2017 International Conference on Energy Development and Environmental Protection (EDEP 2017)
ISBN: 978-1-60595-482-0

Landscape Pattern Evolution and Ecological Protection Planning on Simao to Ninger Segment of the Ancient Tea Horse Road

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Keywords: The ancient tea horse road, Landscape pattern, Evolution, Driving forces.

Abstract. There are a large number of cultural and natural landscapes aggregating and emerging in the ancient tea horse road. Accurately grasp the dynamic change process of landscape pattern in the area, and analysis natural and human driving force in the landscape pattern evolution of history heritage corridor ancient tea horse road that play the role, for to formulate ecological protection planning of the historical and cultural heritage corridor have great significance. This paper selects these towns and villages which stand along the typically initial segment of the ancient tea horse road i.e. route of Simao to Ninger that as the research object. It uses 1999,2006 and 2013 Landsat TM and ETM remote sensing images as the basic data, and integrating use of RS, GIS and landscape ecology related theory methods, and analyses the characteristics of the landscape dynamic evolution and driving forces and driving mechanism for 14 years in this research area. The results show that has significant changes landscape pattern in study area from 1999 to 2013. The main conclusions are as follows. From the level of types, reduction amount of the forest area is the most, a reduction of 7%, the fragmentation degree increases. Urban construction land shows an overall growth trend, its area increases significantly, an increase of 22.3%, the degree of aggregation increases, the connectivity of urban construction land strengthens, and the patch shape tends to be simple. The area of grassland and water overall area trends to increase. The area of cultivated land trends to increase. From the level of landscapes, in this study area, landscape patch density continues to decrease, the total number of landscape patches continues to reduce, on the whole, the landscape patch distribution becomes more continuous, tends to fusion between patches. Landscape separation index trends to be rising, distribution of landscape types tends to be complex and discrete, individual patches are sporadic, scattered. The landscape of the Shannon diversity index and Shannon evenness index shows a certain rising trend, the diversity of landscape structure is increasing. The rising of Shannon evenness index shows that the control force of the original landscape that was in dominant position on the whole landscape is declining, and influence of different landscape types on the whole landscape pattern tends to equilibrium. This research focuses on the analysis on the driving factors and driving mechanism of the evolution of landscape pattern in the study area from natural factors and human factors. The result shows that topographic factors, demographic factors, economic factors, industrialization and urbanization factors, economic system and decision making factors affect the change of landscape pattern jointly. Meanwhile, at different spatial scales and time scales, the main driving forces which have influence on the landscape pattern are not the same.

1. Introduction

The ancient tea horse road is traffic lanes, which originated from Yunnan and Sichuan traditional tea production areas, such as use the carrier transport such as caravan tea in the tea trade to the Tibetan and other traditional tea market, in return exchange the Tibetan horses and fur products. Along the ancient tea horse road pristine natural environment has been severely damaged. By the study of landscape evolution and power factor on Yunnan Tibet ancient tea horse road Simao to Ninger segment , for the development of the regional ecological protection planning provides certain basis. So this research has important practical significance.

1992 first time foreign transportation are referred to as the ancient tea horse road in the Yunnan's history, and caused the attention of scholars. Domestic scholars have researched the history , development process and the history functions for the ancient tea horse road, mainly including archaeology, history and geography, horse tea trade, the development history and historical significance. Especially from the perspective of cultural heritage protection, have researched and put forwarded the overall protection of corridor heritage.

Today, most research in qualitative research, lack of quantitative data and theoretical analysis, rarely involved the research of the evolution of the landscape pattern, lack of the evolution process of mutual influence between human landscape and natural landscape and its internal mechanism research.

Abroad for a long time, many scholars have conducted a lot of related research on the landscape pattern and evolution that is landscape ecology research core and cutting edge[1,2]. In 1989 the first national conference on landscape ecology in Shenyang, since then the landscape ecology research enters the new period of rapid development in our country[3,4]. Domestic research of landscape pattern change driving force, mainly to a single category of the study area landscape pattern change has proceed qualitative or simple quantitative analysis, therefore lack of comparing between different time scales, different times, different regions of category, different regional scales, and lack of interaction mechanism study[5-8]. Study abroad is more devoted to the comparative analysis of driving force factors, system analysis of driving factors factors and the quantitative attempt[9-11].

2. Research Methods

In this paper, on the basis of the theory and method of landscape ecology, using GPS, GIS and RS technology to study the landscape dynamic change in the studied area.

Determine the ancient route and scope of the study area→ Get original remote sensing image of 1999, 2006 and 2013 three different periods in the area→The research area divided into five types of landscape types, the urban construction land, grassland, forest, farmland, water area→through the remote sensing image processing software ERDAS2010 interpretation that generated landscape type map→Using FRASTATS4.3 for software landscape type map the landscape index is calculated with GIS technology, and set up the transfer matrix of landscape types, and then analyze the process of landscape pattern change, the regional landscape pattern evolution that were analyzed→Using the method of mathematical statistics to analyze the main factors that influence the different period of landscape evolution, and find out the main driving factors in the evolution of landscape pattern and study its internal driving mechanism.

3. The Scope and General Situation in the Study Area

Select a region of Yunnan Tibet ancient tea horse road in the start Simao region to Ninger area as the research area, which referred to as Simao to Ninger segment of the Yunnan Tibet ancient tea horse road and a total including five villages and towns.

In the study area is located in pu 'er city, the south, the geographical coordinates on east longitude 100° 45 '06' - 101° 51 '56 ", north latitude 22° 32' 50 "- 23° 20 '47". Study area is 58 km wide from east to west, from north to south long 81 km, with a total area of 2056 square kilometers. By the end of 2013, the population of permanent residents of the area has 263000 people. Terrain in the study area north and south is low and middle is high and ups and downs is bigger, high and steep mountain, deep valley, the landscape characteristics is given priority to mountain, mountain area accounted for 98% of the study area that is a typical mountainous area, local area for reservoir and mid-levels district. Mountains at an altitude is 1500 m on average.

Local area for A small piece of flat land and mid-levels district. Mountains at an altitude of 1500 m on average. The study area belongs to the low latitudes subtropical plateau monsoon climate, there are two south Asian tropical and subtropical clima te types, three-dimensional climate is obvious in a region. Forest land accounts a large proportion in the study area, which have rich forest resources and vegetation cover condition is very good and the forest coverage rate is very high.

4. Landscape Pattern Evolution Analysis

4.1Selection of Landscape Index and the Result of Analysis and Calculation

4.1.1The Landscape Type Level Index

On the landscape type level, patch type area (CA), percentage of landscape types (PLAND), the number of patches (NP), plaque index (LPI), the largest distribution and parallel index (IJI), a total of 5 indicators.

Table 1. Landscape index of the landscape types level in the study area in 1999-2013.

Time	Landscape types	CA (km²)	PLAN (%)	NP	LPI (%)	IJI (%)
1999	grassland	269.4	13.13	7171	0.2	50.32
	woodland	1446.78	70.42	1597	54.43	56.98
	towns	43.97	2.13	1432	0.44	10.68
	water area	12.1	0.55	258	0.46	86.5
	plowland	283.89	13.76	4388	2.63	77.48
2006	grassland	238.06	11.43	6329	0.08	51.15
	woodland	1398.11	68.08	1211	50.26	51.75
	towns	48.81	2.36	728	0.83	11.43
	water area	6.64	0.32	70	0.09	48.54
	plowland	364.52	17.8	3634	2.9	73.44
2013	grassland	284.48	14.02	5381	0.15	49.39
	woodland	1344.44	65.2	1217	46.73	52.55
	towns	54.88	2.64	639	1.21	24.32
	water area	14.89	0.73	245	0.09	70.1
	plowland	357.45	17.41	3266	3.85	77.06

Landscape level index,Patch density (PD) at the landscape level, edge density (ED), spread degrees (CONTAG), separation index (SPLIT), aromatic diversity index (SHDI), aromatic evenness index (SHEI), a total of six indicators.Analysis and calculation results such as table 1 and table 2.

Table 2. 1999-2013 landscape index of landscape level in the study area.

TIME	PD（/km²）	ED	CONTAG	SPLIT（%）	SHDI	SHEI
1999	7.22	78.37	58.98	3.24	0.89	0.56
2006	5.82	64.34	60.16	3.85	0.92	0.57
2013	5.23	87.21	54.94	4.38	0.99	0.62

4.2Analysis of Characteristics of Landscape Pattern Evolution

4.2.1Analysis of Pattern Change of Landscape Type Level

The table 1 shows that from 1999 to 2013, at the level of landscape types dramatic changes have taken place for the landscape pattern in the study area. Forest land area is the biggest decline in landscape types, from 1999 to 2013 reduced 7%, the number of patches (NP) increase, patch fragmentation degree decreases first and then get some relief. Urban construction land area has been increased from 1999 to 2013 increased 24.8%, the largest patch index (LPI) and the distribution and parallel index (IJI) are on the rise, which show that the polymerization degree increased between patches.

Water area increased after reducing first, change is bigger, but the area percentage of landscape types (PLAN) is not large, so the overall volatility is not so obvious.Though the grassland area increase after decreases first, cultivated area increased after decreased first, but the number of patches (NP) is a downward trend, which show that the polymerization degree between their patches are on the rise.

4.2.2Analysis of Pattern Change on the Landscape Level

The study area from 1999 to 2013, landscape level dynamic variation in three time is mainly manifested in the following three aspects:

4.2.3Analysis Dynamic Change of Landscape Patch Size and Density

From 1999 to 2013, the landscape patch density (PD) decrease and boundary density (ED) were increased after decreased first, therefore, reduce the total number of landscape patches in study area, and overall landscape patches distribution become more continuous, tending to fusion between patches. Although landscape distribution becomes continuous, values of boundary density (ED) no single presents the trend of rising or falling that indicate patch shape becomes more complex and diversity. Forest landscape and farmland landscape plays a main role in the whole landscape pattern change.

4.2.4Analysis of Landscape Patches Aggregation Degree Dynamic Change

Landscape isolation index (SPLIT) is on the rise, and it indicate that some plaques in landscape type crushing degree is intensified, the distribution of landscape types tend to be complex and discrete, individual patches are sporadic and scattered.

4.2.5 Analysis of Landscape Diversity Dynamic Change

The Shannon landscape diversity index (SHDI) and Shannon evenness index (SHEI) are an upward trend in the study area, show the diversity of landscape structure is increasing, that is affected by human activities and natural factors, landscape types become gradually more, also illustrates that control force of the dominant landscape for whole landscape is on the decline in the research area, and each landscape types influence on the whole landscape pattern tends to equalization.

4.3 Driving Mechanism of Landscape Pattern Evolution Research

4.3.1 Landscape Pattern Evolution Study on Spatial Scales

Because people activity main within 3 km radius, so the selected path around 3 km range as comparison region of landscape pattern change under different scales.As the ancient tea horse road as the center, 1 km as a interval of the buffer, from the ancient center to outside is divided into three buffer.

Analysis can be seen, within the category of the study area, forest as the main landscape types occupy a larger percentage of 65%, and urban construction land and farmland percentage was mainly affected by human activities is 20%. But in small scale category, such as distances from the center of the ancient road 1 km range, while the main landscape types still is forest land, but under the influence of artificial factors percentage of urban construction land and the cultivated land increased significantly, reached 33%, and woodland percentage is 52%. And with the increase distance to the ancient center, and outside 2 km the scope percentage of forest land and farmland landscape type no obvious change, while the proportion of urban construction land continues to decline, that illustrates the artificial factor within the scope of the ancient road 2 km distance effect is more noticeable.

4.3.2 Landscape Pattern Evolution Research on Time Scale

In the evolution process of landscape pattern, driving factors in different time scales shows different importance in the study area. For a relatively short time scale, climate and topography these natural factors is relatively stable, and has a certain cumulative effect, only has little change in a short time scale.

In short time artificially drive factor cause the obvious change of landscape pattern, especially the implementation of the planning construction.

5. Conclusion and Discussion

From the point of view of landscape types change, 1999-2013, the landscape pattern change significantly in the study area. Forest area is decreasing, and overall there is a growing trend for urban construction area, and the grassland and water area show the overall trend increases, and farmland is overall increase trend.

At the landscape level, overall patches distribution become more continuous, and tending to fusion between patches. Distribution of the landscape types trend to discrete and complex.

The original advantage landscape for the entire landscape control that is on the decline and each landscape type influence for whole landscape pattern that trend to equalization.

From two aspects of natural factors and human factors this study analysis the impact factor and driving mechanism that caused landscape pattern evolution in the research area. Results

show that the topography factors, demographic factors, economic factors, industrialization and urbanization, economic system and decision-making factors mutual influence made the changes of landscape pattern in the study area. At the same time show that under different spatial scale and time scale, the main driving force that impact on landscape pattern that is not the same.

Above results for to formulate ecological protection planning of the historical and cultural heritage corridor that have great significance.

How to establish an effective driving force analysis mathematical model, and further to explore the driving force mechanism that is worthy in-depth discussion and research in the future.

Acknowledgement

The authors would like to express appreciations to support by the National Natural Foundation of China (No. 51468064). The authors would like to express appreciations to colleagues in our laboratory for their valuable comments and other helps.

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