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Strategies for urban green space system plan based on the eco-oriented development mode

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ABSTRACT

Since reform and opening-up, the rapid development has been gotten by our cities and the great progress has been made in the urban construction. With the urban evolvement, China's economy is also advancing with high speed, which brings about the consequential deterioration of eco-environment. The contradiction between economy and eco-environment is increasingly evident as the economy grows. Thereby the development of the city is oriented to the ecological city in the future. Facing the increasingly serious eco-environment problem, the urban green space plan was considered as a relatively independent and very important part of the urban plan system to proposed by the State Council on the National Urban Greening Working Conference in 2001. The urban green space system plan as the main part of ecological city construction, is crucial to the improvement of the eco-environment. In China the severe damage of eco-environment appears as the urbanization advances gradually. The ecological infrastructure has been replaced by the massive artificial infrastructure. We should rethink the increasingly environmental pollution, resource shortage, ecological unbalance and other issues. Moreover the system and methods of the urban green space plan must be obtained the promotion. The urban green space system plan should be operated in a rational and scientific way. This research analyzes the law and trend of the urban development, and discusses the present issues of our country's urban green space plan. The strategies for urban green space system plan in the eco-oriented development mode, are herewith discussed in the study. The ecological functions of green space system plan, such as the gas regulation, the biodiversity and the disaster avoidance, play an important role on the residents' life, it hereby to analyze the appropriate strategies.

KEYWORDS

Urban assumption; Eco-environment; Urban green space system plan; Eco-oriented development mode.



INTRODUCTION

The fast urban development is happening in our country with reform and opening-up. In 1979, 19.9% of our cities have realized the urbanization. In 2011, the ratio has increased to 50%, which proves that the average annual growth rate of our country is far faster than that of the world and ranks in the leading position world-wide. It is the evolution of the urban green space concept of China, as is shown in the TABLE 1. This research takes the ecology as the start to put forward the green space system plan and introduce the law of the urban development and the bio-oriented development mode. The development status of the urban green space system plan has been analyzed, and the strategies for urban space system plan in the bio-oriented development mode has been also discussed in the research.

TABLE 1 : The evolution of urban green space concept of Chian

| Year | Content |
|---------------------|--|
| Former Soviet 1950s | Lie Fu Qin Ke Classification |
| 1960 | The Urban plan Book, <i>Urban Landscape plan</i> , was published. |
| 1963 | <i>Several Provisions on the Urban Landscape Greening Work(draft)</i> was issued. It is first regulatory urban green space classification since the founding of PRC |
| 1975 | <i>Methods of Urban Construction Statistical Index (trial edition)</i> was issued. |
| 1976 | Liu Jialin published the summary of the progress on the urban green space research. |
| 1979 | Ding Wenkui claimed the views on the urban green space classification and quota. |
| 1990 | <i>Urban Lad Classification and plan Construction Land Standard</i> was promulgated. |
| 1992 | <i>Urban Greening Regulations</i> was published, which stipulates that the green land in urban area involves the public green land, the residential greenbelt, the accessory greenbelt, the protective greenbelt, the productive greenbelt and the scenery woodland. |
| 1993 | NO. 784 File-- <i>Provisions on Urban Greening Plan Construction Index</i> was published by the Ministry of Construction. |
| 2002 | <i>Urban Green Space Classification Standard</i> was published. |

ANALYSIS ON THE URBAN DEVELOPMENT

General laws of the urban development

As the Figure 1 shows, it is the Northam S Curve, the general law of urban development, which is proposed through the research by the American Urban Geographer Northam. The Figure 1 presents that the global urbanization develops in certain stages, which can be considered as three stages: early stage, middle stage and late stage. Early stage: in the early stage of the urbanization development, the urbanization level is between 0-3%, during which the urban population increases relatively slowly, and only when the urbanization rate is more than 10%, the speed of the urbanization development intends to increase. Middle Stage: in the middle stage of the urbanization development, the urbanization level is between 30-70%. While the urbanization rate surpasses 30%, the rapid upward trend of the urbanization development appears. Meanwhile the economy increases swiftly. Until the rate reaches to 70%, the urbanization development presents to be steady. Late Stage: in the late stage of the urbanization development, the urbanization rate is over 70%, and during this period social economy and population maintain stable. From the analysis above, our country is in the middle stage of the urbanization development, leading that the urbanization evolves fast and economy develops rapidly. But many problems surly come up with the swift urbanization development. The steady development of city needs sufficient matter and energy coming from the nature in order to form a relationship of requesting and being requested, in which the eco-environment damage will occur when the requesting resource overloads the nature's capacity.

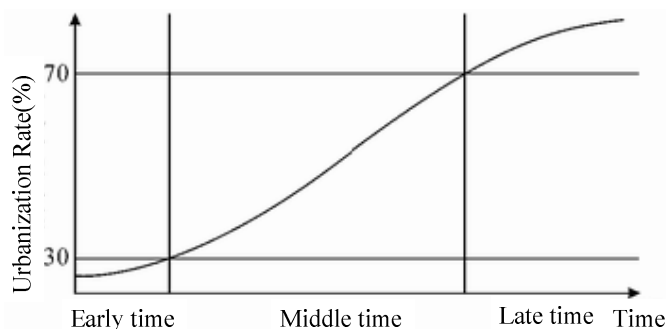


Figure 1 : Northam S curve

Trend of urban development

With the rapid urban development of our country, our social economy changes significantly involving the enlargement of people's production and life, the expanded utilization of the land resources and the obvious expansion of the urban land. The construction of city and town, as the main part of the expansion of the urban land, is an important measure of urbanization. There are two characteristics of the expansion of the urban land:

(1) Being the crucial carrier and asset of our economic development, the urban construction land is under extensive expansion. With reform and opening-up, China's economy form transforms from the planned economy to a market one. The urban construction land increases year by year, especially the expansion of some major cities appears to be extensive. The cultivated field is mostly occupied for the urban enlargement and the land resources development. In order to suit for the urban development, it is necessary to develop the land rationally. But according to the survey, it is easy to change the cultivated field into the construction land, otherwise is quite difficult because the urban land is over expanded and keeps idle to some extent. The over exploitation of cultivated field and the inefficient utilization of land must cause the eco-environmental damage.

(2) The connotative adjustment of urban construction land is out of control. With the acceleration of urbanization, people move to the city constantly, thus various land s for life and production will be increase. The higher requirement to the inner-city land appears while the city develops. In recent years as people's living standard continues to improve and economy increases swiftly, however, infrastructure, public supporting facilities, urban green land, ecological land and other projects are not gained the marked improvement. The mix of the industrial land and the living space will lead the environmental pollution, which reduces the quality of life and effects the appearance of city.

From the analyses above, the acceleration of social economy and urbanization needs land resources. The development of society must guarantee the ecological balance, thus the urban green space plan becomes an important part of the urbanization plan. Finding the balance between production land and living space is the key to counterpoise the urban development and ecology. The specific way is to maintain the ecological land, landscape and other green land that people require while production land, road land and other lands are used to keep economy developing.

Problems in the urban green space system plan

The urban green space system is the basis and main part of the urban ecological system. It is necessary to assure a certain proportion of urban space. The reasonable and perfect layout of the urban green space is indispensable to change into the environment-friendly city. The urban green space plan has drawn the attention of all levels of government. The green land, river, forest and other natural elements in the city have been being applied in the urban construction. The garden city building is also under doing. The urban green area increases year by year. Although the urban green space construction has made some progress, it is still many problems within: (1) The urban green space is occupied maliciously, leading that the total urban greening rate is hard to reach the required level. Previously the infrastructure and public sporting facilities of all kinds of cities are imperfect and have many shortages. When the city's social economy rises rapidly, these issues will be clear, which means that the demand of land increases sharply, but the central land of city cannot meet the demand and the existing buildings are difficult to adjust, thus the only solution is to occupy the green space. (2) The urban green space is designed freely and is without reasonable plan. The development of market economy and the change of land use regulation make the profit to be the most attractive power. Usually the lower greening rate is in the place with higher economy, and vice versa. It is common to plant in the crack. It means that the green space construction always starts after the design of city plan, which contributes that the plan lacks of overall consideration and the urban greening rate misses the requirement.

ECO-ORIENTED DEVELOPMENT MODE AND CONCEPT OF THE URBAN ECOLOGICAL GREENING

Eco-oriented development mode

American scholar Honachefsky put forward the eco-oriented concept. He pointed out that considering the potential economic value of land before the eco-environment is major reason of the ruleless urban expansion of America and the eco-environmental damage. To this issue, he brought forward the thought of ecological optimization emphasizing that regional ecological environment should be planned with the policy of land use. Honachefsky's thought of ecological optimization attracted the response of scholars worldwide. Moreover it guided the ecological optimization to the eco-oriented thought which means the regional development intends to change from the ecological protection to ecological utilization.

Urban ecological greening

The urban ecological greening is to plan the urban green space with ecological principles and technology whose aim is to improve the urban ecological environment, create natural rest space and develop the steady green space. From the aspect of the urban green space, the layout and scale should make up the deficiency of urban landscape, and should give the function zone, ecological environment status, population state, construction layout and other conditions the comprehensive consideration in order to construct green space according to the requirements.

THE STRATEGIES FOR URBAN GREEN SPACE SYSTEM PLAN BASE ON THE BIO-ORIENTED DEVELOPMENT MODE

Macro construction strategies of urban green space system in ecological city

The macro construction strategies of urban green space system in ecological city start from three aspects, as is shown in the TABLE 2 which is detailed introduction below.

TABLE 2 : Macro construction strategies of urban green space system in ecological city

| Direction | | Content |
|-------------|---|---|
| Direction 1 | Integration of Urban and Rural Greening | The integration of urban and rural greening is to consider the greening construction of city and country together. In fact it integrate the greening construction of urban, suburban and planning area. In addition introducing the forest into city belongs to the integration of urban and rural greening. The forest-like city is helpful to improve the urban ecological environment. |
| | Park Trend of Urban Greening | The park trend of urban greening is mainly about to increase the greening area for building large, dense and joint parks. |
| Direction 2 | Green Space Design Humanization | The green space design humanization means to consider the ability o participatory, interventional and ornamental ability of green space in the urban green space design. It is required to provide the residents with natural environment and meet the need of people's living. |
| | Three-dimensional Greening Form | Three-dimensional greening form inquires the reasonable and efficient use of limited land resources to realize the multi-level and multi-structure greening and the combination of various plants, and to increase the sort of green plants and to improve the greening quality. |
| Direction 3 | Construction of Multi-type Corridors | The corridor can protect the biodiversity and play a role like a windward passage. Urban plant road is one important form of the corridors. |
| | Wetland Conservation, Water Resource | The wetland has high ecological value and powerful material production capacity, which is should keep integrate in the urbanization construction. Meanwhile the water resource is the source of residents' living. It is crucial for urban green space system to retain the water resource clear. |

Development strategies of urban green spatial framework under ecological service function

Eight Ecological Service Functions that play important role in the residents' living environment, including gas regulation, climate regulation, interference regulation, soil and land conservation, disaster avoidance, recreation and culture, are chosen as main ecological service functions of urban green space by summarizing and analyzing the research on of direction urban green space plan of relevant scholars. This research involves gas regulation, climate regulation, disaster avoidance to discuss the ecological service functions.

Gas regulation

The atmospheric pollutants include carbon dioxide, carbon monoxide, sulfur compounds, dust, radioactive substances, etc. The plant can remove the atmospheric pollutants by photosynthesis and synergy. Its purifying effect is relevant to the scale of urban green space, plant species and the structure of greening. Generally, the more levels of urban greening, the better purifying effect. They are the environmental benefits of different green space structures in TABLE 4. The atmospheric diffusion is mainly effected by the wind. That is to say the wind direction determines atmospheric diffusion direction and the wind speed decides its level. However the vegetation cover can obstruct the wind to some extent, and reduce the wind speed while purifies the air. That is how the vegetation cover works on the the purifying effect. Which proves that the purifying effect will be unchanged if the green space increase to some extent. It means that the purifying effect of multiple small green spaces is better than that of the large green space with the same area. That is why to take the factor above into consideration completely when the urban green space system is being designed shown as Figure 2 and Figure 3.

TABLE 4 : Environmental benefits of different green space structures

| Green Space Structure | Three Dimensional of Per Unit Area (m ³ /hm ²) | Annual Environmental Benefits(t/a) | | | |
|--|---|-------------------------------------|---------------------------------------|---------------------------------------|----------------|
| | | Yielding Capacity of O ₂ | Absorbing Capacity of CO ₂ | Absorbing Capacity of SO ₂ | Dust-Retention |
| Arbor-shrub-grass Multiple layer Green Space | 79128 | 214.4 | 295.9 | 0.24 | 87.0 |
| Mixed Arbor Forest | 72357 | 196.1 | 70.6 | 0.22 | 79.0. |
| Grass Shrubbery Forest | 11480 | 31.1 | 42.9 | 0.03 | 12.6 |

| | | | | | |
|-------------------------|-------|--------|-------|-------|------|
| Ground Cover | 2000 | 5.4 | 7.5 | 0.006 | 2.2 |
| Plant Nursery | 3560 | 9.6 | 13.3 | 0.011 | 3.9 |
| Garden-like Green Space | 52036 | 141.00 | 194.6 | 0.16 | 57.2 |
| Road Green Space | 4946 | 13.4 | 18.5 | 0.015 | 5.4 |

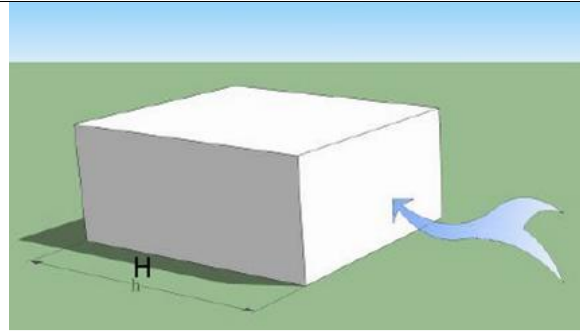


Figure 2 : Space schematic figure

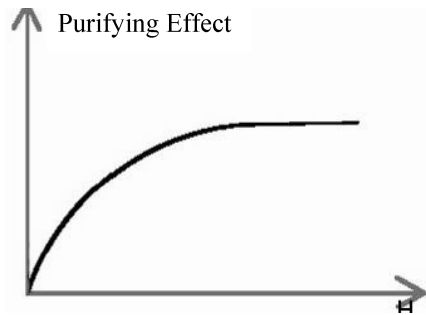


Figure 3 : Curve linear relationship figure

Biodiversity

The urban green space not only meets the demand of resident comfortable living environment, but also maintains the diversity of animal and plant and their healthy growth. Only in this way the ecological balance can keep. In order to retain the biodiversity, the knowledge of landscape ecology must be introduced. Landscape diversity is one kind of landscape ecology. It includes patch diversity, type diversity and pattern diversity. The patch is the gathering place of biological species, whose area is related to the number of biological species. As is shown in the Figure 4, it is the relationship between landscape diversity and biodiversity. From the table below, their relationship is not a simple liner relationship, but is normally distributed, whose reason is that various biological species need different patches. Therefore deciding the appropriate patch size is necessary in green space system plan to meet the demand of the growth of multiple biological species. In the process of biological species' growth, the kinds and amounts in the edge of patch are more than those in the center of patch. Different species inquire patches with different width. That leads us to think about proper size of patch for biological species' activity and life in green space plan, thereby letting the living creature grow and breed.

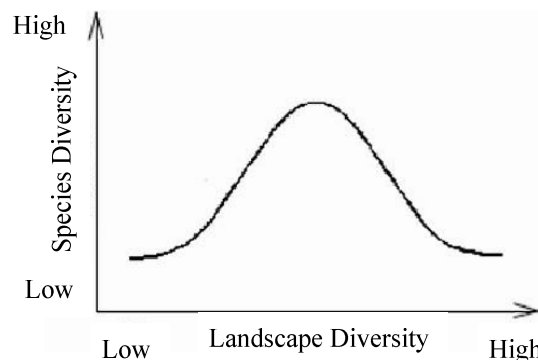


Figure 4 : Relationship between landscape diversity and species diversity

Disaster avoidance

When earthquakes, floods, landslides and other disasters occur, urban green space can avoid or reduce the disasters. It also can provide the temporary shelters for residents and slow down the spread of disasters. The design of the disaster avoidance function of urban green space is to build a certain amount of parks and planning green space. The construction of green spaces should take the tree species into consideration due to different trees have their functions on avoiding and reducing the disasters. The TABLE 5 demonstrates the different functions on avoiding and reducing the disasters of trees.

TABLE 5 : Functions on disaster avoidance of different tree species

| Disaster | Flood, Drought, Landslide | Earthquake, Fire | Windbreak and Sand-fixation(Sandstorm) |
|-----------------------|--|--|---|
| Plant Characteristics | Large and broad tree crown, dense, deep and broad root, shade-enduring, strong rainwater interception | Different to burn | Strong wind-resistance, fast-growing, long lifespan, pyramid or column tree crown |
| Sort of Tree | Willow, maple, walnut, Juglan Pterocarya, stenoptera, metasequoia glyptostroboides, spruce, fir, juniperus chinensis, hazel tree, Oleander, Lespedeza, amomorpha fruticosa | Cycas revoluta, Gingko, Cyclobalanopsis glauca, Mongolian oak, coral tree, palm, Aucuba chinensis, privet, Machilus thunbergii, camellia, Ternstroemia gymnanthera, Daphniphyllum macropodum, Fatsia japonica, | Poplar, willow, elm, mulberry tree, Hippophae rhamnoides, amomorpha fruticosa, Tamarix chinensis, Pinus massoniana, Lodgepole Pine, Sabina chinensis, Chinese sapium, Taiwanacacia, Casuarina, Archontophoenix alexandrae, Arenga pinnata |

CONCLUSION

The damage of ecological environment is becoming serious with the development of society and the enlargement of urbanization. The urban green space can improve the urban environment and keep the balance between urban development and ecological environment. At present, the urban green space system plan has become a major part of urban plan. According to the trend of urban development and existing issues in urban green space system plan, the strategies for urban green space system under the bio-oriented mode are put forward. This thesis explains the macro construction strategies of urban green space system in ecological city, and analyzes the strategies for green space system plan of three functions (gas regulation, biodiversity, disaster avoidance) that effect residents' life. The study provides a direction for the urban green space system plan. The urban green space system plan covers a wide scope of disciplines, thus this research proposes a part of the strategies, and there is much about the spatial layout of urban green space system plan to investigate. Only to complete the urban green space system plan can relieve the burden of present environment and keep the ecological balance.

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