Optimization and Reconstruction of Town and Village Ecological Security Pattern under the Background of Sponge City

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Abstract. Guided by the principles of landscape ecology, taking the area of 50hm\textsuperscript{2} of a Town, as an example, four ecological control factors including cultivated land area, climate hydrology, topography and geomorphology and biodiversity are selected to analyze the characteristics of the ecological pattern under the guidance of each factor. With the expansion of the scale of town and village economy, population scale and land use scale, the situation of ecological security is not optimistic, which is mainly manifested in the shortage of water resources caused by water pollution, serious pollution of river water body, the single ecological landscape system, the lack of biodiversity and so on. The construction and optimization of water security and landscape ecological security pattern can solve the governance and optimization of water pollution and landscape environment, and meanwhile, we need to adapt to local conditions to develop the local dominant industry in order to synchronize ecological construction with ecological security. The optimization and construction of town and village ecological security pattern is a systematic project. We need to take the whole situation into account from point to surface, and provide some reference experience for the optimization and construction of rural ecological security pattern under the background of new-type urbanization. The research and construction of the ecological security pattern is the foundation of making a good plan for the new countryside and promoting the sound development of the town and village.

Introduction

At present, the problems brought about by the construction of new-type urbanization are environmental pollution, the deterioration of the ecological environment, the shortage of resources and the decline of the bearing capacity of the resources and the environment. Many rural areas pursue economic interests unilaterally, without overall planning and research, blocking the contact with nature. So that the local natural resources are damaged, the rural water is polluted, the phenomenon of vegetation destruction is serious, and the ecological security is seriously threatened, which hinders the process of the construction of new-type urbanization to a great extent\cite{1}\cite{2}.

In this context, scholars at home and abroad have put forward the theory of ecological security\cite{3}, which is a new concept mainly based on the shortage of resources, environmental pollution, ecological destruction, biodiversity loss, water ecosystem damage, soil ecological destruction and other ecological problems. Ecological security\cite{4} includes the security of the ecosystem itself, that is whether it can maintain its own equilibrium under external influences, and the safety of the ecosystem to human beings that is whether the ecosystem can provide an environment for human survival and development. The meaning of ecological security\cite{5} has a broad and narrow sense. In a broad sense, it refers to the human living environment, including that the complex environment, such as nature, economy and society, is in a state without threats. The narrow sense of ecological security mainly refers to the health level of water resources, land, biological species, agriculture and so on. This paper discusses the concept category of the narrow sense.
Town and Village Ecological Security Pattern

Ecological Security Pattern

The ecological security pattern[6] belongs to the concept category of landscape ecology. The domestic scholar Kongjian Yu pointed out: “There are some potential spatial patterns in the landscape, which are called ecological security patterns. They are composed of some key parts, points, locations and spatial connections in the landscape, which are very important for maintaining the regional ecological infrastructure and constructing the ecological security pattern.” The rural ecological security pattern is based on the theory and method of landscape ecology. Through the planning and construction of town and village ecological infrastructure, the ecological value and regional characteristics of itself are protected to the maximum extent to minimize the impact of external factors on ecological factors (water, soil, animal and plant, etc). Different regions have the ecological security pattern with different characteristics, so we need to build and optimize the ecological pattern according to different geographical features of different regions[7].

Construction Method Based on Ecological Security Pattern

In this paper, we use artificial research, use topographic map and plant distribution map as the source of information in the survey, and use geographic information system (GIS) to extract the status information. The key elements of ecological patterns, such as river, soil and plant, are analyzed through the single factor. And then the regional ecological security pattern is obtained through the superposition analysis of 3 layers and combined the local cultural background, the optimization and reconstruction are carried out, so as to construct a benign rural ecological pattern with good water ecology, good soil green system and good plant ecological diversity[8].

Research Methods and Technical Routes

Research methods: Taking the area of 50hm² of the town as an example, through the use of topographic maps and plant distribution maps, the field investigation and single factor analysis, and the use of the principle of landscape ecology, the ecological security pattern in the countryside is analyzed. And through the graphic superposition technology, the comprehensive ecological security pattern of the countryside is formed and optimized.

Technical routes: Through the collection of basic information and the village’s topographic maps, plant distribution maps and other image information sources, the mastered information are analyzed. The single factor analysis is used to decompose and analyze four ecological factors including topography and geomorphology, climate hydrology, cultivated land area and biodiversity. The ecological security pattern is optimized and reconstructed by using the principles and techniques of landscape ecology. Finally, a comprehensive ecological security pattern based on green space, water ecology and biological community is formed.

Taking the Town as an Example to Optimize and Reconstruct the Ecological Security Pattern

Background of the Town

The Town, Hunan Province is an important town in the western mountain area. The town area is 220 square kilometers, with a population of 62 thousand, 24 villages and one neighborhood committee. It is 90 kilometers from the provincial capital. Its location advantages are obvious and the traffic is very convenient. The studied area is about 50hm².

The Town actively promotes the national economy and social development “13th Five-Year” planning, accelerates the construction of new-type urbanization, and works hard to build a strong town of ecotourism around the strategies of “ecological county” and “tourism develops the county”. In the process of promoting the construction of new-type urbanization, there are many problems in the Town, including the unreasonable use of water resources, water pollution, farmland non-point source pollution and so on, among which ecological security problems are particularly prominent.

Analysis of Ecological Security Pattern

The ecological security pattern analysis mainly adopts the single factor analysis method, and then
uses the graphic superposition technology to carry on the comprehensive analysis of the ecological security pattern. The detailed analysis process is as follows:

The first one is single factor analysis.

The first point is cultivated land area. According to the frequency distribution of the area ratio of cultivated land, 30% and 65% two grades are determined. Low level security zone: The proportion of cultivated land area<30%. It is the priority area of development and construction. Middle level security zone: The proportion of cultivated land area is 30%—65%. It is the moderate development and construction. High level security zone: The proportion of cultivated land area>65%. It is the basic farmland stipulated by the state for the prohibition of construction. The analysis shows that the cultivated land is dominated by traditional planting industry, and the southwest is the priority area for development and construction.

The second point is climate hydrology. This place belongs to the subtropical monsoon humid climate area, with abundant rainfall, obvious dry and wet climate, and distinct seasons. The annual average rainfall is 1461.3mm, and the rainfall is mainly concentrated from April to July. The annual average temperature is 16.8℃, and the average water surface evaporation is 1370.1mm. There is the Huangcai reservoir in the vicinity, mainly for irrigation, and also for flood control, power generation, aquaculture, water supply, tourism and so on. In the period of high precipitation, it is easy to form flood reverse irrigation and the impact of reservoir dam. The water resources are rich, but there is a shortage of water resources caused by water pollution. Affected by the local bronze industry, the water pollution is serious, and there is even the water quality below class V in some areas.

The third point is topography and geomorphology. It is a typical hilly valley landform. There is the gentle and fertile farmland between the hills, the water is wide, the water resources are rich, it is situated at the foot of a hill and beside a stream and the environment is superior. The land is rich in resources, and the soil type is red soil.

The fourth point is biodiversity. There are a variety of biological species and a wide variety of landscape plants. However, with the improper exploitation of local forestry and mineral resources, the structural changes of biological populations occur, which directly leads to frequent occurrence of disastrous climate and single plant species.

It can be seen from the green coverage rate (park, residential district, road, attached and production green space) is 20% based on the weighted average calculation. It does not meet the target requirement of 40% green cover, and it needs further conversion of farmland to forest to restore a certain proportion of green area.

The second one is comprehensive ecological security pattern.

The ecological security pattern under the guidance of four ecological control factors including cultivated land area, climate hydrology, topography and geomorphology and biodiversity is spatially superimposed to form the final ecological security pattern.

As can be seen from the figure, the southwest that is the red area is the focus of governance. It is necessary to optimize and reconstruct the ecological pattern.

**Optimization and Reconstruction of Ecological Security Pattern**

The first one is optimization and reconstruction of water safety pattern. The long-term accumulation of general point and surface source pollution in the water body will lead to serious internal pollution. Then the pollutants are released to the overlying water, which results in the poor water quality of overlying water. The reason is that a large amount of organic matter exceeds the aerobic metabolic capacity of the microorganism, and the degradation of excess organic matter consumes oxygen, which leads to the hypoxia at the bottom. So that the water body is anoxic, a large number of aquatic organisms die out, biological diversity is sharply reduced, ecological balance is destroyed, and the food chain is no completer existed. According to the characteristics of the local fishing industry, the following techniques are proposed to improve the quality of the water environment of the river course.

The second one is optimization and reconstruction of landscape ecological security pattern.
Landscape elements are mainly composed of patches, corridors and matrix. The area of 50hm$^2$ is used as the artificial patch. But as the construction of the ecological security pattern, the green patches are mainly studied, that is the narrow understanding of patches—it is constructed by the living animal and plant community. The corresponding ecological function is played mainly through the construction of the ecological ditch.

The first point is the ecological ditch refers to the existence of aquatic plants, the ecological ditch enhances the purification capacity of wetland for water pollution. As the interlacing zone on the edge of farmland ecosystem, the higher plant diversity of farmland drainage ditches can provide animal habitat and shelter, and increase biodiversity of farmland ecosystem.

The second point is biodiversity construction. The riverside green space where the aquatic plants, hygrophytes and onshore plants grow together should be used and the structure of the vegetation community on the riverbank should be restored. Combined with the local plant resources, the introduction of exotic species should be restricted and the biodiversity should be protected. The ecological revetment uses a variety of artificial and natural revetments and embankment greening, which provides habitat for fish or aquatic animals. The technical construction of the artificial floating island and underwater forest enriches the species of animals and plants.

The third point is the corridor mainly refers to the boundary channel of stream of people, logistics and ecological environment, which determines the accessibility of the whole patch. Through the construction of trestle bridge surrounded by the water, the park and green space are linked. When people walk on it, it looks like they are floating on the water surface or plant leaves.

The fourth point is the base of this region is mainly based on farmland. When the construction is optimized, the main consideration is to effectively control the agricultural non-point source pollution. The specific technology has been mentioned in the optimization and reconstruction of water security pattern.

Conclusions and Enlightenment

In the construction of the new-type urbanization of the town, with the expansion of the scale of rural economy, population scale and land use scale, the situation of ecological security is not optimistic, which is mainly manifested in the shortage of water resources caused by water pollution, serious pollution of river water body, the single ecological landscape system, the lack of biodiversity and so on.

Through the analysis of four ecological single factors including cultivated land area, climate hydrology, topography and geomorphology and biodiversity, and through graphics superposition, the area with low ecological security level is obtained, and the optimization and construction of ecological security are emphasized. Among them, the proportion of cultivated land area in the southwest side<30%, which is the priority area of development and construction. Through the weighted average calculation, the green area is 20%<40%.

The optimization and construction of regional ecological security pattern are mainly carried out from the construction and optimization of water security and the landscape ecological security pattern. The rural ecological security pattern needs to be highlighted mainly to solve the governance and optimization of water pollution and landscape environment. At the same time, the local advantage industry should be developed according to local conditions in order to synchronize ecological construction and ecological security.

The optimization and construction of rural ecological security pattern is a systematic project, and we need to take the whole situation into account from point to surface. The research and construction of the ecological security pattern is the basis for the new rural planning and the healthy development of the countryside, which helps the government to grasp the direction of the rural construction planning and provides the basis for the government’s decision-making.

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References