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The urban ecological regulation based on ecological carrying capacity

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Abstract

The urban ecosystem is a Social-Economic-Natural Complex system consisting of human beings and their surrounding. Because the integrity of function and structure is crucial to the stability and development of urban ecosystem, it is necessary to carry out urban ecological regulation to optimize urban ecological function and structure to promote urban sustainable development in prior situation. Urban problems can be caused by the imbalance between supply and demand, inadequate resilience to pressure, In this paper, the urban ecological carrying capacity is introduced to improve the comprehensive understanding of urban structure and functions, which reflects the capability in urban supportive system to respond the pressure induced by human activities. And urban ecological regulation is established on urban ecological carrying capacity, thereof we select the threshold value and driving factors in analyzing the feature of urban carrying capacity, which can be acted as breakthrough points in regulation. Moreover the integrity of structure and function can be equal to the spatial-temporal dynamic balance in structure and function, views as the pre-condition in ecological regulation, therefore it is essential for regulation to focus on the spatial-temporal balance of carrying capacity. Based on the relationship between ecological security and ecological carrying capacity, the ecological security can be regarded as the goal or standard of urban regulation. In process of urban ecological regulation, driving factors are recognized and some relevant measures referring to three aspects such as technology, human activities and external factors combined with the feedback in process, are improved ecological carrying capacity, herein it is significant for us to regulate the direction, speed and scale of urban development in order to achieve the urban sustainable development.

Keywords: Ecological regulation; carrying capacity; ecological security; urban ecosystem

1. Introduction

Urban ecosystem consists of several interlinked subsystems—social, economic, and environmental—each representing a complex system of its own and affecting all the others at different structural and functional levels (Zellnr.et al., 2008). Urban development is a major determinant of ecosystem structure and obviously affects the function of natural ecosystems through human activities such as the conversion of land and the depletion of natural resources, the discharge of emissions and waste (Bolund and Hunhammar., 1999), especially accompanied with the acceleration of urbanization and increasingly development of economy, a series of problems in urban ecosystem have increasingly become serious, such as heavy air pollution, ecological degradation and scarcity of various resources etc.(Savard, et al., 2000; Li et al., 2005), on the other hand, the physical

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environment in urban also provides significant services to the human population in urban areas, for example: biodiversity conservation, water supply and air refreshment and so on. Therefore we can make conclusion that the linkage and feedback between the human and natural components of urban ecosystems are key attributes of the integrated ecosystem (Stewaed t et al., 1997).

Furthermore, based on aforementioned analysis, urban ecosystems is obviously different from natural ecosystems, whose particular features can be demonstrated that there contains numerous symbolic artificial facilities which brought about to extent intense disturbance (Botkin and Beveridge., 1997). As we seen, urban ecological problems have intimate linkage with the complexity of structure and function, which derived from many aspects such as the stagger in temporal-spatial characteristics of ecological factors, the disorder of urban metabolism in material or energy flow, the disharmonize relationship between economic development and environmental protection etc(li.et al.,2010, Zhang et al., 2006). In order to find a pathway solving urban ecological problems, a few scholars have made significant effort by proposing or applying ecological theory and methods to ecological adjustment, with the purpose that formulate significant platform to coordinate the relationship between development in urbanization and complex problems of the city (Zhang et al., 2009).

The rudiment of urban ecological regulation derived from simulating dynamic process of urbanization and qualitatively depicting the urban socio-economic factors affected urban development(Frank and Tobias., 2004), otherwise from angle of urban population, it is reasonable for adjusting or planning optimal population to achieve urban form(Adele and Peter., 2001). According to the implementing objects in urban ecological regulation, initially the urban ecological most pay attention to single aspect, which can be classifies as urban greening regulation, adjustment of urban spatial structure, controlling urban traffic pollution and other types of pollution(Wang and Zhang., 2001, Fredrik and Peter., 2005). Accompanied with rapid development of urban socio-economy and the negative impacts that human activities brought about, the urban ecological regulation have carried out considering the whole complex system from more comprehensive or broaden perspective. The urban regulation have emphasized the characteristics such as diversity, self-organization and opening in complex system, which the measure surrounding about enhancing efficient utilized resources and assimilating the pollution degree to maintain the balance relationship between environment and socio-economy. There existed so many urban ecological model and methods recently, such as the ecological footprint model, the landscape models, system dynamics model about control theory and input-output approach in economy. In summary, urban ecological regulation is based on some core urban ecological theories such as self-resilience theory, urban ecological health and ecological carrying capacity, emphasize the balance of structure and functions in urban ecosystem, in order to optimize ecological structure and enhance ecological function, so the sustainable development can be achieved by some effective measurement of urban regulation (Wang et al., 2003. Feng et al.2005, Su et al. 2010.). These methods starting from their respective disciplines, to provide for urban ecological regulation methodological support, however there existed some definite limitation or drawbacks in applied them.

So according to the feature of urban complex system and the analysis of traditional regulating methods in field, then we proposed creative method to some extent overcome the deficiency and can acquire some useful information in process and actualize the regulation quantitatively. The theory of urban regulation carried out as follows: urban ecological regulation is established on ecological carrying capacity, analyzing the threshold and recognizing driving factors in carrying capacity is acts as the breakthrough point, and sustaining the spatial-temporal dynamic balance in urban structure or function is taken as the pre-conditions, and maintaining ecological health or ensuring ecological security views as the objective.

2. Methodology

The urban ecosystem carrying capacity indicates the sustaining function of urban ecological supporting system on urban development，which views as a unity integrated supply of urban ecosystem supporting system with demand of urban development that influence and constraint each other(Yang. et al.,2007). By examining relationship between them, the conflict between the infinite demand of urban socioeconomic development and finite supply of urban ecological supporting system determines the threshold which existed in urban ecological carrying capacity, meantime analogy to applied ecological approaches that can be helpful for understanding function and structure in urban ecosystem, which include the role of key elements and temporal-spatial dynamic in both the social and natural components of urban ecosystems(Xi and Cho., 2007, Fang. et al., 2005). Consequently, based on adopting the theory of ecological carrying capacity and considering its characteristics such as threshold value, temporal-spatial dynamic, we can get the situations of imbalance between demand and supply of ecological carrying capacity, which results in urban ecological deterioration, so urban ecological regulation should focus on the imbalance between supply and demand of these limiting factors which lead the urban problem in development, therefore it is essential to regulate urban ecology based on analysis of ecological carrying capacity.

There exist some cases referring to the ecological regulation based on carrying capacity. Tourism is a resource-orientation industry and brings eco-environmental damage to the destination places. It is especially important to certain hotspot tourist cities to manage excess demand for urban tourism resource at period of large-scale activities(Hunter.,2002), this approach involves commencing with a knowing substantial estimate of the UTECC and selecting index, then make adjustments on the capacity and some effective measure can be made. Subsequently from respective that tourism acts as the complex system, the author make in-depth analysis of coupling relationship between the tourism ecological carrying capacity and tourism life cycle and build a tourism destination dynamic evolution model and theoretical research framework, and it resolves key issues of tourism sustainable development and provides a new thought to explore tourism environmental carrying capacity theory (Yang., 2009).

Moreover, the research adopted the combination of stable and rational methods, build model based on systematic dynamics, simulated a series of index of different tactics in long period, to measure the capability of each tactic in different solution(Chen et al., 2010). By studying the ecological carrying capacity and ecological elastic capability and using the model of vulnerable ecosystem evolvement, the dynamic evolvement of vulnerable eco-system were studied, and the moderate economic exploitation and adjusting and controlling measures of regions with vulnerable ecosystem were put forward(Ran et al., 2002).

Based on above mentioned traditional methods, regional ecological regulation have emphasized on the ecological capacity and begun to regard it as the key point in procedure, herein the regulation has focused on harmonizing these complex relationships between supply and demand surrounding about environment, resource etc. However region ecological regulation simply depend on theory and methods of ecological carrying capacity, and to some extent was assisted by reasonable models and ecological theories such as dynamic system, life cycle assessment and so on(Yu and Guo., 2007). Moreover, the emphasis of urban ecological regulation are to maintain the balance between supply and demand of urban ecosystem carrying capacity and control the impact of human activities below the threshold value of ecological carrying capacity by executing effective measures, meantime in order to implementing regulation, it is necessary to recognize the driving factors in process. So it is significant viewpoint in regulating process to analysis threshold value of ecological capacity and recognize driving factors in urban development. In following section, we focus on two parts in urban ecological regulation: the threshold value in urban ecological carrying capacity and recognizing some key factors.

2.1. The threshold value in urban ecological carrying capacity

From the concept of urban ecological carrying capacity, a definite level of human activities, population growth, land use, economic development, can to maintain residential environment sustainable development and not to lead degradation and irreversible of environment quality((Kyushik, 2005). It is guidable for determining thresholds of carrying capacity to take assessment in practice, such as infrastructure capacity (capacity threshold value) is determined, so the assessment of carrying capacity in drainage and traffic facilities can be carried out according to urban infrastructure(Kyushik, 1998). Reconsidering urban ecosystem carrying capacity regards as the integrity of supply and demand or supportive ability or pressure, which mainly focus on the relationship such as linkages, constraints and impact between supply and demand. The concrete process can be depicted as follows: On one hand, urban growth-oriented economic system often takes that the demand for its ecological carrying capacity is unlimited for grant, on the other hand, since the city owns a fixed physical boundaries and ecological support system has a specific spatial scale and geographic boundaries, so their ability to maintain sustainability, resources and environmental capacity in area are in a definite range, herein the development of urban ecological support system is stable. Therefore, the constraints of urban ecosystem carrying capacity threshold are determined by the contradiction between the socio-economic development of unlimited demand and limited supply of eco-support system, only two counterparts are in mutual adaptation, dynamic balance state, can promote the harmonious development of efficient systems.

Accompanied with advances in technology, technological progress have enhanced the efficiency of resource utilization, however even in ideal conditions technology can play a definite role in coping with over-depletion problem(Holden., 2004). In different category of human activities, the threshold of carrying capacity in urban ecosystem varied and there exists so much difficulty to examine the value. In accordance with analysis, from the relationship between supply and demand in the urban socio-economic system and natural systems, the formula for threshold of urban ecosystem carrying capacity can be expressed as:

$$C' = \min f(P_i, K_i, t, D)$$

In this, P_i represents affecting the ecological carrying capacity of the i element in socio-economic factors such as technology, trade and so on; Ki indicates the k element of the eco-environmental characteristics which consisted urban ecological supporting system, such as updating the law, eco-control ability.; t indicate concrete time; D represent the demand of i element in urban ecosystem, f represent the ecological carrying capacity function which determined by natural factors, social factors and economic factors in period of t time.

2.2 The recognition of key factors

Urban ecosystem carrying capacity is affected by multiple factors, which function was analogy to that "although various ecological factors comprehensively take part in function, the specific circumstances, one or a few several ecological factors have played leading role in specific circumstances " in the role of ecological factors described (Hui et al, 2004). Consequently, the characteristics of urban ecosystem carrying capacity is determined and drove by a few key elements, which under certain conditions key elements such as driving factors that impact the development of urban socio-economic system and to some extent determine the speed and scale of the cities(Susan et al., 2007). It is beneficial to recognize the leading factors in urban ecological supporting system.

Human drivers are play key role in urban ecosystem dynamics, for instance: major human driving forces are demographics, socioeconomic activities, and technology, such as if global demand exceeds the globally available supply, there is strong indication that natural capital is being liquidated—a state that has been termed as overshoot, meantime, one important attribute of Ecological Footprint is thus to document overshoot and link this concern to socio-economic variables such as demographic trends, economic expansion, changes in resource utilizing efficiency, and economic prosperity or lifestyle(Ivan and Anna.,2005,).

Rethinking human activities and their institutions in models of urban ecosystems will be a significant step towards indicating more realistically the human dimension of environmental change.

In order to guide sustainable development, it is essential to find out the main driving factors which can provide us theoretical support when we design the related policy mechanisms, because many of the human impacts on the physical environment are mediated through social, economic, and political institutions that control and guide human activities(Costanza,,2000; Templet, 2000). In this section, the ecological footprint is an indicators of sustainability, therefore many studies have been paid attention to analyze some main driving factors of ecological footprint, and made an useful suggestion for policy-making.

In field about anaylazing driving factors, a EF dynamic prediction model was built by using the partial least square regression(PLS) to the important driving factors of wuhan city in the "11th Five—Year" plan period(luo et al., 2008). Moreover, the Set Pair Analysis(SPA)has been proved to be effective forecasting tool in this field, both total ecological footprint elements and socio-economic factors was simultaneously taken into account, and put forward a series of countermeasures to uphold urban ecosystem in predicting results in application(Zhou., et al. 2007). In the case of Tongchuan city ,the principal components analysis method is applied in calculate value in the correlation ship between seven index referring to socio-economy and ecological footprint pre-capita, and seek to the predominant facyors(Yang and Ren, 2007). The comparison between the innovative PLS method and STIRPAT model were respectively analyzed through recognizing EF's major drivers and identifying the main impact factors of changes in Henan's EF. Thereof, the STIRPAT model, which was originated by Dietz and Rosa, was converted from the widely recognized IPAT that has been used to analyze environmental impacts (Jia et al., 2009). The procedure of analysis has similarly undergone as follows: Firstly, we collected historical (time-series) data to calculate its EF and EC and analyzed the condition of natural resources utilization; Secondly, we used relevent model to analyze EF's major drivers and identified the main influencing factors of changes incalculation; Thirdly, the relevent advices can be made according to analysis.

In conclusion, most studies had focused on the research of unilateral or several aspects' driving factors. A research comprehensively considering almost all of driving factors was still few. On the other hand, most studies had still used some very familar methods. Moreover the prediction made by this method simply take some predominant fatcors in account, and underestimate the correlationship between the subsystems in urban, it is siginificant for combining some effective model(dynamic model) to analysis and predict the varing trend in ecological footprint .

2.3The spatial-temporal dynamic balance of structure or function

The harmony of ecosystem have largely depended on integrity of structure in a complex system, thereof, these different structures or function of complex system have shown distinct features, and the structure and function in urban complex system is always not fixed, and varied in definite period and represented the characteristics spatial-temporal dynamic. Herein ecological carrying capacity is introduced to improve the comprehensive understanding of this system's structure and functions, similarly it is recognized that a certain structure have determined the size of carrying capacity, compared with traditional concept, the urban carrying capacity of the urban ecosystem includes the ability to develop and thus is characterized by being more dynamic. This dynamism shows in the ability of cities to respond when put under pressure and maintain the balance of supply and demand in resource or energy consumption. Clearly, this dynamic is not endless, both environmental, resource and social-economic development capacities have limits. So Through analysis of urban carrying capacity, it is essential for emphasizing spatial-temporal dynamic balance in structure or function to perform the role of carrying capacity. In this section, the spatial-temporal dynamic balance of urban structure and function can be regards as the pre-condition in urban ecological regulation.

The integrity of structure or function in period can ensure the smooth exchange in materials, energy, information, and eliminate the negative influence or response pressure in ecosystem, that equal to remaining effective or open communication between its various subsystems to achieve the sustainable development situation, meantime the structure and function in urban ecosystem can shown the dynamic balance in spatial-temporal and urban carrying capacity can also represented the similar characters. In following, we focus on the spatial-temporal dynamic balance in urban carrying capacity.

Researches on the temporal dynamic in carrying capacity, we mainly focus on ecological footprint, which 'translate' a variety of relevant resources used by a nation, a community, a production process, or an individual into a common unit, namely bioproductive area(Wackernagel and Rees, 1996). So the EF concept has gained much attention in past years. But it seems that the success of EF concept was probably to large extent due to the simplicity of the comparison of EF and EC which indicates a obvious comparison between sustainability and unsustainable ability — even though it is preferred at demonstrating an 'unsustainable' state (=overshoot) to a 'sustainable' one(Wackernagel and Silverstein. 2000). So Rees considered that ecological footprint analysis was not intended to provide a dynamic window on the future, but rather a snapshot in time (Costanza., 2000).

As both socio-economic systems and ecological systems are dynamic and their interaction changes over time, however, time series are much more informative and reasonable for sustainability than 'snapshots (Lenzen and Murray., 2001). Therefore socio-economic factors such as population and economic growth, increases in per-capita consumption, and urbanization influence this dynamic. Without counterbalancing these forces, and their impact on global justice and ecological integrity, humanity may not only be narrowing its options for a sustainable future, but may also be increasing the likelihood of violent confrontations from local unrest. Herein overshoot is a dynamic concept, involving time delays and cumulative effects, time trends are of particular value for documenting human use of natural capital.

Until now, most Ecological Footprint studies have analyzed one or several countries at one point in time. In a time series calculation, the scholars separately applied two methods such as conventional methods and an actual land-use approach to analyze the ecological footprint of Austria, the Philippines, and South Korea for the time period from 1961 to 1999, thereof the 'actual land-use' approach that calculates the physical area occupied for each country's socio-economic metabolism(Wackernagel et al., 2004). Due to the announcement of dynamic equivalence and yield factors, the authors analyze the effect different assumptions respectively by adopting three different yield equivalence such as constant global yield, variable global yield and variable local yield, and present calculations of the ecological footprint (EF) for Austria 1926–1995, therefore, biological productivity essentially determines the outcome of EF calculations, given a certain pattern of socioeconomic metabolism(Haberl et al., 2001). Two indices as the change rate and scissors difference respectively describe quantitatively the development trends of EF and BC and the difference between both trends in a long time series, the index of change rate of EF and BC is examined by a polynomial regression analysis to depict quantitatively the development trends of EF and BC time series, and the index of scissors difference represented the difference between both trends at a point of a long-time series (Yue et al., 2006).

Through aforementioned analysis, it is clear for time series inherently to reveal more about the accounts' sensitivity to different assumptions and the potential for noise in the data than do the single-year calculations which have analyzed in the earlier Ecological Footprint assessments (Haberl. et al., 2001). However, in time series there exist some viewpoints: which kind of yield is selected by measure ecological footprint; and which is the best choice in these; furthermore, discussion in this respect indicates that further work is also needed in order to develop new methods for analyzing the development trend of EF and BC time series in the spatiotemporal dimension, and to give us valid, plausible results and sound advice for policy-making. Although some researchers have keep track of the dynamic variation in urban ecosystem carrying capacity through calculating long time series of ecological footprint values (Wackernagel. et al.,2004; Huang et al., 2007;). However, researches in majority can simply analyze data of each year and then put them into combination, inadequately further explore the inherent principles which can be gotten in the development trend of urban ecosystem carrying capacity. In conclusion, during continuous varying stages in city, there exists relative theoretical threshold of the urban ecosystem carrying capacity, whose scale to some extent can be determined by the strength and rate of ecological stress, so it is appropriate to select the relative capacity method in consideration. Consequently, relative carrying capacity usually regards the ecological carrying capacity as capability, which was predominantly characterized by sing state-space approach or pressure and supporting ability relative comparative trend method (Mao et al, 2003; Xu et al, 2003). So far, a series of methods which put urban ecosystem carrying capacity into dimensionless units include analytic hierarchy process, synthetical index, sustainable development degree approach (Yang and Sui, 2005;) .

2.4. Flowcharts in urban ecological regulation

The urban ecological regulation here is based on urban ecological carrying capacity, which is beneficial for making measure to maintain the integrity of structure and function of urban ecosystem, thereof the integrity can be interpreted as the dynamic balance of spatial-temporal, thereof we mainly focus on the spatial-temporal dynamic balance in ecological carrying capacity on account that the function and structure in system can to large extent determine the size of carrying capacity. then we analyze the characteristics of urban ecological carrying capacity for example threshold or driving factors, it is widely accepted that the problem in city have largely link to the failure of some factors, which definitely determined threshold value in ecological carrying capacity, so two characters can be regarded as the breakthrough point in urban ecological regulation. Herein the objective of regulation is to maintain ecological function and structure stable or health and even to protect urban development in a sustainable circumstance. Subsequently we introduce the concept of ecological security in urban ecosystem, thereof ecological security actually require that to maintain the ecological status must content the need in urban development in current or future, so we can take ecological security as the standard or goal of urban ecological regulation. So we can configure a flowchart that integrated regulation based on carrying capacity and ecological security, the concrete procedure is as follows (figure1). According to the flowchart, there exist two directions that regulate urban ecology based on carrying capacity model: on one hand constraint some human activities can reduce the ecological pressure, and it is essential for focus on the feedback between pressure and carrying capacity, on the other hand optimizing urban form can improve eco-supportive capacity. Through analysis of carrying capacity, this part can be embarked from two aspects: one is enhanced the supportive capability from urban ecological carrying capacity system, the other is improve the utilizing efficiency on urban ecological carrying capacity in socio-economic system.

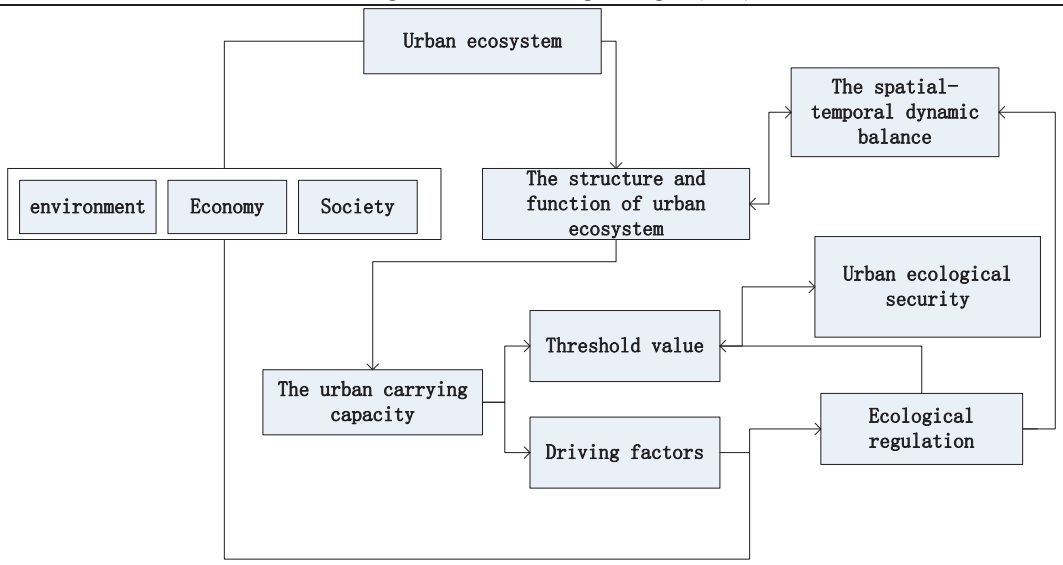

Figure 1 urban ecological regulation based on carrying capacity

3. Discussion

The concept of ecological security was initially proposed by the government of the United States (Ezeonu and Ezeonu, 2000). Since then, although it has been widely considered (Solovjova, 1999; Kullenberg, 2002), there universally have not accepted a uniform definition or configured standard assessment parameters or research methods (Zhao et al., 2006). Traditionally the concept of security denotes safety from injury, harm, or danger, and in most cases it infers no damage to the life, health, property or territory of a region or nation. Many existing and potential problems (economic, ecological and social) are considered within problems of security, simultaneously ecological security has linked with national security, economic security and human well-being. In urban field, so much research on ecological security have focus on temporally dynamic and spatial structure. Moreover ecological security is a priority in acceptable urban development scheme, thereof their resulting cumulative impacts and their associated forcing factors in urban development have become important viewpoint in planning and urbanization research (Batty and Xie, 1994;). In conclusion, ecological security theory informs us that the internal structure of ecosystems is logical and stable and that the service function of ecosystems is positive and tends towards health (Liao et al., 2004), in actuality, ecological security is typically complex processes, and is influenced by the integrity of structure and function. Thus, carrying capacity maybe particularly suitable for assessing ecological security, but there are seemingly no prior applications than carrying capacity for the valuation of ecological security.

Ecological security have an intimate linkage with ecological carrying capacity, if the intensity of impacts in human system can eliminated by ecological carrying capacity and the ecosystem has adequate resilience to external influences, so ecosystem can be viewed as stable, healthy and sustainable, namely the ecological status is security, contrary, if the ecosystem lack resilience to external pressure, the state of ecosystem is unstable, unhealthy, simultaneously the ecological is unsafe. based on analysis of relationship between each other, in highly intricate, and rapidly varied system, forecasting for the changes and regulating impacts internal to urban carrying capacity are necessary in order to conduct the required scientific assessment for correctly assessing ecological security, as well as ensuring the proper management of urban ecosystem. Moreover, there emerged a definite amount methods that applied carrying capacity to assess the ecological security, herein we can categorize the assessing methods into two patterns: the one mainly applied the mathematical methods in assessment, which is based on the establishment of index system and development of a mathematical model, has gradually become a valid tool in the assessment and management of ecological security (Campbell and Bartell, 1998). This method is further applied at the levels of individuals, communities, and even whole ecosystems (Campbell and Bartell, 1998;). Subsequently, the second category is the ecological model, there have been a few studies on ecosystem and early warning systems that have employed different models to describe the dynamics of biological and environmental elements involved in ecological security (Huang et al., 2005,). So the ecological security can be viewed as the objective of ecological regulation.

With purpose that achieving the sustainable development in urban ecological zone, it is essential for adapting relevant measures to regulate the way, strength and speed of economic development activities, which depends on the status of urban structure or function and its driving factors. The size of urban carrying capacity have largely linkage with the driving factors from

perspective supportive or constraint, thus whose size is closely related to the advancement of technology, the way in regional economic activities and external factors in other regions. There often exists intimate correlation between the regions, obvious so many factors outside the region will also affect the size of urban ecological carrying capacity.

It is necessary for regulating urban ecology to make relevant measures according to driving factors in analysis. The driving factors in analysis can be classified as follow technology, human activities and external factors, and we can carry out ecological regulation from following aspects. Firstly the progress in technology and the advancement in management to some extent enhance urban ecological carrying capacity, and which enhance utilizing efficiency of resources and decrease the impact of human activities. The advancement of technology have played important role in urban ecological regulation. Moreover adjusting human activities can improve the urban ecological carrying capacity, on a certain technical level or environmental status, the size of urban ecological carrying capacity is differ by diverse human activities, so adjust the industrial structure and the reasonable layout of industry can improve the regional environmental capacity, otherwise its size can have linkage with people's living level and the style in human consumption. Controlling internal or external factors can affect urban ecological carrying capacity, on one hand, the natural or artificial environment largely determines urban ecological carrying capacity, for example on the other hand, human activities in human activities also have an intimate relationship with this zone, mobilizing useful factors such as the resources and energy import in exterior can increase the capacity in ecosystem. Furthermore feedback in ecosystem also can be another keypoint, the feedback in processes mainly from three aspects: social, economic development and ecological environment, which is in accordance with the driving factors in aforementioned analysis. From perspective of supportive or constraint, the feedback in regulation can be divided into negative feedback adjustment and positive feedback adjustment, herein, negative feedback adjustment can maintain balance and stability in complex system, whose weakness leak to stagnation of the system, but the positive feedback can break the original status, from stable to unstable, acts as the bridge from one state to another state in system. Thereof we can be acquire the information of feedback to carry out urban ecological regulation. In total, there exist two directions that regulate urban ecology, on one hand constraint some human activities can reduce the ecological pressure, and it is essential for focus on the feedback between pressure and carrying capacity, on the other hand optimizing urban form can improve eco-supportive capacity, through analysis of carrying capacity, this part can be embarked from two aspects: one is enhanced the supportive capability from urban ecological carrying capacity system, the other is improve the utilizing efficiency on urban ecological carrying capacity in socio-economic system.

4. Conclusion

As we have known, the researches on urban ecological regulation traditionally is based on relevant theories, the method applied in regulation always is qualitative but lack quantitative. However carrying capacity assessing methods has become an effective approach to measure urban sustainable development by comparing the supportive ability with the pressure in urban, it is applicable to use the method to advance urban ecological regulation. The ecological security can be acted as the goal or objective of urban ecological, although Ecological security includes many aspects, for example, the security of biology and environment, between biology and between human and ecosystem, etc. the connotation in study was reconsider a status in urban ecosystem which indicates the state is not declined and is positive. However the task of integrating early warning and ecological forecasting systems for urban development and management, especially those of rapid urbanization and industrialization, poses a new challenge for urban planners and managers. So we must emphasize the temporal dynamic and the role of different key factors in long period, but there need extraordinary efforts to focus on this point. In addition, urban acts as a complex system, it is heuristic for collecting multi-disciplinary knowledge and systems analysis methods to establish multi-hierarchy and dynamic model in urban ecological adjustment.

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