WATERSHED ECOLOGY AND STUDIES ON FORESTED WATERSHED IN CHANGBAI MOUNTAIN

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Abstract

Taking watershed as research unit, watershed ecology is the discipline studying on structure and function of the complex ecosystem and resources and environments protection in the watershed. Its aim is to provide theoretical foundation for reasonable decision-making of exploitation and usage of the land and waters in the watershed so that economic and social sustainable development of watershed could be realized. Watershed ecology is an appropriate approach to researches and applications of regional ecology, and it is also a significant way to economic and social sustainable development of watershed, so it is necessary to develop systematic research on watershed ecology as soon as possible. Relative studies on forest watershed of Erdaobaihe in Changbai Mountain have been carried out by the Changbai Mountain Forest Ecosystem Open Research Station since 1998. The main researches include: structures and patterns of forested watershed complex ecosystem, influence of fall wood and litter of stream in stream ecosystem, function and management of riparian zone, processes of energy and material flow in the forested watershed and so on.

Key words Changbai Mountain, ecosystem, watershed, watershed ecology

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Watershed is catchment area of a river (or water system) which obtain the water supply from this area. At same time, it is a comprehensive social-economic-natural system which divided into three parts that watershed ecosystem, economic system, and social system, and its basic elements include population, environment, resource, material, capital, science and technology, policy and decision-making and so on. An open system named as watershed comprehensive system is formed by the mentioned elements. People increasingly attach importance to watershed and its economic exploitation owing to being a special area of continual exchange of material and energy.

Taking watershed as study object, and using the theory of modern ecology and method of system science, the laws of material, energy, and information circling in the upland, riparian, and waters are the main study contents of watershed ecology. Based on the studies on the structure and function of watershed ecosystem, the farther research contents are protection, exploitation, and utilization of resources and resolving environmental pollution. The target of watershed ecology research is to provide theoretical base about reasonable exploitation and utilization of land and waters in the watershed, and contribute to the sustainable development of social economy.

Watershed ecology is the optimum approach to research and application of region ecology. It incarnates intersection and unity of researches on land ecosystem and freshwater ecosystem, and makes up the shortcoming, which means separation of studies on land ecosystem and freshwater ecosystem. Hydrology, limnology, ecosystem ecology, and science of soil and water conservation are knowledge source of watershed ecology.

The former research on water or water resources are more aimed at water or water ecosystem, and water ecosystem has frangibility because of its accepting easily the effect from neighbor land area near bank. Otherwise, water is always an important ecological factor in land ecosystem. So, it's very necessary, taking watershed as a compound ecosystem, uniting the researches on water ecosystem and land ecosystem, to develop the study on watershed ecology and its’ management in the theory and the practice. Taking the watershed as research unit, and applying theories of modern ecology and methods of system science, Watershed Ecology research the upland, riparian and water in the watershed and the law of material cycle, energy flow and information transmission between each subsystem. Basing on the
study on the structure and function of watershed considered a compound ecosystem, more studies should be carried out on the development, utilization and protection of various resources and relative environment problems in the watershed at middle and great scales, to provide the theoretical foundation for rational development decision-making of land and water in the watershed and to contribute the sustainable development of social economy in this region. The main character of watershed ecology lies on the combination of water and land ecosystem and the emphasis on comprehensive development and harnessing for watershed, and its’ core is the management of watershed ecology.

Basing on the management of ecosystem, and considering the whole watershed, utilizing and protecting various resources in watershed rationally, Management of watershed ecosystem should come true the maximal comprehensive benefit of the whole watershed and the final goal of its’ sustainable development of social economy. Taking on the definite management action driven by sustainable goal and ensured to carry it into execution by policy, agreements and practice, management of watershed ecology should study the necessary ecological reciprocity maintaining the composing, structure and function of watershed ecosystem, and ecological process to improve on the aptness of management increasingly.

Nature subsystem is the base of the watershed compound ecosystem, which predicate the management of social and economical system must base on the nature ecosystem in the management of watershed ecosystem. They are not divided completely, those considered factors and goals in the management of nature subsystem should involve a great of social and economical factors; and the management of social and economical system can not develop without the management of nature system. So, we should put the study emphasis on the watershed ecosystem management of nature system.

As for the nature ecosystem of watershed, some principles need to be followed in its management, structure and function, energy flow, succession, information exchange, complexity, grade, dynamic equilibrium, self-organization and self-comparability, and the last five is its’ main characters.

Watershed has definite boundary in the geography, which shows the limitation in some sense; and, watershed is an open system undoubtedly, and makes the consanguineous contact and
interchange with outside. Material and energy contacts exist in the various scales and the whole structure of watershed has been made of each scale owing to those contacts. Influence on lower scale will make effect on the whole of watershed; the part control on it will adjust the whole of watershed in a certain extent. For example, the development of watershed will always lead the citied watershed, which should produce far-reaching effect on the watershed and its’ parts. That changing the shed and slope into barren area will affect material flow such as the pathway flow and air flow, and also the fixation and translation of energy flow, and make watershed series changes finally; some can be forecasted in those changes, and some go beyond human’ cognition. Hence, definite adjustment will be made on the whole watershed by means of the control over each part of watershed according to its natural antitype, and rational implement of ecological construct project, and the part control. Of course, the stability of whole watershed will decrease because of part ecological construct project without holistic harmony. Therefore, comprehensive advisement, holistic harmony and implement under various scales should appear in the management of watershed nature ecosystem.

The actuality and advance in China can be concluded as follows:

1. Science and technology reserve and practice of some ten years; such as some tasks of CAS in Yangtse Rive and some typical watershed.

2. Practice and achievements of soil and water conservation and small watershed harness is different with research and its management of watershed ecosystem; science system of soil and water conservation generally belongs to soil preservation, agrology or geography, basing on soil erosion, taking prevention and cure of soil and water losses and its benefit as core; but the intercross and combination of water and land ecosystem is taken as the core of watershed ecosystem research which belong to category of ecology and the combination of ecology and geography, and the relationship and comprehensive model and its regulation of water and land ecosystem is the base. Owing to the development of science at the present time and concrete discipline, the research and management of watershed ecosystem are closely related with soil and water conservation.

3. Researches and management on watershed ecosystem are consistent to the ecosystem management based on certain region, and some regional ecology researches were done in China.

4. Researches on watershed ecology has been advanced and carried out. In China, some scientific institutes such as Institute of Applied Ecology, Institute of hydrobiology have
done some studies.

The concrete content of watershed ecology study includes:

1. Compound model of land and water in watershed and reciprocity mechanism and process of land and water ecosystem;
2. Biology geochemistry process of representative biological elements (C,N,S,P et.al.) in concrete or typical watershed;
3. Spatial structure and heterogeneity of watershed and the change and management of its landscape pattern after been disturbed;
4. Structure and function of riparian, management of riparian and its effect on neighbor land and water ecosystem, such as the study on in-stream fallen wood is an significative aspect;
5. Restoration and management of degraded watershed ecosystem, the study on non-spot fountain pollution and non-agriculture endanger in watershed;
6. Biodiversity of watershed and its function, the evaluation and conservation of watershed biodiversity;
7. Comprehensive evaluation index system of watershed, environment effect and benefit accounting of land and water resources in watershed;
8. Digitizing some representative watershed.

The intercross, infiltration and combination of multi-discipline and various specialties are need to tackle key problem in the study of watershed ecology, which should belong to the category of long-term ecosystem study. Its development should be the process that employ many persons, use greatly and last long time, So, preparation need be set about as soon as possible to develop systematically at an early date and to establish the predominance in this region. For the nation, the combination of supporting poor with science, renovation of forested watershed and harness of environment should be considered, and eco-network in existence can be taken full advantage of to develop the research of watershed ecology in the whole nation. The emphasis of tasks in the near future is to select some representational middling scale watershed, and to organize common collaboration of some correlative research units or individual to develop the study of watershed ecology.

The related research named "Synthetical study on scale, pattern and process of the forested watershed ecosystem" is carrying out in Changbaishan forested watershed. This program is supported by National Natural Science Foundation of China (NSFC39970123) and Changbai
Mountain opened research station. This research is taking Erdaobaihe Watershed, which is in the Changbai Mountain Area, as research object. Some ecological factors and their fractal character will be studied by using principles and methods of landscape ecology and ecosystems ecology, and some technique measures such as remote-sense and GIS, and nonlinear science such as fractal would also be used. Process and pattern will be studied under different scales to synthesize and develop the related methods and theories, and the principles of watershed ecology will be discussed and summarized by compare studying on construction and functions of watershed ecosystem under different scales. This research incarnates the intercross of studying on land and water ecosystem, emphasizes innovation of theory, and develops a new discipline. In the near recent, the research contains:

1. Structures and patterns of forested watershed complex ecosystem;
2. Influence of fall wood and litter of stream in stream ecosystem;
3. Function and management of riparian zone;
4. Processes of energy and material flow in the forested watershed.