

THE DIALECTICAL UNITY OF THE UTILIZATION OF PLANT RESOURCES AND THE CONSERVATION OF BIODIVERSITY

— WITH A SPECIAL REFERENCE TO THE UTILIZATION IN WESTERN HUNAN TUJIA AND MIAO NATIONALITIES AUTONOMOUS PREFECTURE

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Abstract The paper expounds the concept, category, characters of plant resources. The main contents of biodiversity and its significance were introduced. The favorable and unfavorable conditions in use of plant resources in Western Hunan Autonomous Prefecture of Tujia and Miao Nationalities were discussed. The authors put forward the proposals for sustainable use of plant resources. At present, it should be emphasized to adjust the relationship of the utilization of plant resources and the conservation of biodiversity.

Key words Plant resources; Biodiversity; Utilization; Conservation; Dialectical relationship

1 The concept, category and characters of plant resources

1.1 The concept, category of plant resources

Plant resource means all the useful plants, that is, the sum total of living plants which can be used by mankind. They includes the higher plants with archegoniums and lower plants without archegoniums, among them the green plants (especially green higher plants) are ecologically primary productivity on which other living organisms depend for their survival.

1.2 Main characters of plant resources

Because of their special characteristics biological resources differ from other natural resources and occupy a central position in ecosystems. Green plants are imbued with all the following five characters of plant resources and other living organisms with only four ones of them but not the last one.

Diversity

The diversity of plants in the world is very rich. So far there has been about 270,000 higher plants known to us. They occur in all parts of the world, tropics, subtropics, temperate zone and frigid zone. As for one species, it forms its various populations and genetic

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diversity because of variation in its genes and the effects of changes in environment. The primary attribute of the plant diversity in the ecosystem determines other diversity in the same ecosystem.

Regeneration

The capacity of regeneration is an essential distinction of biological resources from other natural resources, or non-biological ones. According to the feature, man should first conserve the reproductive capacity of biological resources in order to attain the goal to utilize them forever.

Regionality

Every species of living organisms has its definite area, large or small. Distributions of plants are strict in definite region. For example, only in humid tropics can rubber tree (*Hevea brasiliensis*), cacao tree (*Theobroma cacao*) occur; only in arid tropics can alligator pear (*Persea americana*) be distributed; only to alpine regions can tundra fritillary (*Fritillaria cirrhosa*), Chinese goldthread (*Coptis chinensis*) be adapted.

Disintegration

In the populations of a living organism, there are genes of the species carrying its the genetic information. Thus any individual of species can not represent the gene pool of that taxon. However, when the numbers of the individuals of the population are reduced to a minimum, the gene pool of the species might be in danger of being lost, and then the extinction of the species will be inevitable. In a biological community, the disintegration of one plant will bring about the extinction of 20—30 other living organisms (P. Raven, 1976).

Community

Every living organism does not exist alone in the world, but live together with other species so as to form biological community. There are interactions between living organisms and surroundings. Living organisms are restricted by surrounding factors, otherwise impact the factors. The role of plants is very obvious. Most of organic materials in soil is the outcome of plants. Vegetation (especially forests) consisting of plants has the function of conservation of water and soil and regulating the climate. This function is especially important to agriculture production and the stability of environments.

Energy Transformation

Among biological resources, plant resources is of a unique style, i. e., directly utilizing the solar energy and then transferring it into chemical energy, which is stored in the all kind of tissues and is released or changed into heat energy under some conditions. Some of photosynthetically autotrophic micro-organisms also have such function.

In the course of utilization of biological resources, we should pay great attention to these five characters, if so, we can formulate a truly rational policy in order to make the biodiversity good for man, and at the same time make them live forever in our globe.

2 The content and significance of biodiversity

2.1 The definition and essence of biodiversity

Biodiversity or biological diversity refers to the variety of life forms of flora and fauna, i. e. living organisms themselves and the diversity and variability of the ecological complex which living organisms depend on for their survival. In exact sense, biodiversity is the sum total of the biological species, genetic variations within every species and their living environment, including all the species of living organisms, all the genes and all the ecosystems they associated with. Presently, about 1.4 million living species of organisms in the world have been described but the total is estimated to excess 5 million (Wilson, 1988). The major habitats and high richness of species are found mainly in tropical areas.

Biodiversity is one of the basic features of living organisms. Like reproductivity, evolution and sociability, it is evolved from and advanced than its parent inorganic world. So the differentiation of living organisms into plants, animals, microorganisms and human beings is the natural results of living materials in the process of evolution.

2.2 The different levels of biodiversity

We may realize and arrange biodiversity both microscopically and macroscopically into 5 levels; ecosystem diversity, community diversity, species diversity, cytological diversity and gene diversity. Among them, species diversity is regarded as the most important and basic one, in concrete and substantial sense. They are the material expression of biodiversity and the material basis for the existence of mankind.

2.3 The relationship between man and biodiversity

Biological resources are the most important material expression of biodiversity, which are evaluated to supply food, medicine, raw and processed materials for industry and energy sources for the existence of mankind and the development of national economy. However, the living things, including plants, animals, microorganisms and human beings, together with their environment (atmosphere, water and soil), compose and interdependent and interactive circular system (ecosystem) in the biosphere. In the system, plants, especially green higher plants, are almost the only primary producers, while animals are the second (herbivores), the third (carnivore) producers and so forth. but all are consumers (from plant consumers downwards) simultaneously. The microorganisms, in addition to having more consumers than producers in nature, play an important role as decomposers in the ecosystem. Mankind, the greatest consumers and probably the greatest and the most effective producer of food and energy in the world, can become a destroyer or a coordinator.

The purely natural relationship of all the trophic levels is built on the food chain linkage, which is maintained by the energy flow and all kinds of matter cycles. After all, among different kinds of renewable resources, the green higher plants belong to the most important group for which the solar energy can be directly and perpetually used in making food and environment for each kind of living organism. And they keep the energy in different forms and different levels. As fourth part, man belongs to the omnivore in the relationship within a ecosystem (Figure 1).

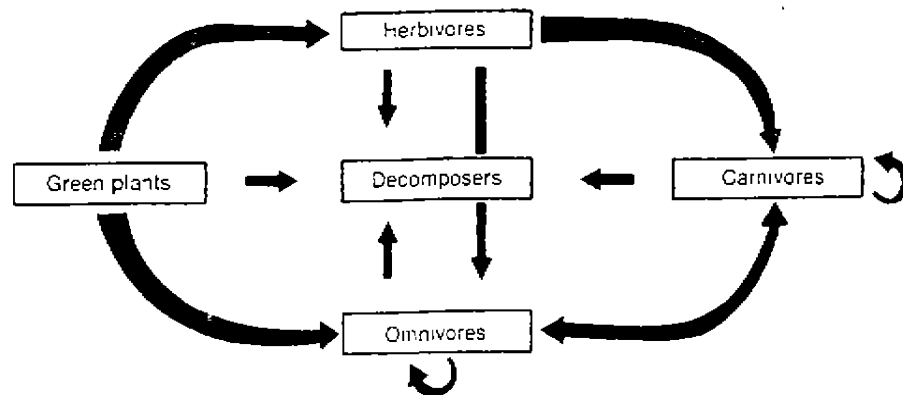


Fig1 Interrelationships among producers, consumers, and decomposers in a food cycle. (after Levine, 1977)

2.4 The value of biodiversity

Outcome of evolution

To explain how biodiversity was produced is to recount a vast segment of our earth's history, dating back in time hundreds of millions of years. Biodiversity is the natural result of living things in the process of evolution during long period of time. This is also the academic value of biodiversity because the formation of it reflect the changes in the natural history, especially from the Cretaceous period on, including plate tectonics, orogenic movements, glaciation etc. Biodiversity is the material basis on which we depend for our survival. If such diversity were destroyed in a moment, man would not exist on the globe, our sole globe.

Direct value

Biodiversity has many functions consisting of both direct value and ecological services. Examples of direct would be the use of many species of flora and fauna for foods, firewoods, fibers, medicines, drugs and raw industrial material. According to the National Research Council [United States](1992), the productivity of agricultural systems is a result of our continual alteration of once wild plant and animal germplasms over thousands of years. Productivity of these agricultural systems today still rests on interactions of diverse organisms within agroecosystems. Genetic engineering, especially in pharmaceutical and food-processing industries, uses natural genetic diversity from natural resources worldwide.

Indirect value

Living organisms are also important in providing ecological services, such as controlling pest populations, regulating water flow and nutrient cycling. Ecosystems consist of many species, each of which has its irreplaceable role in such systems. Stable ecosystems play an important role in regulating climates, stabilizing local hydrology and conserving water and soil. The conservation of ecological diversity means protection of home for man life. In addition, biodiversity has inestimable value of aesthetics and cultures, and is the most important part of tourist resources.

Potential value

Those species man made a full use of are a tiny minority of all the species diversity, that is, most of species are unknown in their uses. Ninety per cent of all the food in the world come from about 20 species, seventy—five per cent from 7 species, wheat, rice, maize and so on. It is a fact that each species has many usages. To solve the world—wide problems of resource utilization, man should not only conduct further study of used living resources, but also look for useful resources within all the unused species. Besides, it is said logically that the vast potential value of genetic diversity in most of unused species is greater than the value of used species.

2.5 The state of biodiversity

Recently, the biodiversity in the world has declined very rapidly. The world lost about one species per day in the 1970s, and by the mid—1980s, the loss increased to about one species per hour(Meyer as cited by Lugo, 1988). Rambo(1989)pointed out that loss of biodiversity is perhaps the most serious human impact on the global environment, as much of the ecological disruption resulting from human activities can be restored but once a species become extinct it can never be reconstructed. The most serious decrease of biodiversity is found particularly in tropical and developing countries because of high population and rapid deforestation. Today, there is a general consciousness that biological diversity must be conserved for sustainable development. The politicians from every part of the world got together in Rio de Janeiro, Brazil and signed the Protect Conventions for the biodiversity in the world. Primer Li Peng attended the meeting and signed the document on behalf of Chinese government, therefore, the protection of biodiversity has become a national activity and national policy in China.

3 The unity of the utilization and conservation

We believe that the rational use of plant resource and conservation of biodiversity is a unity of both aspects of a contradiction and an adjustment of long—term and short—term interests. Because plants are primary producers in every ecosystem, the conservation of them is the most important. The rational utilization must be based on the effective conservation of biodiversity, or else is difficult to be continued forever. Otherwise, only under the circumstance of the rational utilization of living resources, do conservation is probably effective. Both of them should presuppose the existence of each other. The core of the question is the relationship of rationality and effectiveness, and how for us to adjust long—term interest and short—term one. It may be said that the continuousness of human culture will depend to a great extent on the balance of the rational use and effective protection of living resources.

It should be emphasized that from the viewpoint of plant classification, utilization and protection, the great attention must be paid to the diversity of plant diversity, the special characteristics of their functions, the limitation of their utilization intensity, the importance of the comprehensive utilization, and a profound grasp of the relevant laws.

4 The present situation of utilization of plant resources

The Western Hunan autonomous prefecture is floristically put into the Central China Region (C. Y. Wu, 1979), near the centre of that region. It belongs to the Three Gorges—Wuling Mountains Castanopsis—Machilus Forest Region (C. Y. Wu, ed., 1983). There are many concerned research involving the prefecture. An example is the *Keys to Vascular Plants of the Wuling Mountains* edited by W. T. Wang et al. (1995), in which 3807 species, 35 sub-species, 315 varieties and 11 forms in 1039 genera of 207 families are recorded occurring in the whole mountain range. However, the account of the taxa occurring in the prefecture is not in the affirmative. According to the concerned literature (such as the checklist by C. J. Qi as a subject in the major project "The Floristic Study of Chinese Plants" *), some species, which are by inference distributed in the prefecture, are not recorded in the book with keys because of the lack of specimens from the prefecture. The list of prefecture screened out from the book and the checklist is not complete. In general, the number of the taxa of vascular plants of this prefecture could make up 70—80% of the total mountain range.

The prefecture located in the subtropics of China, especially in the downward region from Yunnan—Guizhou to Dongting Lake Plain. There are abundance of rainfall and higher quantity of heat in the prefecture. Its complicated and diverse environment supports an abundance of species. Besides the prefecture has many ancient endemic taxa and is belonging to a second center of Chinese endemism in Central China (H. Peng, 1997). However, the natural background is not clarified completely and the inventory of taxa is far from being finished to the completeness. Such a basis means a limiting factor to the effective use of the plant resources in the autonomous prefecture in the future. It is necessary to make a further investigation and sum up the concerned literature. McNeely et al. (1990) recognized that the foundation for assessing the importance of biodiversity is an inventory of how many species exist, and which species exist where. Therefore, the basic research is also the basis of biodiversity study.

The autonomous prefecture is a place in which many minority nationalities, such as Tujia (Tuchia), Miao, Dong (Tung), Yao, Hui, live together in harmony. Each of these nationalities has their excellent culture. In the course of dealing with the nature, they accumulated rich experience and formed their distinctive individuality. These nationalities differ from one another more or less in perceive the world around them and in learning to make use of the living resources. It is worth to make further study of these characters. McNeely (1995) emphasized the importance of indigenous knowledge and cultural diversity in the management and use of natural resources, and insisted on the conservation of biodiversity by means of biological and cultural approaches.

Other disadvantages in utilization may be universal in mountains of our country. Firstly, the expression of the mode of production is extensive. Living commodities have usually

* Checklist of Seed Plants in Hunan, compiled by Prof. C. J. Qi (a restricted publication).

been sold in the form of raw materials or primary products, have not higher extra value. It is common to exploit resources in its simple use or to put fine resources into petty use. Secondly, the utilization intensity is exceeding the regeneration capacity of living resources. This will reduce the number of individuals to such a minimum that the disintegration of species will be brought about inevitably. Thirdly, synthetic comprehensive utilization remains to be emphasized and to be implemented because every kind of useful organisms has many usages. We have always be utilizing it in its single use. Fourthly, once some kind of organism is very popular in markets, one often exploit it exhaustively. Traced to its source, the nuclure of the question is the lack of consciousness of conservation and synthetic utilization.

5 Some proposal for rational utilization

5.1 Synthetic uses of forest resources

In the utilization of forest resources, we should change the single way of lumbering, but pay attention to the multiple functions of forests, ecological services, regulation of climate and so on. On the basis of the good conservation of shelter — forests and forests for water and soil conservation, we should rationally and appropriately use timber forests having synthetic utilization in mind. The value of animals, microorganisms, fungi, wild medicinal materials and wild fruits should be much than that of single lumbering. The traditional thought of pure afforestation of Chinese fir (*Cunninghamia lanceolata*) should be changed.

5.2 Agroforestry

Agroforestry is a synthetical way of utilization and management of forest and soil resources applied widely in the whole world. The theory of sustainable development guides the thoughts of agroforestry. Different types of agroforestry should be in accordance with the naturally geographical regionalizations. The autonomous prefecture is belonging to Central China Region (S. D. Lai et al., 1994), in which several successful types of agroforestry were summarized and theorized. The homestead agroforestry, Chinese fir — crop intercropping system etc. are worth to be paid attention to in the prefecture.

5.3 The Ethnobotany

The history of human resource exploitation tell us that utilization of every species of plants is derived from the indigenous knowledge. At present when we are looking for useful plants in order to solve the crises the whole world is facing, the ethnobotanical knowledge is very important. The ethnobotanic researches contribute to further understanding the interactions between man and factors of environments and other organisms. It will conduce to help local people to manage natural resources. The transferring of successful indigenous knowledge to ecologically similar areas can be used to manage natural resources.

5.4 The solution of energy problem

In the countryside of the prefecture, the main energy still comes from forests, such as firewood for cooking and charcoal for keeping warm in winter (the way of keeping warm can be seen in many county towns in Wuling Mountains). If the way of utilization were continued, the forests would not exist later. The prefecture is rich in hydropower, thus the local

hydroelectric development is well worth doing. However hydroelectric construction is expensive, the alternative is the methane gas. It can be taken as a good example that methane gas is replacing wood as a major energy source in Lijiang Naxi (Nahsi) Autonomous County, southwestern Yunnan Province. The methane is derived from decayed animal and human excrement that was piped from latrines and pigsties into special pits. Plastic pipelines then bring the methane gas from the pits to local houses for use. Another is growing fast-growing trees for firewood just as the Swedish people are growing fast-growing poplar trees and willow trees for the same use in their country. If the energy problem is solved, the serious environmental disaster will be stopped very soon.

5.5 Intensive farming

Look for a kind of economical plant with boundless prospects to further exploit it then to put the commodity with higher extra value made of (or from) it to the market. The bamboo utilization can explain the subject of our talk. There are more than 20 species of bamboo in the prefecture. Nearly every species has many usages, as for food (tender shoots), building materials, weaving bamboo articles, ecological services, ornamentals and so forth. Let us take as an example. They are nutritious, contain 18 amino acids, of which the essential amino acid make up 32% (in scattered bamboo), even up to 37.2% (in caespitose bamboo) (C. M. Hui et al., 1996). In addition to the domestic markets, abroad markets are mainly distributed in three major parts: Europe—North America, Japan and Southwest Asia. For example, only in 1987, did Japan import 73,000 tones of canned bamboo—shoots from Taiwan, Per tons is worth 1,000—1,200 dollars. It is clear that its commercial prospect is boundless. We should screen out some bamboo species with delicious tender shoots to cultivate them and to make synthetic use of it so that we can form a bamboo industry.

5.6 The investment before utilization

The research on the utilization of living resources often start with difficulties during the lack of money. Most of enterprises have not the determination to invest in the exploiting researches of a long-term cycle. Many basic, synthetic study (such as the inventory of species of plant resources) is usually difficult to draw appropriate attention and get financial support. At present, Hunan Province is one of the few provinces in China which have not their provincial floras published. This will seriously hinder the further exploitation and utilization of plant resources. Therefore, the government's coordinating and supporting is badly in need.

Reference

- 1 Hui C M, Du F and Yang Y M. The Cultivation and Utilization of Bamboo. Beijing, Chinese Forestry Press, 1996
- 2 Lai S D et al. Regionalization of agroforestry systems. in Li W H, Lai S D. (eds.) Agroforestry in China. Beijing. Science Press, 1994, 81—258
- 3 Levine L. Biology for a Modern Society. C. V. Mosby Company, Saint Louis, 1977, 19—40
- 4 Lugo A E. Estimating Reductions in the diversity of Tropical Forest Species. In Biodiversity, E. O. Wilson (ed.), Washington, D. C., National Academy Press, 1988, 58—70
- 5 McNeely J A et al. Conserving the World's Biological Diversity. IUCN, World Resource Institute, Con-

- servation International, WWF, World Bank, 1990
- 6 McNeely J A. Conserving Diversity in Mountain Environments; Biological and Cultural Approaches. International NGO Consultation on the Mountain Agenda Lima, Peru, 1995
 - 7 National Research Council, Conserving Biodiversity; A Research Agenda for Development Agencies. Washington, D. C., National Academy Press. 1992
 - 8 Peng H. The endemism of seed plants in Mt. Wuliangshan, Act. Bot. Yunnan, 1997, 19(1):1-14
 - 9 Rambo, Terry A. Global Environmental Change and the Sustainability of Rural Resource System in Southeast Asia. Suggestions for a Khon Kean University Project as a part of a New SUAN-EAPI Research Initiative, 1989
 - 10 Raven Peter H. *Ethnic Affitude, Conservation of Threatened Plants*. Plenum Press, New York, 1976, 155-179
 - 11 Wilson E O. The Current State of Biological Diversity. In Biodiversity E. O. Wilson(ed.), Washington, D. C., National Academy Press, 1988, 3-18
 - 12 Wang W T(editor-in-chief). *Keys to Vascular Plants of the Wuling Mountsins*, Beijing, Science Press, 1995
 - 13 Wu C Y. The regionalization of Chinese flora, Act. Bot. Yunan, 1979, 1(1):1-22
 - 14 Wu C Y(ed.). *The vegetation of China*, Beijing, Science Press, 1983

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植物资源的利用及生物多样性保护的辩证统一*

——兼论湘西土家族苗族自治州的植物资源利用

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[摘要] 本文介绍了植物资源的定义、范围及特点,生物多样性的主要内容及意义。对湘西植物资源利用的正、负方面的一些条件进行了讨论,并提出了对持续利用植物资源的建议。目前应特别强调处理好植物资源的利用及生物多样性保护的关系。

关键词 植物资源;生物多样性;利用;保护;辩证关系

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