (PD).

3 Results and analysis

3.1 The spatial distribution characteristics of the Buyi villages

The Buyi villages are mainly distributed in the elevation range of 783-1362m, with an average elevation of 1020 m. The Buyi villages in China are mainly distributed in the altitude range of 900-1200m, accounting for 39.28% of all villages. Secondly, there are distributed on an altitude gradient of 1200-1500m, accounting for about 30.35% of villages. Figure 1 shows the spatial distribution of villages in different elevation gradients. Buyi villages are mainly distributed in the central and western parts of Qiannan Prefecture and the northwestern part of Qiannan Prefecture.

The Buyi villages in China are mainly distributed in the range of 0.83°-12.04°, with an average value of 9.24°. Most of Buyi village is located at a slope of 4.5°-8.5°, accounting for 34.54% of all villages. They are mainly distributed in the central and western parts of Qianxinan Prefecture and the western and southeastern parts of Qiannan Prefecture, Buyi villages are distributed on gentle slopes of 0.5°-0.45° and gentle slopes of 8.5°-12.5°, while only a few ethnic villages are distributed on steep slopes with a slope greater than 20.5°.

The villages of the Buyi group are distributed in the slope range of 12.26-357.68. The northern slope is the main aspect of the Buyi villages, and 32.06% of the villages are on the northern slope. The slope of the village is followed by west slope and south slope, accounting for 26.72% and 22.90% of the village, respectively. The number of Buyi ethnic villages distributed in east slope is relatively small.

Based on the Getis-ord General G function, the spatial autocorrelation analysis of the elevation, slope and aspect of Buyi villages shows that China's Buyi villages are clusters of high values on the slope, and the probability of random distribution is less than 1%. The ethnic villages are densely distributed on the slope. The Bouyi villages have no clustering distribution in elevation and slope direction and are distributed randomly.

3.2 Changes of Land Use Patterns in Ethnic Villages of Buyi Nationality

In the 0-3km buffer zone of China's Buyi ethnic villages, the proportions of different land-use types are different. In 2020, the proportion of the woodland area was the highest, accounting for 46.32%, followed by cultivated land and grassland, accounting for 29.50% and 23.52% of the total area, respectively. The area of water and construction land is relatively small. Because ethnic villages are affected by elevation and slope, the following will analyze the land-use pattern from different gradients of elevation and slope.

3.2.1 Changes of Land Use Pattern in Elevation in the Buffer Zone of Buyi Village

From 1990 to 2020, the total area of the Buyi villages is different in different gradient land-use types. Most Buyi villages are located in the area with an elevation of 900-1200m, followed by 1200-1500m, and only a tiny part of the area is located at 300-600m. The degree of land use change in the buffer zone from 1990 to 2020 is on the rise. Among them, the land use change reaches the maximum value from 2010 to 2020, indicating that the land in the region the utilization pattern has undergone tremendous changes. Different land use types show other trends. Construction land and water bodies show an increasing trend, while forest land and arable land show a downward trend. The water area increases in two gradients of 300-600m and 600-900m. Most of the construction land is located within 900-1200m and 1200-1500m above sea level. In 2020, the proportion of construction land will increase from 0.34% to 1.93%. This shows that the Buyi villages will be affected by urbanization in 2020. The woodland area above 1500m shows a decreasing trend, while the grassland area decreases at low altitudes of 300-1200m.

3.2.2 Changes of Land Use Pattern on Slope in Buyi Villages

The change results of different land use patterns in Buyi Village on the slope are shown in Fig 2. From 1990 to 2020, Buyi villages were mainly distributed in slopes ranging from 0.5 ° to 8.5 °, followed by slopes ranging from 8.5 ° to 16.5 °, while a few villages were distributed in slopes ranging from 16.5 ° to 20.5 ° and above 20.5 °. Forest land is mainly distributed in the gradient of 0.5 °-8.5 ° and 12.5 °-20.5 °. The forestland is distributed primarily on the range of 0.5 °-16.5 ° slope, which shows an upward trend and a downward trend from 1990 to 2020. This indicates that the conversion of cropland to grassland for the forest in 2000 has a specific impact on villages; however, this work needs to be further strengthened with the development of urbanization. The farmland is mainly distributed in the low slope range of 0.5 °-8.5 °, and the developed land area decreases gradually from 1990 to 2020. From 1990 to 2020, the grass-

land increased first and then reduced, mainly in the range of 0.5 °-16.5 ° slope. The waters showed an upward trend from 1990 to 2020. From 1990 to 2020, the construction land area showed an upward trend, in which the increase rate was the highest in 2020. The construction land mainly distributes in the flat land of 0.5 °-8.5 °, its area ratio increases from 0.30% to 1.71%.

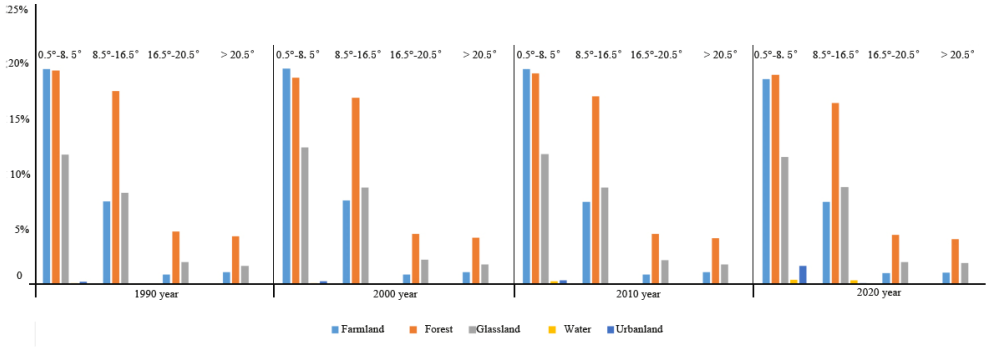

Fig. 2. The land use area ratio of ethnic villages from 1990 to 2020

3.2.3 Changes of Landscape Pattern Index of Buyi Villages

The change results of different landscape pattern indexes in Buyi Village are shown in Table 1. From 1990 to 2020, the Largest Patch Index (LPI) in the 0-3km buffer zone of Buyi villages remained unchanged, indicating that the area of dominant land use types in the buffer zone remained unchanged. The Shannon diversity index (SHDI) shows an upward trend, indicating that the landscape composition in the buffer zone is more abundant. The Contagion Index (Contag) value of the 0-3km buffer zone of the Buyi ethnic villages from 1990 to 2020 is relatively large and shows an upward trend after declining, indicating that the regional landscape is fragmented from 1990 to 2010, but there are some dominant landscape patches in the region in 2020 Start to connect, and the degree of fragmentation is reduced. The Aggregation Index (AI) is large but showing a downward trend, indicating that the aggregation degree among the plaques is high, but there is a tendency of fragmentation. The landscape shape index value is rising, indicating that the patch shape is developing irregularly and the patch composition is becoming more complicated. The value of Interspersion and Juxtaposition Index (IJI) showed an upward trend and then a downward trend, indicating that from 1990 to 2010, the overall plaques developed towards uniformity, but the area of certain types of plaques increased from 2010 to 2020, and this type of plaques formed towards aggregation.

Table 1. Landscape pattern index of different buffer zones

Buffer	Time	LPI	SHDI	CONTAG	IJI	AI	SHEI	PD	LSI
0-3km	1990	96.2332	0.2014	91.4917	66.8714	97.0542	0.1124	0.0077	5.2394
	2000	96.2332	0.2019	91.4675	67.4782	97.0488	0.1127	0.0078	5.2474
	2010	96.2332	0.2022	91.4504	68.3158	97.0500	0.1129	0.0077	5.2456
	2020	96.2332	0.2051	91.9796	65.3307	96.9511	0.1054	0.0078	5.3847
3-6km	1990	86.9734	0.4144	83.3136	58.9319	92.7652	0.2129	0.0170	11.4896

2000	86.9734	0.4156	83.2609	59.3583	92.7549	0.2136	0.0172	11.5052
2010	86.9734	0.4168	83.2035	60.3917	92.7557	0.2142	0.0172	11.5052
2020	86.9590	0.4223	82.9417	63.8252	92.6710	0.2170	0.0185	11.6317

From 1990 to 2020, the Shannon's Diversity Index (SHDI) and Shannon's Evenness Index (SHEI) of the 3-6km buffer zone of the Buyi villages showed an upward trend, indicating that the landscape is rich in composition and the patches are distributed evenly. The Contagion Index (Contag) value is relatively large, showing a downward trend, displaying that the landscape is highly fragmented. The Interspersion and Juxtaposition Index (IJI) are in a median state, showing an upward trend, indicating that the plaques are dispersed and uniformly distributed. The Aggregation Index (AI) value is more enormous and shows a downward trend. The patch density gradually increases, implying that the types of patches in the 3-6km buffer zone are growing and the degree of aggregation between patches is high.

Compared with the 0-3km buffer zone, the land use pattern change trend of the 3-6km buffer zone is different. The patch size of the 0-3km buffer zone is smaller than that of the 3-6km buffer zone. The patch diversity of the 3-6km buffer zone of the village is greater than that of the 0-3km buffer zone of the village, and the landscape shape index is much higher than the 0-3km buffer zone of the village, and the patch shape is more complicated. The degree of spread and aggregation is lower than the 0-3km buffer zone of the village, indicating that the degree of landscape fragmentation is higher than the 0-3km buffer zone.

4 Conclusion

This study analyses the altitude, slope, and aspect of the Buyi villages based on their spatial concentration. To gain a deeper understanding of the living environment of the Buyi group, the distribution pattern and change trend of land use in elevation and slope in the study area were analysed by establishing a buffer zone in villages. According to previous studies, land-use changes can reflect regional development trends and life patterns to a certain extent. At present, scholars in China and abroad are exploring the coexistence and sustainability of humans and ecosystems based on land use patterns. In summary, the research method used in this study is operable and the experimental results are also meaningful.

The study results show that most of the Buyi villages are located in areas with medium elevations and gentle slopes, and the overall pattern is high in slope. This shows that the Buyi consider slope issues when choosing residences, which is related to the life customs of the Buyi. The Buyi are called the "hardworking people," and their arable land is the second-largest land use in the village. At the same time, arable land is mainly distributed in low-slope areas, which is consistent with the common sense of the Buyi who often live in fertile river valleys or dams. The construction land of the Buyi is also largely covered in low-slope areas. As the largest land-use type, the Forest covers a large area in various slope ranges, providing a guarantee for the area's water and soil conservation, the security of the Buyi people's housing, and the nation's sustainable development.

At present, the aggregation of patches in the 0-3km buffer zone of Buyi villages is developing towards decentralization, the shape of the patches is complicated, and the landscape diversity has increased, while the degree of fragmentation of the patches in the 3-6km buffer zone is

higher. With the continuous spread of urbanization in my country, the Buyi villages have been affected in recent years, mainly in the substantial increase in construction land and the declining area of arable land, which will conflict with the inheritance and development of the Buyi ethnic culture. It is a minority in the future. The problem of cultural protection is also a problem that continues to be solved.

This study only studies the changes in land use and landscape pattern of Buyi villages from the time series. In the future, we can deeply analyze the driving factors of the landscape pattern and provide straightforward suggestions for the management of Buyi villages.

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