
Payment for Ecosystem Services in China: An Overview

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Abstract

To address the multiplying conservation challenges and resource constraints in face of breakneck economic growth, policymakers in China have become increasingly interested in developing new approaches in environmental policy. For this reason, Payment for Ecosystem Services (PES) is becoming a topic of discussion in society. This paper provides a general review of PES in China from both a theoretical and a practical perspective. It starts with an outline of relevant terms used by the international community, and is followed by a discussion of major components covered in PES for implementation, including basic principles, methods to determine compensation standards and approaches. The main PES programmes that have been implemented are presented. The paper reveals that PES in China has unique characteristics, compared to other countries, and that the necessary policy frameworks for developing PES and purely market-based instruments in China are rapidly taking shape. However, to successfully implement PES, the relations and conflicts between central government and local governments, between the government and the market, and between PES and poverty alleviation must be taken into consideration.

Keywords: ecosystem services, PES in China, PES programs, compensation

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1 Introduction

Due to the rapid development of China's economy, ecological and environmental problems have increasingly become bottlenecks, restricting the overall sustainability of the country's socio-economic development. The Chinese government has proposed a concept of scientific development with an emphasis on people-centred, integrated, coordinated and sustainable development. Special attention has been placed on ecological construction through various policies and means, which has contributed significantly to the improvement of ecological conditions in China. However, policies related to ecological conservation are not readily in place. In particular, economic policies for ecological construction are still lacking, leading to an unequal distribution of ecological benefit and economic benefit between protectors and beneficiaries, polluters and victims. Consequently, beneficiaries are gaining from ecological benefit without bearing the responsibilities and costs of deteriorating the ecosystem, whereas the protectors are not being offered the necessary economic incentives. In China, both purely public goods and the common pool of resources have the common issue of externality generated in the process of supply and consumption. Most ecosystem services are public goods (MEA, 2003) and rivalrous in consumption. For this reason, PES from the government is required to internalise the externality caused by consumption activities (Yu and Ren, 2007). Externality is divided into positive externality (external economical) and negative externality (external uneconomical). Positive externality refers to the fact that the production or consumption of some economic entity benefits other economic main bodies, albeit without gaining compensation from the latter, such as ecosystem conservation in nature reserves and upper reaches of river basins. Negative externality refers to the fact that the production or consumption of some economic entity damages other economic main bodies, albeit without providing compensation to the latter, such as environmental pollution by enterprises and the eco-environmental destruction caused in the process of mineral resources development. Negative externality also involves the damaging economic agent not incorporating the negative external costs into his economic decision-making. With respect to ecosystem services (ES) and PES, this implies the consumption of ES at unsustainable levels. As to the internalisation of externality, there are three different approaches in the economic circle: "Pigovian Tax", Coase's "Ownership" and PES (Pigou, 1932; CCICED, 2007).

The unique feature of most ecosystem services is that they are unaccounted for and unpriced, and therefore remain outside the domain of the market. Against this national backdrop, policymakers in China have become increasingly interested in developing new approaches in environmental policy to address the country's multiplying conservation challenges and resource constraints (Zhang *et al.*, 2010). This includes a growing number of programmes that are increasingly utilising Payments for Ecosystem Services (PES) schemes, in line with international trends towards applying PES primarily as a way to improve economic efficiency through market-based instruments to internalise environmental externalities (Engel *et al.*, 2008; Pagiola and Platais, 2007). The Chinese government has made the development of "PES schemes" a priority. The State Council release no. 39 [2005] entitled *State Council Decision Regarding Using the Scientific Development View to Strengthen Environmental Protection* states that the government "...should improve PES policy, and develop PES schemes as quickly as possible," (State Council, 2005, Section 23, sentence 7). China's *11th Five-year Guidelines* (2006–2010) call for innovation in environmental policy, and the development of PES pilots, and for policy-makers to quicken the pace of development of PES schemes, to develop intra-regional and watershed-related PES schemes, and to resolve funding issues regarding conservation. In response to the *11th Five-year Guidelines*, China's Ministry of Environmental Protection (MEP) issued *Guiding Opinions on the Development of Eco-compensation Pilot Work* (MEP, 2007), and set up prioritised fields for implementing PES.

This paper aims to review PES programmes in China. It starts with an introduction to the terms relevant to PES amongst scientific communities and decision-makers across the globe. This

is followed by general principles used in PES and a discussion of the major PES programmes that have been implemented in China, as well as future perspectives concerning PES. This paper will provide a basis for the scientific community to carry out further PES research and for policy-makers to review and improve their decision-making processes on the basis of previous experiences and lessons made.

2 Terms relevant to Payment for Ecosystem Services

Ecologists, environmentalists, social scientists, policy-makers, community leaders and others have used various terms to describe market-based instruments that reward the stewardship of ecosystem services benefiting “external” actors. When such programmes initially attracted significant attention in the 1990s, the predominant name was *payment for environmental services*. In recent years, however, critics have challenged both the *payments* and *environmental* components of this nomenclature (Engel *et al.*, 2008; Bennett, 2009). From an ecosystem point of view, ecosystems provide services that sustain, strengthen, and enrich various constituents of human well-being (Kumar and Muradian, 2009). To maintain a healthy ecosystem and, at the same time, to meet the basic requirements of human well-being, scientists have started studying payment for ecosystem services, which is often abbreviated to PES. Terms relevant to PES are as follows:

Ecosystem Services (ES): ES are the benefits people gain from ecosystems to sustain human well-being (MEA, 2003; Kumar and Muradian, 2009). These include provisioning services such as food and water; regulating services such as the regulation of floods, drought, land degradation and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious and other non-material benefits (Table 1). With regard to PES, all of these ES are taken into consideration.

Payment for Ecosystem Services (PES): PES is a type of market-based environmental policy instrument. Some of these instruments incorporate, to varying degrees, aspects of market-based approaches (Sterner, 2003). They can be essentially defined in terms of payments to land managers and others to undertake actions that increase the quantity and quality of desired ecosystem services, which benefit specific or general users, often remotely. PES, effectively, provide incentives to address market failure by altering the economic incentives faced by land managers or others who can affect the delivery of ecosystem services (CCICED, 2007). In this sense, it can be argued that PES fits within the broad category of market-based (economic) instruments that include taxes and charges, subsidies and tradable permits (DEFRA, 2010). PES is defined as a transaction between providers and beneficiaries of ecosystem services, using innovative instruments to manage and measure transactions between providers and beneficiaries of ecosystem services (Kumar and Muradian, 2009). PES has emerged as one of the most innovative and cost-effective responses to the management of ecosystem services. Payments have been successfully designed and executed for carbon, watershed services, genetic material and various other nutrients.

The basic idea behind PES schemes is that the users/beneficiaries of a service compensate the providers. Beyond this, PES can vary according to a number of characteristics, including:

- **Provision of ecosystem services**, which can be based on one specific service (e.g. carbon sequestration), and/or bundles of ecosystem services (e.g. carbon sequestration plus biodiversity enhancement) (CCICED, 2007).
- **Financing**, which can come from different sources, including: the government effectively purchasing on behalf of a large number of beneficiaries. For example, public benefits purchased through Environmental Stewardship relating to landscape and biodiversity on behalf of English public private companies and individuals, downstream water users paying for watershed management on upstream land (Berry, 2006; CCICED, 2007).

- **Payment approaches**, which can be classified into two main categories: output-based payments based directly on the delivery of ecosystem services (which can also be referred to as payments for results), and input-based payments for the adoption of particular land uses or land management practices that are expected to deliver additional ecosystem services and benefits (typical of many agri-environment subsidies).

Eco-compensation: Urgent needs for payment for ecosystem services in China have led to a wide range of policy and programme innovations, many under the broad heading of “eco-compensation”, which is a term directly translated from the Chinese word *shengtai buchang* into English. The term was officially defined for the first time by the China Council for International Cooperation on Environment and Development in 2007, in a research project on PES. It stated that eco-compensation is a type of institutional arrangement to protect and sustainably use ecosystem services, and to adjust the distribution of costs and benefits between different actors and stakeholders, mainly through economic measures (CCICED, 2007). In other words, eco-compensation schemes aim to protect the ecological environment and improve relations between man and nature. It is a public regulation that aims to adjust relations between the stakeholders involved in ecological conservation on the basis of ecosystem service values, costs of ecological conservation, opportunity costs, and via government means and market schemes.

Internalisation of externalities is the key to eco-compensation. The theories of Pigovian Tax and Coase Transaction cost have a high policy significance for eco-compensation schemes. In the current selection of policy approaches concerning eco-compensation, various policy measures have different adaptive conditions and scope, and are subdivided according to the property rights and equity considerations of public goods concerning the issues of eco-compensation and the extent of ownership. If the marginal transaction fee via governmental adjustment is lower than the marginal transaction fee via voluntary consultation, it is better to take the approach of Pigovian Tax, e.g., by levying an eco-tax (fee) on the beneficiaries and destroyers of the eco-function, so as to solve the compensation issue.

The Chinese term “eco-compensation schemes” (*buchang jizhi*) appears to encompass both PES-like policies that involve direct payments from the government to individual and community-level suppliers of ecosystem services, as well as policies that develop frameworks of cooperation between various levels of government for the financing and sharing of costs of environmental protection and restoration. Compared with the term PES, eco-compensation emphasises the more institutional and political aspects of payment. This is because in China, apart from policy approaches concerning eco-compensation, direct payment in terms of monetary or in-kind to protectors of ecosystem services is currently often made by governments, and the market mechanism is not yet fully functional. The growing use and importance of eco-compensation within China’s environmental policy framework is indicative of a greater emphasis not only on developing innovative market-based instruments for environmental policy, but also on resolving property rights and equity issues surrounding the use and protection of natural resources, which should be taken into consideration when creating eco-compensation schemes.

Although many Chinese policy and programme innovations relevant to PES fall under the broad heading of “eco-compensation”, for international audiences and reference, we have chosen to use the umbrella term “Payment for Ecosystem Services (PES)” in this paper, to refer to the wide range of compensation made to the providers of ecosystem services. These payment schemes are currently being shaped in China, and are often at different stages of development – ranging from one-off payments between the beneficiaries and providers of ecosystem services to cap-and-trade markets (CCICED, 2007).

Table 1: Ecosystem services and their constituents (MEA, 2003).

Service	Provisioning Services	Regulating Services	Cultural Services	Supporting Services
Explanation	<i>Products obtained from ecosystems</i>	<i>Benefits obtained from regulating ecosystem processes</i>	<i>Non-material benefits obtained from ecosystems</i>	<i>Services necessary for the production of all other ecosystem services</i>
Sub-category	<ul style="list-style-type: none"> • Food • Fresh water • Fuel wood • Fibre • Biochemicals • Genetic resources 	<ul style="list-style-type: none"> • Climate regulation • Disease regulation • Water regulation • Water purification 	<ul style="list-style-type: none"> • Spiritual and religious • Recreation and ecotourism • Aesthetic • Inspirational • Educational • Sense of place • Cultural heritage 	<ul style="list-style-type: none"> • Soil formation • Nutrient cycling • Primary production

3 Major components of PES schemes in China

The eco-compensation scheme comprises three key components: responsibility scheme, compensation criteria and compensation methods. The responsibility scheme defines the identities of and the responsibilities to be borne by the interested parties in the eco-compensation scheme. The responsibilities borne by the interested parties may be defined following the property right system and the PPP (Polluter Pays Principle), UPP (User Pays Principle) and BPP (Beneficiary Pays Principle) in addition to the specific requirements of the applicable laws (CCICED, 2007).

The compensation criteria may either be identified based on the evaluation and calculation of the cost of environmental treatment (i.e. input in environmental protection) (Bai *et al.*, 2008) and the loss caused to the ecological environment (the value of ecological services) (CCICED, 2007) or, as another option, through gaming and negotiations between both interested parties (Yu and Ren, 2007).

The methods and approaches of compensation may be defined in accordance with many systems. However, the key factors involved therein are the compensation subjects and operational schemes. Based on the difference between the subject and the operational schemes of such compensation, eco-compensation may fall into two major categories, i.e., government compensation and market compensation (Bennett, 2009; Yin, 2009).

3.1 Basic financial principles for PES schemes

The principle parts of PES have been identified in accordance with the responsibilities and roles of the stakeholders involving in ecological conservation or damage. The following principles have been applied for PES in China (CCICED, 2007):

- *Damager Pays Principle (DPP)*: Here the damager should take responsibility for the negative impact of his activities on the ecosystem and pay for the rehabilitation of damaged ecosystems.
- *User Pays Principle (UPP)*: This refers to users of environmental resources having to compensate the state or public representatives for using scarce resources due to their public ownership. The principle could be embodied in other ecological management fields at different scales, such as the taxation of individuals for arable land occupation, cutting trees and non-wood resources, mineral resource exploration; the enterprises should pay resource use fees after obtaining permission for use.
- *Beneficiary Pays Principle (BPP)*: The beneficiary should pay the provider for ecological services at upstream and downstream locations. For the majority of ecosystem services that are “public goods”, the establishment of PES requires governmental support. The government should take great pains to protect natural reserves that play an important role in the ecological security of the country, such as upstream, wind-break and sand-fixing areas, flood regulation areas, etc. However, BPP is broader in coverage than the UPP principle in the sense that, in some cases, benefits do not need to be derived from the use of resources; for instance, benefits gained could be clear air and landscape amenities generated due to ecosystem conservation by other individuals.
- *Compensation to the protectors*: Those groups and individuals who contribute to ecological construction should be compensated according to their investment and opportunity costs, the benefits provided by ES, beneficiaries’ gains and the rehabilitation cost of damage.
- *Property rights*: Within the context of the mainstream conceptual basis for PES, i.e. Coasean economics, eco-compensation in fact attempts to reduce transaction costs by allocating property rights and establishing bargaining processes between those who provide the services and those who are willing to maintain or enhance the provision of such services through a payment (i.e. buyers of services) (Muradian *et al.*, 2010; Pascual *et al.*, 2010). In the Chinese context, property rights are closely related to land use rights and the right to commercialise services generated from land resources, such as payment for the conversion of crop land into grass and forest to improve ecosystem services and functions.

3.2 Determination of compensation standards

Compensation standards could be determined in accordance with four values: investment by protectors and opportunity costs, beneficiaries’ gains, rehabilitation costs of damage and the value of the ecosystem services.

- *Direct investment and opportunity costs incurred by protectors*: Protectors’ investments in terms of human resources, materials and capita resources should be taken into consideration when devising compensation standards. In addition, the opportunity costs of protectors should also be considered. In theory, the sum of direct investment and opportunity costs should be the base-line for setting the standard (CCICED, 2007).
- *Beneficiaries’ gains*: A positive externality results when the benefits of conservation activities are not fully received by those involved in these activities (e.g. if beneficiaries have free use of ecological services and products without payment) (Li and Liu, 2010). In order to internalise such externality, beneficiaries should pay the full amount for ecological service providers. Thus, eco-compensation standards can be accounted for via the price and volume of market transactions.

- *Costs of rehabilitating damage:* Resource development can cause biodiversity extinction, water loss, soil erosion and water pollution, and can affect ecosystem services such as soil and water conservation, climate regulation, etc. The costs incurred for pollution treatment and ecological restoration should therefore be paid.
- *Value of ecosystem services:* Evaluation of ecosystem services is used to calculate the value of soil and water conservation, climate regulation, biodiversity conservation, landscape beauty, etc. Many studies on the evaluation method have been carried out both in China and abroad. However, due to lack of standards for indicator selection and the valuation of the services, as well as the fact that ecosystem service values are much higher than compensation capacity, the evaluation results could only be considered as theoretical ceiling values when setting compensation standards (CCICED, 2007).

A practical standard could be determined through negotiation amongst stakeholders and in accordance with the real situation in the country and its regions, for instance, levels of economic development and ecological deterioration, and dynamic adjustment is required that takes into account ecological conservation and socio-economic development.

3.3 Approach for PES

According to the compensation methods, major approaches can be divided into compensation in cash, compensation in kind, compensation via appropriate policies and compensation via appropriate technologies and knowledge (Zhen *et al.*, 2010; Li *et al.*, 2011). Implementation bodies and their operational schemes are key to determining the chief characters of compensation methods, which can generally be categorised into two types: government compensation and market compensation.

- *Government compensation:* The government compensation scheme is currently the most important and easily implementable type in China. The government identifies who should be compensated and how much should be paid by taking the provision and protection of ecosystem services into account. It aims to ensure national ecological security, social stability and regionally coordinated development, and adopts the financial subsidy, policy support, project implementation, taxation reform and talent input as the compensation methods. The government compensation scheme includes financial transfer payment, policy support with regional differences, ecological protection projects and an environmental taxation system.
- *Market compensation:* The objects of market compensation could be the property of the ecological and environmental elements, ecosystem services or the performance or quota of the environment pollution treatment. Pigou (1932) theorised that market schemes, such as taxes and subsidies, could be used to align private and social costs and benefits in a society more closely. In practice in China, the government usually provides subsidies to those who protect ecosystems, for instance, by providing subsidies to farmers for converting their land from farmland into grassland and forest. The specific amount of subsidies may be based on economic loss from farming products, e.g., total income from selling harvests from farmland. Meanwhile, taxes are collected from developers on the basis of the total turnover from selling the products, e.g. from mining activities.

Although it follows the same theoretical basis, eco-compensation in China is a broader concept than PES because it has a built-in penalty concept. The unique characteristics of PES in China are summarised as: (1) the government domination of PES with a focus on institutional and policy aspects to determine compensation schemes; (2) a lack of a real marketing mechanism due to low marketisation, and externality cannot be totally solved by pure market instruments; (3) top-down approach of implementing PES; and (4) adoption of the penalty concept by setting, for instance, the “damager pays principle,” and so on.

4 The rapid rise of PES in China

4.1 Major PES programmes in China

The Chinese government has been experimenting tentatively with PES programmes for decades. In the early 1980s, the Ministry of Water Resources began to directly contract out fragile lands in some small watersheds to households for management, though with limited success (Liu, 2005). These initiatives have been embodied in the Water and Soil Conservation Act of the P.R.C. (1991), one of the first pieces of legislation passed to introduce market schemes into watershed management. It allows some small watersheds to be auctioned or leased to farmers or other private investors for development, with the lessee being obligated to protect against soil erosion and degradation. Since 1999, there have been a growing number of programmes that, in line with international trends, are increasingly utilising Payments for Ecosystem Services (PES) schemes. Several initiatives have been carried out successfully at national, regional and local levels. One example is the flagship Sloping Land Conversion Programme (SCLP – *tuigeng huanlin huancao*), which, for example, is arguably a PES programme (Wunder, 2005; Pagiola and Platais, 2007; Engel *et al.*, 2008; Bennett, 2008). Table 2 summarises the major eco-compensation programmes that have been realised in China in recent years, and their magnitude.

Table 2: Major PES programmes in China (Bennett, 2009; Yin, 2009).

Target	Program / Policy	Size
Water Quality & Quantity	Watershed Eco-compensation Programmes	Total budget of RMB 14.6+ billion, RMB 703+ million already spent, plus annual payments of RMB 288+ million.
	Water Use Rights Transfers	Total estimated project costs of RMB 2.777 billion, RMB 1.149+ billion invested so far.
Forest-related	Sloping Land Conversion Programme (SLCP)	Total budget of RMB 337 billion (of which RMB 130.1 billion has been spent from 2000 to 2006). 139 million mu (9.27 million ha) of cropland enrolled and 205 million mu (13.67 million ha) of wasteland afforested.
	Central Government Forest Ecosystem Compensation Fund (FECF)	A total of 1.578 billion mu (105.2 million ha) of national level key public benefit forest area enrolled by the end of 2007. Cumulative total investment of RMB 13.34 billion by the end of 2007 (RMB 3.34 billion in 2007 alone).
	Provincial-Level FECF (complementary to central government FECF)	Apart from national key public benefit forest area, 1.15 billion mu (76.7 million ha) of provincial-level public benefit forest area enrolled by the end of 2007. Subsidies of RMB 1.2 billion in 2006.
	Natural Forest Protection Programme (NFPP)	Total targeted forest area of 1.023 billion mu (68.2 million ha), of which 846 million mu (56.4 million ha) is designated as natural forest area. Total budget for 2000–2010 is RMB 96.2 billion, of which the central government will provide RMB 78.4 billion.

Table 2 – *Continued*

Target	Program / Policy	Size
	“Three-Norths” Shelter-belt Programme	Completed afforesting 367 million mu (24.47 million ha), and controls desertification on over 450 million mu (30 million ha) and soil erosion on 300 million mu (20 million ha) of land. Total estimated budget for the current period of the programme (2001–2010) is RMB 35 billion, of which RMB 25 billion will be from the central government.
	Beijing-Tianjin Sandstorm Source Control Programme	Total programme budget is RMB 50 billion, of which Beijing is to invest RMB 3.9 billion. By the end of 2007, 47 million mu (3.13 million ha) of land had been afforested, and total expenditures were RMB 19.9 billion.
	Forest Vegetation Restoration Fee	RMB 8.044 billion from 2003 to 2005.
Soil erosion	“Four Wastelands” policy (4W)	The size of the programme is likely to be huge both in terms of land area and revenue generated for local governments and participating farmers, as well as in terms of imputed labour costs of soil erosion prevention.
	Soil Erosion Control Fees and Soil and Water Conservation Installation Compensation Payments	No information available, although probably huge in terms of revenue generated and land area involved, since this policy encompasses the whole of China.
	Yangtze River Upper Watershed Water and Soil Conservation and Key Prevention Programme	As of 2004, more than RMB 15.929 billion spent for management of soil erosion on over 8 million ha.
Eco-agricultural	National Green and Organic Food Certification System	Large and growing, though exact numbers are not readily available.
	Dalian City, Liaoning Province, Green Agriculture Support Subsidy	No number available on the programme’s total budget or the number of farmers who have benefited from these subsidies.
	Shanghai Organic Fertiliser Subsidy	The size of the programme has expanded from use of 15,000 tons of organic fertiliser on 100,000 mu (6,667 ha) in 2004, to 120,000 tons of organic fertiliser on 600,000 mu (40,000 ha) in 2006. From 2004 to 2006, a total of RMB 56.25 million was spent in subsidies.

Table 2 – *Continued*

Target	Program / Policy	Size
	Beijing Organic Fertiliser Subsidy and Safe Pesticides Subsidy	RMB 20 million invested in 2007 to subsidise the use of 75,000 tons of organic fertiliser used on 200,000 mu (13,333 ha) of grain fields in 13 counties in Beijing.
	National VAT Tax Exemption for Organic Fertiliser Use	No numbers are available on the size of total tax exemptions.
	Rural Biogas Development	Central government investments of RMB 12+ billion from 2003 to 2008. Provincial and local government investments of RMB 1.5 billion in 2006 alone. Programme activities from 2004 to 2008 encompassed counties and 98,600 villages, with 10 provinces issuing complementary policies. A cumulative total of 26.23 million household biogas stoves installed by the end of 2007. The programme aims to have a total of 40 million household stoves installed by the end of 2010.
	Promoting Conservation Tillage	Central government investment of RMB 170 million from 2002 to 2007, with matching local government investments of RMB 1.78 billion. Enrolment of 30.62 million mu (2.04 million ha) of conservation tillage area, and almost 100 million mu (6.67 million ha) of no-tillage area. Project encompasses 15 northern provinces.
Carbon	Clean Development Mechanism	China hosts 22 per cent of registered CDM projects and supplied 73 per cent of global CDM credits in 2007; 725 million tons CDE.
	Voluntary Carbon Market	The Asia-Pacific region (China data N/A) supplied 39 per cent, or 16.4 MtCO ₂ e of global VERs.
	China Green Fund	RMB 300 million. 1.05 million mu (70,000 ha) of area for afforestation.
Emissions trading	Ongoing Piloting of SO ₂ and COD Emissions Permit System and Emissions Trading	Transactions of 970 tons/year of COD, 28,500+ tons plus 1,007 tons/year of SO ₂ (contract lengths unknown). RMB 52.81+ million in transactions. More than RMB 9.3 million in government pilot support funding.
Other	Government Green Procurement	Huge potential market size. In 2006, total government procurement was estimated to be over RMB 300 billion.

As shown in Table 2, subsidies are part of eco-compensation instruments in China. According to Pigou (1932), market mechanisms such as taxes and subsidies, could be used to align private and social costs and benefits in a society more closely. Specifically, taxing or subsidising an individual by exactly the amount of the positive/negative externality they produce by a given activity “internalises” 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 damage he creates, he would chose production and damage levels that are socially optimal. If a person who protects an important ecosystem is subsidised by exactly the amount of 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.

As indicated above, most of the PES programmes in China are targeted to improve water quality and quantity, to control soil erosion, and promote eco-agriculture production. The watershed PES programme aims to ensure watershed ecological security and the sustainable use of water resources. It is useful in dealing with the ecological and economic relationship between upstream and downstream locations to promote the economic development and environmental protection of upper reaches and to realise the sustainable development of the entire watershed. In developing countries, several billion dollars are spent on watershed payments. The watershed compensations in China are currently being carried out at three levels. The first is the national project to protect the eco-environment of rivers in western China. The second is the trans-watershed water rights trading and fiscal transfer project, dominated by the government of Zhejiang province. The third is the watershed compensation system created by Fujian provincial government of southern China. Unlike international experience of market-based compensation for watershed (CCICED, 2007), market-based compensations are scattered in some areas in a quasi-market or semi-market status. The free trade market has not yet formed in China, but is foreseen as an effective means of compensation for watershed.

The eco-agricultural programme was established to promote the adaptation of organic production and sustainable resource management activities. The Chinese government provides subsidies for the use of organic fertilisers and bio-fuel energy, and promotes conservation tillage techniques. Meanwhile, a national green and organic food certification system has been widely implemented in China. These measures have contributed considerably to the improvement of ecosystem services, such as soil and water conservation, emissions reduction and water purification.

The main goal of SLCP is to reduce soil erosion and desertification, and to increase China’s forest coverage by retiring steeply sloping and marginal lands from agricultural production. Available data indicates that soil erosion affects roughly 360 million hectares of land in China, some 38% of its total area, more than three times the world average (Huang *et al.*, 1999; World Bank, 2001; SFA, 2003). The programme covers 25 provinces. The forest area of SLCP implementation increased by 22.9×10^6 ha from 1995 to 2005, including 9.0×10^6 ha of afforested land converted from farmland, 12.6×10^6 ha of waste hills and unreclaimed lands suitable for forestation and 1.3×10^6 ha of mountain areas sealed for forestation.

Figure 1 presents a graphical illustration of converted land area under SLCP by year. During the pilot phase, an average of 408,000 hectares of cropland was converted per year. Upon full-scale implantation beginning in 2002, however, this jumped to 2.9 million hectares per year, a more than six-fold increase. The number of enrolled counties also rose significantly, by 374%, between the end of 2001 and the end of 2002 (Bennett, 2008).

The total investment in this programme hit the 103 billion RMB mark by the end of 2005. SLCP mandates that farmers who participated in land retirement and conversion be compensated. It stipulates that farmers who convert degraded and steep sloping cropland into either “ecological protective forests” (defined by the State Forestry Administration as timber-producing forests), or

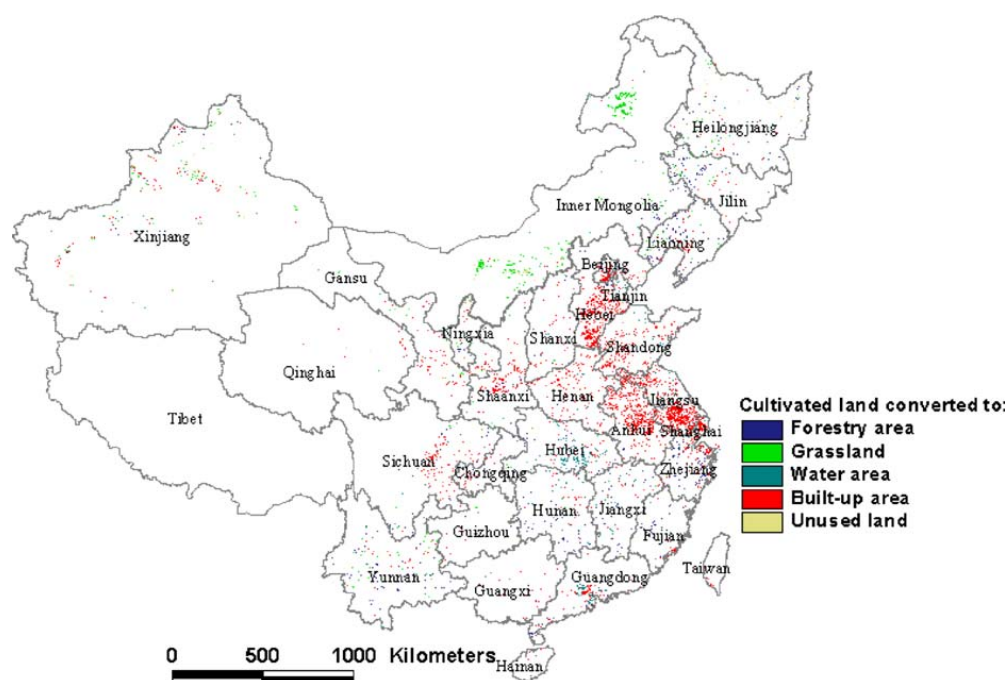


Figure 1: Distribution of land converted from cultivated land to other uses, 1986 to 2000 (Deng *et al.*, 2006)

“economic forests” (orchards or plantations of trees with medicinal value) will be compensated with an annual in-kind subsidy of grain, a cash subsidy and free saplings at the beginning of the planting period. The grain subsidy is set at 2,250 kg/ha in the Yangtze River Basin and 1,500 kg/ha in the Yellow River Basin. The cash subsidy is 300 RMB/ha per year. Both grain and cash subsidies are for 8 years if ecological forests are planted and for 5 years if economic forests are planted (in the more recent policy, the 8-year and 5-year compensation period can be extended another round, but with half the payment). However, payment for land converted may often be small and variable compared to household income. For instance, research conducted in southern China revealed that annual payments received by farmer households comprise a small share of the total household income (i.e. around 2%, see Zhen *et al.*, 2006, 2010; Li *et al.*, 2011) because these households and communities already have the incentive to protect and improve their local environment – this is considered a successful aspect of the programme. Our survey has shown (Figure 2) that most farmers were Willing To Pay (WTP) between 750 and 1,125 RMB/year, and the consensus rate decreases steadily with increasing bid value, and an average annual per household payment was 956 RMB/ha. Even so, whether farmers would reclaim converted land into agriculturally productive land as soon as the programme and associated payments are terminated is still a challenge for policy-makers to achieve ecosystem conservation objectives. Other case studies (Uchida *et al.*, 2005; Xu *et al.*, 2010) have indicated that those households that originally did not wish to participate in the programme, or who are not compensated adequately for their opportunity costs of participation, will simply return land to cultivation at the end of the subsidy period. Results from the survey indicate that this is not a small share of participants, although some farmers are overcompensated.

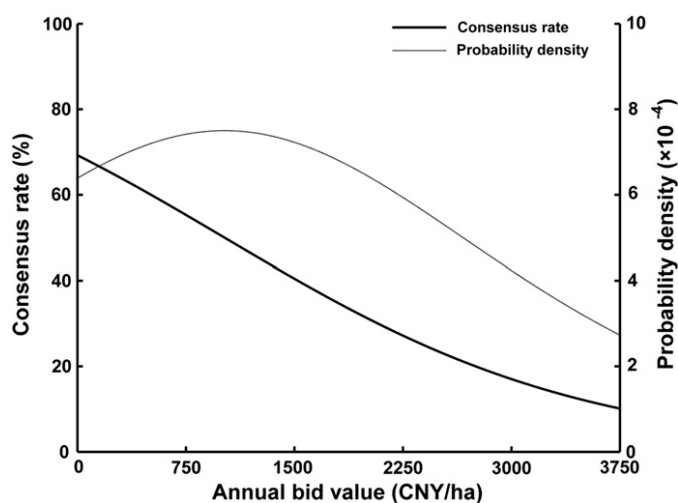


Figure 2: Functional relationships between bid amount, consensus rate and probability density of WTP (from Zhen *et al.*, 2011).

4.2 Pilot studies on PES implementation in China

As a response to the *11th Five-year Guidelines*, China's Ministry of Environmental Protection (MEP) issued *Guiding Opinions on the Development of Eco-compensation Pilot Work* (MEP, 2007). In this, the MEP detailed four main areas of focus for the development of PES pilots: watersheds, key ecological function areas, mineral development areas and nature reserves. Based on the research progress and urgent needs for decision-making, the China Council for International Cooperation on Environment and Development (CCICED) established the Task Force on PES and policy research, with the aim of establishing national strategies and sectoral policies for PES, and making concrete proposals and recommendations to the government. Table 3 lists the major findings from the pilot studies, which includes subject to pay, approach for payment, capital sources and standards for payment.

It is concluded from this programme that local governments are responsible for establishing PES of urban water sources and local small watersheds within their administrative boundaries and that they should cooperate with the central government to establish PES for cross-boundary medium-sized watersheds. With the exception of the further improvement of existing ecological protection programmes, an urgent issue is to establish long-term effective schemes for PES. Meanwhile, compensation standards could be determined following the four kinds of values: investments by protectors and opportunity costs, beneficiaries' gains, rehabilitation costs of damage and ecosystem services. According to Rule of Thumb, the sum of direct investment and opportunity cost should be the base-line for determining the standard, while the value of ecosystem services is considered to be the theoretical ceiling values for compensation.

Table 3: Findings from the pilot study in selected key fields for PES in China.

PES Items	Watershed	Mineral resource	Forest	Nature reserve
Whom to pay (Subject)	Water users Pollutants	Government pays for rehabilitation of abandoned mines Mine owners	Beneficiaries Damagers of forest resources	Government Beneficiaries
How to pay (Approach)	Government sets up a platform for stakeholder negotiation. Public payment, one-to-one trading, in kind and cash, training, eco-certification	Capital compensation, rehabilitation project	Fiscal transfer, tax reduction, immigration subsidy, market trading, ecological marks	Government purchases, fiscal transfer, policy (tax mitigation, subsidy), project, international support
Where is the money from (Capital sources)	Tax, eco-compensation funds, preferential credit, overseas capital, programme aid	Fiscal transfer, eco-compensation funds from the owner, mines compensation bond	Compensation funds, earmarked funds for eco-conservation, ecological taxation	Fiscal transfer, multiple financing channels (NGOs, volunteers)
How much is to be paid (Standard)	Direct investment and opportunity cost upstream, cost of newly constructed infrastructure, water consumed downstream	Value of ecosystem damage, cost of environment rehabilitation	Direct expense of re-plantation, opportunity costs for forests protection and benefits gained from forest ES	Value of ES, protection costs, losses from ES degradation

5 Future perspectives

Economic developments in China have been rapid, and policy-makers still face numerous challenges in creating effective and financially sustainable policies for PES. To deal with such challenges, the following important relations shall be taken into consideration: 1) Relations between equity and efficiency in PES schemes. As addressed by Pascual *et al.* (2010), the relationship between equity and efficiency in PES emphasise the role of the institutional setting, social perceptions about economic fairness (or distributive justice of the payments), uncertainty and interactions between agents, including power relations. This is essential for Chinese eco-compensation, considering the centralised government system and existing close interrelations among the agencies. The central government should provide policy guidance, a legislative basis and financial support for local governments to establish PES schemes. It would also have to guide local governments in formulating, in the first place, country-wide and regional-wide, inter-watershed PES schemes. It is widely accepted that local governments are the main actors in formulating and implementing PES schemes. 2) Relations between the government and the market. Both the government and the market play an important role in establishing compensation schemes. However, China's policy-makers are still new to PES and market-based instruments in general. Based on the ecological conservation status and the market development in China, the government plays a key role in establishing PES schemes, including policy and law, and provides support for large-scale compensation. 3) Relations between PES and poverty alleviation. PES differentiates from poverty alleviation, and does not further the purpose of social equality and narrowing the gap between the rich and the poor (Li and Liu, 2010). Many assumed that PES will contribute to poverty reduction by making payments to poor land users, while others have warned of the potential dangers (Pagiola *et al.*, 2005; Grieg-Gran *et al.*, 2005; Wunder, 2008). However, PES schemes can be used to give rural dwellers a new social role as ecosystem service providers for ecosystems under stress. PES can thus serve to help them achieve these goals while financing the transition to more profitable and ecologically-friendly production systems. 4) Relations between "blood generating" and "blood transmitting". A "blood-generating" kind of compensation should be encouraged by initiating eco-conservation and capacity rising programmes, while a "blood-transmitting" kind of compensation could be applied for ordinary people. However, as far as the multifunctional role of agriculture is concerned (Van Huylenbroeck *et al.*, 2007), once ordinary people, such as farmer households, receive compensation, they would be able to participate in production and trading activities to generate income for a substantial livelihood, which is important for the long-term conservation of ecosystem services. 5) Relations between integrated and sectoral platforms. An integrated PES platform dominated by the government would have to be established to ensure effective operation. However, various platforms should be encouraged at the local levels to explore various types of compensation. For instance, the private sector could have a potential role to play in PES. As a means to bring in the private sector, the government could start making a stepwise transition from fully public to public-private partnerships and private initiatives in a way that makes sense in the Chinese context. A legal framework will first need to be provided that will facilitate individual companies to make small PES deals.

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