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Evolution of the forest's attributes and matching policy

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Abstract Due to the embarrassment that may occur from trying to define the forest in the present situation, this paper gives a new approach through the functional analysis of the forest rather than a simple physical description. Here, the forest is now actually the result of natural and social work. The forest has provided the environment, the economic resources and the infrastructure, respectively, and for now, the forest appears as a structured body and takes responsibility in modern human society. With its characteristics of varied hierarchical structure, limited functions, an open system, a dynamic system, moderate mould ability, varied stable equilibrium, etc., it is suggested that the related matching policy on forests should be updated as follows: to define the forest in its entirety, to specialize the public management, to diversify the management objectives, and to cultivate the forest as a continuous procedure. From the experiences of developed countries, we establish a new state-owned forest system.

Keywords forest, attribute, infrastructure, evolution, matching policy

1 Introduction

The development of human society in deconstruction and reconstruction has exerted great influence on existing forests. The modern science of research on forest functions is continuously altering recognition of the forest. All these lead to a substantial impact on the concept of forest from both traditional academic significance and legal significance. According to the statistics of researchers, there are hundreds of definitions of forest all over the world, from the views of the academe, law, and society (Zhao, 2002). None of them, however, can give a comprehensive summary of the attributes and connotations of a forest. The mass appearance of forests with non-completely

natural meaning gives an indistinct acquaintance on forest management, which gives rise to the fierce conflict on both practical and theoretical levels. There will come a series of errors if we take only the natural process as the research target, which will lead to an erroneous impact on the effective management and use of forests.

The integrity and accuracy of the recognition of forests is the significant basic theoretical problem concerning the modern forest, which determines modern forest management. Therefore, re-recognition of the modern forest seems rather necessary and urgent. However, due to the massive difference in recognition level, there exists great difficulty in recognition of the forest through traditional methods such as induction and description, which also tend to produce a rigid and one-sided recognition of forests. The author believes that the current approach to forest recognition is from the perspective of functional attributes. This paper attempts to analyze the evolution of forest attributes historically, from which several substantial characteristics can be revealed. In addition, countermeasures and suggestions on forest management policy adjustment are proposed based on these characteristics.

2 Background of the study: historical evolution of forest attributes

The modern forest, to a great extent, is the result of the interaction between nature and society. The evolutionary process of forests has changed from the prehistorical natural process to the complex process of nature-economy-society. To be exact, the modern forest is the reconstructed forest after socialization, and there is obvious socialization reconstruction of forests in China. China is a country with several thousand years of civilized history, which includes natural ecological systems being affected over a long period and repetition by traditional agricultural activities. Great changes have taken place in China in the aspects of population, economy, politics, and culture as a result of the impact of modern western industrial civilization, which is a historical change that had never happened in 3000 years. In the last 50 years, China has gone into a period of rapid population increase, economic growth, and drastic social

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change, and the general economy shows extensive development. The change of the social economic status in China has exerted deep influence on the natural ecological system, including the forests. On a global scale, forests, even the whole of nature, have been experiencing this changing process. Thus, the scholar regards the geologic time after the quaternary period as "the age of man". According to the United Nations (UN) assessment report on global forest resources (FAO, 2006), there are only 13×10^8 hm² of forest area that have not been heavily disturbed by human activity and local species, with 45% distributed in South America, 23.3% in North America and Central America, 19.7% in Russia, and 12% in other areas. The disturbance mentioned is the direct effect, because there is no pure land if the indirect effects like pollution and climate change are taken into consideration. Meanwhile, large numbers of plantations, as well as forest forms and patterns with specific functions, appear on the earth. In addition, human migration of the species has reached an unprecedented level.

There is a clear trace of the evolution of forest attributes considered under the process of social transformation, although forests have been totally changed by human disturbances for thousands of years. From ancient times to present society, forest attributes have gone through the evolutionary process relating to environment, resources and infrastructure.

2.1 Environmental attributes

For a long period, from the birth of humans to the agricultural period, the forest was an environmental factor to human beings, namely a matrix in landscape ecology. According to historical research (Ma et al., 1997), forest cover in China reached over 60% in 2000 B.C. That is to say, the cover could be 10% to 15% in the most drought-stricken area of Xinjiang, which was far higher than the cover now. The forest remained good until the spring and autumn and warring stage period.

Agricultural development should be the main reason for early forest degeneration in Chinese history. Deforestation was carried out in large scale in order to acquire the cropland and lessen the disturbance of forests to agriculture. The activity consisted of trying to change forests into cropland and separate forest from agricultural land and villages, the primary measure in the development of agriculture. In recent years, due to the enforcement of ecological protection measures concerning the conversion of cropland to forest, the seizure of firearms, and the protection of game, the problem of cropland damaged by wildlife has appeared in some mountainous areas. In fact, it is the problem encountered by human beings in history regarding the conflict between agricultural activity and the forest environment. From the American immigration to the period before 1900, there are many records regarding the

burning of flourishing forests in North America to explore croplands (Williams, 2000). In the Daxinganling region of Northeastern China, due to the maintenance of hunting, no place was largely disturbed until the large deforestation area set up in this region after the founding of China.

In general, there was low-density and concentrated population at that time, with the forest disturbance area concentrated in the plain area and the bank of the river in proximity to the center of politics and economy. The forest remained the main environmental factor in the remote mountainous area. When the forest is seen in the form of environmental attributes, the main disturbances are fire and natural succession, and the human disturbances are pioneering and cutting in the proximity to residential areas, without health problems (Wei, 2006).

2.2 Resource attributes

From the late period of agricultural society to the middle and late period of industrial society, the forest was considered as a kind of resource, with the main functions of providing timber, construction materials, fuel, and forest chemical products. During the period of late middle ages and early industrial age, the forest was treated as a "crop" to be managed, which was an important financial source of the European Royalty. The so-called science forestry appeared at that time (Scott, 1998) and the normal forest model came from the accurate control of forest growth at that time. In the early immigration of 300 years ago in America, energy resources, construction materials, even many tools came from the forest, and the people felled the woods without control. During the 50 years since 1949, China has taken the forest as an important resource for economic construction (Lei, 2005). The cause of forest disturbance in the Badalin Region in Beijing was the construction of the Great Wall and the palaces, and fuel and wood provision for the military. In the late Qing Dynasty, masses of wood were used to build the Jingzhang Railway. In the view of forestlands, the attribute of forests was still obvious, that is to say, the timber forests took the role of wood resources provision.

It was the time when the forests were destroyed most seriously, especially after the period of improvement of cutting tools. Due to the excessive felling, the forest patterns of America changed a lot in 1900, with the whole felling of forests in the northern part of the country, and there came a series of environmental problems like floods and sandstorms, some of which severely threatened the people's health in the center of the country. As the severity of the problem was realized, the forest guard service was established in the Agriculture Ministry in 1905 to pay attention to the protection and recovery of forests.

The attributes of forests are the most important symbols of the formation concerning traditional forestry. At present, resource attributes can be found in most of the forest

recovery, management, investigation and monitoring, felling and utility, even the social recognition. In addition, great conventional thinking has formed.

2.3 Infrastructure attributes

In 1984, ecological infrastructure first appeared in the “Man and Biosphere Program” proposed by UNESCO. What is more, it became one of the five principles of ecological city plans. The so-called ecological infrastructure means the ability of natural ecological systems like forest ecological systems, nature reserves, and wetlands to provide for the ecological service and its persistence (Liu et al., 2005). After the period of western developed countries coming into the post-industry era, the attributes of infrastructure (Gao and Jin, 2007) began to appear. The theoretical symbol was the formation of some theories and concepts like differentiated forestry theory and classified management, studies on the ecological service function, recovery ecology, as well as bio-diversity protection. There were the division of commercial forest and ecological forest, the appearance of great development concerning plantation forest, nature reserves, species protection, protection forest, and wetland in the aspect of practice. The world began to realize that forest ecological systems alike have become a new kind of infrastructure, called the ecological infrastructure, besides the traditional type in modern society. Further assessment was discussed in the Millennium Ecosystem Assessment by the UN, in which the service functions of the ecological system were classified into four types: supply service (providing food and water), adjustment service (flood control and diseases control), culture service (benefits of spirits, entertainment and culture), and support service (maintenance of element recycling regarding the living environment for life on the earth). That is to say, the ecological system as the ecological infrastructure provides society with public products and services. At present, the concept of the ecological infrastructure has gone into each aspect of social production practice, and it has become an important part of infrastructure construction in modern society. The detailed contents include that positive measures should be taken to recover and reconstruct the forest ecological system which is fit for living by human beings, with essential ecological service functions, like the construction of urban forests, determination of water reserves, construction of the forest protection system, forest park, protection of forest ecological system and wetlands.

At present, global society has begun to have a common sense on the infrastructure attributes of forests. In 1997, Costanza et al. (1997) took various technical economic methods to estimate the service values of forest ecological systems alike, which provided direct theoretical support for the ecological infrastructure. The description of the infrastructure attributes concerning the forest began to be

clear after several forestry conferences. The theme of the 10th Forestry Conference was the forest as future heritage (Shi, 2004). The priority topic focused on the ecological benefits of the forest, such as control of the greenhouse effect, water and soil conservation, bio-diversity protection, and development of rural areas. In this conference, forest functions were promoted to the level of probability of influencing human life and the earth’s future. In 1997, the 11th Conference in Turkey passed the “Antalya Declaration” and it pointed out that various types of forests not only provide the people with important social, economic, and environmental products and services, but also make a great contribution to food supply, water and air purification, and soil conservation. Further explanation was made in the aspect of the infrastructure attributes of forests. In the recent 12th Conference held in Quebec, Canada, the theme was the forest as life’s source, and there were three topics: human beings’ forests, the earth’s forests, and harmony of humans and forest (Ma, 2006). The core and essence of the three topics were analyzed, and the following was determined: positioning of the forest as an important infrastructure in human society and economic development, in the operation of the earth’s ecological systems, and in the management of society and forests. The ecological infrastructure of forests shows typical manifestation in China. The functions of the forest were concluded as ecological products, cultural products, and economic products by the National Forestry Bureau recently (Jia, 2006), which further explained the increasing emergence of the basic function of the forest in the development of modern society. In addition, it was the best proof of the infrastructure attributes concerning forests in the view of functions. The infrastructure attributes of forests have some difference with the traditional infrastructure, such as the biomaterial structure of the main body and diversity of land right. However, they did not affect its basic positioning as the infrastructure of modern society. In essence, the infrastructure attribute of forests is taken from the environmental attribute. It gets the public’s concern because of its scarcity.

The forest has the matrix characteristics of landscape ecology in a certain scale range, but it shows great infrastructure characteristics in a large scale in the view of function positioning. For example, the forest coverage of Badaling Area of Beijing has reached 60.7%, and it shows matrix characteristics from the landscape view. However, the infrastructure value will be shown with no doubts if the area is taken as the landscape conservation of the Great Wall, as well as the place for the ecotourism of citizens in Beijing. It is the inevitable result of the change and relative stability regarding the spatial geographical pattern of the forest and human beings. There will be no significant influential value of the succession of patterns of ecosystems without the existence of human society. In addition, the natural ecological process demonstrated by the matrix

is replaced by the integrity and security of the forest landscape conservation considering the forest health to some extent.

The infrastructure attribute of forests has begun to get the concern of the government, academic organs, and the public to some extent. In recent years, the relative governments proposed that the shrubs belong to the part of the forest (Zhu, 2003), adjustment of the lowest standard of the canopy density of forestlands, and discussion on the life infrastructure (Li, 2008), which is a recognition of the infrastructure attribute of forests from the objective view. However, there is no concerted recognition on the issues of advantages and disadvantages of plantation forests, and the boundaries of forest and plateau. Apart from the factor of benefits, there is great difference in society on the recognition of forest.

3 Contents of the study: several features of the forest in the modern significance

The analysis of the evolution of forest attributes is actually an examination of the public and social recognition of the forest boundaries in the level of form and function regarding the forest existence. It is easy to find that the forest with the infrastructure attribute shows certain functional structure in the spatial and functional pattern of modern society. Even when considering the individual trees, the boundaries not only mean the forest and its relied land, but also include the environmental influence produced by trees, even the complex system constructed by humans, properties, and the relative legal system and social culture. It is also the case in a larger scale with more complex problems. The great change of the intention and extension of forest leads to the great challenge of the nature and integrity of the forest ecosystem with the traditional significance in both theory and practice. The forest with modern significance carries the obvious universal forest meaning, compared with the academic and legal definition of the traditional one. It has six features.

3.1 Multi-level structure

In the discussion of forest issues, the concept of multi-level forests should be confronted. Apart from the natural attributes of the forest, like the natural geographical distribution, arbor and shrub species, it is necessary to see the forest from other views. That is to say, in the view of spatial scale, there is the division of forest, forest sites, forest ecosystem, forest landscape, regional forest; in the view of forest origin, there is the difference among the plantation forest, the natural forest, and the virgin forest; in the view of functional type, there is the difference between the public forest and the commercial forest. In addition, there is the age difference among the young forest, the medium forest, and the mature forest.

There are various functions with various levels and structures. In discussions of the forest, different researchers and benefactors have certain differences and uncertainties, which always leads to the unconcerted recognition.

3.2 Functional diversity and limitation

There is no doubt of the functional diversity of the forest, but more attention should be paid to the limitation of certain functions. That is to say, there are certain special functions under some conditions. It is impossible to require the full implementation of the virgin forest, non-disturbance forest, as well as the solution to all the regional ecological problems. The reflection of the sandstorm phenomenon, the ice and freeze damage in the beginning of the year 2008, and the destruction of the natural secondary forest in the high-height region all can fully demonstrate the above problem.

3.3 Openness of the system

Whether the simple forest structure is composed of the pure forest with the same age, or the complex structure of the multi-level with various age levels, the functional structures of forests have much to do with their living environment. It ranges from air to light, or from soil to water, or from non-organism to organism, or from spatial pattern to chemical process, even the bioprocess, and all the above have multi-level and multi-orientation relationships, with great uncertainty and non-prediction, which is an important challenge in the study of forest health. The openness of the system makes the forest differ much from the traditional infrastructure types. The boundary of the forest in the modern meaning is fuzzy, depending on the temporal and spatial scale of the referred issues.

3.4 Dynamics of the system

The forest is a dynamic system composed of organisms, non-organisms, and ecological processes. Due to the different origins of the system, different environments, and various disturbances, there may be differences in the operation route. In the process of operation, the components and structure of the system may change. Each state of the forest is a response to natural and human disturbances. Under the condition of the short-term and relatively stable natural environment, it is mainly demonstrated as the result of conscious or non-conscious human disturbances. The possibility of the change should be recognized in modern society, and excessive change should be prevented too.

3.5 Moderate plasticity

The traditional forest mainly manifests as a natural phenomenon, while the forest with the modern meaning has become a phenomenon influenced by both humankind

and nature, showing certain plasticity and reconstruction. For example, in the management of the plantation forest, change of species, density, and management plans are commonly used. In the investigation of the farm-protection forest of the Aksu Region of Xinjiang, the first generation of farm-forest net took the method of poplar trimming that promoted branching, considering the needs of flood resistance to fortify the banks, and the branches provision. The growth state and the protection effect were both good. As for the regional forest, species components and spatial pattern would change due to human disturbance. According to the study of Ma et al. (2005), the ecological public forest in Beijing is mainly the plantation forest built by way of stock planting and sowing after the founding of the new China. It gets 63.6% occupation of the total area, while the natural secondary forest only takes 36.4%, which recovered by wild seeding and sprout regeneration. There is a difference between the percentage of the main dominant species and the type of zonal vegetation population, which is also not the same as the process of natural succession. Due to the close relationship between the structures and functions of the forest and its state, the study of the forest with the modern meaning should pay great attention to the moderate plasticity issue. The natural zonal distribution and the forest species and the structures at the climax community are not the absolute reference standard of the forest silviculture, as well as the ecological public forest.

3.6 Multistability

The relative study has shown that there exists diversity in the climax community of the same zonal vegetation (Xu, 2004). That is to say, as a dynamic system, the forest has the feature of multistability. To large extent, the study of forest health includes both the quantity and the quality of the changing forest, instead of the natural forest under little human disturbance. In addition, the complexity of the problem is reinforced more with the appearance of massive introduced species and cultivated species in the cross-regions of the forest species. Out of the limitation of the subjective recognition or the objective conditions, the influence on the forest landscape ecological pattern cannot get an accurate assessment in the short term. However, the stable artificial landscape built by the traditional agricultural landscape provides some reference enlightenment more or less. To some extent, it can reduce the excessive rebuke of the plantation forest. What is more, if the coordinated interaction between forest resources and economic and social development can be done, there will be great theoretical and social significance in the win-win for people's wealth and forest development. Take the camellia development, for example. If 3.35×10^6 hm² of camellia forest can be reconstructed, there will be promotion from 5 to 50 kg per unit yield. That is equal to the replacement of 1 hm² rapeseed by 1 hm² camellias,

reducing the pressure from importing edible oil from abroad and improving the product structure of the edible oil. Proper management can maintain the stable state of the forest landscape and the function of the natural systems.

4 Conclusions and suggestions

The forest with modern significance is a product of the interaction of nature, the economy, and society. At present, the forest should not be considered just as a pure natural phenomenon when doing a study on it. The positioning of forest attributes should be changed in modern society, and the forest should be studied, recovered, and managed on the basis of the positioning of the infrastructure attributes. In addition, management policy should be adjusted accordingly. Five adjustment suggestions are proposed.

First, the integrity of the forest should be recognized. An important aspect of forest recognition in modern society is to extend the concept of the forest. That is to say, the forest is based on the infrastructure, instead of timber production. As for the range of forests, the management of the forest ecosystem should gradually replace the management of forestland. In addition, the integrity of the natural ecosystem, including forest, wetland, plateau and desert, should be considered in the future.

Second, the administration should be specialized. The complexity of forest management with modern significance should be fully recognized, avoiding the simple and short-term management. In the specific work of forest management, both the academic results and the limitation should be taken into account, broadening the professional sense and the ability of macroscopic and dialectical thinking. Not only should the public-oriented single forestry index problem, like forest coverage and volume, be solved at present, but more indexes concerning the forest state, like the forest health, should also be provided for the public.

Third, management goals should be diversified. The dynamism and diversity of the forest determines the large difference between forest management and the production of industrial products, the traditional infrastructure management as well. In forest management, adaptation to local conditions is a basic principle. It will be harmful to forest production and management if industrial standards alike are emphasized to be used.

Fourth, the management process should be successive. The positioning of the infrastructure attribute of the forest is beneficial to alter the people's wrong idea of planting trees without forest management.

Fifth, the location should be nationalized. On the basis of the division of the ecological functions, the state should take the way of redemption to buy the forest with important ecological locations, bringing it into the state-owned forest system. There is experience from developed countries like the USA worth learning in this issue. Meanwhile, in the

reform of the current collective forest property system launched in South China, the overall consideration should be made in the dispersion and concentration of the forest property. The forest owned by individuals should be guided to go the way of cooperative management gradually.

The stated opinions above partially or wholly fit ecosystems like wetlands, plateaus, and deserts.

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