

A Study on Shanghai's Practice based on the Organic Evolution Theory of Urban Green Space System*

LANG ZHANG¹, YING XU²

1. Shanghai Municipal Greening Administration 2. School of Art

1. Fudan University, 2. Jiangsu University

1. No.768, Jiaozhou Road, Jingan District, Shanghai City, 2. No.301, Xuefu Road, Zhenjiang City, Jiangsu Province

CHINA

1. zhanglang18@sohu.com, 2. xuying110111@126.com

Abstract: The urban ecological network can construct an interaction between human beings and the natural environment in a better way. And it has a decisive legal effect on the protection of the ecological environment and the improvement of its quality. The research on urban green space system varies from urban gardens and greenbelts transformation to ecological-social-economic compound ecological green space. Taking Shanghai as an example, from the point of view of ecological network planning, this paper explored the six genes (which are public policy, relationship between urban and rural areas, internal structure, the resources use way, the functions of ecological green space) and their variation to the influence of urban green space system evolution, in order to improve urban green space system organic evolution theory system.

Key-Words: The organic evolution theory of urban green space system; Basic ecological network; Six gene internal variation; Action mechanism; Plan layout pattern of urban green space system; Shanghai

With the thought of integration between urban and rural areas and the rise of the ecological network, planning subject concept evolution occurs, which leads to the development of the urban green space system planning guidelines. It finally changed the urban green space system layout structure, and better promoted the overall efficiency of the urban greening and the improvement of environmental quality. This grid-like spatial structure formed by ecological green network can integrate and organize the urban and rural structure into the natural network, avoiding the unlimited development of cities, especially hyper-metropolis. Synthesizing the development of each planning theory, urban green space system layout structure will ultimately evolve towards the direction of the ecological green space network, which is integral, systemic, hierarchical and ecological [1].

1 The Propose and Theme of the Organic Evolution Theory of Urban Green Space System

The urban green space system is an important component of the urban ecosystem and a complex "nature-society-economy compound ecosystem" itself. Similar to biological evolution, the urban green space system meets essential requirements for evolution as an organic integrity: (1) It is an open system, only through openness can exchanges between inside and outside materials, information and energy occur; (2) It is an imbalanced system, which is reflected in all kinds of exchanges with the environment; (3) Only certain ecological niche difference exists, flow of materials, information and energy can be produced. Therefore, rules of biological evolution are still applicable to evolution of urban green space system to some degree.

In 2007, after summarizing the deficiencies and weak links of the current research on urban green space system development in China, Zhang combined "evolutionism" with "urban green space system", introduced Darwin's evolutionary thinking to the planning of urban green space system and put forward a new urban green space system development theory, "the organic evolution theory of urban green space system", with the support of

Fund Program: The Research on Climate Ecological Benefits of Shanghai's Ecological Network Planning

some basic theories such as the systematic theory, the control theory and the dissipative structure theory and the understanding of the subject (people) as the main line[2].

The purport of the organic evolution theory of urban green space system is based on the viewpoint of integrity, hierarchy, openness and dynamism. With the development of the city ,which has brought about great leaps in urban green space system development in the fields of society, institution, investment, plan and determination, and through natural and artificial selection (with the mutation and zooming of urban green space system layout structure as positive variation pattern, that is, in the “non-durable” mutation way), the ideal of sustainable development can be realized, thus increasingly leading the relationship between man and nature during the process of urban development towards a harmonious and efficient dynamic balance [3].

The mode of urban green space system evolution is as follows: changes of external environment and human cognition promote the production of gene variation inside urban green space system; after double choice of natural selection and manual selection, positive gene variations are kept and negative ones are gradually eliminated; natural selection and manual selection

have decisive effect on gene variation; manual selection is restricted by natural selection (environment) and finally promote the organic evolution of urban green space system (Fig.1).

The urban green space system is an organic integrity with composite structure and its organic theory of evolution is put forward by combining the evolution of the object of the green space system itself and the subject of the concept of human beings. The theory targets at guiding urban green space planning, construction and management to achieving innovation and promotion of concepts as a kind of self-examination, anticipation and integration of urban green space system planning and construction ideas[2].

2 The Inevitability of Shanghai Green Space System Planning Evolving to the Basic Ecological Network Planning

The development of urban green space system keeps changing from low level to high level, from simple to composite in terms of form, structure, function and other aspects with the view of organic evolution of urban green space system. After the reform and opening up, there are three systematic plans for Shanghai green space system, which happened in 1983, 1994 and 2002 respectively, and among them, the version of 1994 and 2002 played an important role in the urban green space system planning layout.

Significant changes on planning concept, region range, elements expansion, and structure evolution of the three versions of the green space system planning have taken place, and the organic evolution from “urban green space layout” to “urban green space system”, then to “city region green space and forest system”, and finally to “urban ecological network system” has been realized[4] (Fig.2). The 1994 version of Shanghai green system planning was based on the principles of ecological development — the co-existence of cities and nature— and the layout structure — the large area of green space in the suburb, “circle” and “wedge” in the city, and contiguous green space in the urban fringe. The 2002 version of Shanghai green system planning emphasized the overall environment in the city regional level, which represents the structure of “circle, wedge, corridor, park and forest”, and the improvement of the ecological environmental quality in the central city, taking the form of net structure based on “large greening area”.

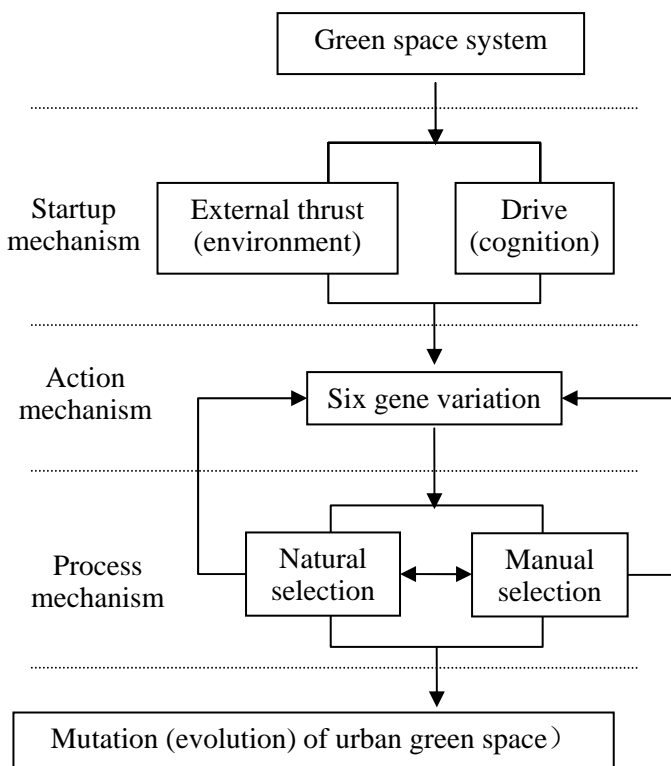


Fig.1 Organic evolution ideograph of urban green space system

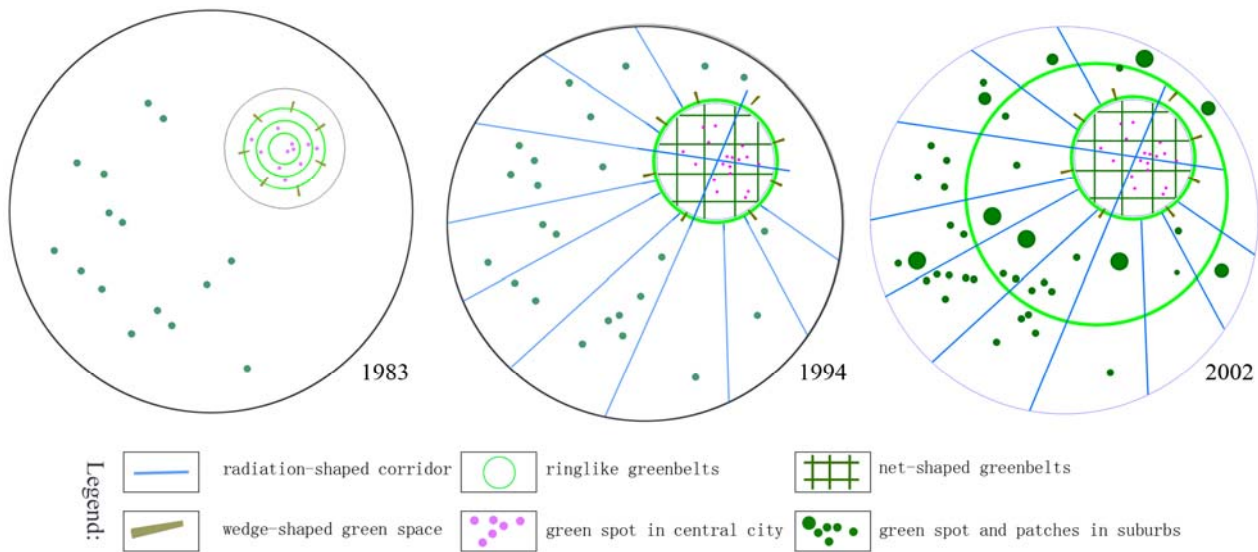


Fig.2 Organic evolution of urban green space system plan layout pattern in 1983,1994 and 2002 of Shanghai

After two changes, Shanghai's urban green space system has initially formed a city regional green ecological system, combining city and suburb and boasting rational structure, balanced layout and perfect and stable ecological functions. However, integrity, continuity, uniformity, proportionality and comprehensiveness remain to be further optimized and improved.

In recent years, with the rapid development of Shanghai urban economy and urbanization, the ecological planning and construction has experienced a developing process of increasing resource types and changing planning structures from simple to complex, from inorganic to the systematic[5]. Although Shanghai ecological environment protection and construction have been obviously bettered, data show that its urban ecological resources have been reducing year by year. According to statistics, during 2005 to 2009, Shanghai ecological land resources have declined significantly, with the annual average decline, accounting for 1.5% of the total land area. Therefore, the ecological land in the city space resources must be under planning control so as to prevent Shanghai urban ecological resources from declining trend year by year. Considering land resource constraints, Shanghai must explore innovative ways to reasonably use limited land resources, give full play to the structural effect of ecological resources, and realize sustainable development.

The thought of basic ecological network, which combines Architecture, Landscape, Geography, Environics and other subjects based on the principles of landscape ecology, is a new concept of ecological environmental planning. The land types

corresponding to basic ecological network cover a much bigger scope than urban green space, including urban green space in the urban construction land, other open space with ecological, landscape or recreational value, agricultural land, forest land, wet land, hills and waters besides construction land, emphasizing that structural and functional connections between natural and semi-natural factors are made for the realization of valid ecological process. For hyper-metropolis like Shanghai, the regional environment of the city and the inner city environment are more complex. There must be inevitable and complex ties interwoven into a network between any ecological elements[6](Fig.3). Today, our city environment is deteriorating and urban ecological network space better embodies the close and holistic relationship between the city and its environment around.

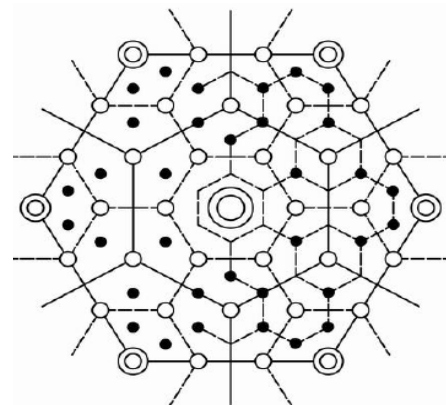


Fig.3 The model of macroscopic level city ecology green space network

In 2009, in accordance with the work arrangements of the municipal government, the "combination of two regulations" (the overall

planning and land use planning) was completed. Taking it as an opportunity, the basic ecological network planning was launched at the end of 2010 and approved by the Shanghai municipal people's government in May 2012. The construction and establishment of Shanghai's basic ecological network space is indispensable for the maintaining of the city's ecological security, the further implementation of the urban ecological space layout system determined by the general planning, the strengthening of the follow-up implementation and management of the construction of ecological space, and the clarification of the total amount and layout structure of ecological land. Moreover, it is also significant for us to define the control line of ecological network space according to different categories and grades and stipulate the regulative and guarantee measures for ecological space [5,7-8].

The implementation of the work also shows the necessity that Shanghai green space system evolve into basic ecological network planning. First, the scheme of a thorough city regional ecological network is an important task to implement scientific outlook on development and promote socialist conservation culture. Second, structuring a healthy eco-space system is an important constituent part to shape core competitiveness of a cosmopolis. Third, constructing a rational eco-space system is an inevitable choice to optimize urban spatial form and balance urban spatial structure.

3 Action mechanism for evolution of Shanghai urban green space system planning to basic ecological network planning

The organic evolution of urban green space system is the joint result of the action mechanism, which is the interior genetic variation of the structural relationship between fundamental power, public policy, urban-rural relationship, internal structure, resource utilization mode and others, and two process mechanisms, namely, natural selection and manual selection[3]. Hereinto, dynamic mechanism, which consists of urban economy, industrial structure and infrastructure construction, is the social and material foundation of urban green space system. Public policy of urban greening is an important method for government intervention and urban greening guiding; structure of urban green space decides the specific forms of layout and the development direction of urban green space system; building of the urban-rural integration ecological network is an effective way to improve sustainable

development of urban green space system; utilization mode of urban ecological resources is important evidence for the adaptation of the urban green space system to natural selection; function developing of ecological green space is a significant judgment standard for urban green space system evolution. Exactly because of these gene variations, mal-conformation of urban green space system is produced, thus realizing diversity and finally motivating the entire evolution of urban green space system.

3.1 Propelling of the fundamental power

Urban economy, industrial structure and infrastructure construction are the social and material foundation of urban green space system evolution. In the evolution process of super-huge urban green space system, great-leap-forward development of urban economy serves as the fundamental power of green space system evolution; industrial restructuring drives the mutation of urban spatial structure and changes the movement of urban system material, energy and information as the basic power for the evolution of urban green space system; at the same time, infrastructure planning becomes important impetus for the evolution of urban green space system.

Urban economy development is the fundamental impetus for green space system evolution. Meanwhile, economic development provides an essential material foundation for green space system evolution as its driving force. According to statistical data, urban green space construction and financial investment of China indicate positive correlation. The construction and development of ecological network also need economic input and guarantee of greening management. Zooming of the urban spatial structure serves as a basic motivation for the evolution of green space system that evolves to superior system mutation. Through industrial restructuring, the urban space structure has transformed from capital-intensive type to technology and knowledge intensive type, so as to maximize the economic benefit of the city and further improve the urban land value. We have more and better ecological network space for layout and planning, therefore, the layout structure of the green space system can be optimized gradually. The continuous adjustment of urban economy development and industrial restructuring helps to promote the scientific development of urban ecological environment, influencing, accumulating, dispersing and coordinating various social and economic activities

in urban regional space. Infrastructure planning improves the flow of material, energy and information between cities and their surrounding areas, utilizing various space-time resources in an efficient way. Therefore, a new round of infrastructure planning and construction is also an important motivation of the green space system evolution.

3.2 Guarantee of public policy

Public policy is a major means of government to interfere with and guide the improvement of urban greening, and also a decisive guarantee to promote evolution from urban green space system to basic ecological network. The Chinese State Council determined two kinds of new management systems of urban area, which are “City with county” and “Withdraw county setting districts”, in order to strengthen the relations between cities and suburbs and create conditions for regional urbanization and integration of urban and rural areas. *Land-use Statute Classification*, which was issued on August 10, 2007, implemented the principle of urban and rural integration and divided urban and rural lands at the same time, thus realizing all coverage of land classification [9]. *The Act of the People’s Republic of China on Urban and Rural Planning*, which was implemented on January 1, 2008, further regulated and constrained planning formulation, construction, management and supervision of the implementation of urban and rural areas integration, bringing vitality to the coordinated development of urban and rural areas, overall regional planning, and ecological coexistence [10]. In 2010, Shanghai has carried out a basic ecological network planning which further promoted the perfection of the structure of regional urban green space system. Shanghai’s green space construction experienced leapfrog development.

3.3 Relationship variation between urban and rural areas

Building the urban-rural integration ecological network is an effective way to improve sustainable development of urban green space system. With the river and road greening as the division of the regional structure, urban green space system planning applies not only to urban areas, but also to the expansion of the administrative region, introducing ecological environment resources of the region, thus forming the urban-rural integration ecological network and promoting the sustainable development of urban green space system.

The construction and establishment of Shanghai’s basic ecological network space in 2010 is indispensable for the maintenance of the city’s ecological security, the further implementation of the urban ecological space layout system determined by the general planning, the strengthening of the follow-up implementation and management of the construction of ecological space, and the clarification of the total amount and layout structure of ecological land, all of which made the layout formed and the function coordinated and the “urban-rural integration” truly achieved. Shanghai’s basic ecological network planning carries out the ecological space system of “belt, wedge, zone, sources” in the city area, which is determined in the general land use plan to maintain the ecological security. The establishment of the “ring radial” type ecological network space system should also be sped up, with the “belt, wedge, corridor, garden” as the main body in the city center, green belts and ecological interval zone as the anchor of the surrounding areas of the city center and urban ecological corridor and ecological conservation areas as the base in the city range [12].

3.4 Optimization of internal structure

Structure of urban green space decides the specific forms of layout and development direction of urban green space system. Large public green space is the main body of the urban green space system, which plays an important role in improving urban ecological environment, reducing city heat-island effect, protecting biodiversity and providing recreation places for the residents.

The planning, based on the characteristics of Shanghai as a plain region, its stage of economic development and its trend of ecological space, has initially formed the construction path of the “Great Ecological Space”. It is defined that islands at the Yangtze river estuary, the Dianshan Mountain lake source region, the Hangzhou bay leisure zone, and the East China sea wetland and its natural reserve form the basic ecological source region and ecological strategic security space; the suburban ecological space includes nine ecological corridors and ten ecological conservation areas, and the surrounding areas of the city center mainly includes the city’s “dual rings” and sixteen ecological interval belts of the surrounding area of the center of city; taking “ring, wedge, corridor, garden” as the basic pattern, the green space system of the centralized urbanization area links regional ecological spaces to each other (Fig. 4).

The planning has changed the viewpoint and practice of taking urban green space system planning as a follow-up and complement of urban planning and bid farewell to “greening in every corner” era. Its establishment gives priority to the green space system, which is the skeleton of urban development; nature protection was brought into the early stage of urban construction and planning; in terms of reducing environmental pollution, the important role of the green space system in restoring nature, overall maintaining urban ecological system and reshaping the urban landscape, and actively guiding the city’s layout and planning should be highlighted.

The ecological environment directly or indirectly reflects the rationality of the utilization of land resources. China is a country with a large population but relatively less cultivated land and limited resources, especially in the city where ecological resources are even scarcer, so the utilization mode is quite important in the adaption of urban green space system to natural selection. In urban green space system, wetland, forest land and farmland are the mainly-used ecological resources. In recent years, large tracts of forest and green spaces in non-urbanized areas also functioned as urban green lung, exerting a direct impact on the ecological environment, urban landscape, and biodiversity conservation,. The total area is about 671.1 square kilometers, accounting for 10.6% of the total area of Shanghai.

Agricultural lands refers to the lands applied directly to agricultural production, including the cultivated lands, garden plots, forest lands, grasslands and other agricultural lands (land information is sent [2001] 255). From a systematic standpoint, the ecological system of the agricultural lands is made up of geomorphic climate, hydrological, soil plants, animals and other natural elements [14]. At present, China’s urban green space system planning has actively included forest lands and cultivated lands into urban green belts, which protect the cultivated lands and the open space between cities.

The wetland resources in Shanghai are very rich, which cover a total area of 3197.14 square kilometers, accounting for 34.0% of the whole area. *Shanghai Wetland Protection and Recovery Planning (2006-2015)* (Shanghai Forestry Bureau, 2005), based on the development and utilization of tideland resources and the substantial increase of greening areas, effectively keeps the ecological characteristics and ecological service functions of main lake wetlands so as to provide basic ecological space for the ecotype city.

In 2009, wetland, forest land, and agricultural land have been included into Shanghai urban green space, thus the total green space was increased sharply. The planning will integrate different kinds of ecological space into four major categories, namely, green space, garden space, farmland and wetland, realizing the integration of ecological space area and the interconnection of city area as well as the harmonious development of the ecological benefit, society and economy.






-  Ecological greenbelt
-  Ecological corridor
-  Ecological conservation area
-  Central city
-  Center city surrounding area
-  Countryside

Fig.4 Structure Diagram of Regional Ecological Space

3.5 Transformation of ecological resource utility pattern

3.6 Evolution of ecological green space function

The functional development of ecological green space is a significant criterion for urban green space system evolution. Ecological green space in the 21st century should better protect biodiversity from the systematic standpoint. With the introduction of the surrounding ecological resources, ecological environment of the species within the city and region should be improved so as to build a ecological network that integrates urban and rural areas, ensuring the smooth transfer of species and the integrity and continuity of all kinds of ecological process. It's necessary to establish a series of ecological green lands, such as natural type landscape green spaces, ecological recreation areas, ecological sensitive areas and natural habitats, etc. in order to coordinate comprehensively the relationship between production activities and recreation of human beings and ecological protection.

According to the principle of harmonious co-existence between man and nature, the basic ecological network planning of Shanghai has designed an urban greening system, which embodies coordination between urban and rural areas, various reasonable greening cohesion and perfectly stable ecological function, and reflects the comprehensive development trends that green space's ecological functions, such as environment, recreation and ecological function, are changing. The evolution of its ecological functions is as follows: the first is the planning structure and the ecology of the layout, that is, the construction of ecological corridor and ecological network, ecological restoration, the combination between natural system process and urban development process, and the construction of the habitat community, etc; the second is the ecological function that maintains the balance of urban ecological system. Taking ecological concept as a guide, "ecological priority" as the prerequisite, and "ecological balance" as the leading factor, from the standpoint of the urban integral space system, the green spaces in the whole city and surrounding areas should be designed and controlled to maximize the ecological benefits and to promote the sustainable development of the city; the third is that the ecological green space is a kind of ecologically-compensatory greening. Green space planning should be given top priority as an urban ecological infrastructure, not an addition of urban construction, especially in areas where it will have a significant influence on the city's ecological environment.[5].

4 Conclusion

After thirty years' development, Shanghai's green space system layout has developed from the point and line structure of "greening in every corner" to the dotted urban network structure of "green planning" of "one center with two wings, three rings with ten lines, and five wedges with nine groups", then to the urban greening systemic circulation in which the "subjects" interacts with each other through the "network" and the "core" with the city territory, the centralized urbanization area and the public green space of all levels as the core, large suburban ecological forests as the main body, and the greening of areas surrounding "rivers, lakes, the sea, roads, islands and the city" as the network[10]. It has laid the foundation for "Shanghai in forest" and "green Shanghai".

Urban green space system is an organism with evolutionary ability. From the view of organic evolution, internal factors and external environment of urban green space system jointly promote the change of it, while actually evolution and development of urban green space system may be either positive or negative. However, the construction of the urban ecological network space is based on the principle of landscape ecology and the reasonable model of urban green space system evolution from the perspective of urban spatial structure, which will be bound to lead the green space system to the trend of a reasonable evolutionary mechanism.

Fund Program: *The Research on Climate Ecological Benefits of Shanghai's Ecological Network Planning*

References:

- [1] ZHANG Lang, LI Jing, FU Li. Layout of Urban Green System: Characteristics and Trend. *City Planning Review*, VOL.33,NO.3,2009,PP.32-36,49
- [2] ZHANG Lang. *The research of the green space System's layout structure and construction of hyper-megapolis — take Shanghai for example* [Doctoral Dissertation]. Nanjing: Nanjing Forestry University, 2007
- [3] ZHANG Lang. A Study on the Organic Evolution Theory of Urban Green Space System. *Chinese Landscape Architecture*, VOL.24,NO.1,2008,PP.87-90
- [4] ZHANG Lang. Study on the Construction of Basic Ecological Network System in Shanghai Based on the Organic Evolution Theory[J] *Chinese Landscape Architecture*, VOL.28,NO.10,2012,PP.17-22

- [5] ZHANG Lang. *The Research of the Green Space System's Layout Structure and Construction of Hyper-megapolis – Take Shanghai as an Example*. China Architecture & Building Press, 2009
- [6] ZHANG Lang. Research on the Evolution Background of Shanghai Urban Green Space System *Shanghai Construction Science & Technology*, NO.2,2009,PP.21-25
- [7] ZHANG Shiyu. Green Space System Planning in Shanghai. *Urban Planning Forum*, NO.142, NO.6, 2002, PP.13-16.
- [8] ZHOU Zhican. Research in the Planning of “Basic Ecological Control Line” in Our Country. *Urban and Rural Planning*. VOL.1, NO.3, 2011, PP.62-66.
- [9] *Land-use statue classification (GB/TZ1010 — 2007)*China Standards Press, 2007
- [10] *The law of the People's Republic of China on urban and rural planning act*. Law Press China,2007
- [11] ZHANG Lang. A Study on the Mechanism of the Organic Evolution of Urban Green Space System — With Shanghai as the Example. *Chinese Landscape Architecture*, VOL.24, NO.3, 2008,PP.82-86
- [12] Shanghai Municipal Planning and Land Resources Administration, Shanghai Greening and City Appearance Administrative Bureau. *The Basic Ecological Network planning Project of Shanghai* (Number: 200934700202058G)[Report]2011.1
- [13] WANG Peng. *The Study of Urban Green space network Planning — A Case Study of Shanghai City* [Doctoral Dissertation]. Shanghai: Tongji University, 2007
- [14] TIAN Keming, WANG Guoqiang. Study on Ecological Security of Agricultural Land Evaluation. *Areal Research and Development*, VOL.24, NO.4,2005,PP. 79-82