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Policy and Practice Progress of Watershed Eco-compensation in China

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Abstract: The ecological protection of the watersheds in China is being confronted with a lot of problems such as soil and water erosion, water pollution at present. Therefore watershed eco-compensation is becoming a question of common interest. Based on the analyses of the major problems and their origins in the watershed protection in China, the paper discusses the concerned policies including relative rules and laws, financial policies and water right transaction policies. Simultaneously the paper reviews the practices carried out in China, including the ecological construction project in the western China, the trans-provincial eco-compensation practice and the small watershed eco-compensation practice. According to the present situation of eco-compensation practices and the future policy requirement, this paper finally puts forward four key problems to be solved in the watershed eco-compensation of China in the future.
Keywords: watershed; eco-compensation; ecological protection

1 Introduction

At present ecological protection of the watersheds in China is confronted with a lot of problems such as soil and water erosion and water pollution. When the rainfall runoff and snowmelt runoff increase remarkably the flood calamity will take place more frequently. The primary cause of these environmental problems lies in the non-competitiveness and non-exclusiveness of watersheds as the public goods for both the upstream and downstream. Just for the existence of these two attributes, the phenomena of "public tragedy" and "hitchhike" occur during the use of resources in the upstream and downstream. If the resources are developed unduly in both the upstream and downstream, the utmost carrying capacity of a watershed will be reached. As a result the resources will be destroyed severely and the "public tragedy" will occur (Shen and Yang, 2004). If the downstream area can enjoy the benefits from the resources protection of the upstream, then the phenomena of "hitchhike" will appear in the downstream. In fact, however, the public watershed will result in the overuse of resources in both upstream and downstream, and the "hitchhike" will lead to the deficient investment to the environmental protection in the upstream. As a result, the imbalance of supplies and demands of natural resources will appear, which results in the aforesaid calamities such as soil erosion, water pollution, water area occupation and flood. So the protection of ecological environment has been more and more urgent, and the watershed eco-compensation has become an effective approach for environmental protection (Shen et al., 2005).

With the in-depth recognition of the function and value of the ecological services of watershed, various forms of cases about the eco-compensation appeared in different watersheds all over the world, and most of them have obtained ideal results of economic benefits and ecological effects, which reflects the importance of the compensation in watershed protection. The eco-compensation for the watershed means that the ecological protection in the upstream directly influences the quality of the ecological environment of downstream, and the downstream should compensate for the protection efforts and opportunity costs of the upstream. The upstream and downstream share the ecological resources and construct the environment together (Zhuang, 2004).

At present, the overseas eco-compensation of watersheds can be classified into three types from the angle of the public participation forms. The first type is the spontaneously organized market compensation, that is, the one-to-one commercial compensation between the upstream and downstream. The typical case is the clean water supply transaction between New York City and the

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upstream in the watershed (Perrot-Maître and Davis, 2001). The second one is the government-leaded market compensation. After the government defines the environmental standard for some resources exploitation, various departments who do not reach or exceed the standard can make transactions on the quotas. Such cases include the salinity credit transaction in the control of basin salinity in Australia, and the urban developing rights transaction, the wetland restoration credit transaction and the nutrient credit dealing system in US. The third one is the public payment compensation dominated by government. The government offers the project funds and investments directly. The cases include nature reserve plan, wetland plan, and Columbian watershed management system in US. In recent years, Chinese government has studied the advanced international experiences and explored the compensation policy suitable to Chinese situations. A number of explorations in the compensation in different dimensions have been carried out (Chomitz and Brenes, 1999; Tognetti, 2001; Scherr et al., 2001; Swingland, 2002; Clay, 2002; Rosa et al., 2003).

2 Legal Basis of Watershed Eco-compensation

At present, there is no definite provision about the compensation method for the loss caused by the trans-regional river pollution and economic compensation for the exploitation and use of water resources in the existing laws in China. But some relevant legal provisions are still found in the existing laws (Table 1).

Table 1 Relevant rules and laws connected with watershed eco-compensation

Relevant rule and law	Content connected with watershed eco-compensation
The Constitution of the People's Republic of China	Article 9: The state ensures the reasonable utilization of natural resources and prohibits the purpresture or destruction of natural resources by any organization or person and by any means.
General Principles of the Civil Law of the People's Republic of China	Article 83: The neighborhood of the estate should correctly deal with the mutual relations in the water catching, drainage, transit, aeration and lighting according to the principle of favoring productions, facilitating people's life, solidarity, mutual assistance, equality and rationality. Anyone who damage or cause loss to the neighborhood should stop the damage, eliminate the obstacle and compensate. Article 124: Whoever violates the national provisions of environmental protection, and pollutes the environment or harms others should hold civil liability.
The Environmental Protection Law of the People's Republic of China	Article 16: Local governments at different levels should be responsible for the regional environmental quality and take measures to improve it. Article 19: Measures should be taken to protect the ecological environment during the development and utilization of natural resources. Article 41: Anyone who caused the pollution has the obligation to eliminate the damage and compensate for the loss of the department or individuals that are directly influenced.
The Law on Prevention and Control of Water Pollution of the People's Republic of China	Article 5: All the departments and individuals have the obligation to protect water resources and are entitled to supervise and impeach the behaviors of pollutions. The departments and individuals who are victims are entitled to ask for the elimination of damage and compensation for the loss. Article 55: The department which caused water pollution should be responsible for the elimination of damage and compensate for the loss.
The Water Law of the People's Republic of China	Article 3: Water resources belong to the nation. Water in all the pools and reservoirs of the collective economic organization in agriculture belongs to the collectivity. The nation protects the legal rights and interests of the departments or individuals in the development and utilization of water resources.
The Detailed Rules on the Implementation of the Water Law of the People's Republic of China	The basic principle of the remunerative use of water resources includes the rules of water-intaking permit, remunerative utilization of water resources, and the fees of water resources committed for the water protection. The rule of the taxes and fees related to the exploitation and pollution of water resources is planned to be made.
The Statute of Collection and Use of Effluent Fees	Effluent fees should be paid in accordance with the sorts and amounts of effluences discharged to the atmosphere, the oceans and the water. Double fees should be paid when discharge amount exceeds the standard.
Some Suggestions on Strengthening the Environment Protection and Management of Construction Projects in the Western China Development	Article 7: In the environment protection and management of construction projects the government should strengthen the protection of regional ecological functions of such areas including natural reserves, riverhead regions, important water conservation regions, flood adjusting regions, wind protection and sand fixation regions, important soil and water conservation regions, important fishery regions, marshes and oasis. All the projects that lead to the degradation in the ecological functions should be stopped. The supervision and management of resources exploitation and the protection of water, lands, forest and grass, wild species, sightings and historical cultural heritage should be strengthened…
The State Council Decision on Strengthening Environmental Protection Aiming at the Implementation of Scientific Development View	The ecological compensation policy should be enhanced, and the ecological compensation system should be established as soon as possible. The ecological compensation should be considered in the transfer and payment of central and local finance. The experiment sites can be established at national and local levels.

From the above-mentioned legal provisions one conclusion can be drawn that anyone who caused the trans-watershed water pollution must hold the responsibility of compensation, which reflects the principle in the environmental legislation. That is to say, whoever caused pollution must deal with the pollution. The downstream compensates for the economic loss of the upstream, which is in accordance with the above-mentioned statutes. Thus there is a profound lawful basis for the watershed eco-compensation in China.

3 Policies of Watershed Eco-compensation

Some policy evidences for watershed eco-compensation can be found from the policies about the eco-compensation in China. However the thorough and flexible use of these evidences is an important problem.

3.1 Financial transfer payment

Financial policy is important to the regulation and control of entire social economy. It changes the regional and social developing patterns using the inducement of economic interests. In the present financial system the financial transfer payment and special funds have an important role in the establishment of eco-compensation system. From 1998 to 2002, financial departments at different levels raised money by all means to ensure the payout in commonality service fields (such as agricultural construction and environmental protection). Investment was increased to support the infrastructure construction including the regulation of rivers and constructions of important ecological projects. From 1998 to 2001, 41.71×10^9 yuan (RMB) was committed to the three key ecological projects including Natural Forest Protection Project, the Grain for Green Project, Prevention and Control of Wind-Sand Sources in Beijing-Tianjin-Hebei Region from the central government finance, which promoted greatly the compensation of watershed ecological environment (Wan et al., 2005).

3.2 Transaction of water right

The "Suggestion about the Water Rights Transfer" made at the beginning of 2005 by Ministry of Water Resources of China defined that water right transfer is the transfer of access rights of water resources. Water is the basic natural resources and strategic economic resources and the important foundation of sustainable development of economy and society. The frequent flood and drought, severe soil erosion, serious water pollution and the shortage of water resources have become the important factors restricting the development of socio-economy in China. In order to solve the problem of water resources shortage the most primary method is to build a water-economizing and pollution-preventing society, optimize water resources allocation, and improve the use efficiency and benefits of water resources. The basic role of the market to resources allocation should be exerted fully to fulfill the reasonable allocation of water resources. Water right transfer experiments should be carried out all over the country for the establishment of a perfect water right system. Simultaneously the restriction on water right transfer should be defined, which including the following contents: Firstly, except for the national special stipulations, if the total amount of water used by any client exceeds the available amounts of a watershed or a region, the water right can not be transferred to other clients outside the watershed or the region. Secondly, water rights in the groundwater exploitation-restricted area can not be transferred. Thirdly, the water right committed to the ecological environment can not be transferred. Fourthly, the water right transfer that perhaps influences the public benefits, ecological environment or the benefits of the third party can not be transferred. Fifthly, the water right can not be transferred to the industry that is restricted by the country (Shen, 2004).

4 Practices in Watershed Eco-compensation

4.1 Ecological construction projects in riverhead region of western China

The western region is the headstream of several great rivers of China. The present ecological construction projects related closely to the protection of ecological environment include the Grain for Green Project, Natural Forest Protection Project, the Changjiang (Yangtze) River Protection Project, and the planned Construction of Three-river Source Nature Reserve and the Construction of Ecological Function Area in the Source Area of Great Rivers.

4.1.1 Grain for Green Project

According to the 10-year plan for the Grain for Green Project (2002–2010), 22 provinces and cities including 10 provinces and cities in the western China are involved in the project. Within the ten years the project will implement the conversion of 5.3×10^6ha of cropland into forest, afforestation of 8.0×10^6ha in barren areas suitable

for forest, land and water erosion control of 36×10^6ha, wind protection and sand fixation of 70×10^6ha. The compensation for the Grain for Green Project includes two parts, the compensation from the country to farmers and from the country to local governments. The country offers free food supplies, seed and seedling fees, and management fees to farmers, and compensates local finances by payment transfer for their revenues reduced in the Grain for Green Project.

4.1.2 Natural Forest Protection Project

According to the national Natural Forest Protection Project (2000), the upper reaches of the Changjiang River and the upper and middle reaches of the Huanghe (Yellow) River are the key areas of the project. There are natural forests of 70×10^6ha, which accounts for 69% of the total area of the national natural forests. With the stopping of felling the forestation in the land suitable for forest in this region should be carried out. In the project period of 2000–2010 about 3.67×10^6ha of hillsides was planned to be closed for reforestation and forestation of 8.66×10^6ha will be carried out. Then the forest coverage in this region will be increased to 21.24% in 2010 from 17.5% at present. The total investment of the entire project was up to 106.4×10^9 yuan, of which 18.8% was basic construction investment and 81.2% was special funds. The State Council of China also stipulated that the debts of the forest industry enterprises which have trouble in paying back due to the stopping of felling can be remitted.

4.1.3 Construction of Three-river Source Nature Reserve

The three rivers refer to the Changjiang River, the Huanghe River and the Lancang River here. The three-river source region is located in the south of Qinghai Province, to the northeast of Tibet Autonomous Region and the west of Sichuan Province. The area of this region is more than 302.5×10^3km^2, accounting for 32.7% of the total area of Qinghai Province. Being the source of the three great rivers, it is named as "the water tower of China". In January 2005, the State Council of China authorized the general plan of ecological protection and construction in Three-river Source Nature Reserve. The construction project includes 3 categories, 13 construction items and more than 20 sub-items. The total investment was up to 7.5×10^9 yuan. This indicated the formal start of the ecological construction and environmental protection project in this region. The goal of the project is to restore the ecological function in this region, establish a harmonious relation between human and nature, implement the sustainable development of the economy and the society, and increase revenues of farmers and lift them out of poverty.

4.2 Trans-provincial cooperation of ecological protection of watershed

At present one common problem in trans-provincial watersheds is that the protection of ecological environment in downstream is based on the sacrifice of the development in upstream. In consideration of this problem, the trans-provincial cooperation of watershed ecological protection is still in active exploration.

4.2.1 Cooperation in Beijing, Tianjin and north of Hebei Province

The upstream regions bear so great loss to protect the ecological environment that the gap between the rich and the poor becomes more and more distinct. The region of Beijing, Tianjin and north of Hebei Province is the water source region of Beijing and Tianjin. To protect the water resources and environment, enormous manpower, material and financial resources were invested. The development of economy in upstream is restricted due to the high requirement in the quality of ecological environment in downstream. At present four optional approaches are put forward by experts to facilitate the compensation and the quick development of economy in this region (Liu et al., 2006).

The first is to establish an assessment system of green GDP in both upstream and downstream, and carry out assessment of ecological assets and environmental pollution loss, so as to evaluate the results of the general economic development.

The second is to make a compensation policy of public finance. The nation and the local governments in downstream and other local governments at different levels which get direct benefits should provide certain amount of funds, together with the available compensation funds, in order to establish a special fund for the regional ecological compensation. This special fund is used for the compensation for the loss of the usufruct of regional water resources and ecological forestry land, the loss of the right of developing traditional industry and highly-water-consuming agriculture, the loss of local economics in improvement of environmental quality of surface water and the enhancement of regional standard for ecological function, and the management fees of ecological projects and natural reserves.

The third is to explore the market compensation policy and establish a system of water right transfer between the region and the downstream. The downstream should pay water resources fees to the region regularly according to the market price. Water price and wastewater treatment price in downstream should be increased to compensate for the loss of traditional industry and highly-water-using agriculture. Ecological environment compensation tax should be levied in the down wind direction regions to improve the subsidy in the Grain for Green Project. National government should pay the regions regularly with certain management fees for the national ecological protective projects in these regions.

The fourth is to explore the compensation policy of the technical projects. The central government and local governments at different levels in the downstream region should set up some technical projects in the region every year to facilitate the substitutable industry or provide subsidy for the non-pollution industry to support the development of ecological industry. The local government should permit and support the developing experimental zones in the downstream region, and should grant the policy in land use and the movement of enterprises favoring the development of these zones.

4.2.2 Eco-compensation practices in Dongjiang River source region

The Dongjiang River is the important water source of Shenzhen, Guangzhou, especially Hong Kong. But in a long period, there were obvious unfairness and interests conflicts in the protection of water source between upstream and downstream, especially between the source regions in Jiangxi Province and the regions along the river in Guangdong Province. At present, the eco-compensation system being explored by experts and governments is mainly to exert the compensation function of Guangdong Province and Hong Kong.

The first is to establish the compensation fund by Guangdong Province to pay the government of three counties in the Dongjiang River source region for the protection and construction of ecological environment. The sources of this fund include: 1) the financial revenue of Guangdong Provincial Government; 2) part of compensation fees from Hong Kong to Guangdong according to the quality and amount of water offered by the Dongjiang River; 3) part of water fees from the downstream regions; 4) part of the electricity generation income of Fengshu Dam according to the present compensation proportion to Heyuan City.

The second is flexible and various technical and developmental assistance. One effective approach is that Huizhou, Dongguan and Shenzhen make "pairs" with the three counties in the river source region. Technical and developmental assistance may include the technical research in development of mineral resources, industry transfer and cooperative project construction, stuff training and job opportunity offering and so on.

The third is to found the supervise organization. As Guangdong Province is the major beneficiary of the ecological protection (also the major undertaker of ecological damage) and the contributive party of the compensation, a supervise organization led by Guangdong Province should be founded in the cooperation of Jiangxi Province. The members of the organization are from the contributive party and the responsible party in the beneficial region. Dynamic monitoring and inspection of the compensation implementation and the funds use should be carried out regularly to ensure the effective work.

4.2.3 Cooperation in Xin'an River watershed

The Xin'an River watershed stretches across Anhui and Zhejiang provinces. In order to protect the ecological environment in Huangshan City, Anhui Provincial Government increased the investment in the ecological construction and environmental protection. With the closing and denial of certain project, the development of traditional industries is restricted so that the economic development of the upstream is influenced and the economic gap with the downstream is increasing. In order to relieve the double pressure in environment protection and economic development, and eliminate the economic gap in the regional development, a cooperative ecological construction and sharing system is being be established.

Considering the features of water resources and water environment, the scope of the cooperative ecological construction region is the whole watershed of the Xin'an River, including two counties of Hangzhou City, Zhejiang Province, and the whole region of Huangshan City, Anhui Province. While the sharing region covers not only the entire ecological construction region but also the relatively open social economic system including the existing and potential regions, departments and populations of water using, that is, the socio-economic system directly or indirectly sharing the water resources and water environmental benefits. After defining cooperative ecological construction region and sharing region, the regional cooperative mechanism should be established. Funds from all sources should be raised to ensure the

protection of ecological environment and accelerate the development of economy in both upstream and downstream.

4.3 Eco-compensation within one province

4.3.1 Market-based measure of Zhejiang Province

The practice of watershed eco-compensation in Zhejiang Province has got ideal results. The practice includes the following contents:

The first is the water right transaction. According to the agreement between Dongyang City and Yiwu City made on November 24, 2001, Dongyang City transferred permanent water right of $50\times10^6 m^3$ from Hengmian Reservoir to Yiwu City with a price of 4 yuan(RMB)/m^3.

The second is the building of development districts in different regions. This is a new expanding form of eco-compensation. Within county scope, Anji, Deqing, Ninghai, Lin'an all made different developing policies of eco-compensation for development zones in different regions. According to these policies, taxes and profits of projects and investment introduced from the upstream regions will all be returned to the upstream. Within urban scope, Jinhua City established a benefit compensation mechanism for the national ecological demonstration zone, and this is the first case that the upstream implements development and construction in the downstream. The "Jinpan Economy Development Zone of Supporting the Poor" was established as the productive land for Pan'an County from upstream, and the corresponding support including favoring policy and infrastructure was also made. In Shaoxing City, the Xinchang Medicine Chemical Industry Garden was established for the development of Xinchang County, which effectively reduced the water pollution in the upstream of the Xinchangjiang River. Within province scope, the "Jingyin Economy Development Zone of Supporting the Poor" established by Jingning and Yinzhou counties is a successful case, and Jingning County gets about 55×10^6 yuan of taxes from this development zone.

4.3.2 Water resources protection of small watershed in Guangdong Province

The Tanjiang River originates from the Niuweiling of Yangdong County, Yangjiang City. The main river runs from the west to the east across Enping County, Kaiping County, Taishan County and Xinhui City. The total length of the river is 248km and the area of watershed is 6026km^2. Within Jiangmen City the main stream of the river is 210km long and the watershed area is 5769km^2.

In order to improve the water environment management of Tanjiang River watershed, organized by the government of Jiangmen City, the first responsibility book about water resources protection was signed with Enping County, Kaiping County, Taishan County and Xinhui City in 1990. Then Heshan and Jiangmen cities also joined the work of the union protection. After more than 10 years of exploration, a water environment management pattern for the Tanjiang River characteristic of "clear responsibility, united protection, total-quantity planning, synthesis preventing and controlling, quantification inspection, and mutual supervision" was formed and played vital role in the water environment protection. Its main procedures include: 1) defining the goal, duty and responsibility of water quality protection by signing the responsibility clause; 2) establishing the special fund of water resources protection, collected from all members in the region, and managed and used by the municipal governments; 3) implementing the cross-city boundary water quality standard management, and setting up the cross section of water quality monitoring scientifically; 4) scientifically planning and reasonably using water resources according to the water quality protection plan; 5) establishing quantification examination for the environmental protection work of all cities; 6) implementing united approval system for important projects with a daily effluent of over 300t. The responsibility plan of water resources protection can provide important evidence for the exploration of eco-compensation mechanism in the Tanjiang River watershed.

5 Conclusions

Watershed eco-compensation is a very complex field, and there are many technical problems to be solved, such as the service function assessment of ecosystem in upstream, the analyses on the investment of ecological protection and so on. These problems are the important foundations of eco-compensation. Although some standards about eco-compensation have been made in practices, they are not suitable to be as the reference evidence for similar watershed within national scope. This is because that there are still some problems about the quantification of eco-compensation. To be concluded, the following essential technical questions are to be further studied in order to provide more scientific references:

(1) Definition of main responsible body of ecological compensation. The main body is different in various

dimensions, so it is necessary to decide who is the main body, nation or upstream or downstream?

(2) Evaluation of ecological services of the watershed. This work is very difficult but it is the key step in the design of compensation project. The evaluation should be scientific and reasonable so as to provide adequate and scientific evidence to the meaningful compensation.

(3) Analyses on the investment in the protection of ecological function. As the investment in the ecological protection is wide and covers many items, overall consideration is needed so as to make the eco-compensation be more reasonable.

(4) The design of compensation project and the analysis of feasibility. The compensation project must be made on the basis of above-mentioned steps, and it must be practical and be accepted by all the parties involved in the compensation.

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