Research on the Construction of Zhaoqing City Infrastructure under the Guidance of Ecological Security

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Abstract: In the context of urbanization, the Earth's ecosystem and ecological services are severely affected. Rapid urbanization and disorderly expansion have caused the destruction of regional ecological environment and waste of resources, and also brought potential risks to regional ecosystems. From the perspective of landscape ecological security pattern, based on the current situation of Zhaoqing city development, the safety pattern of urban geological disasters, hydrological system, local culture and biological protection in Zhaoqing was analyzed. With the assistance of RS and GIS technology, the Zhaoqing urban ecological infrastructure with high, medium and low levels of safety was constructed, and the ecological conflict space between ecological infrastructure and construction land was identified.

1. Introduction
At present, China's economy is developing at a high speed, but at the same time it faces an ecological environment crisis, which seriously threatens the ecological security of the country. The expansion rate of urban construction land in China is significantly higher than the population growth rate. In the past 34 years, China's urban construction land has increased by 6.44 times, with an average annual growth rate of 6.27%. The per capita construction area of Chinese cities is 129.57 square meters, which greatly exceeds the national standards, and is also significantly higher than the average of 84.4 square meters per capita in developed countries and 83.3 square meters per capita in other developing countries [1]. This trend extends from the eastern coastal areas to the inland, from the central towns to the rural areas, forming a situation of “city going green”, destroying the original ecological balance, causing regional ecological environmental crisis and seriously affecting regional ecological environment security. In order to strengthen ecological environment protection, ensure urban ecological security, guide urban scientific planning and layout, optimize urban spatial structure, and take Zhaoqing urban ecological infrastructure as an example to explore the construction of urban ecological security pattern.

2. Concept of Ecological Infrastructure
The concept of ecological infrastructure was first proposed in the 1984 UNESCO Man and Biosphere Programme (MAB). The ecological infrastructure is essentially a natural system on which urban and rural sustainable development depends. It is the basis for urban and rural residents and their residents to continuously acquire nature's services, including providing fresh air, food, sports, recreation, and safety. Asylum as well as aesthetics and education. With the deepening of research, the idea of ecological infrastructure is reflected in the emphasis from simple "protection" to the use of EI to guide the development of the city, thus achieving the "EI-oriented urban development" approach[2].

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In the process of urbanization in China, it faces the problem of urbanization and ecological environmental protection. Unreasonable urban development and construction have damaged the regional ecosystem structure, resulting in weakened ecosystem service functions, seriously threatening residents' production and life, and affecting environmental sustainable development. How to strike a balance between urban development pressure and ecological environmental protection, restore the natural system's service function to the city, and achieve sustainable urban development has become a difficult problem for the current government and planning and design circles. Just as protecting water sources is our lifeline, the bottom line of urban safety development is the basic maintenance of ecosystem services.

3. Theory of Landscape Ecological Security Pattern
There are some potential spatial patterns in the landscape, which are composed of some key local, point and positional relationships. This pattern plays a key role in maintaining and controlling an ecological process called landscape ecology [3]. Safety pattern Landscape ecological security pattern is based on landscape ecology theory and method in the late 1990s. Based on the relationship between landscape processes and patterns, it is critical to distinguish the landscape pattern impacting the health and safety of these processes through the analysis and simulation of landscape processes. The landscape ecological security approach takes the landscape process (including regional hydrological cycle, species space movement, disaster process diffusion and urban sprawl expansion) as a process of achieving landscape control and coverage by overcoming spatial resistance. To achieve effective control and coverage, strategically important landscapes elements, spatial locations, and connections must be captured. The pattern formed by such key elements, strategic locations and connections is the landscape ecological security pattern, which is of great significance for maintaining and controlling ecological processes or other horizontal processes [3].

At present, the relatively mature method for identifying the landscape ecological security pattern is to realize landscape control by constructing the Minimum Cumulative Resistance (MCR) of the ecological process. The MCR model is based on the GIS spatial analysis module to analyze the degree of separation of landscape patches and serve as the basis for landscape pattern optimization. The landscape pattern optimization MCR model is mainly realized in the GIS by relying on the minimum cost distance (Cost Distance) model. By using the landscape resistance surface characteristics to distinguish the landscape ecological strategic points, it extends to the discrimination of the landscape ecological security pattern. The formula for calculating the MCR model is as follows:

$$MCR = \sum_{j} (D_{ij} \times R_{i})$$  \hspace{1cm} (1)

f is an unknown positive function, reflecting the positive correlation between the minimum resistance of any point in space and the spatial distance of the base of a landscape that it traverses and the characteristics of the landscape base. Dij is the spatial distance of the base of a landscape from the source to a point in space; Ri is the resistance of landscape to the movement of a species. Although the function f is unknown, the (Dij × Ri) value can be considered as a relative measure of the path of a species from a source to a point in space, where the maximum value of resistance from all sources to that point is used. By measuring the accessibility of this point, the constructed resistance surface can reflect the potential possibilities and trends of species movement [4-5]. The landscape ecological security pattern theory as a dynamic spatial structure model is a method of constructing ecological infrastructure. It regards the horizontal landscape process as a process of overcoming spatial resistance to achieve landscape control and coverage, and requires corresponding constraints and discriminant parameters as well as the theoretical and technical support in hydrology and ecology.

4. ZhaoQing City Ecological Infrastructure Construction
American landscape ecology experts Ahern and Ndubisi divide ecological infrastructure into three categories by analyzing ecological services and ecological process functions: Biotic, Abiotic, and Cultural [6]. This comprehensive and inclusive model based on landscape ecology clearly recognizes
the interaction between biotic and abiotic systems and humans. It is also known as the ABC model and is widely used in the planning and construction of ecological infrastructure in the United States. As a result of ecological security pattern of different types of landscapes, ecological infrastructure embodies that the realization of ecological functions requires the integrity of ecological processes. The completion of ecological processes requires the support of ecological space, and the ecological infrastructure is the guarantee of ecological functions.

This paper analyzes the non-construction land structure of ZhaoQing City, draws on the ecological infrastructure concept, and uses the ABC model as a framework to identify the landscape ecological security pattern, and establishes the landscape ecological security pattern of geology, biology, hydrology and local culture through computational composition and spatial superposition to produce ZhaoQing urban area ecological infrastructure network.

4.1 ZhaoQing City Basic Profile and Data Sources
ZhaoQing City is a rapidly urbanizing city. It is located in the central and western part of GuangDong Province, northwest of the Pearl River Delta, and has five districts including DuanZhou District, DingHu District, GaoYao District, ZhaoQing New District and ZhaoQing High-tech Zone (DaWang). The total plan of ZhaoQing City is characterized by high terrain in the northwest and south, and flat terrain in the northeast to southwest. The low-mountain landforms in the northwest and the south are mainly distributed in the main mountain bodies such as Beiling Mountain, DingHu Mountain and Rouge Mountain. The main urban construction land is distributed in the northeast to southwest plain. Considering the difficulty and timing of data acquisition, this paper selects the remote sensing image of LANDSAT (Tursing Landsat System)TM series as the main data source, and combines ZhaoQing urban topographic map, land use status map and land use change table for processing and analysis.

4.2 ZhaoQing City Hydrological System Security Pattern
Flooding is inevitable as part of the river's natural processes, but floods can be minimized through ecological planning. From the perspective of spatial planning, by studying the distribution pattern of floodplain, the thesis provides a basis for planning land use decision-making, and planning flood-prone areas as wetlands and open spaces is an effective way to reduce flood disasters and their effects [9]. The flood safety pattern of ZhaoQing City should be started from different scales of watersheds. By establishing a coordinated flood control system, corresponding flood control measures should be established according to the risk level.

Because this paper is based on GIS simulations, it is necessary to calculate flood levels or adjustable flood flows and energy levels at different safety levels. It is safe enough to discharge the flow and the amount of adjustable flood storage, so it is necessary to obtain historical hydrological and monitored storm runoff data to calculate the reasonable height of the flood level reduction and the area of flood spread. At the same time, by collecting the flooding range of historical floods, the different ranges of floodplain, flood detention zone and flood protection zone are analyzed, and the scale, pattern and river buffer width of different flood risks are determined, and the cooperative flood control dynamics of wetlands and rivers are established. The system determines different levels of safety based on different risk levels.

The hydrological analysis module in GIS is a means to effectively analyze and simulate hydrological processes, which can simulate the regional runoff process and identify potential wetlands. The hydrological analysis module generally requires digital elevation data (DEM) to simulate the runoff process, and then establishes a flood surface based on the flood level at different safety levels to obtain the flood submerged range. ZhaoQing City is mainly composed of XiJiang River Basin and XingHu Wetland, JiuKeng River Reservoir (Kowloon Lake) Wetland Core Area and New Area Wetland Core Area. It comprehensively evaluates the ecological and social benefits of the XiJiang River Basin and its wetlands, and follows the protection of its ecosystem health. The spatial and spatial pattern of wetland resources is planned for the connectivity between the corridors and wetlands,
the stability of large wetland patches, and the ecological channels provided for urban groups. It is selected as a concrete case to discuss the flood control safety pattern based on flood volume. Firstly, the CAD contour data of ZhaoQing New District is converted into DEM data as the basic data of the runoff process simulation. Through GIS to simulate the runoff process, the location and extent of potential wetlands can be obtained by encountering stagnation points in low-lying areas, mainly distributed in the wet areas of the XiJiang River Basin. Based on the ArcGIS, the flood surface elevation raster data is established based on the flood water level, and the simulated water level of each point in the area is obtained [3]. Then calculate the difference between the elevation of the flood surface and the terrain elevation to obtain the flood inundation range of different return periods (Fig. 1).

4.3 The Safety Pattern of Geological Disasters in Zhaoqing City

The analysis of the geological disaster safety pattern should first be based on the sensitivity analysis of regional geological hazards, superimposing the spatial distribution of various geological hazards such as mountain collapse, landslide, slip, ground subsidence and ground fissure, and determine the source of geological disasters. Then, through the analysis of the types of local disasters and the analysis of land use patterns in disaster-prone areas, the regional and spatial linkages that play a key role in the protection of geological disasters are determined. The extent of the buffer zone is affected by factors such as the type of geological hazard, development intensity, distribution, frequency of occurrence, topographical geological conditions, precipitation conditions, and intensity of human activity. Finally, through the spatial superposition of the spatial distribution of various disaster sources, the safety pattern of geological disasters with different safety levels is obtained.

The geological disaster factors of ZhaoQing City mainly include various geological disaster factors such as mountain collapse, landslide, slippage, land subsidence and ground fissure. Based on GIS, the elevation and slope are graded to obtain the sensitivity distribution of geological disasters. The spatial distribution of geological disaster sources is identified by superimposing various geological hazard factors (Table 1, Fig. 2).

| level of safety | Risk source | Debris flow, landslide, collapse | fracture zone | ground setting |
|----------------|-------------|---------------------------------|---------------|----------------|
| Low safety level | Elevation >1000m, slope >30 degree, collapse Center | 100m around the fault zone | Surface subsidence center zone, cumulative settlement > 2.0 m |
| Medium safety level | The height is 500m, the slope is 15--30 °, the center of collapse is 300m. | 300m around the fault zone | 150m around the land subsidence center, cumulative settlement > 1.5 m |
| High safety level | Collapse center 500m | 500m around the fracture zone | The circumference of the center of the heart is 300 m, and the cumulative subsidence is 0.3cu 1.0 m. |

4.4 Zhaoqing City's Biosafety Security Pattern

The biosafety safety pattern is mainly to construct the minimum resistance model (MCR) to simulate the minimum resistance value that they analyzing the resistance surface outside the core habitat (source). The safe pattern of biological processes generally consists of sources (core habitats), buffer zones (low-resistance areas around the source), corridors and radiant channels (low-resistance channels connecting multiple sources), and strategic points (critical to biological processes). The nodes of the landscape are composed of landscape elements. This method of identifying the landscape safety pattern will select the model to analyze, that is, the identification of the
“matrix-corridor-plaque” model in landscape ecology. It is best to select migratory birds as indicator species, which is conducive to the communication between elements. Sexuality reflects the strategy of the overall biological safety of the region.

Wetland and forest land with an area larger than 25hm2 in Zhaoqing City are selected as the habitat of protected species. The space resistance coefficient of different land cover types is selected by using the spatial resistance coefficient of different land cover types (Table 2). Superimposed, the resistance surface of the space movement of the protected species and the ecological corridor with the least space resistance of the species movement are obtained, and the bio-protection safety pattern of ZhaoQing City based on the analysis of the horizontal ecological process is formed (Fig. 3).

Table 2 Spatial resistance coefficient of horizontal ecological process analysis

| land cover types | Spatial resistance coefficient |
|------------------|------------------------------|
| river system     | 10                           |
| forest land      | 0                            |
| open forest land | 10                           |
| shrub forest     | 30                           |
| Base pond        | 100                          |
| meadow           | 30                           |
| dry farm         | 300                          |
| Construction land| 500                          |

4.5 The Local Culture Security Pattern of ZhaoQing City

It is necessary to study the current landscape from a historical perspective as a result of past natural processes and human interference [13]. From the perspective of ecosystem service function, the local landscape and cultural heritage resources integrating natural environment characteristics and local cultural characteristics have cultural diversity, spiritual and religious values, educational values, social connections, aesthetic and intellectual, and cultural heritage values. Recreation and eco-tourism and many other functions. The introduction of the concept of ecosystem service function makes people's understanding of the local cultural landscape not only stay in the cultural sense, but the dual carrier of culture and natural function [13].

This paper studies the safety pattern of local culture landscapes as the “source” of the local cultural landscape elements in the region. The recreation activity is regarded as a process of horizontal expansion, and the safety of the local cultural landscape is constructed through the establishment of the space resistance surface Bureau. As the birthplace of GuangFu culture, ZhaoQing selects the cultural landscape protection units such as ZhaoQing FuCheng historical and cultural blocks and the typical GuangFu villages and the Gaojiu area, the SangJi fish pond agricultural culture demonstration area as the source of the local cultural security pattern. The land cover type sets different spatial resistance coefficients (Table 3), and establishes the minimum cumulative resistance surface through the distance model to obtain the safety landscape of the local culture landscape with different safety levels (Fig. 4).

Table 3 Spatial resistance coefficient of cultural landscape process analysis

| land cover types    | Spatial resistance coefficient |
|---------------------|-------------------------------|
| river system        | 500                           |
| forest land         | 300                           |
| open forest land    | 200                           |
| shrub forest        | 100                           |
4.6 Zhaoqing Comprehensive Ecological Infrastructure

Based on the above-mentioned hydrological system safety pattern, geological disaster safety pattern, bio-protection safety pattern and local cultural security pattern, spatial computing and superposition based on GIS can obtain the comprehensive ecological infrastructure of Zhaoqing City with different security levels (Fig. 3, Table 4).

| Ecological security level | Ecological infrastructure occupation | Construction land |
|---------------------------|--------------------------------------|-------------------|
|                           | area/km² | scale/% | area/km² | scale/% |
| Low safety level          | 1072     | 35.86   | 1918     | 64.14   |
| Medium safety level       | 1829     | 61.18   | 1161     | 38.82   |
| High safety level         | 2321     | 77.64   | 669      | 22.36   |

The comprehensive ecological infrastructure of Zhaoqing City is divided into three different security levels: EI with high security level is the ideal state to realize the functions of various ecosystems in the region. The security scope can be moderately opened according to local conditions. The medium-security level EI is an appropriate scale for maintaining a complete ecosystem of the region, and can be constructed within certain limits; the low-security level EI is the threshold for ensuring the ecological security of the city, and is an insurmountable red line in urban and rural development.

5. Zhaoqing City Ecological Conflict Space Identification

Based on GIS, the ecological infrastructure of Zhaoqing City will be superimposed on the spatial distribution of construction land in 2015. It can be found that the spatial conflicts between ecological infrastructure and construction land are mainly concentrated in the edge zone of the existing built-up area, along the North Ridge of Zhaoqing. It is a concentrated area of space conflict, including Zhaoqing High-tech Zone (DaWang) and Zhaoqing New District; in addition, the ecological infrastructure of the low (bottom line) safety level of Duanzhou District and DingHu District is affected by the embedded construction land, and the Duanzhou District is along the mainstream of the XiJiang River. Distribution, Duanzhou District is distributed in the form of industrial parks. Although the area is small, because it is the bottom line of regional ecological security, the impact of construction activities on regional ecological processes and ecological functions is more prominent (Fig 5).
6. Conclusion

The disorderly expansion of the rapid urbanization area has caused the deterioration of the ecological environment and the waste of land resources, and at the same time exacerbated the potential regional ecological risks. From the perspective of natural evolution of land, based on the landscape ecological security pattern theory and MCR model, with the aid of spatial analysis techniques such as RS and GIS, the non-biological-biological-cultural category is borrowed from the spatialization and spatial model calculation of data. The analysis framework identifies the geological disasters, hydrological systems, biological protection and local cultural security patterns of ZhaoQing City, and then superimposes each single ecological security pattern to obtain comprehensive ecological infrastructure with different security levels (Fig 6).

By superimposing construction land on ecological infrastructures with different safety levels, it can be seen that the ecological conflict space in ZhaoQing City is mainly concentrated in areas along the North Ridge including ZhaoQing City east and ZhaoQing New District. Drawing on the optimal landscape pattern of “segregation between agglomerations”, according to the topographical features of the plain river network and the actual land use pattern, the “matrix-corridor-plaque” model has become the maintenance of regional ecological security urban and rural non-construction land structure. Inevitably, the “Mountain-Jitang-Farmland-City” model is a concrete manifestation of the...
paradigm of mountain landscape pattern research. As the ecological bottom line of landscape ecological security pattern, urban and rural non-construction land must protect these bottom lines as ecological infrastructure, in order to realize the basic pattern of ZhaoQing livable city, which has far-reaching strategic significance for scientific planning urban development and expansion.

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