

Ecological Land in Arid Hilly

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Cities in hilly arid areas of northwest China have generally experienced a low level of economic development; they also have unique natural characteristics such as climate, soil, terrain, environment, and surface cover. High quality ecological lands are those that provide humans and the environment with relatively high levels of ecological services including soil, water, and air purification, adsorbing pollutants, or providing water or nutrients needed by plants. This paper uses an improved model to evaluate the importance of ecological land in the core urban area of Lanzhou with specific attention to natural ecology and human needs. The purpose of this research is mainly twofold: (1) to construct a significant evaluation system for ecological land in the northwest arid hilly area, via the study's methodology; (2) to explore the structure and spatial distribution characteristics of ecological land in the core area of Lanzhou in a practical sense, to reveal the development characteristics of urban ecological land in the arid hilly region of northwest China, and to provide some guidance for the long-term development of Lanzhou.

Keywords: ecological land ; ecological function ; ecological demand ; comprehensive evaluation ; northwest China ; Lanzhou city

1. Overview

With the development of China's economy, society expects businesses and governments to maintain a high-quality environment. People's demand for a clean and ecologically stable living environment is growing ^[1]. The protection of important ecological land is an urgent task in support of the sustainable development of urban and rural areas in China, while identification and evaluation can effectively identify and screen ecological land by giving it a value, which is an important starting point for the construction of an ecologically sound civilization. Ecological land can be defined as land that provides humans, plants, and animals with environmental services including soil, water, and air purification or the mitigation of pollution, as well as providing natural land for grazing, recreation, or other needs ^[2]. For example, as ecological land, natural wetlands and grasslands can provide greater amounts of ecological services for humans than urbanized lands with little green space.

The identification of an ecological source is not only related to the formulation of a land use strategy and a choice of urban development path, but is also the basis for the establishment of an urban and rural ecological security pattern. It is of great significance to the play of regional ecological benefits and the coordination of the relationship between regional ecological protection and economic development. Originally, identification of ecological land was relatively coarse; for example, nature reserves or habitats of key species were often directly selected as the source of an ecological security pattern in scientific research and practice ^{[3][4]}. However, the designation of nature reserves ignores the specific conditions and characteristics of the environment, while the habitats of key species are limited by the availability and accuracy of species observation data. To avoid these shortcomings, scholars began to try to establish an index system from multiple perspectives that could be used to evaluate the importance of ecological patches, and regard the natural ecological attributes of these patches as the core of ecological land designation. The attributes of ecological patches, such as land cover type, patch area and shape, biodiversity maintenance, ecological sensitivity, and soil and water conservation, have become common indicators for the construction of systems designed to evaluate the importance of ecological land ^{[5][6]}, and some studies have also included the structural importance of ecological patches in the evaluation framework ^[7]. These studies have greatly improved the scientific basis of ecological source identification. However, the importance of ecological land with the same natural attributes still varies by location ^[8]. With the acceleration of the process of urbanization in China, a large amount of ecological land in cities has been replaced by urbanized land, which has led to a scarcity ^[9]. The ecological land located in an urbanized area can beautify the environment, improve the local microclimate, shield residents from noise, provide convenient and comfortable resting places for human beings, help urban residents free themselves from the shackles of a reinforced concrete jungle, and help people relax in a natural environment ^{[10][11][12]}. This has an important value that ecological land on the periphery of a city cannot replace. Relatively intensive activities of residents occur in areas with ecological land, which has a relatively high service efficiency and visit rate ^[13]. In

view of this, in recent years the evaluation of the importance of ecological land has been developing continuously. In addition to the natural service function provided by ecological patches, some studies have also included the need of human society for ecological service in its evaluation systems. The goal is to comprehensively delineate the ecological land that plays an important role in urban development from the dual perspectives of nature and society [14][15][16]. Doing so improves the methods of identifying important ecological sources in cities and strengthens the systematic process involved in the evaluation system. However, few such studies have been conducted in China, and this small number of studies is mainly oriented to the cities of eastern China [15][16], ignoring the adaptability of arid inland cities in northwest China. The climate and soil conditions, land cover, ecological status, level of economic development, and urban spatial layout of arid hilly areas in northwest China have unique characteristics. Therefore, it is necessary to adjust the index selection, weight distribution, and calculation method according to local conditions in the process of evaluating the importance of ecological land. At the same time, China has put forward the strategy of providing for ecological protection and producing high-quality development in the Yellow River Basin [17][18]. It is of practical significance to evaluate and study the importance of ecological land use for the arid inland cities along the upper reaches of the Yellow River in support of the ecologically sound management and economic development of the whole basin. In this context, this paper hopes to establish an improved evaluation model, which will help to identify and evaluate the importance of ecological land in arid and hilly areas in northwest China, and fill the gap in related fields of study. Moreover, this paper chooses Lanzhou as a case study considering that Lanzhou is the only provincial capital city in China where the Yellow River runs through the city and also serves as an important node of the Yellow River Basin and “one Belt and Road” initiative. For a long time, due to the dual influence of natural conditions and human activities, the ecological land in Lanzhou has been occupied and many habitats have been divided, which has greatly affected the urban environmental quality [19].

2. The main research conclusions

(1)

The model used to evaluate the importance of ecological land was based on the dual perspectives of the function of providing ecosystem services and the intensity of ecological demand. This model is more suitable to evaluate for the need for ecological protection in arid and hilly areas of northwest China and highly urbanized areas. Compared with only considering the ecosystem service function of ecological land, the research results can consider the demands and needs of urban residents and can effectively identify the types of ecological land that have a high degree of ecological demand within the city, which has practical significance for the protection of ecological resources in the core of the city.

(2)

For the core urban area of Lanzhou, even from a single perspective of ecological function, urban parks and public green space in densely populated areas of urbanized area also have very important ecological values. After adding an evaluation of the intensity of ecological demand, the ecological importance of parks and other green space in urbanized area was further strengthened. This seems to be a major feature of cities in the arid areas of northwest China, unlike cities in the coastal areas of southeast China. Generally speaking, the combination of ecological protection and urban development often involves contradictory trade-offs. Urban sprawl will disturb natural ecosystems, turning a large area of green space into hard impervious surfaces, and destroy the circulation of natural material and energy. However, it seems that the relationship between development and environmental protection needs to be reexamined in the arid hilly areas of northwest China. The cold climate and limited rainfall result in natural low biodiversity with limited green space in the arid hilly areas of northwest China. The ravines and deep valleys greatly weaken the ecological value of the non-urbanized areas. Some urban parks and public green spaces in the urbanized areas are adequately funded and maintained, which has significantly improved the ecological benefits they provide; they may even provide the most important natural services and ecological support for some cities. Therefore, urban sprawl may not necessarily be the cause of ecological damage for cities in arid hilly areas of northwest China; in contrast, urbanization may provide opportunities for ecological restoration and improvement. Of course, the premise requires land managers to pay attention to the planning for and management of existing ecological land [46], as well as managing the integrity of the overall ecological spatial pattern of the city.

(3)

The *most important* and *very important* ecological land in the core area of Lanzhou only accounted for 5.86% of the total area of all ecological land within the city, indicating that high-value ecological land in the core area of Lanzhou is still very scarce. Among these important areas, the water area (mainly the Yellow River and its waterfront space) is the ecological land with the highest average ecological value in Lanzhou, followed by forest land. In addition, one can see that the land type with the highest spatial proportion among all levels of ecological land is grassland. Grassland can be said to be the ecological land with the most potential in the core urban area of Lanzhou; its ecological function will be continuously lost

over time if it is not properly managed and protected. Careful planning and use can allow grassland to serve as an indispensable ecological barrier in Lanzhou, which can not only play an ecological function but can also provide good aesthetic space and recreational opportunities for the general public.

(4)

From the perspective of spatial distribution, the urbanized areas of Chengguan and Anning districts accounted for a large proportion; these areas have a limited amount of ecological land, but the *most important* ecological land is also mostly distributed here. Qilihe and Xigu districts have more *generally important* graded areas of forest, grassland, and bare land, although the current ecological value of these lands is limited; nevertheless, these lands have great potential for ecological improvement, which should be considered in the future. With the accelerating development of Lanzhou in recent years, a large number of underused ecological lands in Qilihe and Xigu undoubtedly include valuable properties in the core urban area of Lanzhou. These areas will need to be continuously improved to reach their peak ecological service capacity in light of urban sprawl and urban function transfer. Appropriate land management should be carried out to further improve the level of connectivity through the construction of ecological corridors, so as to form a scientific and reasonable regional ecological security pattern and lay a healthy and sustainable material foundation for a new round of urban development.

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