

Study on the Ecological Security Pattern of Zhaoqing City's Eastward Expansion

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Abstract. Under the background of urbanization, rational use of limited land resources and scientific analysis of the ecological bottom line of urban development have very important practical significance. Taking the typical Zhaoqing city of the Pearl River Delta as an example, using the landscape safety pattern theory, through GIS technology analysis and simulation of the city's geology, hydrology, biodiversity and local cultural heritage spatial pattern, analyzing the key factors of safety development, and identifying the ecological development of the city. The bottom line protects sensitive areas of ecosystem services, builds a comprehensive urban security landscape, and achieves scientific and healthy development in the process of urban expansion.

1.background

1.1 The ecological bottom line of urban expansion

Ecosystems Services are products and services that humans derive from ecosystems and are a source of boon for human survival. Often, ecosystem services are grouped into four categories: regulatory services, supply services, support functions, and cultural services^[1]. However, in the process of rapid urbanization in China, blind urban expansion and irrational urban construction undermine the balance of the original ecosystem, leading to the weakening of ecosystem services and the sustainable development of severe cities. How to strike a balance between urban development and the maintenance of ecosystems, maintain the function of ecosystem services in urban development, coordinate the contradiction between ecological protection and urban development, and achieve stable development of cities has become a difficult problem for the current urban planning and design department. . The bottom line of urban ecological security is the maintenance of the basic ecosystem of the city.

At present, China's Yu Kongjian and other scholars have made a series of studies on urban landscape pattern changes and ecological effects, ecosystem service value assessment, ecological security, and ecosystem health assessment. However, in the face of rapid urbanization, how to identify the ecological bottom line of urban expansion? Further discussion is needed. From the perspective of urban ecological planning, the safe development of urban safety is the basic function of maintaining urban ecosystem. In the urban planning process, it is necessary to first determine the key areas of the natural ecosystem, and to protect its spatial pattern, and then plan the spatial form of urban development.

Natural ecosystems provide important services for the city's ecological environment, including climate regulation, biodiversity conservation, hydrological regulation, and aesthetic enlightenment. These important ecological services are irreplaceable in urban development and are also the key



conservation areas in our urban planning. Maintaining the security landscape of these basic ecological services is the ecological red line of urban development.

2. Methodology: Building an ecological security landscape

According to Yu Kongjian's principle of landscape safety, the maintenance of ecosystem services requires a landscape pattern in a specific area. This spatial pattern of maintaining urban ecosystem services is an "ecological security pattern"^[2]. For the city, the ecological infrastructure that the city can continue to develop is the ecological security pattern. It provides comprehensive ecosystem services for the city and its residents, and maintains the healthy and sustainable development of the urban ecosystem. It is the basic way for us to build a livable city.

Under the background of urbanization with high human-land relationship, the ecological security pattern needs to sort out the basic landscape structure to strengthen the ecological service function. To this end, the protection of the basic landscape structure requires only a minimum amount of critical land to protect the city's ecological service function, forming the city's lowest ecological security pattern, that is, the safety bottom line of urban development^[3]. The theory of ecological security pattern that protects key spatial patterns is mainly used in the process of urban expansion, ensuring ecosystem security with an efficient landscape pattern, maintaining historical and cultural processes, biodiversity, and water security. Based on landscape ecology, the ecological security pattern theory simulates the process of urban expansion, the diffusion process of geological disasters, the flow of water resources and the trajectories of organisms to identify the spatial pattern and landscape elements that play a key role in the ecological process. The ecological security pattern theory absorbs ecological carrying capacity, dialectical planning ideas, game theory, etc., and applies it to many urban ecological planning practices to verify the scientific nature of its planning.

This project takes Zhaoqing, a typical urbanization representative of China's fast Dawan District, as an example to study the minimum ecological security pattern that guarantees the basic ecosystem services of Zhaoqing City, and provides an ecological bottom line for urban eastward expansion analysis, providing urban planning and land use. Theoretical reference.

3. The bottom line of the ecological security pattern of Zhaoqing City's eastward expansion

3.1 The threat to the Zhaoqing ecosystem

At present, Zhaoqing City is backed by Beiling Mountain and faces the Xijiang River. The land resources are seriously insufficient, the urban development is limited, and the ecosystem is relatively fragile. The basic ecological services in Zhaoqing City are facing crisis and challenges, mainly in the following aspects:

(1) The water regulation ability is weakened.

In recent years, in the rapid urbanization process in Zhaoqing, a large number of original Sangji fish ponds was filled, and the original wetlands was used for building buildings, and the surface hardening was too much, which reduced the ability of wetland fish ponds to stop flooding, reduce flood peaks and provide habitats. The ability of the ecosystem to regulate water is weakened.

(2) Protection against geological disasters

Zhaoqing's geological conditions are complex, and most of them are karst landforms, which are prone areas for geological disasters. From the perspective of spatial distribution, mountainous areas are concentrated distribution areas of geological disasters such as collapse, landslides, and mine ground subsidence, while parts of the plain are threatened by geological disasters such as karst landform subsidence. In the process of human development and utilization of various resources, some unreasonable construction, such as stone mining, unreasonable development of mountainous areas, and construction land near the ground fissure, have laid a safety hazard for the occurrence of geological disasters.

(3) Biodiversity is seriously affected

Rapid urbanization, unreasonable development and utilization of land resources and other human

activities have destroyed the original ecosystem, directly leading to the disappearance, fragmentation and separation of biological habitats, and the changes in habitats have caused species to disappear. This phenomenon occurs in fast urban areas.

(4) A large number of native plants were eradicated in urban construction, and native natural patches disappeared. Instead, “landscape trees” were planted. These landscaping projects generally lacked ecological common sense, resulting in a single planting structure and inappropriate alien species in the construction area. Due to the introduction of other reasons, the urban habitat is destroyed, and the processes of foraging, breeding and habitat of the organism are seriously affected.

(5) lack of cultural services

Zhaoqing has a long history and cultural resources and is one of the birthplaces of Guangfu culture, such as Song City Wall, Lijiao Tower, Yuejiang Tower, Chongzhen Tower, etc. They are used to shape the cultural landscape of Zhaoqing Guangfu, satisfy the spirit of the citizens and swim. Demand plays an important role. However, in the process of rapid urbanization, these historical and cultural landscapes have not received due attention, and their integrity and authenticity have been greatly damaged. Therefore, these historical and cultural landscapes and the ecological environment in which they are located should also be fully protected, forming a continuous landscape network, becoming a public space for educating future generations and carrying out ecological recreation and cultural education, and combining with the existing greenway recreation system.

Therefore, under the conditions of rapid urbanization and limited natural cultural resources, in order to achieve healthy urban development, we must protect the ecological red line of urban development, avoid the destruction of ecosystems in the process of urbanization, and the safety of urban ecosystems.

3.2 Countermeasures and approaches: constructing an ecological security pattern and ensuring urban ecological security

Based on the above-mentioned urban ecosystem theory, according to the specific situation of Zhaoqing City's development, select the key elements of urban ecosystem services, from the four major processes of geological disasters, hydrology, biodiversity, and cultural heritage, using GIS spatial analysis technology and landscape safety. The pattern theory analyzes and judges the key spatial pattern of the ecosystem, namely the landscape security pattern, and further integrates them to construct a comprehensive landscape security pattern of the city^[3]. Based on the complete concept of ecosystem services, this integrated landscape security landscape can be called the ecological security landscape, which is the ecological infrastructure that guarantees the ecological security of Beijing's cities and regions. The ecological security landscape provides the city's basic ecosystem services, while defining urban patterns and urban development patterns (Fig 1).

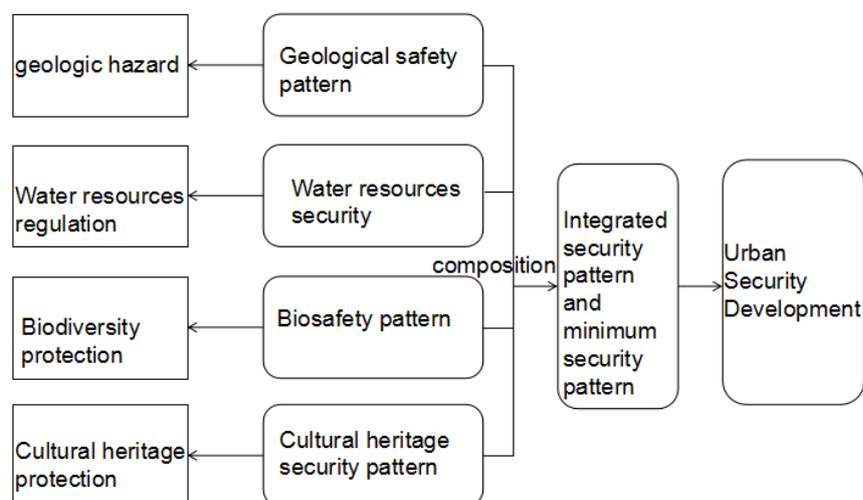


Fig1 Urban ecological security pattern and ecosystem relationship

3.3 Zhaoqing City Ecological Security Pattern Construction

According to the technical route of Figure 1, the comprehensive ecological security pattern of Zhaoqing City was obtained through systematic research based on the above four major processes (Fig. 2). According to the level of ecological security pattern integrity, it can be divided into three levels of safety, high, medium and low, corresponding to the ideal, satisfaction and bottom line security pattern (Table 1). It should be noted that the ecological bottom line of Zhaoqing City is not only represented on the drawings, but more importantly, it forms an ecological function network providing a variety of ecosystem services on the land of Lingnan. This landscape pattern can be described as: XiJiang, XingHu, Dongtun Honghu and Beilingshan are important ecological sources, with forest and wetland as plaques, through linear elements along the Xijiang River, Beiling Mountain Forest Belt, and FuCheng Cultural Heritage. The established ecological corridors and cultural heritage corridors form the ecological infrastructure network of the matrix-plaque-corridor mosaic pattern. It can provide a variety of ecosystem services for flood control, water resources protection, soil and water conservation, geological disaster prevention, biodiversity conservation, cultural heritage protection, etc., and can maintain the city's ecosystem security. The sustainable development of the ecological foundation is also the ecological bottom line of urban expansion.

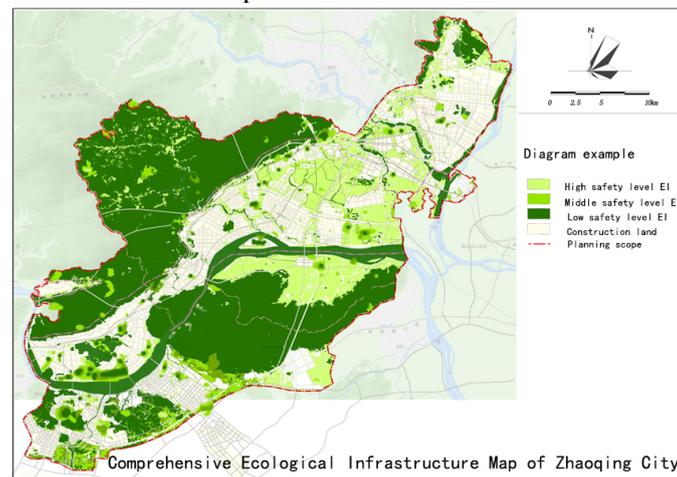


Fig 2 .Comprehensive ecological security pattern of Zhaoqing City

3.4 Urban development pattern based on ecological bottom line

On the basis of the research on ecological security pattern, the “bottom line safety pattern” is selected as the premise of urban space development, and the future urban space development pattern is simulated [3]. Urban plaques such as Zhaoqing Duanzhou District, Dinghu District, Zhaoqing New District, GaoYao District and major urban built-up areas in other suburbs of Dawang are regarded as the “source” of urban space development, and according to the future Zhaoqing per capita construction land and Zhaoqing city total. The scale of development of the new district identified in the plan (2018-2035) will be evaluated for the future development potential of the city.

In analyzing the impact factors of urban construction land expansion in Zhaoqing, the land use status roads, buildings, public facilities and ecological infrastructure are selected as the main factors for simulating the future development of the city. Then, according to the analysis of the suitability of different landscape elements for urban space development, the landscape resistance surface of urban expansion is constructed. Finally, the Arc GIS is used to simulate the eastward expansion of Zhaoqing City. According to the results (Fig.2), using the low-level ecological security pattern to celebrate the urban development pattern, due to strict control of the ecological security pattern, the basic ecological services can be guaranteed, and the core ecological network of Zhaoqing is also formed. The construction land is centered on DuanZhou, DingHu, GaoYao, Xinqu Center and Da Wang District. It will first be filled and expanded, and then expanded along the main trunk line. Some construction sites will be reserved in the construction area of the central city and the surrounding group. Under the

low-level ecological security pattern, Zhaoqing City Development can provide construction land and agricultural and forestry land of about 1,160km², which can meet the requirements of the 598km² construction land in 2035, which is predicted by the Zhaoqing Urban Land Use Master Plan. It can also meet the ecological land and basic farmland land. The demand for construction land. Compared with the green space area of 562km² in the “Zhaoqing Urban Green Space System Plan” and the prohibited urban construction area of 511.42km² in the “limited construction area” plan, the land area required for the ecological security pattern is at least 309.1km².

Tab1.Zhaoqing ecological security pattern

level of safety	area	Division basis	Protection strategy
Bottom line security pattern	Area 562km ² Accounting for 48.5% of the total urban area.	Location of geological hazards; high risk areas for floods; rivers, lakes, ponds and core wetlands themselves; core biological habitats, corridors, historical and cultural heritage and core protected areas of recreational resources.	Protect the most abundant ecosystems, which can stay healthy for a long time. Can have the choice to carry on the key protection, and carries on the non-key protected area development and construction.
Satisfactory security pattern	Area 794 km ² 68.5 per cent of total urban area	Geological hazard buffer zone; flood risk area; lake pond and core wetland buffer zone; general biological habitat, corridor, historical and cultural heritage and recreation resources protection scope.	In order to protect the richer ecosystem, the ecosystem can be restored in a short period of time; it is necessary to protect the ecosystem, limit the development and construction, and bring it into the scope of limited construction.
Ideal security pattern	Area 906km ² 78.1 per cent of total urban area	Geological hazard buffer zone; flood risk area; lake pond and core wetland buffer zone; general biological habitat, corridor, historical and cultural heritage and recreation resources protection scope.	Protect the most abundant ecosystems, which can stay healthy for a long time. Can have the choice to carry on the key protection, and carries on the non-key protected area development and construction.

4. Conclusion

In the context of rapid urban expansion, it is of great strategic importance to protect the ecological bottom line of urban ecosystems and maintain the ecological service functions of cities. The research shows that the essence of protecting the ecological bottom line of the city is to protect the most critical areas of ecosystem services and maintain its minimum ecological security pattern. The bottom line of ecological security is a safety barrier for urban development and a preliminary infrastructure plan for urban development planning. The city's development and construction planning must be based on the ecological processes and patterns of the land, prioritize the protection of key areas of the ecosystem, and then plan and layout the construction land according to the needs of social and economic development^[4]. In the planning process, according to Yu Kongjian's “anti-planning” ecological theory, the ecological process is simulated and analyzed, the key pattern of the basic ecosystem is prioritized, and the ecological network is established in the urban expansion area to ensure the safe development of the city.

Taking the Zhaoqing urban area as an example, this paper studies the ecological security pattern of urban development. The conclusions show that ecological environmental protection does not mean that many or more construction land must be sacrificed, and it is not necessary to sacrifice the economic value of land use. Rather, it is possible to ensure the basic ecosystem services of the city and its security pattern through the design of a scientific and rational spatial pattern, with as little land as possible, while meeting the requirements of urban development; this preview also reveals that the spatial pattern of the city is the ecological processes and patterns defined by the land are defined by the ecological bottom line of the city and should not be planned with an image of urban spatial form.

(Guang dong Province Innovation and Entrepreneurship Project)

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