

# Study on the Strategy of Landscape Renewal and Ecological Restoration in Urban Fringe for Sustainable Development

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**Abstract:** This article discusses the landscape and ecological problems faced by urban fringe in the process of urbanization. With the rapid development of urbanization, the landscape and ecology of urban fringe are destroyed, and the existing research and practice are insufficient. This article aims to explore the strategy of landscape renewal and ecological restoration in urban fringe for sustainable development. By expounding the relevant theoretical basis, following the principles of ecological priority, integrity, people-oriented, cultural heritage and economic feasibility, this article puts forward landscape renewal strategies such as spatial optimization, landscape shaping and functional compounding, as well as ecological restoration strategies such as vegetation restoration, water body restoration and ecosystem reconstruction. Following these principles and implementing corresponding strategies can promote the coordinated development of ecology, society and economy in urban fringe, realize the harmonious coexistence of city and nature, and provide theoretical and practical guidance for the sustainable development of urban fringe.

## 1. Introduction

With the rapid development of urbanization, the urban fringe, as a transitional zone between urban and rural areas, plays a vital role in the sustainable development of the city [1]. Urban fringe is not only the frontier of urban expansion, but also a sensitive area of ecological environment, facing many landscape and ecological problems [2]. The rapid urbanization leads to the destruction of the original natural landscape in the urban fringe, the confusion of land use and the damage of ecosystem function [3]. Unreasonable development and construction make the landscape of urban fringe chaotic, which can not meet the residents' demand for high-quality living environment [4]. In this context, landscape renewal and ecological restoration in urban fringe areas have become an inevitable choice to realize urban sustainable development [5]. Landscape renewal can improve the spatial environment of urban fringe and enhance its aesthetic value and cultural connotation. Ecological restoration is helpful to restore the damaged ecosystem, enhance the ecological service function and ensure the ecological security of the city [6]. The two complement each other and jointly promote the sustainable development of urban fringe.

At present, there are still some shortcomings in the research on landscape renewal and ecological restoration in urban fringe [7]. Some studies only focus on a single landscape or ecological aspect, and lack of in-depth discussion on the synergistic relationship between them. Some practical projects failed to fully consider the uniqueness of urban fringe in the implementation process, resulting in unsatisfactory results [8]. Therefore, it is of great practical significance to study the strategy of landscape renewal and ecological restoration in urban fringe for sustainable development. The purpose of this study is to systematically analyze the problems faced by landscape renewal and ecological restoration in urban fringe by combing relevant theories and practices, and to explore scientific and reasonable strategies. It is hoped that this study can provide theoretical support and practical guidance for the sustainable development of urban fringe, promote the harmonious symbiosis between city and nature, and create a more livable and suitable environment for residents.

## 2. Theory of landscape and ecology in urban fringe

As a special region between cities and villages, urban fringe has unique concepts and

characteristics. It is a transition zone from urban built-up area to rural area, which has some characteristics of both urban and rural areas, complicated land use types and frequent population flow [9]. In urban development, urban fringe is in a key position, which is not only the main bearing area of urban expansion, but also an important barrier of urban ecological security.

The related theories of landscape renewal provide important guidance for the development of urban fringe. Landscape ecology theory emphasizes the relationship between landscape pattern and ecological process, and holds that reasonable landscape pattern can promote the healthy development of ecosystem. In the urban fringe landscape renewal, the application of this theory can optimize the layout of landscape patches, corridors and other elements, and enhance the connectivity and ecological functions of the landscape [10]. At the same time, the place theory pays attention to excavating the historical and cultural connotation and uniqueness of the place, so that the landscape renewal can reflect the local regional characteristics and cultural context, and enhance the residents' sense of identity and belonging to the place.

The theory of ecological restoration is also the key basis for ecological protection and restoration in urban fringe. The theory of ecosystem restoration advocates that the damaged ecosystem can be restored to its original natural state and its structure and function can be restored through human intervention [11]. The theory of ecological succession points out that the ecosystem has the ability of self-repair and development. In the process of ecological restoration, we should follow the law of natural succession, reasonably guide the positive succession of the ecosystem, and realize the sustainable recovery of the ecosystem.

### 3. Principles of landscape renewal and ecological restoration under the guidance of sustainable development

The concept of sustainable development runs through the whole process of landscape renewal and ecological restoration in urban fringe, guiding the development of various practical activities. The following principles are of great significance to the sustainable development of urban fringe.

#### 1) Ecological priority principle

Ecosystem is the foundation of urban fringe development, and ecological protection must be put in the first place in landscape renewal and ecological restoration. In practice, we should fully respect the structure and function of natural ecosystem to avoid further damage to the original ecological environment. Key points and measures for the protection and restoration of ecological elements in urban fringe areas are shown in Table 1:

Table 1 Key Points and Measures for the Protection and Restoration of Ecological Elements in Urban Fringe Areas

Ecological Element	Key Points for Protection and Restoration	Specific Measures	Expected Effects	Implementation Period
Natural Vegetation	Maintain community integrity and diversity, prevent invasion by alien species	Designate protected areas, monitor growth, and replant native species	Restore vegetation cover, enhance ecological stability	1-3 years
Water Bodies	Ensure water quality, restore ecological functions, and improve self-purification capacity	Control sewage discharge, construct purification facilities, and dredge waterways	Achieve water quality standards, maintain a healthy aquatic ecosystem	2-5 years
Wildlife Habitats	Protect and create habitats, facilitate species exchange	Preserve and restore habitats, establish migration corridors and buffer zones	Increase the variety and quantity of wildlife	3-5 years

#### 2) The principle of wholeness

The landscape renewal and ecological restoration of urban fringe should proceed from the whole, and comprehensively consider the natural, social and economic factors in the region. It should not only pay attention to the integrity of landscape and ecosystem itself, but also pay attention to the

coordinated development with surrounding cities and rural areas. In landscape planning, the landscape style of urban fringe should be integrated with the overall style of the city, while retaining the rural characteristics. In the aspect of ecological restoration, it is necessary to build a regional ecological network to realize the connectivity and integrity of the ecosystem.

### 3) People-oriented principle

The ultimate goal of the development of urban fringe is to provide better living environment for residents. Therefore, landscape renewal and ecological restoration should fully consider the needs of residents and improve their participation. In the design process, designers can increase public spaces such as leisure, entertainment and fitness to meet the needs of residents' daily activities. At the same time, residents' environmental awareness can be enhanced and their active participation in landscape renewal and ecological restoration can be encouraged through publicity and education.

### 4) The principle of cultural inheritance

Urban fringe often carries rich historical and cultural information, so landscape renewal and ecological restoration should pay attention to the excavation and inheritance of regional culture. Through the protection and restoration of historical buildings, cultural sites and other material cultural heritage, as well as the inheritance and promotion of folk culture, traditional skills and other intangible cultural heritage, the urban fringe has a unique cultural charm.

### 5) Principle of economic feasibility

In the process of landscape renewal and ecological restoration, economic factors should be fully considered to ensure the feasibility and sustainability of the project. It is necessary to plan the capital investment reasonably and choose economical and applicable technologies and materials. By developing eco-tourism and green industry, we can realize the organic combination of ecological benefits and economic benefits, and provide continuous economic support for landscape renewal and ecological restoration.

Following these principles can make the landscape renewal and ecological restoration of urban fringe steadily advance on the road of sustainable development and realize the coordinated development of ecology, society and economy.

## 4. Strategies of landscape renewal and ecological restoration for sustainable development



Figure 1 Livable and suitable urban fringe

Under the guidance of the concept of sustainable development, scientific and reasonable

strategies should be adopted in the landscape renewal and ecological restoration of urban fringe to coordinate the relationship between ecology, society and economy and create a livable, suitable and eco-friendly urban fringe, as shown in Figure 1.

#### (1) Landscape renewal strategy

##### 1) Spatial optimization strategy

Reorganization and planning of urban fringe space is an important basis for landscape renewal. By integrating the fragmented land, we can optimize the land use structure and improve the land use efficiency. For example, designers can plan scattered industrial land centrally and set up ecological isolation belts to reduce the impact on the surrounding environment; At the same time, public green and open spaces should be increased to enhance residents' quality of life. According to different functional areas, traffic streamline is planned reasonably to ensure the convenience and safety of traffic in the area.

##### 2) Landscape style shaping strategy

Excavating the regional cultural characteristics of urban fringe and integrating them into landscape design can create unique landscape features. Designers can collect local traditional architectural elements and folk cultural symbols and apply them to the design of new buildings and landscape sketches. Based on the colors and materials of local traditional buildings, the street landscape with regional characteristics is created. Historical and cultural relics should be protected, restored, and repurposed. Abandoned ancient post stations, for example, can be transformed into cultural exhibition centers to ensure the continuity of regional history and culture. Specific design methods and examples of landscape modeling are shown in Table 2:

Table 2 Specific Design Methods and Examples for Landscape Character Sculpting

Landscape Character Sculpting Element	Specific Design Method	Example	Visual Effect	Cultural Connotation Embodiment
Traditional Architectural Elements	Extract roof and door/window styles for use in modern architecture	The community service center adopts a pitched roof	Possesses a traditional charm and coordinates with the surroundings	Inherits architectural cultural characteristics
Folk Cultural Symbols	Incorporate paper-cutting and embroidery patterns into landscape features and pavements	Park pavement integrates paper-cutting patterns	Adds a lively cultural atmosphere	Showcases the charm of folk art
Historical and Cultural Relics	Protect relics and recreate functions in conjunction with the surrounding area	Restore ancient bridges and construct walkways and viewing platforms	Becomes a distinctive landscape node	Continues historical memories and contexts

##### 3) Functional compound strategy

Relevant departments should actively promote the diversification and compounding of landscape functions in urban fringe areas to meet the diverse needs of residents. Specifically, it is necessary to focus on building a comprehensive park integrating leisure, entertainment and education. A popular science education area can be reasonably established in the park, and ecological knowledge can be widely disseminated through it. In addition, the function of cultural display should be integrated into the business district, so as to enhance the cultural connotation of the business space. At the same time, we should also encourage residents to actively participate in the use and maintenance of landscape functions, and enhance their sense of belonging in this way.

#### (2) Ecological restoration strategy

##### 1) Vegetation restoration strategy

In view of the damaged vegetation in the urban fringe, scientific vegetation restoration methods are adopted. Land managers should prioritize the planting of local species to improve vegetation adaptability and survival rates. For a large area of bare land, vegetation blanket, spray seeding of

grass seeds and other methods are used for rapid greening. In ecologically fragile areas, vegetation protection zones should be established to limit the interference of human activities and promote the natural restoration of vegetation.

#### 2) Water body restoration strategy

Improving the water quality and ecological function of urban fringe is the key to ecological restoration. Relevant departments should strengthen the supervision of sewage discharge and cut off pollution sources. Using ecological floating island, constructed wetland and other technologies to purify the water body, improve the self-purification ability of the water body. The restoration of the river's natural meanders expands its ecological shoreline and creates habitats for aquatic organisms.

#### 3) Ecosystem reconstruction strategy

In order to restore the integrity and stability of the ecosystem, the ecosystem in the urban fringe should be rebuilt. The planning strategy should construct an ecological matrix, centered on forests, wetlands, and farmland, and connect all ecological patches through corridors to form a complete network. It can introduce or restore some key species, promote the material circulation and energy flow of the ecosystem, and improve the service function of the ecosystem.

#### 4) Intelligent drainage regulation strategy

To address the challenges of urban stormwater management and flood control in urban fringe areas, it is necessary to develop an intelligent drainage regulation system. This system integrates real-time monitoring technology with sponge city infrastructure to enable precise control and dynamic optimization of drainage networks. Venturi flowmeters are deployed at critical nodes within the drainage network to continuously monitor flow velocity and discharge. These real-time hydrological data are transmitted to the central control platform, which uses algorithms to analyze the current state of the system and predict potential spillover risks. Based on this analysis, the platform automatically issues commands to adjust the operation state of downstream sponge infrastructure. This closed-loop control mechanism changes passive drainage into active intelligent regulation, which can greatly improve the efficiency of rainwater management and reduce the risk of urban flood.

## 5. Conclusions

In this article, the landscape renewal and ecological restoration of urban fringe facing sustainable development are deeply studied. On the theoretical level, this article clarifies the concept, characteristics and position of urban fringe in urban development, and combs the theories related to landscape renewal and ecological restoration. In the discussion of principles, the principles of ecological priority, integrity, people-oriented, cultural inheritance and economic feasibility are established. The principle of ecological priority emphasizes the protection of the basic position of the ecosystem, and various ecological elements are protected and restored through specific measures. The principle of wholeness pays attention to the coordination and unity inside and outside the region. People-oriented principle puts residents' needs at the core. The principle of cultural inheritance digs deep into regional culture. The principle of economic feasibility ensures the sustainable development of the project. These principles are interrelated and indispensable, and jointly point out the direction for the development of urban fringe. In terms of strategy formulation, landscape renewal starts with space optimization, style shaping and function compounding, re-plans land use and transportation, integrates with regional culture to shape distinctive features and realize functional diversification. Ecological restoration can improve the ecological environment and restore the integrity and stability of the ecosystem through vegetation restoration, water body restoration and ecosystem reconstruction. With the support of theoretical foundation, the adherence to principles and the implementation of strategies, the urban fringe is expected to move forward steadily on the road of sustainable development, and realize the coordinated development of ecological environment, landscape quality and social economy.

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