

Eco-compensation Mechanism and Policies in China

Task Force for Eco-compensation Mechanisms and Policies

1 Significance and necessity of establishing eco-compensation mechanism in China

As China's economy has developed rapidly, ecological and environmental problems have increasingly become bottlenecks restricting the overall future sustainability of the country's socio-economic development. The Chinese government has proposed the concept of scientific development with emphasis on people centered, integrated, coordinated and sustainable development, and special attention has been put on ecological construction through various policies and means which has been contributing significantly to the improvement of ecological conditions of the country. However, policies related to ecological conservation are not readily in the place, particularly economic policies for ecological construction are still missing, leading to unequal distribution of ecological benefit and economic benefit between protectors and beneficiaries, damagers and victims. Consequently, beneficiaries are gaining from ecological benefit without bearing responsibilities and costs of deteriorating the ecology, but the protectors are not getting necessary economic incentives. The distortion of such relations brings China's ecological conservation into a very hard condition and affects coordinated development among the regions and stakeholders involved in. There is a high need to establish eco-compensation mechanism to solve those problems for readjustment of ecological benefit and economic benefit of the stakeholders, improvement of eco-environmental protection, and equable development between rural and urban, regional and social development.

Eco-compensation mechanisms have become a hot topic in the society. The representatives of the National People's Congress and the China's People's Political Consultative Conference have addressed in the resolution of the establishment of the relevant mechanism and policies over the years. And the academic community has initiated research in the field of assessment of eco-system services that has provided a strong theoretical basis for eco-compensation mechanism and policy design. Last but not the least, the Central Government and many local governments have started to explore approaches for eco-compensation. Several laws and regulations have been

promulgated, such as “Decision for fulfilling scientific development and enhancing environmental protection of the State Council” in Dec. 2005, “The compendium of the 11th five-year plan for the domestic economy and social development” in 2006. These documents stress that eco-compensation mechanisms should be adopted as soon as possible. To ensure long term effects of the mechanism, the State Council has proposed that “the eco-compensation mechanism should be on the basis of the principles of whoever develops protects, whoever damages treats, and whoever benefits treats”, indicating that China has already had a strong basis for eco-compensation mechanism in terms of political willingness, practical implications and scientific basis.

Based on the research progress and urgent needs for decision making, the China Committee for International Cooperation on Environment and Development (CCICED) established the Task Force on eco-compensation and policy research in 2005, with aims of establishing national strategies and sectoral policies for eco-compensation, and making concrete proposals and recommendations for the government. The Task Force contains six thematic research fields including national strategy, theory and method, watershed, mineral resource development, forest and natural reserves. Summary of domestic and international experience, interview of governmental officials at central and line agencies involved in, and field surveys and several internal and international conferences have been conducted in the due course and this report makes general summary and recommendations generated from the research.

2 Definition and theoretical basis of Eco-compensation

2.1 Definition and connotation

There still does not exist a relatively clear and uniform definition for eco-compensation. Based on the research conclusions and integration with the actual situation in China, eco-compensation may be defined as follows: Eco-compensation is a type of institutional arrangement to protect and sustainable use ecosystem services, and to adjust the distribution of costs and benefits between different actors and stakeholders, mainly through economic measures. In other words, eco-compensation mechanism aims to protect ecological environment, improve man-nature relations. It is a public regulation aiming at adjustment of relations between the stakeholders involving in ecological conservation on the basis of ecosystem service values, cost for ecological conservation, opportunity cost, and via

means of the government and market mechanism. There are broad and narrow senses of understanding the concept: in a broad sense, the eco-compensation refers to both the incentives to the protection of ecosystem and natural resources, or the compensation to the loss of damaging ecosystem and natural resources, and charges to the environmental polluters. In a narrow sense, it refers to the first meaning as described above. In China, as a series of laws and regulations are available for pollution charges, it is therefore needed to establish an eco-compensation mechanism based on ecosystem service. This research hence adopts the narrow concept of eco-compensation.

The main contents covered in the eco-compensation are: 1) to compensate the costs of ecological conservation and restoration or damage; 2) to internalize the economic benefit externalities via economic means; 3) to compensate the opportunity costs of foregone development due to ecological conservation or restoration activities; 4) to invest in ecologically significant regions or targets. Internalization of external cost is a basic principle of eco-compensation. Protectors' investment in protection and relevant construction for improvement of ecosystem services, or their opportunity cost are considered as determines of external economy for eco-compensation, and the costs for rehabilitation of ecosystem services and opportunity cost of the victims are considered as determines of external non-economy.

As the narrow definition of eco-compensation is similar with Payment for Ecosystem Services (PES) and Payment for Ecological benefit (PEB), this report therefore uses those terminologies simultaneously.

2.2 Theoretic bases

The theories of ecological economics, environmental economics and resource economics, especially eco-environmental value theory, and the theories of externalities and public goods are the basis for the research.

2.2.1 Eco-environmental value theory

In theory, eco-compensation is an economic means to promote ecological protection. Therefore, knowledge of the characteristics and value of ecosystems and the natural environment is fundamental for implementing eco-compensation mechanisms. Policymakers and the public have long operated under the implicit assumption that natural resources and ecosystem services are inexhaustible and undegradable. However, with the worsening state of the country's environment, the importance of the environment is being increasingly recognized. The development of

in-depth knowledge from the research of ecosystems, especially of ecosystem service functions, is an important support to build up eco-compensation mechanisms. Costanza and MA have played the epoch-making role in such research.

The world's ecosystems serve many functions, including supply functions, regulatory functions, cultural functions as well as support functions. When making decisions relevant to ecosystems, both human welfare as well as the intrinsic value of ecosystems should be considered at the same time.

2.2.2 Externality theory

Externality theory is the foundation for environmental and resource economics and policy. Positive/negative environmental externalities resulted if during the production or consumption process environmental benefits/costs are created that are not fully captured by the producer or consumer of these benefits/costs. As a result, the production and consumption choices made by these actors, which are determined by their private costs and benefits from the activity, diverge from those that would be socially optimal, since a wedge exists between the private and social costs and benefits of the activity. The result of this is a range of adverse environmental outcomes, including insufficient conservation activities and excessive resource exploitation.

A. C. Pigou theorized that market mechanisms such as taxes and subsidies could be used to more closely align private and social costs and benefits in a society. Specifically, taxing or subsidizing an individual by exactly the amount of the positive/negative externality they are producing by a given activity “internalizes” the externality (i.e. the full social cost and benefit of the activity are also the individual's private cost and benefit), so that the individual's private decisions reflect socially optimal decisions. Thus, if a damager is taxed by exactly the amount of damages he creates, he would chose production and damage levels that are socially optimal. If someone who protects an important ecosystem is subsidized by exactly the amount of the public benefits created by the ecosystem, the individual's private decisions would also be socially optimal. As such, the government should make use of such “Pigouvian Taxes” when the private and social environmental costs and benefits of an activity diverge.

2.2.3 The public goods theory

Related to externalities are public goods. Pure public goods are goods that are non-competitive and non-exclusive. These two characteristics mean that the market is a poor provider of the socially optimal quantity of public goods. This is because

consumers – assuming that others will also be paying for its provision – will have little incentive to pay their full “willingness to pay” for the good, resulting in the market supply being lower than what is socially optimal level. This is commonly referred to as the “free rider” problem. Another, similar type of problem is the “tragedy of the commons”, which describes the situation wherein the rights governing use of a commonly used competitive good (e.g. groundwater) lack clarity and enforceability, thereby making it a *de facto* non-exclusive good, resulting in its overuse (i.e. use beyond what is socially optimal).

Due to these problems, the government is seen as the key provider of public goods. However, determining the “socially optimal” level of public goods provision requires dialogue and debate in society as a whole.

3 Current state of research and initiatives at national and international levels

3.1 Research and practice of eco-compensation abroad

Internationally, eco-compensation refers to PES or PEB, and it can be categorized into four main types (Sara J. Scherr et al. 2006, Developing future ecosystem service payment in China: Lessons learned from international experience):

(1) Direct public payments (such as China’s Natural Forest Protection Program, Grain for Green Program, and Ecological Forest Protection Program) in which the government makes payments directly to rural landowners and other providers of ecosystem services. This form of PES is the most common globally. This category may include conservation easements, where landowners are compensated to set aside part or all of their land for conservation purposes.

(2) Cap-and-Trade Schemes (such as the European Union Emissions Trading Scheme) in which a government or regulatory body first sets a limit (a “cap” or a “floor”) on the amount of ecosystem degradation or pollution permitted in a given area. Firms or individuals subject to these regulations are given the options to meet their obligations either by complying directly, or by financing other landowners to undertake conservation activities that fully offset that damage. “Credits” reflecting such offsets may be traded and thus acquire a market price.

(3) Direct Private Payments: Direct private payments function much like the public payments described above, except that non-profit organizations or for-profit

companies take the place of the government as the buyer of the ecosystem service in question. These payments are often referred to informally as “voluntary payments” or “voluntary markets” because the buyers engage in transactions without any regulatory incentives. Businesses and/or individual consumers may engage in non-compliant markets for reasons of philanthropy, risk management and/or in preparation for participation in a regulatory market (Hawn 2006).

(4) Eco-Certification Programs enable consumers to choose to pay a price premium for products produced in a way that is certified by an independent third party, according to standard criteria, to be ecologically friendly.

In a recent global overview of emerging markets for forest ecosystem services, over 280 cases of actual and proposed payments for four sets of ecosystem services were examined. These include 75 deals for carbon sequestration, 72 for biodiversity conservation, 61 for watershed protection, 51 for landscape beauty and 28 for sales of “bundled services”. Far from being concentrated in the developed world, these cases were drawn from a range of countries in the Americas, the Caribbean, Europe, Africa, Asia and the Pacific.

As for ecological protection relevant to agriculture, the U.S. and Europe both have programs involving land retirement for ecological restoration, in which direct payments are made to farmers for management practices that protect soil and other ecosystem services. In the 1950s, the American government created the Soil Bank Program, the precursor to today’s U.S. Conservation Reserve Program, which is similar to China’s 1980 desertification prevention plan. In these arrangements government play a stronger role in establishing levels of payments and compensation, and provide a vehicle for greater public participation and transparency.

Payments for watershed protection services can be grouped into several categories including water quality, water quantity, and flood control. These three categories of services, while linked, often have different beneficiaries and are furthered by different land use practices; thus, they are commonly the focus of separate markets. Public payments for all three categories of watershed services, as well as private payments for water quality and water quantity, have the potential to evolve into significant areas for pro-poor PES. As for watershed compensation, the one of the successful cases is that the Australia government promotes the watershed integrated management compensation work at local levels via government subsidy. South Africa annually invests about 0.17 billion \$US for watershed protection, water quality improvement and water supply increase with combining watershed

protection and restoration programs and poverty reduction actions.

As for historical ecological damage issues, the U.S government has created a new fund for ecological restoration. In Germany, a specific mineral rehabilitation company takes charge of the mineral restoration, the capital of which is composed of center government (75%) and local governments (25%); In the case of damages that occur after a law has been instated, restoration is implemented by mineral developers.

Regarding forest ecosystems, the key methods to realize the eco-compensation are: biodiversity protection, carbon sequestration and landscape beauty and recreation. Under the two largest and most well-known carbon cap and trade schemes-the European Emissions Trading Scheme (EU-ETS) and the Kyoto Clean Development Mechanism-362 million tons of CO₂ and 400 million tons of CO₂, respectively, were traded in 2005. According to Point Carbon, this was a 700 mt increase in volume over 2004 and amounted to a combined worth of \$9.4 billion (Point Carbon 2006).

In a view of compensation for landscape beauty and recreations, these services often overlap with biodiversity services, and the commodity being purchased by tourists is access rights to scenic beauty, not biodiversity per se. payments to land stewards by enterprises that cater to tourists are typically negotiated on a case-by-case basis. Furthermore, in the case of national parks, payments are often not conditional: local communities are required to curtail their activities in the park, but as compensation they receive a portion of park revenues. In terms of landscape beauty payments, the most frequent market-based mechanisms used to attach value to these services were: access rights/entrance payments such as visitor fees (50%), package tourism deals (25%) and management arrangements or projects (25%) (Landell-Mills and Porras 2002).

As for natural area protection like biodiversity protection, the eco-compensation in this field has become a good approach for the owners and managers of forest resources for their good stewardship of biodiversity. The contents in detail are as following: purchase of high-value habitat(private land acquisition, public land acquisition), payment for access to species or habitat(bio-prospecting rights, research permits, hunting, fishing or gathering permits for wild species and ecotourism use), payment for biodiversity-conserving management(conservation easements, conservation land lease, conservation concession, community concession in public protected areas and management contracts for habitat or species conservation on

private farms, forests, grazing lands, tradable rights under cap & trade regulations(tradable wetland mitigation credits, tradable development rights and tradable biodiversity credits) and support biodiversity-conserving businesses(business shares in enterprises that manage for biodiversity conservation and biodiversity-friendly products). In a word, eco-compensation money is raised via government budget or funds, and it is carried out combining with the agriculture, watershed and forest research at abroad.

Above all, there is much useful experience on the theory and practice of eco-compensation that can be drawn from other countries, including how to formulate a solid legal basis for eco-compensation, how to design sound market-based instruments, how to tap into different sources of finance for conservation and how to enhance public participation. However, even for developed countries, development of the concept of PES is still at an early stage. Furthermore, there are significant differences between China and western countries in terms of culture, history, social and economic conditions. As such, we cannot simply copy the measures of foreign countries. As indicated by the forest-trends report “Around the world, policymakers and PES stakeholders highlight the fact that developing successful PES schemes is a learning process. No single set of policy tools and targets will provide a definitive solution to China’s environmental priorities and challenges.” Thus, while we learn the useful experience aboard, we have to develop our own approaches for the establishment of eco-compensation mechanisms and policies based on Chinese particular set of conditions.

3.2 Domestic research and implementation of eco-compensation programs

Chinese experts began to carry out research on eco-compensation in the early 1990s. The assessment of various ecosystem services around China was first initiated via learning from international experience. More recently, numerous articles have been published in this field. The research conclusions show that the ecological and environmental value of ecosystem is far more than the value realized via market transactions. Some obstacles such as limitations in the current economic accounting system and market failures resulting in environmental externalities have led to continued negative impacts on ecosystems and the environment. As such, mechanisms for eco-compensation have been increasingly viewed as a potentially valuable approach, among many market-based tools, to better address conservation

and environmental issues.

In a view of eco-compensation practice, namely firstly, state budget as the primary source of finance for eco-compensation cooperated by relative departments at different levels; secondly, local and regional initiatives; thirdly, participating in the global market transaction. All of these policies and implementations would provide abundant lessons and experiences for establishing eco-compensation mechanisms. In conclusion, the key aspects on eco-compensation in China are: forest, natural reserve protection, mineral and watershed.

3.2.1 Forest and nature reserve protection eco-compensation

Eco-compensation practices for forest and nature reserve conservation and restoration have been carried out for a long time. The central government has invested heavily in such practices, resulting in significant successes. In fact, in addition to the Forest Ecological Benefit Compensation Fund (FEBCF), many of the six key State Forest Development Programs could be considered as types of eco-compensation schemes for reversing long-term ecosystem degradation. The State Council, in reissuing The Notifications on the Key Issues of Economic Reforms in 1992 prepared by the State Economic Systems Reforms Commission, proposed that “the stumpage fee system and Forest Eco-compensation be established, and the utilization of forest resources be paid for.” In 1993, the State Council, once again in the Notifications on Strengthening the Tree-Planting and Greening Work, proposed “reforming the investment mechanism for tree-planting, and gradually adopted the Forest Eco-compensation System”. In 1998, the Decisions on the Revision of the Forest Law of the People’s Republic of China were passed by the Second Meeting of the National People’s Congress. Clause 6 of the Decisions stipulates that “A forestry fund system shall be established. The state shall set up the Forest Ecological Benefits Compensation Fund, to be used for the planting, tending, protection and management of forest and tree resources in Protection and Special-use Forests specializing in the provision of ecological benefits.” The pilot implementation phase of FEBCF started from 2001 and ended in 2004. In December, 2004, a videophone conference on FEBCF claimed that it had entered the formal implementation stage around China based on the results of the 3-year pilot implementation work. The Ministry of Finance and the Ministry of Forestry promulgated Provisions on the Management of Forest Ecological Benefit Compensation Fund. This circular provided the institutional framework for establishing the FEBCF in China, and specified that the state budget would be the

primary source of capital for the program.

3.2.2 Watershed eco-compensation

In terms of watershed eco-compensation, local initiatives have mainly focused on protection of drinking water sources for cities, involving management schemes between upstream locales and downstream municipalities, such as the water resources protection cooperation between Beijing municipality and Hebei province, the eco-compensation between the Guangdong Provincial Government and upstream areas of the Dongjiang River, the compensation scheme between Xinanjiang River areas and the Zhejiang Provincial Government. The key policy measures are fiscal transfers between municipal governments or the integration of relative channels of capital for compensated areas. Meanwhile, some market-based instruments of eco-compensation are being explored at local government levels, such as water resource transaction mechanisms. There is the successful case of water use rights transactions between Dongyang City and Yiwu City in Zhejiang Province. The incremental cost of increasing the supply of drinking water for Yiwu City via reservoir construction is estimated to be RMB 6/m³ water. However, the cost is estimated to be only RMB 1/m³ via a water-saving project in upstream Dongyang City. As such, Yiwu City decided to purchase from Dongyang City the permanent rights to 50 million cubic meters of water from the Hengjin Reservoir in Dongyang City. Similar arrangements are being developed in Ningxia Hui Autonomous Region and Inner Mongolia Autonomous Region.

Added to this, a “development relocation” eco-compensation scheme has been initiated in Zhejiang and Guangdong Provinces. In order to avoid upstream pollution and to offset the opportunity cost of foregone production of upstream areas like Panan County, the *Jin Pan Economic Development Area for Poverty Reduction* has been established in Jinhua City of Zhejiang Province. As the production base of Panan County, the government of Jinhua City has created a package of preferential policies for this economic development area. As a result, this area’s industry value increased to 0.5 billion yuan in 2003 from the production, accounting for 40% of the total financial revenue of Panan County. There are five similar cases in Zhejiang Province, some of which have been carried out and others which are about to be implemented.

3.2.3 Mineral resource development eco-compensation

Since the early 1980s, the Chinese government levied mineral resource taxes in order to create incentives for efficient and equitable resource exploitation. The

Mineral Resource Compensation Fee was charged for the purpose of mineral exploration, development and the protection of state mineral resources rights. Although the compensation fees have been used for environmental restoration at central and local levels, eco-compensation issues were only given minor consideration in policy making. In particular, the Rules for Implementation of the Mineral Resources Law of the People's Republic of China (issued in 1997) stipulate specific responsibilities for mineral developers regarding water and soil conservation and restoration and environmental protection. Under these Rules, the mineral restoration fees should be handed in to the relative departments as performance bonds by mineral developers. Taking Guangxi Zhuang Autonomous Region as an example, these performance bonds (a.k.a. "mineral deposit") were used to create incentives for enterprises to minimize impacts and restore the ecological damage from their activities. If an enterprise doesn't take such measures to minimize and restore damage, the government can use this mineral deposit to hire special company to complete it. Thus, this can be viewed as a type of eco-compensation.

In many places, eco-compensation fees are levied depending on of the total quantity of mineral resource exploration or proportion of the turnover, the funds are used for treatment of eco-environment problems. As a successful case of eco-compensation, the government of Zhejiang has taken two approaches to deal with both newly built and existing mines. For newly built mines, a fund for environmental restoration is set up based on the compensation standard of cost per area of mining for offsetting environmental damage combined with the principle of "whoever exploits protects, whoever damages treats". For abandoned mines, use of this mechanism is based on the principle of "whoever benefits treats". If there are no beneficiaries, or these are hard to define, government then funds and implements environmental restoration of the abandoned mine.

3.2.4 Regional Eco-compensation

At the national level, in the early of 1980s the central government started a number of large-scale ecological construction programs. These include the National Forest Protection Program, the Sloping Land Conversion Program, the Desertification Combating Program around Beijing, the Key Shelterbelt Development Programs in the Three North Region and the Middle and Lower Reaches of the Yangtze River, the Wildlife Conservation and Nature Reserve Development Program, and the Industrial Forest Plantation Development Program. All of above programs have the definite objectives of eco-compensation, and

represent hundreds of billions of RMB in investment. The state budget for western area infrastructural construction increased by 220 billion RMB between 2000 and 2003, accounting for 37% of total government bonds in the four years. Fiscal transfers dramatically increased from RMB 5.3 billion in 2000, to RMB 17 billion in 2003, to RMB 45 billion in 2004. Central government capital used for West China infrastructural construction increased from RMB 17 billion in 2000 to RMB 24 billion in 2003. The state budget on poverty reduction in West China is about RMB 17.5 billion. Although these fiscal transfers and development and assistance policies have not taken eco-compensation into consideration and are seldom used for ecological construction and protection, the Chinese government has said that it has compensated western areas for the opportunity cost of foregone economic development due to environmental protection and historical ecological environmental problems. In addition, the above mentioned six ecological programs belong to a kind of eco-compensation for long-term ecosystem degradation.

3.2.5 Local Practices on Eco-compensation

Zhejiang province is the first one to implement eco-compensation system in China. In Au 2005, the provincial government enacted “Notions for further perfection of eco-compensation mechanism”, and set up the basic principles for establishing the mechanism, i.e., “whoever benefits treats, whoever damages treats”, “making overall plans, co-development”, “development step by step, putting the difficult one at the first and the earliest one at the last”, and “implementing the mechanism simultaneously and moving forward rationally”. The major measures include: perfecting the public financial system, structural readjusting and optimizing financial payout, enhancing eco-compensation in financial transferring; stressing management system of resource fee levies for proper compensation, exploring method of eco-compensation to support development of less developed regions; emphasizing environmental treatment, establishing economic compensation system for polluters pay; exploring market based mechanism and bringing all actors into environmental protection and ecological construction. At the implementation level, the provincial government is responsible for compensation of eight inter-regional watersheds, and the municipal and county governments pay attention to eco-compensation within their regions. At present, six cities including Hangzhou city (the provincial capital) are working on eco-compensation mechanism and related implementation issues at local levels.

Although several successful initiatives had been carried out at national, regional

and local levels, significant research still needs to be done on their theoretical underpinnings and practical implementation. Current challenges include the following: lack of a commonly-agreed-upon definition of “eco-compensation”; the gap between the theory and practice of eco-compensation mechanisms; the need to improve the scientific understanding of ecosystem services and basis for compensation standards; the need to develop more sources of finance for these schemes; stakeholders’ lack of information and human capital to implement these schemes; the existence of significant institutional constraints; the lack of a legal framework for accurately addressing society’s and the economy’s needs.

4 General Framework and Key Fields of Eco-compensation

4.1 General Framework and Key Fields of Eco-compensation

The Chinese government has been tentatively experimenting with eco-compensation for decades. The institutional framework of eco-compensation need to be established among the multi-departments with different temporal and spatial scales. There have been existing different compensation actors (Table 1). In a view of geographical scale, the issue of eco-compensation can be grouped into two types: eco-compensation at international and national levels. The international eco-compensation issue includes global forest and biodiversity conservation, pollutant transfer (industry, products and pollutants), etc.

Table 1. The regions, types, contents and methods of eco-compensation

Region	Types	Contents	Methods
International	Ecological and environmental issues at global, regional and national levels	Forest and biodiversity conservation, pollutant transfer, green-house gas emission, trans-border rivers etc.	Global purchase under multi-concession; Eco-compensation under regional and bilateral agreement; Market trading at global, regional and national scales.
National	Watershed	Compensation between upstream and downstream	negotiation at local level
		Compensation of cross-provincial boundary medium watershed	Fiscal transfer
	Compensation of small watershed at local level	Market transaction	
	Ecosystem services	forest	Fiscal transfer of the State
		grassland	Eco-compensation fund;
		wetland	

		nature reserve	market transaction enterprises participation
		ocean	
		agriculture	
	Important eco-function zones	Water conservation Biodiversity conservation soil and water conservation, flood control ...	Public finance; NGO's donation; Private enterprises participation
	Natural resources exploitation	Reclaim wasteland Vegetation rehabilitation	Beneficiary pays; Damager pays; Developer pays

The important areas of eco-compensation should be set thoughtfully based on the need of practice and the foundation of implementation. Meanwhile, we can, according to the range of responsibility, set down a clear priority field for which the government promotes the establishment of mechanism, i.e. eco-compensation mechanism of forest, grassland, wetland, important eco-function zones, development of mineral resources and cross-boundary medium watershed the central government focuses on. Local governments are responsible for establishing eco-compensation of urban water source and local small watershed within their administrative districts and cooperate with the central government in establishing eco-compensation of cross-boundary medium watershed. Specially, considering the regional and important eco-function zones compensation, such factors should be noticed as the difference of different regions and ecosystems, and the contribution of different elements, etc.

4.2 Principal Parts and Basic principles of Eco-compensation

The principal parts should be identified in accordance with the responsibilities and roles of the stakeholders involving in the ecological conservation or damages. The following three principles could be applied for compensation:

4.2.1 Damager Pays Principle

Damager Pays Principle (DPP) means that the damager should take the responsibility for the negative impact of his activities on ecosystem. This principle is appropriate for solving regional ecological problems.

4.2.2 User Pays Principle

The User Pays Principle (UPP) refers to the users of environmental resources should compensate the state or the public representatives for using the scarce resources. The UPP could be embodied in other ecological management fields at different scales, such as taxation of arable land occupation, cutting trees and

non-wood resources, mineral resource exploration, the enterprises should pay for resource use fees after getting permission for the use.

4.2.3 Beneficiary Pays Principle (BPP)

According to the principle, the beneficiary should pay the provider for ecological services at upstream and downstream. For the majority of ecosystem services that are “public goods”, the establishment of eco-compensation requires support from the governments. The government should make extraordinary efforts to protect natural reserves which play important roles in ecological security of the country, such as upstream, wind-break and sand-fixing areas, flood regulation areas etc. Moreover, international society shall bear responsibility, and the common resources inter- or intra- regions should be compensated by the beneficiaries in accordance with the benefit gained.

4.2.4 Compensation to the protectors

Those groups and individuals who contribute to the ecological construction should be compensated according to their investment and opportunity cost.

4.3 Methods and Basis for Determination of Compensation Standards

Compensation standards could be determined following those four values: investment of the protectors and opportunity cost, gains of the beneficiaries, rehabilitation cost of the damages, and ecosystem services.

4.3.1 Direct investment and opportunity cost of the protectors

Investment of the protectors in terms of human resources, materials and capita resources should be taken into consideration while making compensation standards. Apart from this, opportunity cost of the protectors should also be considered. In theory, the sum of direct investment and opportunity cost should be the base-line for setting the standard.

4.3.2 Gains of the Beneficiaries

A positive externality results when the benefits of conservation activities are not fully received by those who involve in these activities (e.g. if beneficiaries freely use ecological services and products without any payment). In order to internalize such externality, beneficiaries should pay full amount for ecological service providers. Thus, the eco-compensation standards can be accounted via the price and volume of market transaction.

It is simple to set the standard through market trades. Meanwhile, it initiates protector to takes good advantages of new technique to cut down the protection cost, creating a virtuous circle and promoting ecological protection.

4.3.3 Cost for rehabilitation of the damages

Resource development can cause biodiversity extinction, water loss & soil erosion, water resources and environmental pollution, and affect certain ecosystem services such as water conservation, soil and water conservation, climate regulation, etc. Thus according to the damager treats principle, the cost of pollution treatment and ecological restoration should be paid.

4.3.4 Value of Ecosystem Services

Evaluation of ecosystem services is used to calculate the value of water conservation, soil and water conservation, climate regulation, biodiversity conservation, landscape beautification, etc. Many studies on the evaluation method have been done in China and abroad. However, due to lack of standard for indicator selection and valuation of the services, as well as the huge gap between ecosystem service values and compensation capacity, the evaluation result could only be considered as theoretical ceiling values for compensation.

Practical standard could be determined through Game-negotiation and in accordance with the real situation of the country and the regions, for instance, levels of economic development and ecological deterioration, and dynamic adjustment is needed with consideration of ecological conservation and socio-economic development.

4.4 Approach and Methods of Eco-compensation

There are several means and methods for the eco-compensation. According to the compensation methods, it should be divided into compensation in cash, compensation in kind, compensation via appropriate policies and compensation via appropriate technologies and knowledge; and according to the spatial distribution of compensation, into horizontal and vertical compensation; according to spatial size, into environmental elements compensation, regional and international compensation. And implementation bodies and their operational mechanism are cores determining the chief characters of eco-compensation method, and it can be generally categorized into two types namely government compensation and market compensation.

4.4.1 Government compensation

The government compensation mechanism is the most important and an easily to be implemented type in China currently. The government compensation mechanism considers the government or the upper level governments as the provider, and the regional and local governments and stakeholders as the compensation receivers. It aims to ensure the national ecological security, social stability, regional

coordinated development, and adopts the financial subsidy, policy support, project implementation, taxation reform and talent input as the compensation methods. The government compensation mechanism includes financial transfer payment, policy support with regional differences, ecological protection projects and environmental taxation system.

4.4.2 Market compensation

The objects of the trade could be the property of the ecological and environmental elements, the ecosystem services, or the performance or quota of the environment pollution treatment. A typical market compensation mechanism includes the government payment, one-to-one transaction, market trade and ecological marks, etc.

5 Pilot Study in Selected Key Fields

5.1 Watershed Eco-compensation

Recently, a lot of money, materials and labor have been invested to protect watershed environment in order to ensure watershed ecological security and sustainable use of water resources. However, in upper reaches of most of the rivers in China is poor in economy and fragility in ecosystem, and the people living in those regions eagerly need to be alleviated from poverty strike, so there exists conflict between economic development and environmental protection in such areas. Thus, to establish watershed eco-compensation mechanism is helpful to deal with ecological and economic relationship between upstream and downstream to promote economic development and environment protection of upper reaches and realize sustainable development of the whole watershed.

The key to establish watershed eco-compensation lies in straightening the relation among the responsible bodies. The relations vary by different watershed scales. Therefore, the establishment of China's eco-compensation will differ in accordance with the watershed scales. But the design of watershed eco-compensation follows the same procedures, i.e., firstly, to determine the watershed scale; secondly, to determine the stakeholders of the watershed—the responsible bodies; thirdly, to calculate the compensation standard on the basis of investment and development opportunity cost of the upper reaches due to ecological protection, or to construct a platform for the parties to negotiate and come up with a compensation standard; fourthly, to choose proper eco-compensation method; fifthly, to design watershed eco-compensation policies.

The principal parts in watershed eco-compensation include beneficiaries who benefit from water uses, and individuals or enterprises who bring negative impacts on either quantity or quality of water through contamination drainage. And the receivers of watershed eco-compensation are those contributing to environment protection and sustainable use of water resources and living in the upstream and surrounding areas.

The methods of watershed eco-compensation include cash compensation, compensation in kind and policy compensation, etc.

Approaches for watershed eco-compensation are: levying tax for watershed eco-compensation, watershed eco-compensation fund, preferential credit, and overseas capital and program aid. It is obvious that the watershed eco-compensation in China is mainly carried out through government investment and only a small fraction of the investment are from private sectors. And market-based eco-compensation is at its early stage and scattered in some areas, and it is believed that market-based compensation would become an effective means of compensation in China.

Standard determination should consider the three aspects: (1) direct investment of the upstream region for ensuring water quantity and quality, including water resources reservation, treatment of environmental pollution and non-point agri-pollution, construction of urban water treatment plants, and investment in irrigation facility construction, etc. (2) indirect investment or the opportunity cost including investment in water saving, allocation of migrants, and loss in limiting industrial development, and (3) the cost of newly constructed infrastructure for water purification and water quantity guarantee such as irrigation facility, environmental protection program, which should be compensated by the downstream according to water quantity provided and the gap of economic development between the upper and down streams.

5.2 Mineral Eco-compensation

Mineral resources are indispensable raw materials for agricultural and industrial production and social-economic development. The extraction and utilization of the mineral resources promotes economic development of China. At the same time, it also leads to serious environmental problems. Therefore, it is urgent to regulate the relations between ecological damage and protection. Although some relevant researches have been carried out in China, there are no specific rules and regulations on ecological compensation, no unified and standard management systems and

compensation policy.

The overall method of establishing mineral resources eco-compensation is with reference of foreign experience and the practical situation in China, to make clear the providers and their responsibilities by taking into consideration of the previous damage and the new damage made.

The previous damage is to be taken charge by the government through establishment of Abandoned Mines Reclamation Fund. And the capital source involved includes fiscal appropriations and the Abandoned Mines Ecological Restoration Fee. The new damage must have to be burdened by the mining enterprises by granting mining licenses and paying for the ecological compensation bond. The mining enterprises should not only pay for the abandoned mines, but also the ecological compensation bond and the planning of ecological rehabilitation.

There are two forms of compensation for damaged ecological environment: cash and rehabilitation. Cash compensation is for the direct damages caused by coal exploration such as damages of on-ground objects, personnel reallocation and land occupation etc, and rehabilitation compensation is for the enterprises to rehabilitate the damaged environment back to the original state including direct rehabilitation by the enterprises and government projects.

Therefore, the mines eco-compensation fund consists of two parts: "Abandoned mines ecological restoration fund" and "Mines Ecological Compensation Bond". The first one operates in a way that the local environmental departments or bureau of land and resources levies funds for the "Abandoned mines ecological restoration fund" and forwards it to the center government, who will establish a special account and use the fund as an earmarked fund. The second one works in a way that the mining enterprises transfers the "Mines Ecological Compensation Bond" directly to the state or opens a special bank account and put the fund in, the use of the funds will be monitored by the center government.

The standard of eco-compensation should be determined based on the cost of rehabilitation. It is feasible and reasonable as it could not only protect and restore ecosystem and environment, but also protect the basic right of victims.

5.3 Forest Eco-compensation

Forest is one of the most important terrestrial ecosystems on the earth. Apart from provision of timber and other goods, forests have vital effect on the environment and provide significant ecological services for the people. However, a larger part of the value of those ecological services could not be realized via market

transactions. The only way is to internalize the external economy of forest ecological effects for partially or completely realize the values of forest ecosystem.

The study on forest eco-compensation is proved as the earliest one in the field of eco-compensation in China and lots of experience obtained is used by the other sectors. The problems remain are unclear definition of the concept, insufficient coverage, low standard for compensation, single capita source and lack of a long term compensation mechanism, etc.

According to “Management of funds for forest ecological effect compensation” issued by the State Bureau of Forest and the Ministry of Finance, the ecological benefit forest should be compensated including agroforest and special usage forest. At present, the total area of ecological effect forest is 0.104 billion ha (0.055 billion ha out of which is non-natural forest), but only 0.026 billion has been compensated by 2005. The government program such as natural forest protection and grain for green do play important role in forest eco-compensation, however, after termination of those programs, there would be no proper means to encourage the farmers to conserve the forest and prevent them from damaging the forest. Therefore, the up-coming eco-compensation mechanism shall integrate those three programs into a fund for forest eco-compensation, adopt a good fund management system and establish a long term mechanism.

The standard of forest eco-compensation should be established scientifically based on direct expense of plantation, opportunity cost for forests protection and benefits from forest ecosystem services. And the regional difference, forest types and tree species, plantation methods and the level of economic development should be taken into consideration. Recently, the standard for forest compensation is only RMB 75 /ha. It is only a subsidy from the government. Based on a research result, the value of forest ecosystem is far more than the wood itself (normally it is 5-25 times of the wood’s value), if taking 10 times as an example, the compensation standard reaches 19800 RMB/ha/yr, which is unreachable in reality and could be considered only as an ceiling standard or value for compensation. The standard based on cost of forestation and opportunity cost is 4300 RMB/ha/yr and 2350 RMB/ha/yr for planned forest and existing one respectively, which could be considered as the base-line standard of eco-compensation. The standard could be increased on the basis of financial capacity with consideration of regional characters, forest types, plantation methods and regional difference in economic development.

As for the approach and method of forest ecological effect, governmental

financial transfer should be enhanced, the fiscal transfer payment for forest eco-compensation should be increased, the multiple financing channels should be developed and the system of “Ecological Taxation” should be established. The forest ecological benefit is public goods. For this reason, the government should take a leading role in compensating the cost for provision of forest ecological effects, maintaining reproduction function of ecological products for maximization of the benefit. The levy objects should include those gaining forest ecological benefits (organizations, enterprises and individuals). The levy would cover the large or medium sized reservoirs, hydroelectric plants, water plants, scenic tour spots relied on the forest landscape, the water shipping companies, fresh-water aquiculture, wildlife hunting in the forest, and coal mines in and nearby the forest region

5.4 Nature Reserve Eco-compensation

China is one of the countries with the richest biodiversity in the world. Therefore, it has been awarded the title of “the great nation of biodiversity” and “the spot of biodiversity in the world” by international natural protection organizations. In the meantime, China also faces the serious threats arose from the pressure of the largest population and the rapidest economic development. Vegetation degradation, biological invasion, overuse of the wild resources, exhausting of the water resources and the desertification lead to dozens of the wild species to the endangered verge. The establishment of nature reserve is one of the most important measures to conserve biodiversity and recover the ecological functions. But at the same time, to some extent, the establishment of nature reserve also has an adverse effect on the traditional production activity and life style of local people. So, a basic question in the management of nature reserve at present is how to coordinate and solve the contradiction between the nature protection and regional economic development.

Eco-compensation approaches for the natural reserves mainly include government purchase, government transfer payment, preferential policy, exemption of taxation, offering subsidies, exclusive funds, industry-based and region-based compensation mechanisms, project-based compensation and the support from the international society.

The compensation standard should be calculated based on the evaluation of the ecosystem services, the cost for reserves’ conservation and the loss due to protection activities.

According to case studies in natural forest reserve of Hainan province, Poyang Lake nature reserve of Jiangxi province, Xilinguole grassland ecosystem functioning

reserve of Inner Mongolia, we advocate that RMB 8250/ha can be used as a reference for eco-compensation in natural forest reserve of Hainan province, 11250 RMB 8250/ha or RMB 3300 per household for Poyang Lake nature reserve and RMB 8000 per household for Xilinguole grassland ecosystem functioning reserve.

The following table shows the outcome of pilot study in selected key fields:

Tab 3. Pilot Study in Selected Key Fields

	Watershed	Mineral resource	Forest	Nature reserve
Subject	Communities benefiting from water uses, Individuals and enterprises draining contaminate to watershed, Responsibility & obligation of the stakeholders is determined based on the size and range of the watershed.	The government is responsible for eco-compensation of abandoned mines via establishing rehabilitation funds, and the mine owner is responsible for the post law damage.	Protectors of forest resources (government, enterprises and individuals), All beneficiaries of forests ecological benefits (organizations, enterprises and individuals), Damagers of forest resources (enterprises and individuals)	Government purchases ecosystem services of nature reserves, Development of the natural reserves under the role of conservation, all beneficiaries pay (organizations, enterprises and individuals)
Approach	The government sets up a platform for negotiation of the stakeholders. Public payment, one-to-one trading, compensation in kind, policy compensation, talent compensation and ecological marks are methods for compensation.	Capital compensation, rehabilitation project	Fiscal transfer payment Tax reduction Immigration subsidy Market trading Ecological marks	Government purchases, fiscal transfer payment, policy compensation, tax mitigation, subsidy allocation, preferential credit, eco-compensation fund, project compensation, international support.
Capital sources	Tax for watershed eco-compensation, watershed eco-compensation fund, preferential credit, overseas capital and program aid	Fiscal appropriations from the government for rehabilitation, Abandoned mines ecological compensation fund from the owner, Mines ecological	To maintain and increase investment in key ecological construction, to add earmarked funds for eco-conservation, to develop the multiple financing channels, to establish the system of	Fiscal appropriations, multiple financing channels (NGOs, volunteers)

		compensation bond	“Ecological Taxation”	
Standard	Direct investment and opportunity cost of upstream regions, cost of newly constructed infrastructure for environmental protection, and water quantity and quality received by the beneficiaries.	The value of damages on ecosystem, environment and natural resources, the cost of environment rehabilitation	Direct expense of plantation , opportunity cost for forests protection, and benefits from forest ecosystem services for planned and existing forest.	Ecosystem services, protection cost, damage loss.

6 Policy Recommendations for Implementation of Eco-compensation Mechanism

6.1 Establishing and perfecting the legislation process of eco-compensation step by step

The field survey shows that it is imperative to accelerate the eco-compensation legislation process in order to identify the scope, targets, means and standards for eco-compensation under the framework of law. Considering complexity of law making procedures and urgent need of eco-compensation implementation, it is suggested that three steps should be adopted in the process of eco-compensation legislation. Firstly, before the eco-compensation law is being enacted, an eco-compensation implementation policy guideline should be formulated by the State Council. Secondly, based on the policy guideline and nationwide practice, the policy guideline would be revised and finalized as “eco-compensation statute”. Thirdly, on the basis of the second stage of work, “the eco-compensation statute” would be upgrade and finally enacted as “the eco-compensation law”.

The purposes of enacting “the eco-compensation law” is to regulate eco-compensation actions, unify eco-compensation management, and shape an authoritative, efficient and normative eco-compensation mechanism, lay a legal foundation for eco-compensation implementation, and push forward the eco-compensation implementation towards right track. The five principles that should be followed while making the law are:

- (1) **Sustainable development.** To associate economic development with

eco-restoration, and strengthen ecological conservation and restoration while promoting socio-economic development, and ultimately realize a coordinated development between socio-economy and eco-protection.

(2) **Adjustment of measures to local conditions, and provision of compensation by types.** To provide eco-compensation in accordance with local conditions and ecological types, and eco-compensation plan would have to accord with the national eco-restoration arrangement and socio-economic development plan.

(3) **Adjustment of measures to temporal dimension, and promotion of eco-compensation by phases.** To make eco-compensation framework by taking into consideration of temporal scales, and the overall objective and specific objectives with time line should be reflected in the framework. A “Three Step” strategy could be adopted for eco-compensation, i.e., perfect phase of eco-funds, collateral phase between eco-fund and eco-tax, and eco-tax phase. The Steps could be completed by 2020 when the country moves into a well-off society after implementation of the three five-year plans, or 15 years. It is expected that a perfect eco-compensation mechanism could take effect by then.

(4) **Unification of the plan and its implementation by sectors.** To ensure a successful fulfillment of eco-compensation mechanism, the formulation of an “overall eco-compensation plan” should be based on the same ground. The governmental departments should be encouraged to participate in the process, and implement the plan according to their actual situation.

(5) **Pilot study associated with a step-by-step demonstration.** To conduct pilot studies wherever necessary, and explore relevant laws, regulations and standards for an effective eco-restoration management system, and financial management system. And relevant roles and regulations should be in place, and their operations be regulated for a large scale demonstration.

6.2 Dealing with several important relations in eco-compensation

(1) **Relations between the Central Government and local governments.** The Central Government should provide policy guidance, legislative basis and financial support for local governments for establishing eco-compensation mechanism. It would also have to guide the local governments to formulate, at the first place, country wide and regional wide, inter-watershed eco-compensation mechanism. It is widely accepted that local governments are the main actors in formulating and implementing of the mechanism.

(2) **Relations between government and market.** Both the government and

market play an important role in establishment of eco-compensation mechanism. However, based on the ecological conservation status and market development in China, the government plays a key role in establishing eco-compensation mechanism including policy and law, and provides support for a large scale eco-compensation. Only in some cases where providers and receivers of the compensation have been clearly identified, eco-compensation could be implemented via market approach.

(3) Relations between eco-compensation and poverty alleviation. Eco-compensation differentiates with poverty alleviation. And eco-compensation is not for social equality and narrowing the gap between the rich and the poor. A mixture of eco-compensation and poverty alleviation would lead to an increasing damage of ecosystems. It is vital to establish a coordination and interaction mechanism between the key protection areas and beneficial areas, and guide the beneficial areas to provide socio-economic support to protection areas.

(4) Relations between “blood generating” and “blood transmitting”. “Blood generating” kind of compensation should be encouraged through initiating of eco-conservation and capacity rising programs, while “blood transmitting” kind of compensation could be applied for the ordinary people.

(5) Relations between the new funds and the previous funds. The priority should be given to solve the problem existing in the new funds. Only on the basis of successful management of the new funds, can the previous ones be solved. The local governments and enterprises shoulder responsibility for the new funds, while the previous funds should be solved by the central government.

(6) Relations between integrated and sectoral platforms. An integrated eco-compensation platform dominated by the government should be established for an effective operation. However, various platforms should be encouraged at the local levels for exploration of various types of eco-compensation, particularly those related to forest, mineral resources, irrigation and environmental protection. An integrated and earmarked eco-compensation fund should also be ready and managed by different sectors via specific accounts for an effective and active participation of the departments involved in.

6.3 Enhancing efforts for financial transferring, and increasing funding via various sources

(1) To establish eco-conservation oriented financial transferring system. It is a direct and ease mean for eco-compensation. But environmental impact should

share a high weight and the investment in ecologically fragile and the key protection regions should be further increased. Following equality and common service principle, financial transfer to the western regions should be increased, and for the areas with ecological importance (e.g., natural reserves) or containing ecological key elements (e.g., ecological forest), purchasing by the State could be encouraged for a long term investment mechanism in ecological important regions for socio-economic development and improvement of living standard of local people.

(2) **To encourage the local governments to support eco-compensation.** The local governments should not only guide the establishment of eco-compensation within their administrative border, but also support national eco-compensation programs based on their financial capacity.

(3) **To complete financial policy system of eco-compensation and develop the multiple financing channels.** The government means remains as a key one of eco-compensation in China, and market approach should be further explored. A eco-compensation mechanism with consideration of people's demand for ecological services, public's willingness to pay, strengthening the initiatives of private enterprises, intensifying the communication with financial department, seeking the technique support of relative experts and establishing special fund donated by international NGOs should be set up for a diversified compensation approach.

6.4 Improving the management mechanism of eco-compensation

For the meantime, it is urgent to strengthen eco-compensation work and integrating projects related to eco-compensation within departments and administrative borders. The eco-compensation work across the departments and boundary should be carried out through negotiation with the coordination of the upper level organizations.

For the long run, it is necessary to establish an eco-compensation management committee/group under the leadership of the State Council. And it could comprise relevant ministries, such as the Commission for Development and Reform, the Ministry of Finance, the Bureau of environmental Protection, the Bureau of Forestry, The Ministry of Irrigation, and the Ministry of Agriculture, for coordination, supervision, arbitration, reward and punishment. Several office could be established under the umbra of the committee as line offices, and a Technical Consultative Commission consisting of experts should be set up for policy and technical consultancy.

Wherever necessary, formulating local management committee/group in line

with the national one.

6.5 Raising stakeholders' awareness of eco-compensation and encouraging their active participation through broad propaganda and education programs

A great attention and support to eco-compensation must be paid by the whole society. It is suggested that a series of activities related to propaganda and scientific education on eco-compensation must be conducted to raise public awareness; to clarify the relevant policies; to encourage the public actively participating in eco-compensation. Community is the lowest and basic unit for implementation of eco-compensation mechanism. The success of eco-compensation depends directly on the knowledge, perceptions and willingness of community residents. Therefore, in the process of policy making and planning, the public participation should be encouraged and the way of "learning by doing, improving in practice" should be adopted. In the poor areas where are short of professionals and financial supports, relevant international projects should be used as a platform for capacity building of governmental agencies and local communities to promote natural protection. The targets for capacity building should also include decision makers, planners, managerial personnel and enterprise managers.

6.6 Enhancing scientific research and pilot study eco-compensation

Eco-compensation mechanism is a new research field with features of complexity and long-term tasks. It covers ecological protection and reconstruction and collection and utilization of relevant funds. Eco-compensation mechanism is at its early stage in China due to a low level economic development and conflicts between economic development and ecological conservation. It is therefore suggested to integrate eco-compensation issues into national key scientific research plan, for instance, techniques for eco-compensation standard, accounting of physical values of ecosystem services, conjunction of ecosystem services and eco-compensation, targets, standards, methods of eco-compensation, as well as ecological impact assessment of the resource development and key projects, etc. Moreover, ecological monitoring system research should be stressed in order to provide technical support to establish an effective eco-compensation mechanism.

Meanwhile, implementation via pilot studies should be enhanced positively. Based on the previous work and practices, every department should carry out pilot

studies, establish eco-compensation mechanism and refine related policies actively.