

# Payments for Ecological Services and Eco-Compensation

Practices and Innovations  
in the People's Republic of China



National Development  
and Reform Commission



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Proceedings from the  
International Conference on Payments for Ecological Services

Ningxia Hui Autonomous Region, People's Republic of China  
6–7 September 2009

Edited by  
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# Foreword

Over the past 30 years, the People's Republic of China (PRC) has transformed itself from a closed agrarian economy to a global industrial and economic powerhouse. The rapid economic growth and transformation has lifted hundreds of millions of people out of poverty. However, this success has been achieved at an enormous cost to the environment. Rapid industrialization and urbanization have been accompanied by accelerated exploitation of natural resources and massive increases in discharge of pollutants.

One of the key reasons for environmental degradation is that the valuable services provided by natural ecosystems are not properly priced in the market system. Currently, economic instruments that attempt to create such markets or promote sustainable management of natural resources are not fully in place, leading to an unequal distribution of ecological and economic benefits between protectors and beneficiaries. As a result, natural ecosystems continue to be degraded or lost at an alarming rate. Indeed, many have argued that the failure of society to compensate for conserving the environmental services is a key contributory factor to the rapid and environmentally damaging changes in the ecosystem that are taking place in the PRC, in particular, and the world, in general.

Payments for ecological services (PES) have thus become increasingly important policy instruments internationally to create incentives for sustainable ecosystem service provision, address livelihood issues for the rural poor, and provide sustainable financing for protected areas. Related to this, policy makers in the PRC have been experimenting with new approaches to environmental management, resulting in a wide array of policy and program innovations under the broad heading of eco-compensation.

These proceedings are collection of papers presented at the International Conference on Payments for Ecological Services, which was held in Ningxia Hui Autonomous Region on 6–7 September 2009. This conference was jointly hosted by the PRC National Development and Reform Commission, the Ministry of Environmental Protection, the Government of Ningxia Hui Autonomous Region, and the Asian Development Bank (ADB). In attendance were some 500 provincial and central government representatives from more than 14 provinces and 7 central ministries, and a number of international experts.

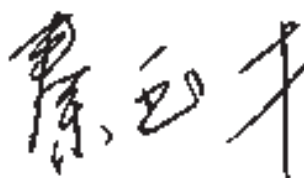
The conference concluded that international experience in PES programs and other market-based environmental policy instruments have great potential to inform the PRC's developing eco-compensation policy framework on the creation of an enabling environment for private sector participation. It was also highlighted that the PRC is gaining a wealth of experience on eco-compensation to inform both domestic and international experience in the evolving role of government in protecting and ensuring the provision of ecosystem services. These proceedings also discuss the evolution of eco-compensation policy within the PRC's environmental regulatory framework, summarize important developments in the PRC and internationally, provide policy recommendations, and suggest possible next steps.

ADB's *Strategy 2020: The Long-term Strategic Framework of the Asian Development Bank (2008–2020)*, focuses its support on three distinct but complementary development agendas of the region: inclusive economic growth, environmentally sustainable growth, and regional integration. Supporting PES scheme in the PRC will significantly contribute to all three of these strategic agendas.

The findings, as summarized in the proceedings, offer a good basis for further strategic policy dialogues between the PRC, ADB, and other development partners on instituting PES schemes. Such a policy dialogue between the PRC's ministries and development partners should continue and become a regular event for instituting PES. As indicated in the proceedings, the current and future policy dialogues will map out ways of designing effective PES schemes in the PRC and generating a preliminary framework that will guide ADB financing to better serve the PRC's PES scheme development.



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These conference proceedings have also benefited from the strong support of, and close collaboration with, the National Development and Reform Commission (NDRC), through whose successful organization and hosting of the conference, the information provided in this report has been made possible. ADB is particularly grateful to Du Ying, vice chairman of the NDRC, for his leading role in cross-ministerial efforts on payments for ecological services in the PRC. ADB would also like to thank Qin Yucai, director general of the Department of Western Regions Development of NDRC, and his colleagues Zhang Yadan, Tong Zhangshun, and Xiao Weiming for their excellent coordination and technical capacity in dealing with this cross-agency work.



# Executive Summary

This publication presents and synthesizes the proceedings of the *International Conference on Payments for Ecological Services*, held in Ningxia Hui Autonomous Region on 6–7 September 2009. The conference was jointly hosted by the People's Republic of China's (PRC) National Development and Reform Commission, the Ministry of Environmental Protection, the Ningxia Hui Provincial Government, and the Asian Development Bank (ADB). The conference was convened to provide support for the development of national guidelines, policies, and legal frameworks for eco-compensation programs in the PRC.

The conference concluded that international experiences in payments for ecological services (PES) programs and other market-based environmental policy instruments have great potential to inform the PRC's developing eco-compensation policy framework in creating an enabling environment for private sector participation. It was also highlighted during the conference that the PRC is building its own wealth of experience in eco-compensation to inform both domestic and international environmental policy development on the evolving role of government in protecting and ensuring the provision of environmental services.

Key policy findings from the conference are as follows:

- While the terms “PES” and “eco-compensation” are often used interchangeably, eco-compensation is a broader term, encompassing PES-like policies and programs as well as a range of other policy and program types.
- Given the range of meanings as well as policy and program types associated with the term “eco-compensation,” evident in both the provincial case studies and presentations made by domestic experts, the term eco-compensation needs to be clearly defined to enable the government to develop a national policy and legal framework.
- PES and eco-compensation will not, by themselves, be able to resolve the issues underlying the PRC's current environmental challenges, which include ambiguous property rights over ecosystem services, a dearth of effective platforms and mechanisms for interagency and interregional cooperation, and lack of effective and powerful enforcement authorities for environmental regulations. However, at the same time, eco-compensation and PES have great potential to serve as valuable new instruments within the PRC's environmental policy tool kit.
- The Government of the PRC has a golden opportunity to use eco-compensation policy as a means to introduce more incentive-based mechanisms into environmental policy. Such mechanisms will help to improve outcomes and reduce the costs of conservation and environmental protection.
- While the valuation of ecosystem services is an important ongoing part of developing ecosystem service markets, PES, and eco-compensation programs, policy makers focus less on calculating these values, and more on designing the mechanisms necessary to allow stakeholder negotiations to effectively arrive at eco-compensation subsidy rates.
- General subsidy may not be the most cost effective eco-compensation mechanism with which to obtain ecosystem service provision. A range of possible mechanisms, which allow for variable subsidy rates, can be used to more cost effectively achieve outcomes.

- Eco-compensation policy and programs need the necessary legal and policy frameworks to be effective. This includes clarification of property rights and mechanisms for effective coordination and cooperation between different regions, levels of government, and government agencies.
- In developing its eco-compensation framework, the Government of the PRC should also carefully consider developing policies to promote and engender greater private sector participation in ecosystem service markets. This will help unlock a wider range of funding sources for conservation, and the participation of a broader array of economic actors in protecting and improving important ecological and environmental resources. This is an important consideration, since the potential for private sector investment and participation in conservation in the PRC looks to be significant.
- The government needs to carefully consider how, and when, poverty reduction goals can be effectively incorporated into eco-compensation policies and programs. In some cases, these two goals can be effectively combined in a common policy instrument. In other cases, however, it might be more effective to create complementary policies that separately target these goals.

The majority of provincial case studies in the conference have focused their discussions on the compensation of watershed services, suggesting the existence of significant potential for payments for watershed services in the PRC. These case studies also demonstrate the need for clarifying and strengthening the PRC's legal foundations governing rights and responsibilities over watershed services in the context of integrated river basin management. The sheer scale of the Conversion of Cropland to Forest and Grassland program—which now extends to all corners of the PRC—suggests a wide variety of local de facto implementation regimes which, if better documented, could provide valuable lessons learned and innovative examples.

Given these developments, the Government of the PRC has a real opportunity to provide leading examples of public sector PES programs and policies that catalyze the development of ecosystem services markets. Such opportunities will only be realized, however, with better documentation, research, and evaluation of the PRC's ongoing eco-compensation programs.



# Introduction

The proceedings of the *International Conference on Payments for Ecological Services* are synthesized and presented in this publication. The conference, held in Ningxia Hui Autonomous Region on 6–7 September 2009, was jointly hosted by the People's Republic of China's (PRC) National Development and Reform Commission (NDRC), the Ministry of Environmental Protection (MEP), the Ningxia Hui Provincial Government, and the Asian Development Bank. The conference was convened to provide support for the development of national guidelines, policies, and legal frameworks for eco-compensation programs in the PRC. About 500 provincial and central government representatives from over 14 provinces and 7 central ministries, as well as a range of international experts, attended the conference.<sup>1</sup> The participants shared their experiences, lessons learned, and case studies regarding international developments in payments for ecological services (PES), market-based environmental policy instruments, and domestic eco-compensation programs and policies. The conference concluded that international experiences in PES programs and other market-based environmental policy instruments have great potential to inform the PRC's developing eco-compensation policy framework on the creation of an enabling environment for private sector participation. It was also highlighted that the PRC is building its own wealth of experience in eco-compensation to inform both domestic and international environmental policy development on the evolving role of government in protecting and ensuring the provision of ecosystem services. This publication also

discusses the evolution of eco-compensation policy within the PRC's environmental regulatory framework, summarizes important local and international developments, and provides policy recommendations and suggestions for next steps.

The PRC is at an exciting stage in the development of its national environmental policy framework. The fast-paced economic growth of the past 3 decades, while having lifted hundreds of millions of rural dwellers out of poverty, has also greatly multiplied the environmental challenges faced by policy makers at all levels of government, increasing pressures on fragile ecosystems, creating a range of new pollution and environmental safety issues, and further straining the country's already limited per capita natural resource base. The economic growth imbalance across different regions signifies regional differences in environmental resources and pressures. Regions with relatively fast economic growth exert greater demand on natural resources (such as water, land, and forests) for food, water supply, and energy consumption, much of which are provided by poorer regions. Policy makers are debating the extent to which the economically advanced regions should pay poorer regions for the provision of these environmental services. Eco-compensation is important to promote sustainable use of natural resources and more balanced growth across regions.

At the same time, growth has created opportunities, since the PRC's economic miracle is giving the government the financial capacity to reverse environmental damage through closer monitoring, enforcing existing

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<sup>1</sup> The 14 provinces are Anhui, Chongqing, Fujian, Gansu, Guangdong, Guizhou, Hainan, Jiangsu, Jiangxi, Liaoning, Ningxia Hui Autonomous Region, Qinghai, Shanxi, and Zhejiang. The seven ministries are the National Development and Reform Commission, the Ministry of Environmental Protection, the Ministry of Finance, the Ministry of Agriculture, the Ministry of Water Resources, the Ministry of Land and Resources, and the State Forestry Administration.

environmental laws, and funding new environmental initiatives and policies (Figure 1). The rapid, albeit imbalanced, growth across the PRC is providing richer regions the financial capacity to recompense poorer regions for ecosystem services. At the nexus of these countervailing trends, policy makers have been experimenting with new approaches to environmental management, resulting in a wide array of policy and program innovations under the broad heading of eco-compensation. Many of these incorporate, or provide a framework for, market-based approaches to environmental policy, and in particular PES.

Before the 11th Five-Year Plan (2006–2010), the PRC central government has been giving increasing attention on the development of eco-compensation mechanisms. The 11th Five-Year Plan calls for policy makers to innovate in environmental policy, to develop eco-compensation pilot projects, to quicken the pace of development of eco-compensation mechanisms—especially intraregional and watershed-related eco-compensation mechanisms—and to resolve funding issues regarding conservation. In 2005, the State Council released Document No. 39, *State Council Decision Regarding Using the Scientific Development View to Strengthen Environmental Protection*, which states that the government “...should improve eco-compensation policy, and develop eco-compensation mechanisms as quickly as possible” (State Council 2005).<sup>2</sup> The PRC’s MEP has also issued its own *Guiding Opinions on the Development of Eco-compensation Pilot Work*, which details four main areas of focus for the development of eco-compensation pilots: nature reserves, key ecological function areas, mineral development areas, and watersheds. The related department of the State Council also sets out fundamental principles for the development of eco-compensation policies and mechanisms (MEP 2007):

- (i) Those who develop and exploit resources should also protect the

environment, those who destroy the environment should repair it, those who benefit from it should subsidize it, and those who pollute should pay.

- (ii) Responsibility, right, and power are synonymous.
- (iii) “Win-win” development should be achieved by jointly realizing public construction of the environment and public benefit.
- (iv) Government guidance should be combined with market regulation, wherein funding source diversification and greater harnessing of market forces is encouraged.
- (v) Central policy should adapt to local conditions and energetically innovate.

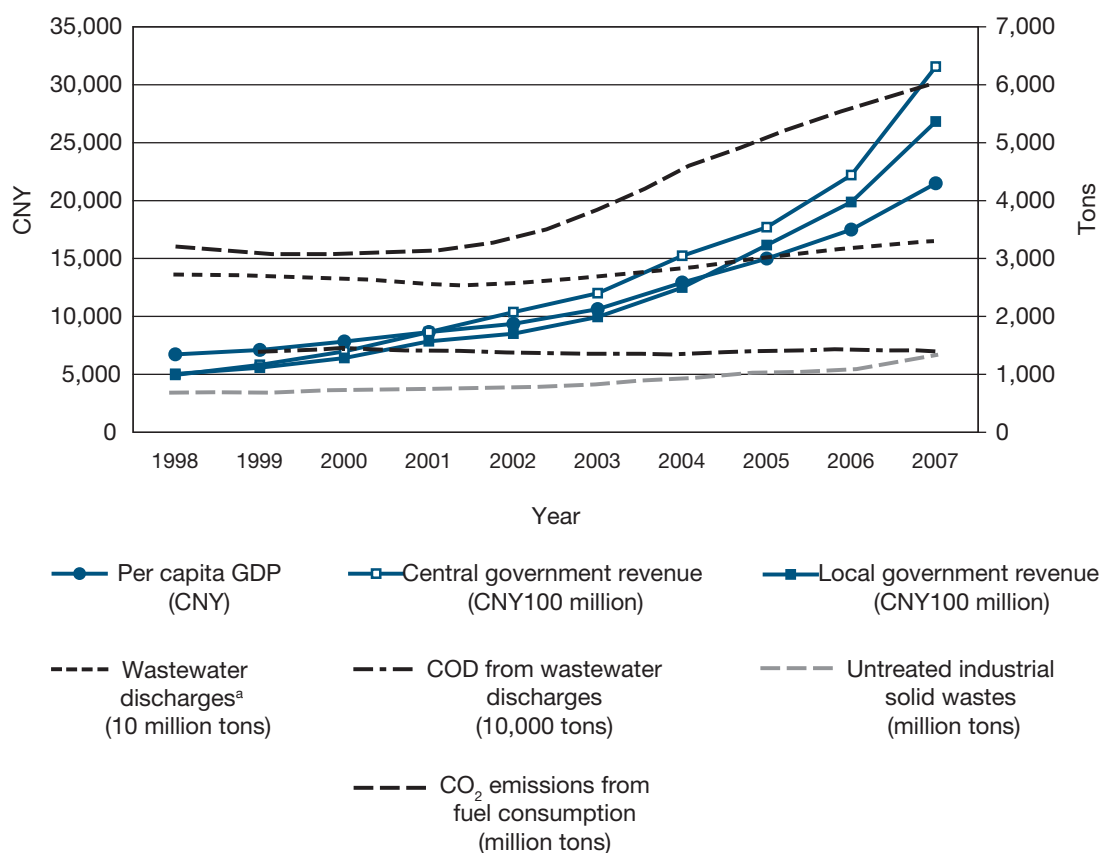
The PRC has already been driving some of the largest public PES schemes in the world. Over CNY130 billion has been spent since 1999 on the Conversion of Cropland to Forest and Grassland Program—a program that pays farmers to retire and afforest or plant grasses on sloping or marginal cropland—with over 9 million hectares (ha) of cropland enrolled.<sup>3</sup> More than CNY13.34 billion has been spent since 2001 on the Forest Ecosystem Compensation Fund, a program that pays households, communities, and local governments to protect key forest areas, and which currently covers 44.53 million ha of forest area across 30 provinces in the PRC (State Forestry Administration [SFA] 2008, SFA 2007, Economic Daily 2007).<sup>4</sup> Local governments have been important contributors to this process, adapting centrally designed eco-compensation programs to their own needs, drawing upon multiple central and provincial policies and funding sources to weave together hybrid programs, and creating their own distinct initiatives that often feed back into central government policy development. This has resulted in a diverse mosaic of initiatives and public programs that incorporate payments and incentive-based elements into national, provincial, and municipal levels, and has been the

<sup>2</sup> Section 23, sentence 7.

<sup>3</sup> This program is also known as the “Sloping Land Conversion Program” or “Grain for Green.”

<sup>4</sup> Provincial-level *Forest Ecosystem Compensation Fund* programs cover an additional 76.7 million ha, and in 2006 contributed CNY1.2 billion in complementary subsidies.

**Figure 1 Government Revenue versus Selected Pollution Indicators, People's Republic of China, 1998–2007**



CNY = yuan, CO<sub>2</sub> = carbon dioxide, COD = chemical oxygen demand, GDP = gross domestic product.

<sup>a</sup> Wastewater discharges are calculated as discharges from consumption plus untreated industrial wastewater discharges.

Source: National Bureau of Statistics of China, various years. CO<sub>2</sub> emissions data are from the International Energy Agency (2009).

backdrop to a healthy debate on how to improve these programs and explore and develop other market-based tools and regulatory innovations to better address the PRC's environmental and development challenges (Bennett 2009).

More recently, the 2007 State Council work plan has called for "...deepening product pricing and emissions fee reforms for key natural resources, perfecting a resource taxation

system, and improving a paid mineral resource use system; quickening the development of eco-compensation mechanisms." The PRC's revised water pollution control law now states that "the PRC will, via such means as financial transfers and payments, develop sound environmental protection compensation mechanisms for regions located in drinking water source protection areas, and river, lake, and reservoir

upper watershed water environment and ecological protection areas.”<sup>5</sup>

In 2009, both President Hu Jintao and Premier Wen Jiabao also made clear statements reiterating that the PRC will develop a “sound system of paid use of (mineral and natural) resources” and “eco-compensation mechanisms” (Jin and Zuo 2009, Wang et al. 2009).<sup>6</sup> Against this backdrop, the central government is in the process of developing a national eco-compensation policy framework, and possibly a law, in preparation for the drafting of its 12th Five-Year Plan (2011–2015). The NDRC has already produced a first draft of the PRC’s national eco-compensation regulations. The purpose of the *International Conference on Payments for Ecological Services* in Ningxia, and this volume of proceedings, is basically to inform this ongoing policy development process.

Section II of this publication discusses the course of the PRC’s evolving eco-compensation policy framework, and summarizes selected provincial case studies presented during the conference. Section III presents the conference speeches by officials of the PRC and the academic papers from domestic experts, which discuss and contextualize the legal, financial, scientific, and policy issues surrounding the development of effective eco-compensation and PES programs in the PRC. Section IV assembles the papers presented by the international experts at the conference. Section V concludes by synthesizing conference findings into a set of specific policy recommendations.

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<sup>5</sup> National People’s Congress. 2002. Law of the People’s Republic of China on the Prevention and Control of Water Pollution (Amendment of 1988 Law), Section 1, Article 7.

<sup>6</sup> On March 2009, at the second session of the 11th National People’s Congress, Premier Wen Jiabao stated the need to “Accelerate the development of a sound system of paid use of mineral resources and eco-compensation mechanisms.” In October 2009, at the 17th National Congress of the Communist Party of China, President Hu Jintao stated that the PRC “will develop a sound system of paid use of resources and eco-compensation mechanisms” (Wang et al. 2009).

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# The People's Republic of China's Evolving Eco-Compensation Framework: Background and Select Provincial Case Studies

It is apparent from much of the current academic and policy debate in the People's Republic of China (PRC), as well as in the provincial case studies presented at the conference, that there are many different interpretations of eco-compensation. While the Chinese term “eco-compensation mechanisms” has often been paired or used interchangeably with the term “payments for ecological services” (PES)—especially in comparison between the PRC and the rest of world—significant differences between these two concepts exist. PES schemes generally consist of negotiated contractual arrangements involving direct payments between those who provide and those who benefit from ecosystem services. A classic definition comes from Wunder (2005), who characterizes PES as

*“(1) a voluntary transaction in which (2) a well-defined ecosystem service (ES) (or a form of land use likely to secure that service) (3) is bought by at least one ES buyer (4) from a minimum of one ES provider (5) if and only if the ES provider continues to supply that service (conditionality)”.*

More simply put, PES refers to voluntary transactions where a service provider is paid by or on behalf of service beneficiaries for land, coastal, or marine management practices that are expected to result in continued or improved service provision.<sup>1</sup> When successful, PES creates positive economic incentives for land owners to conserve or even improve the function of their lands for services as varied as watershed protection, carbon sequestration, and biodiversity conservation, thereby increasing land owners' awareness of the true value of their properties. In the process, PES schemes may bring new resources and new incentives to conservation—a particularly important development when funding for conservation is scarce. PES has been gaining popularity internationally as a valuable new policy tool for achieving conservation outcomes more effectively and efficiently in certain contexts than traditional command-and-control measures.

In contrast, eco-compensation is a broader term, encompassing PES-like policies and a range of other policy and program types, both with and without market-based elements (Bennett 2009). At its very beginning, eco-compensation was initiated as a means for

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<sup>1</sup> Given that a number of PES approaches exists, a variety of terms have been used to describe PES, including “market mechanisms for environmental services” (Landell-Mills and Porras 2002; Pagiola, Landell-Mills and Bishop 2002; and Wunder 2005); “compensations for environmental services” (Rosa, Kandel and Dimas 2003); “rewards for environmental services” (Pro-Poor Rewards for Environmental Services in Africa [PRESA]); and “agri-environmental payments” (OECD 2009).

the PRC's environmental agencies to both strengthen their administrative power and better finance environmental rehabilitation and protection. In 1993, the National Environmental Protection Agency (NEPA) issued the Notice Regarding the Confirmation of NEPA's Ecological Environment Compensation Fee Pilots (NEPA 1993).<sup>2</sup> During the period that the fee was levied (1993–2002), only government environmental agencies and the environmental community called for the development of eco-compensation policy. As the concept of PES became more widely known in the PRC beginning in 2003, however, enthusiasm for eco-compensation gradually spread to the water sector, financial sector, the central government, and upper watershed local governments, with each of these developing their own perspective and understanding of the term. The provincial case studies presented at the Ningxia conference suggest that the term eco-compensation now includes programs that

- (i) involve direct payments from the government to individual and community-level suppliers of ecosystem services to ensure and improve ecosystem service provision;
- (ii) compensate households, communities, or regional governments for regulatory takings associated with environmental policy (e.g., as a result of the creation of protected areas or restricted development zones for conservation, and the associated introduction of land-use restrictions or requirements);
- (iii) create horizontal frameworks of cooperation and financial transfers between different regional or administrative levels of government to ensure and improve ecosystem service provision by clarifying and better apportioning responsibilities and costs;
- (iv) adjust or introduce fees, levies, taxes, tax breaks or subsidies on resource uses to increase funding for or to

- incentivize conservation, environmental management, and/or restoration;
- (v) increase upper-to-lower-level government financial transfers to better fund environmental management; and
- (vi) compensate regions, especially in the PRC's lesser developed west, for past and current extractive and environmentally damaging resource uses as part of the country's economic development.

These approaches are not mutually exclusive, as many eco-compensation policies have multiple aims and contain more than one of these elements. The PRC has a long history of developing policies to better internalize the costs of environmental protection. One of the earliest examples presented at the *International Conference on Payments for Ecological Services* in Ningxia is Yunnan Province's Phosphorous Mine Environmental Restoration Levy (1983), which served as the starting point for similar mining fee pilot projects in numerous provinces in the 1980s and 1990s (Li and Liu 2009, Jin and Zuo 2009). These were later formalized in 1994, with some regions using these fees for environmental protection and post-mining restoration. Such work is ongoing, with Fujian and Guangdong provinces recently introducing or revising mining environmental management methods (Jin and Zuo 2009). It could even be argued that the Government of the PRC has long been experimenting with PES programs. The 1991 Water and Soil Conservation Law of the PRC allows some small watersheds to be auctioned or leased to farmers or other private investors for development, with the leaseholder permitted to keep the economic gains of forestry or agricultural activities conducted on the land in return for being obligated to protect against soil erosion and degradation.

The launch of the Conversion of Cropland to Forest and Grassland Program in 1999 was the starting point for the current drive toward

<sup>2</sup> The original name of the Ministry of Environmental Protection (MEP) was the National Environmental Protection Agency (NEPA). After 1998, it was upgraded to State Environmental Protection Agency (SEPA), and in 2008 was upgraded to the ministerial-level MEP.

developing eco-compensation mechanisms. Its sheer scale has provided an important central government policy signal, generated significant momentum and local capacity building, and has catalyzed a vigorous discourse among policy makers, experts, and officials regarding the use of innovative payment methods to achieve conservation objectives.<sup>3</sup> Since its launch, numerous eco-compensation and environmental policy and program innovations have taken shape across the country.

Watershed ecosystem services are clearly the most important targets for these programs. Most of the provincial eco-compensation programs in the following case studies directly target these services, with the remainder having important watershed co-benefits. This is hardly surprising. Although the PRC ranks fifth worldwide in terms of total freshwater resources, its per capita freshwater resources of 2,258 cubic meters accounts for less than one-third of the world average (Food and Agriculture Organization of the United Nations 2003). In the area north of the Yangtze River Basin, per capita freshwater resources is only one-tenth of the world average (Ministry of Water Resources 2000). On 26 July 2010, the Ministry of Environmental Protection reported that 43.2% of state-monitored rivers were classified as Class IV or worse, meaning the water was unsuitable for human use. Last year, as a whole, it was 42.7% (The Economist 2010).<sup>4</sup> About 400 of the country's 640 major cities face water shortages, and 700 million people lack access to safe water (Turner and Otsuka 2006).

Provincial eco-compensation programs that directly target watershed ecosystem services can generally be categorized into two groups: those grappling with ways to better coordinate watershed management across jurisdictional boundaries, and those directly targeting management in the upper watersheds

of reservoirs and river systems that are important sources of drinking water. Programs in the first group generally involve the development of cross-jurisdictional management frameworks that map out responsibilities, rights, and targets, and include a range of different financial transfer mechanisms. Fujian's eco-compensation programs to manage the Jiulong, Min, and Jin river watersheds, for example, use cost-sharing arrangements and lower-to-upper watershed financial transfers to improve funding for upper watershed water quality management. Conversely, Anhui, Jiangsu, and Liaoning provinces each have programs—either active or in the design stages—that involve a system of financial penalties that are levied on cities or counties along designated rivers if monitored water quality in their respective river sections is less than stipulated targets. Levied charges are deposited to general funds to defray needed water treatment and management costs to cities in the lower watershed. Between January and April 2009, Liaoning Province had collected CNY7.75 million (\$1.1 million) in levied penalty fees using this mechanism.<sup>5</sup>

Programs in the second group, which are also cross-jurisdictional in a number of cases, generally involve some form of direct compensation from downstream beneficiaries (water users and governments) to upstream ecosystem services providers (local governments, communities, and households), with compensation being linked with the implementation of upper watershed zoning restrictions and land-use requirements. One of the earliest of these types, the Jinpan Development Zone in Jinhua City, Zhejiang Province, restricts industrial development in upstream Pan'an County while compensating for this by offering off-site development options downstream. Other programs in the provinces of Fujian, Guangdong, Jiangxi, and Zhejiang

<sup>3</sup> Though not officially labeled as an eco-compensation program, numerous academic and policy documents categorize it as such.

<sup>4</sup> In the PRC's system of water quality classification, Class I is the highest quality, suitable for headwaters and national protected areas. Class III is the lowest water quality, but still considered suitable for drinking. Classes IV and V are considered to be suitable for agricultural use or for normal landscape needs. Worse than Class V is considered to be highly polluted, in which water system functionality has been severely degraded.

<sup>5</sup> Payments are received by the Cross-Administrative-District Municipal Section River Discharge Water Quality Target Assessment Program.

Table 1 Comparison of Provincial-level Diversity of Eco-compensation Programs from the Case Studies

PROGRAM TYPES  PROVINCES		ECO-COMPENSATION TYPES													
		Forest and Grassland Services				Watershed Services					Mining Deposit Funds	Ecological Function Zones			
		NFPP	CCFG	Central Government FECF	Provincial FECF	CGG	Inter- provincial Payments	Intra- provincial Payments	Emission Trading	Water Use Rights Trading			Ex-situ Development Zones		
Eastern		Fujian		✓	✓			✓							
		Guangdong		✓	✓			✓	✓				✓		✓
		Hainan	✓		✓	✓									✓
		Jiangsu		✓	✓	✓			✓	✓			✓		✓
		Liaoning		✓	✓	✓							✓		
		Zhejiang			✓	✓			✓	✓		✓	✓		
Inland		Anhui		✓	✓	✓			✓				✓		
		Jiangxi		✓	✓	✓			✓						✓
		Shanxi	✓	✓	✓	✓							✓		
Western		Chongqing	✓	✓	✓	✓			✓				✓		✓
		Gansu	✓	✓	✓	✓		✓			✓				
		Ningxia	✓	✓	✓	✓		✓							
		Qinghai	✓	✓	✓					✓					✓

CCFG = Conversion of Cropland to Forest and Grassland Program, CGG = Conversion of Grazing to Grassland Program, FECF = Forest Ecological Compensation Fund Program, NFPP = Natural Forest Protection Program.

Source: Compiled from the Proceedings of the 2009 International Conference on Payments for Ecological Services.

(and programs under development in Anhui Province) involve direct financial transfers to upper watershed governments and communities to pay for improved land management practices and to compensate for foregone agricultural income caused by land-use restrictions. These programs often also include ecological migration components, which consist of financial incentives to induce households living in ecologically fragile upland regions to resettle in downstream urban areas. Chongqing Municipality, for example, provides both housing and employment benefits in a program of this type.

Both groups of watershed eco-compensation programs are also trying to improve financial sustainability by diversifying funding sources to include earmarked funds from various government departments and/or by requiring local matching funds. Alternatively,

financial sustainability of these programs can also be improved by better linking costs and benefits of ecosystem services provision through the addition of resource use fees, such as surcharges on water fees that pay into watershed program or reservoir management funds.

The diversity of provincial programs seen in the case studies reveals that the national government has ostensibly been leading the charge to develop eco-compensation mechanisms and other innovative environmental policies, while provincial and local governments have been key contributors to and, in some cases, initiated this process. The water use rights trading scheme developed in 2000 between Yiwu and Dongyang cities presented in the Zhejiang Province case study, for example, was the first of its kind in the PRC, and it developed relatively independently from

**Figure 2 Provincial Gross Domestic Product and Eco-compensation Programs**



FECF = Forest Ecological Compensation Fund.

Source: Bennett 2009.

the central government. The program has since stimulated a range of related schemes in other provinces and catalyzed the development of national guidelines and regulations for trading water use rights. Similarly, Guangdong Province was first to institute a provincial forest ecosystem compensation fund program, ahead of the national program. Jiangsu and Zhejiang also started to design a system in 2008 to trade emissions between point and non-point sources. Their practices suggest cap-and-trade systems for emissions and effluence could be a valuable future policy option, so long as there would be better monitoring and enforcement. Establishment of a pollution permit trading platform may soon debut in various locations across the country.

Table 1 displays the diversity of eco-compensation programs in the different provinces, varying from forest ecological compensation fund to an emission trading program.

As seen in the provincial case studies, and illustrated in Figure 2, eco-compensation program activities and innovations closely track provincial per capita gross regional product (Bennett 2009). The richer provinces in the sample—Fujian, Guangdong, Jiangsu, Liaoning, and Zhejiang—are where the most activity and innovation are happening at the local level. Conversely, the case studies from the poorer provinces in the sample—Gansu, Jiangxi, Ningxia, and Qinghai—are clearly more dependent on central government programs and funding. This suggests that the central government can adopt multiple roles in its evolving eco-compensation policy framework, serving as an enabler and a facilitator of innovation and experimentation in the richer regions—which have the capacity and financial resources to address their own environmental issues—while playing a more central financial and policy role in the country's poorer areas.

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## Group 1: Eastern Provinces

### Case Study 1: Fujian

Since 2003, Fujian has been a national leader in watershed eco-compensation programs, developing and implementing programs for three of its key rivers: Min, Jiulong, and Jin. The initiation and exploration phase for these programs covers 2003–2008. In 2008, the Ministry of Environmental Protection (MEP) placed the Jiulong and Min river eco-compensation programs within the first group of national eco-compensation pilot programs. The Jiulong River eco-compensation program was implemented first (2003), followed by the Min River and Jin River eco-compensation programs (2005). All of these programs consist of cost-sharing arrangements involving lower-to-upper watershed financial transfers for improved water quality management and investment. For the Jiulong River, Fujian's second largest river with an annual average flow of 14.6 billion cubic meters (m<sup>3</sup>), water quality in the upstream section between Longyan and Zhangzhou municipalities has been relatively poor, since these municipalities lack the necessary financial capacity to effectively manage water quality. This section is also a key source of drinking water for downstream Xiamen, which is economically more developed and has the financial resources to contribute to improved water quality management.<sup>1</sup> In comparison, the Min River is Fujian's largest, with an annual average flow of 62.1 billion m<sup>3</sup>. The watershed area covers half of the province, and the river valley is one of Fujian's key economic zones, mainly consisting of the mountainous upper and middle watershed municipalities of Sanming and Nanping, and coastal (downstream) Fuzhou Municipality. The river valley is the site of significant industrial development and consequent water pollution, with 60% and 40% of Fujian's total chemical oxygen demand

(COD) and ammonia nitrogen water pollution emissions, respectively, occurring in this area. Upstream husbandry operations have grown quickly, together with household waste production, all of which have been contributing to increasingly severe water pollution in face of lagging environmental management investment. Similar to Xiamen, downstream Fuzhou is a key beneficiary of watershed ecosystem services, while also being economically more developed.<sup>2</sup> Finally, the Jin River is Fujian's fourth largest, with annual average flow of 4.8 billion m<sup>3</sup>. While it is a key water source for all cities, counties, and districts of Quanzhou Municipality, mass industrial production in the river valley coupled with lagging environmental investment has meant that 90% of household and industrial wastewater from upstream Nan'an, An'xi, Yongchun, and Dehua cities or counties has been discharged directly into the river. As a result, in 2005, only 77% of the drinking water sources for these four cities or counties, and only 66.7% of the drinking water sources for Nangaogu—the supply point for Shishi and Jinjiang cities—were up to standard.

In response, eco-compensation programs were launched for these three watersheds. For the Jiulong River, a total of CNY24 million–CNY28 million was raised annually during 2003–2008: Xiamen provided CNY10 million/year, Zhangzhou and Longyan each contributed CNY5 million/year, Fujian's Environmental Protection Bureau provided CNY4 million/year during 2003–2004, and CNY 8 million/year during 2005–2008. For the Min River, a total of CNY50 million was raised annually during 2005–2008: Fuzhou contributed CNY10 million/year, Sanming and Nanping each contributed CNY5 million/year, and the provincial Development and Reform

<sup>1</sup> The municipality's 2005 total output value and financial revenues were CNY102.955 billion and CNY9.895 billion, respectively—1.6 and 3.7 times those of Zhangzhou, and 2.7 and 4.8 times those of Longyan.

<sup>2</sup> Fuzhou's 2005 total output value and financial revenue were CNY148.206 billion and CNY9.745 billion, respectively—3.8 and 5 times those of upper watershed Sanming City, and 4.2 and 6.5 times those of middle watershed Nanping City.



Commission and Environmental Protection Bureau each contributed CNY15 million/year. For the Jin River watershed, a total of CNY20 million was raised annually during 2005–2008: Quanzhou municipality contributed CNY5 million/year, while the eight downstream counties, cities, and districts benefiting from watershed ecosystem services contributed a total of CNY15 million/year, with contributions based on relative water use. Supporting policies, procedures, and principles for funds procurement and use, and monitoring and verification measures were established in the *Jiulong River Watershed Integrated Restoration Special Funds Management Measures*,<sup>3</sup> in the provincial Finance Bureau and Environmental Protection Bureau's *Min River Watershed Water Environmental Protection Special Fund Management Measures*,<sup>4</sup> and in Quanzhou Municipality's *Jin River, Luoyang River Upstream Water Resource Protection Subsidy Special Fund Temporary Management Regulations, and Implementation Rules and Regulations*.<sup>5</sup> In all of these programs, investment focused on comprehensive watershed management, including the establishment of husbandry, aquaculture, and household waste treatment facilities and management measures, water source protection and restoration, management of agricultural non-point source pollution, prevention and treatment of industrial pollution, and the creation of online pollution source monitoring and supervision. As a result, water quality compliance rates in the Jiulong River watershed have improved from 84.3% achieving Class I-III in 2004 to 87.7% in 2008. Likewise, water quality compliance rates for

the whole Min River valley have improved from 83% achieving Class I-III in 2004 to 98.5% in 2008. And, for the Jin River watershed, compliance rates for the drinking water sources of all cities, counties, and districts have reached 100%.

With support of the national government, Fujian has entered the second phase of its watershed eco-compensation mechanism development, using the lessons from these pilot programs to create a classification system for the 12 key watersheds in the province, for use in developing similar eco-compensation programs.<sup>6</sup> Classification is based on, among other things, the degree to which watersheds cross administrative boundaries, the level of water pollution severity, and the complexity of the causes and required responses. Programs in watersheds with good water quality, for example, will focus primarily on maintaining and improving environmental quality.<sup>7</sup> In terms of cross-provincial programs, MEP is helping Fujian and Guangdong negotiate the development of a joint program for the Ting River watershed. Subsidies for Jiulong, Min, and Jin river watershed programs are being steadily raised,<sup>8</sup> and a variety of additional measures are also being introduced to increase financial resources for watershed management. These include a surcharge on water resource fees for use in eco-compensation, a levy on hydropower stations that contribute to the deterioration of water quality, and a "green insurance"<sup>9</sup> fund for heavily pollutive industries. In addition, Fujian is also focusing on developing the necessary local and provincial legislative and policy support, management mechanisms, water quality targets, and incentives.

<sup>3</sup> 《九龙江流域综合整治专项资金管理办法》

<sup>4</sup> 《闽江流域水环境保护专项资金管理办法》

<sup>5</sup> 《晋江、洛阳江上游水资源保护补偿专项资金管理暂行规定》和《实施细则》

<sup>6</sup> The State Council has clearly required in *Some Opinions Regarding Supporting Fujian Province's Acceleration of the Western Straits Economic Zone Development*, issued in May 2009, that "eco-compensation measures between upper and lower reaches of Minjiang River, Jiulong River and other river valleys shall be improved, watershed management eco-compensation mechanisms for the Tin River (Han River) in Longyan, Shantou and Chaozhou shall be promoted, as shall be inter-watershed cross-administrative zone cooperative ecological environmental protection."

<sup>7</sup> This includes, for example, the Jiao Stream, Huotong Stream, Dong Stream, and Zhang River watersheds.

<sup>8</sup> By 2010, total funds for the Min, Jiulong and Jin rivers will reach CNY100 million, CNY90 million and CNY15 million, respectively. Beginning 2011, governments will increase their contributions based on their GDP growth rates. For example, Quanzhou, beginning in 2009, increased its contribution to the Jin River program from CNY20 million to CNY30 million.

<sup>9</sup> The polluters have to buy insurance for possible pollution accidents, with which the insurance company will pay for the pollution accidents in case of such an accident.

## Case Study 2: Guangdong

Since 1998, Guangdong has steadily increased government funding for environmental programs, while also developing and expanding its range of eco-compensation policies and programs. Provincial government funding for the environment has increased from CNY20 million in 1998 to CNY500 million currently, with watershed and forestry protection being key concerns. For example, the provincial government is investing CNY2.5 billion in funding during 2008–2010 for the construction of wastewater treatment facilities in the mountainous regions in the north and underdeveloped regions in the east and west, which are key upper watershed areas. The government has also focused on developing frameworks of cooperative management over key watershed areas. The Tan River Model was developed in the 1990s, whereby all cities and towns along the Tan River were required to sign a “Responsibility Pledge”<sup>10</sup> as part of a water pollution management system characterized by science-based targets and responsibilities, comprehensive prevention measures, and regular monitoring and verification. A special fund has been created for water quality protection, funds have been earmarked for specific water quality investments, and subsidies provided. As a result of this program, stable water quality and watershed functionality for the Tan River has been maintained for the past 10 years, in face of the growing pressures brought on by rapid economic growth. In recent years, provincial and local governments have also begun to develop programs of financial transfers to upper watershed areas for environmental management and poverty reduction. Guangdong was the first province to establish a provincial Forestry Ecosystem Compensation Fund (FECF), in 1999, and it has been steadily increasing FECF subsidies. Under the current plan, the provincial Finance Bureau will increase subsidies further by CNY30/ha/year during 2009–2012, to reach CNY270/ha by 2012. An increasing amount of funding for FECF, especially for upper watershed

forest area, is planned to come from the developed downstream Pearl River Delta region. At the local level, the finance department of Shenzhen municipality pays per capita subsidies of CNY500 per month to residents in the zoned “ecological control areas” of Dapeng, Kuichong, and Nan’ao as compensation for implementing stipulated ecological protection activities and land-use restrictions, and the municipality also plans to expand this system to cover water resource protection areas.

Shenzhen’s example also highlights the province’s focus on implementing a policy of paid resource and environmental use. This includes paid permits and security deposits for mineral extraction rights, with monies to be used for environmental protection and restoration of mining areas, a paid water use permit system, balanced compensation for appropriation of cropland, and a pollution emissions permit and fee system. As with Shenzhen, various municipalities in Guangdong are developing such policies to address their particular concerns. Dongguan City, for example, has initiated a subsidy program to facilitate the shift to a less pollutive industrial structure, providing CNY350 million and CNY450 million in subsidies for facilitating upgrades to greener and less energy intensive technology in the cement and husbandry and/or aquaculture sectors, respectively, and also providing subsidies for the closing of brick kilns and for enterprises to voluntarily move to industrial parks with improved pollution control and management facilities. Similarly, Guangdong is also providing subsidies of CNY12/ton for ironworks and CNY15/ton for steelworks to close low-tech, pollutive and energy-intensive facilities. As part of this drive, the provincial government has also been strengthening its regulatory and policy framework. The *Guangdong Province Regulations on Water Protection in Cross-administrative Area River Sections*, issued in 2006, stipulates that construction projects

<sup>10</sup> The municipal or township governments sign an agreement with higher level governments, in which the lower level governments promise to take specific responsibilities in protecting the watershed environment.

will not be approved if they will add to water pollution emissions in cross-administrative river sections that have not achieved pollution control targets. The *Guangdong Province Water Resource Management Regulations for the Dong, Xi, Bei and Han Rivers*, issued in 2009,

establishes management departments for these four large watersheds to promote unified watershed management of water resources, and lays the groundwork for the development and expansion of cross-jurisdictional watershed eco-compensation programs.

### Case Study 3: Hainan

Hainan's main efforts toward eco-compensation have been in the development of its provincial FECF, which has focused on protecting and managing its biodiversity-rich interior mountainous forest region. Hainan's interior is one of the PRC's key regions of rich, globally significant biodiversity, and is an important headwater area for the island. It is also the location of most of Hainan's officially designated "poor townships" and 90% of its low-income population. Since the protection of this region's key ecosystems has created significant constraints on the ability of local communities to develop economically, it has been necessary to create an eco-compensation mechanism to adjust the relationships between these ecosystem service providers and the beneficiaries. In 2006, Hainan issued *Hainan Province Ecological Financial Transfer Payments Provisional Measures*, which details a system of monetary compensation to cities and/or counties that suffer financial losses from efforts to manage and protect "forests providing significant public benefits."<sup>11</sup> Beginning in 2006, total subsidies of CNY20 million/year have been paid—distributed based on a range of factors—to a number of cities and counties for the protection and management of "key areas with forest providing significant public benefits" that are not covered under the PRC's Natural Forest Protection Program or the national FECF. Subsidy rates are the same as the national FECF—CNY75 per ha of forest area—with city and/or county governments responsible for disbursing these funds to grassroots units. To date, Hainan has paid CNY60 million in subsidies, with 87.15% of this going to the central mountainous region. In 2008, Hainan strengthened and extended this program by issuing the *Notice Regarding Provisional Measures for the Establishment and Development of a Central Mountain Region Eco-compensation Mechanism*, which stipulates that subsidy payments will gradually be increased over 5 years beginning in 2008, to CNY60 million/year.

Changjiang County provides an excellent case study of program implementation. Wangxia

Township—which is classified as a "poverty township" within the county and is near the Bawangling Protected Area—is the main location for program implementation within Changjiang. Based on the minimum welfare standard for rural areas, agricultural households are paid CNY33/month, with these payments going directly to individual household bank accounts accessible via program-issued bankcards. As per program stipulations, the provincial Finance Bureau, Forest Bureau, and other relevant departments conduct both regular and random inspections of program areas, and disburse subsidy funds upon certification that program criteria are met. The finance and forest bureaus have the right to cancel payments to households or villages that do not meet minimum program criteria, with payments curtailed the following month. In 2007, total subsidy payments made in Changjiang were CNY1.17 million. In 2008, the program was expanded to encompass all of Changjiang's 14,000 ha of collective public benefit forest area, adding all households in Qicha Township, and four villages in Shilu Township, with annual subsidies totaling CNY1.4 million. An additional four villages have been included in the program in 2009, based on the findings of a special working group organized to investigate community income losses resulting from restrictions introduced by the program on the cultivation of crops in forest areas.

During 2006–2008, Hainan collaborated with the Canadian International Development Agency and the World Bank to carry out research on eco-compensation policy, and together with the Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, completed the Feasibility Study on Eco-compensation Mechanism Policy in Hainan's Central Mountain Area and Hainan Provincial Eco-compensation Mechanism Framework Design (Draft). As part of this collaboration, the provincial government hosted several international and domestic workshops, and based on these, completed the Hainan Province Eco-Compensation Management Measures (draft for comment).

<sup>11</sup> Forests in the water head areas, along the water bank, in the sloping land.

## Case Study 4: Jiangsu

Jiangsu Province has been involved in a range of innovative environmental programs, with the goal of developing a modern economic system that is able to better internalize the costs of environmental protection, management, and restoration within economic activities. To support this work, the provincial Finance Bureau has established a special fund of almost CNY3 billion/year for provincial-level energy saving and emissions reduction, circular economy development, and Tai Lake watershed management. Work to date has consisted of mapping out and delineating environmental zones within the province, promoting a system of environmental pricing and paid resource use, developing pilot programs for pollution emissions rights purchasing and trading in the Tai Lake watershed, promoting a “Rewards in place of Subsidies”<sup>12</sup> policy to encourage improved environmental management and a cross-district water quality management system, and developing relevant legal and policy frameworks.

To lay the groundwork for improved environmental management, Jiangsu has developed a regional environmental zoning system. In March 2009, the provincial government publicly issued the *Jiangsu Province Key Ecological Function Protection Zone Regional Map*. This lays out a regional zoning system comprised of 12 key ecological protection categories, under which are 569 key ecological function protection zones subdivided as follows: 19 nature reserves, 38 public forest parks, 68 scenic areas, 2 geological parks, 149 drinking water source protection zones, 18 public water adjustment and storage zones, 29 key water source zones, 6 key aquaculture water areas, 95 wetlands, 64 clean water channel protection zones, 47 public benefit forest areas, and 34 special ecological production areas.

With the support and attention of the National Development and Reform Commission, the Ministry of Environmental Protection, and the Ministry of Finance, Jiangsu began water pollution emissions rights trading pilot work

for the Tai Lake watershed in 2007. This has involved setting initial prices, developing basic market infrastructure, strengthening the capacity of key watershed monitoring and control units, and promoting a system of regional emissions reductions and total emissions control. Through large-scale survey work, initial prices have been set at CNY2,600–CNY4,500/ton for COD and CNY2,245/ton for sulfur dioxide (SO<sub>2</sub>). By 2009, Jiangsu has begun implementing a paid emissions rights pilot program for ammonia nitrogen and total phosphorous emissions, and has developed a city-level water pollution emissions rights trading market. Almost 1,000 enterprises have made purchases during a period of more than 1 year, with total proceeds of over CNY10 million to be used for environmental protection and environmental resources market development. An initial market for the trading of the emissions rights for major water pollutants in the Tai Lake watershed will begin in 2010. Jiangsu has also been relatively one of the earliest in the PRC to increase emissions fee standards. The goal is to increase fees to the point where enterprises find it more cost effective to improve their own emissions management and prevention capacity than to pay penalties. On 1 July 2007, the fee for air pollution emissions was increased from CNY0.6/equivalent unit to CNY1.2, and the fee for water pollution emissions was increased from CNY0.7/equivalent unit to CNY0.9. In 2008, Jiangsu collected CNY2.1 billion in fees under this system, the most of any province for 8 consecutive years. Jiangsu also increased household sewage management fees to CNY1.05–CNY1.15 during the 10th Five-Year Plan and to CNY1.3–CNY1.6 during the 11th Five-Year Plan for the Tai Lake watershed area, and from CNY0.8/ton to CNY1–CNY1.2/ton for central and northern Jiangsu during the 11th Five-Year Plan, with these fees directly used for city and/or county sewage plant construction and operation costs.

The province has also been promoting policies to improve management of its key

<sup>12</sup> Enterprises whose discharge is up to standard are rewarded. Formerly, these enterprises are given subsidies to treat pollution.



watersheds. This has included the development of a cross-district water quality management system, whereby upper watershed administrative zones of rivers pay lower watershed zones penalties—to offset added water pollution management costs—based on the amount by which water quality entering the lower zone exceeds targets. Based on survey work, the following penalty rates have been set: CNY15,000/ton of over-target COD, and CNY10,000/ton of over-target ammonia nitrogen and total phosphorous. To date, the program has divided the key river branches and water corridors feeding into the Tai Lake basin—covering 80% of the water volume of the watershed—into 30 sections for program monitoring and subsidy assessment. Another policy, initiated in 2008, is the “River Chiefs” policy. This has made party and government leaders and all levels of government responsible for watershed management, and has set down specific water pollution management responsibilities, targets, liabilities, and funding. Such work has already produced significant outcomes. Emissions of major pollutants have seen significant total reductions over the past 2 years, where 99% and 103% of the targets for COD and SO<sub>2</sub> emissions for the Tai Lake watershed set out by the national government in the 11th Five-Year Plan have been reached as of mid-2009, completing these nationally stipulated reductions ahead of schedule. In terms of the “River Chiefs” policy, according to data, 67 of 79 river sections assessed in Wuxi Municipality in 2008 complied with standards, with a compliance rate of 91%. This compares with only 45 sections during the same period in 2007.

Jiangsu has also been developing a “Rewards for Subsidies” policy to create rewards to encourage good environmental management. To encourage administrative villages to conduct comprehensive environmental management and participate in provincial environmental checks and assessments, an award of CNY20,000 per village has been set, to be used primarily to subsidize the costs of within-plan village management of industrial pollution sources, household wastewater and garbage collection, and husbandry wastes. To promote improvement of industrial pollution source management and to meet emissions targets, the provincial Finance Bureau has earmarked CNY320 million/year, to be awarded based on enterprise pollution control investments and performance checks for reductions in the emissions of major pollutants.

Jiangsu has also been developing the necessary legal and policy foundations for these programs. Legal foundations have been set down in *Jiangsu Province Tai Lake Water Pollution Prevention and Management Regulations*, *Jiangsu Province Water Resource Protection Regulations*, and *Jiangsu Province Ecological Public Benefit Forest Protection Regulations*, while policy frameworks have been outlined in *Opinions Regarding Strengthening Environmental Protection and Ecological Construction*, *Opinions Regarding Putting into Effect Environmental-Protection-Prioritized Scientific Development*, *Policy Measures for Practical Environmental Protection*, *Jiangsu Province Environmental Resource Regional Subsidy Methods*, and *Jiangsu Province Tai Lake Watershed Key Water Pollutant Emission Target Paid Use and Trading Pilot Plan*.

## Case Study 5: Liaoning

In accordance with the 11th Five-Year Plan's "Scientific Development View,"<sup>13</sup> and in response to President Hu Jintao's strong encouragement during a provincial inspection visit to "...strengthen ecological protection, develop sound eco-compensation mechanisms...", Liaoning has been energetically developing a range of eco-compensation and other environmental policies and programs in recent years, with the goal of becoming the best of the first batch of national eco-compensation pilot regions. In line with this, Liaoning has established an eco-compensation mechanism steering committee consisting of representatives from the key government stakeholders, including the provincial Environmental Protection Bureau, Finance Bureau, Forest Bureau, and Water Resources Bureau, to best organize and delegate the necessary research and policy tasks. The province has also been paying close attention to the eco-compensation policies of other provinces and locales, including Zhejiang and Fujian, and has been focusing on the development of eco-compensation pilot programs in the key areas laid out by the Ministry of Environmental Protection in its *Guiding Views Regarding the Development of Eco-compensation Pilot Work*.

One of Liaoning's current eco-compensation programs targets its eastern region, a key upper watershed area for the province's drinking water. As detailed in the *Notice Regarding the Policy to Implement Financial Compensation to the Key Eastern Ecological Region* and the *Liaoning Province Key Eastern Region Eco-compensation Policy Implementation Measures*, issued in 2007 and 2008, respectively, the provincial Finance Bureau has, since 2008, earmarked CNY150 million annually for eco-compensation, targeting 16 counties and/or municipalities in the province's eastern region—including Jiangxiuyan County, Xinbin County, and Qingyuan County—that have at least 66,667 hectares (ha) of forested area, or that have natural forest area of at least

33,333 ha and a large reservoir.<sup>14</sup> Subsidies are disbursed directly to county governments each month, and are calculated based on the weights of 70% for forested area and 30% for forest volume, with subsidy reductions calculated based on (i) share of within-county water environment function zones that do not achieve water quality standards, and (ii) rate of increase of intensively eroded area. Program documents also stipulate how funding is to be disbursed and managed, and that the relevant departments have the responsibility to produce accompanying regulations to ensure proper implementation.

Another important program involves a system of financial incentives to improve water quality in the Liao River. In 2008, Liaoning issued the *Notice Regarding Provisional Measures for Liaoning Province Cross-District River Water Quality Target Assessment for River Sections Exiting Cities*. This program encompasses 14 provincially administered municipalities, and 27 main channel and tributary branch sections that exit cities and are monitored for water quality. Using the targets stipulated in national and provincial pollution control plans and provincial and municipal environmental responsibility promissory documents, this program targets COD (the Ganchao section target potassium permanganate index), with participating cities levied penalties for failing to achieve pollution control targets, which are paid to the next downstream municipality to defray the added water pollution management costs. For each 50% that water quality surpasses targets, the penalty is CNY500,000 for river sections in the Liao River main channel and CNY250,000 for other river sections, with monthly assessments conducted by the provincial Environmental Protection Bureau and reported to the relevant cities. The program, which began in 2009, also stipulates that the provincial government will legally pursue and prosecute the responsible authorities for those

<sup>13</sup> A political doctrine that believes development has economic, human, and environment dimensions.

<sup>14</sup> In the PRC's land classification system, "forested area" is land zoned as "forest area" (i.e., is allowed to have forests on it) that has forests on it. "Natural forest area" refers to state-owned forest land with natural forests.

river sections that consistently fail to achieve targets, or are the source of severe pollution disasters. Through April 2009, CNY7.75 million in penalties has so far been collected from seven cities—including Shenyang—involving 14 river sections.

Liaoning has also been developing and implementing regulations to improve the environmental management and restoration of mining operations. In 2007, the provincial government issued the *Liaoning Province Geological and Environmental Protection Regulations*, followed by the *Liaoning Province Mine Environmental Restoration and Management Security Deposit Management Provisional Measures*. In 2008, the provincial Bureau of Land and Resources, the Bureau of Finance and the Environmental Protection Bureau jointly issued the *Views on the Implementation of Liaoning Province Mine Geological and Environmental Restoration and Management Security Deposit Management Provisional Measures*. These documents stipulate that all mining enterprises and holders of mineral resource rights have the legal obligation to carry out environmental restoration and management of their mining operations. These parties must also—with the same county or higher-level land and resources administrative management office that is responsible for issuing the mining permit—sign a mine environmental restoration and management promissory letter, lay out a *Mine Geological and Environmental Protection and Integrated Management Plan*, and provide a mine environmental restoration and management security deposit, paid all at once or in installments. Mine environmental restoration and management activities must be implemented throughout the whole mining process, and for 2 years after the mine is

closed. Upon fulfilling his obligations during the mine's operation, and receiving approval, 85% of the deposit is returned to the mining rights holder. Upon completion and approval of responsibilities during the post-mining 2 year period, the rights-holder will receive the remaining 15% of the deposit with interest. The Provincial Land and Resources Bureau, together with the Environmental Protection Bureau and other relevant bureaus, formulate the relevant ecological restoration standards and targets.

In addition to these programs, Liaoning is also exploring other policies and programs. With the help of the Liaoning Academy of Environmental Sciences, for example, the province has been conducting research to develop an eco-compensation mechanism to manage the upper watershed of the province's important Dahuofang Reservoir. Research results so far have estimated the value of the watershed ecosystem services of the upper watershed area of the Dahuofang Reservoir to be between CNY90 million–CNY656 million, based on the lower bound of ecological protection and restoration costs and the upper bound of the upper watershed's ecosystem service function value. Based on benefit extent and willingness and ability to pay, research results have estimated that 64.1% of program subsidies should be provided by Shenyang Municipality, with the remainder provided by Fushun Municipality. Once the reservoir's pipeline project is complete, eco-compensation payments are to be paid to the reservoir's upper watershed areas, with 7.7%, 43.9% and 48.4% of total subsidy payments to go to Fushun, Xinbin and Qingyuan counties, respectively, as based on basin area and reservoir inflow water quality.



## Case Study 6: Zhejiang

Zhejiang Province has for several years been at the leading edge of national developments in eco-compensation policy, and currently boasts a range of pioneering programs—especially sub-provincial initiatives. As such, it has been included in the first group of national government eco-compensation pilot regions. The provincial government has emphasized improving conservation and environmental management measures, with watershed ecosystem services being of key concern.

Some of Zhejiang's earlier programs have been about the mining sector, via the use of security deposits to ensure sufficient environmental management, protection, and restoration during mine development and operation. During 2001–2003, Zhejiang issued the *Zhejiang Provincial Government Notice Regarding Mine Natural Eco-Environmental Management Revolving Fund Collection and Management Measures*, followed by the *Zhejiang Provincial Government Notice Regarding Implementing the Strengthening of Mine Eco-Environmental Protection and Management Work*. This policy has to date resulted in the collection of a total of CNY870 million in funds for use in mining area environmental protection, restoration, and management.

Zhejiang is notable for the significant amount of local-level innovation that has been occurring in eco-compensation, with innovations taking five main forms: (i) off-site poverty reduction economic development zones; (ii) water use rights transfers; (iii) reservoir upper watershed environmental protection; (iv) eco-compensation contracts; and (v) paid emissions rights use and trading. One of the earliest innovations has been the off-site poverty reduction economic development zones. These give upstream regions development options in downstream areas in exchange for upstream development restrictions to reduce water pollution. The earliest of these is the Jinpan Development zone between downstream Jinhua City and upstream Pan'an County, launched in 1996. Since then, this approach has been expanded with the establishment of the Longwan, Meixu, Yuyao, and Jingning zones, which have included a range of accompanying policies and incentives such as tax rebates for

industries that shift development to downstream development zones.

Another early innovation has been the water use rights trading. The first water use rights transfer contract in the PRC and one of Zhejiang's best known local programs was signed in 2000 between Dongyang and Yiwu municipalities in the Jinhua River watershed. Under the contract, the more developed lower watershed Yiwu Municipality has agreed to pay CNY200 million in water resource development funds to upper watershed Dongyang Municipality for the purchase of use rights to 50 million cubic meters of high quality water resources. As part of this arrangement, Dongyang is improving water-saving measures and water-use efficiency, while Yiwu is contributing to the development and upgrading of the relevant infrastructure. This program has since spurred significant activity and innovation across the PRC in water use rights transfers.

Another interconnected set of innovations has involved restructuring and rationalizing the financing of reservoir upper watershed environmental protection, which has also included eco-compensation contracts. Currently, 69% of Zhejiang's county-level and above municipalities have reservoirs as their main water source. In many cases—such as for Shaoxing City's Tangpu Reservoir and Taizhou City's Zhangtan Reservoir, as well as for Hangzhou and Wenzhou municipalities and Deqing County—regional governments have been using specific portions of water fees to contribute to special funds for use in upper watershed environmental management and conservation via eco-compensation. In some cases, direct contracts are being developed between districts. One example of this is a formal eco-compensation agreement signed between the Fucun Township of Jindong District, Jinhua City, and the Yuandong Township, whereby lower watershed Fucun pays upper watershed Yuandong CNY50,000 per year to finance improved upper watershed management and protection.

Zhejiang has also been focusing on the development of emissions trading programs. The provincial government has issued the *Guiding Opinions Regarding the Development*

*Pilot Work for Emissions Rights Paid Use and Trading*, and the relevant provincial departments have established the *Zhejiang Province Emission Rights Paid Use and Trading Pilot Work Plan*, and have begun pilot work. The *Zhejiang Province Circular Economy Pilot Implementation Plan* has also passed an expert meeting of the National Development and Reform Commission, and at the same time the province has issued the *Zhejiang Cross-District River Section Water Quality Protection and Management Measures (Trial)*, which clarifies rights and responsibilities. With the support of the provincial government and the relevant bureaus, Jiaxing City pioneered the creation of pollution emissions paid use measures. At present, Zhejiang is steadily developing emissions trading pilots throughout the province, has set up an emissions trading center, and is embarking on the creation of the relevant supporting documents, laws, and management plans.

In terms of the broader policy framework, Zhejiang officially launched its “ecological province”<sup>15</sup> development drive in 2003. In 2004, the province launched the “811” program, which targets comprehensive water quality management in 8 major watersheds and 11 key environmental protection monitoring and management areas. Zhejiang Provincial Governor Lu Zushan stated in the government’s 2005 work report that Zhejiang will “Thoroughly implement the plan for an Ecological Province, strongly promote ‘10 million ecological construction’ projects, put into practice ecological public benefit forest protection measures and improve eco-compensation mechanisms.” In August 2005, the province also issued the *Several Views on Improving Eco-compensation Mechanisms*.<sup>16</sup> In April 2006, Zhejiang issued the *Qiantang River Headwaters Area Eco-environmental Protection Provincial-Level Financial Transfer Payments Provisional Measures*,<sup>17</sup> followed by the necessary regulations. In this, Zhejiang’s provincial finance bureau earmarked CNY200 million to support 10 counties, cities, and districts in the Qiantang River watershed

to improve conservation and watershed management measures, restructure industry, and invest in pollution prevention and control. Currently, the provincial government is focusing on expanding eco-compensation programs to encompass its eight major watersheds. In 2008, the provincial government issued the *Zhejiang Provincial Eco-environmental Protection Financial Transfer Payments Trial Measures*.<sup>18</sup> This focuses on the province’s eight major watershed areas, encompassing 45 counties and/or municipalities, earmarking CNY800 million in 2008, and CNY1 billion in 2009. Much of the province’s current drive has focused on both increasing investment in environmental programs and improving management and monitoring capacity. In 2008, for example, the province handed down punishments for 10,824 cases of environmental law violations, collecting CNY385 million in penalties.

Over the past several years, Zhejiang has been establishing the necessary laws and regulations for environmental protection. These include 17 local-level laws and regulations such as the *Zhejiang Province Solid Waste Pollution Environmental Management Regulations*, the *Zhejiang Province Water Pollution Management Regulations*, the *Zhejiang Province Environmental Pollution Monitoring and Management Measures*, and the *Zhejiang Province Nature Reserve Management Measures*. The provincial party committee and government have also created some 30 environmental protection policy documents, such as the *Several Views Regarding Implementing the Scientific Development View to Strengthen Environmental Protection*.

Zhejiang has also been active in promoting forest conservation and management. Since 2004, the provincial government has added funds to complement the national Forestry Ecosystem Compensation Fund, increasing national subsidies from CNY120/ha to CNY225/ha. In 2005, the government formalized this with the creation of the *Zhejiang Provincial Forest Ecological Benefit Compensation Fund Management Measures*. To date, the province has spent CNY1.818 billion on this program.

<sup>15</sup> A comprehensive advancement in ecological protection in a province, which is measured with a series of indicators of both ecological protection and economic development.

<sup>16</sup> 《关于进一步完善生态补偿机制的若干意见》(浙政发(2005)44号)

<sup>17</sup> 《钱塘江源头地区生态环境保护省级财政专项补助暂行办法》(浙政办函(2006)31号)

<sup>18</sup> 《浙江省生态环保财力转移支付试行办法》

## Group 2: Inland and Western Provinces

### Case Study 7: Anhui

In recent years, Anhui Province has placed great importance on developing eco-compensation mechanisms to improve the management of key watersheds. The *Anhui Province Opinions on Actualizing State Council Decision on Using the Scientific Development View to Strengthen Environmental Protection* states that Anhui should “develop eco-compensation pilots for the Xin’an River Watershed and Dabie Mountain Area.” Thus, since 2005, Anhui has been conducting research work in developing pilot projects for these key watershed areas. The province has also focused on developing eco-compensation mechanisms to manage the Huai River watershed.

In response to central government suggestions, Anhui Province produced the *Xin’an River Watershed Shared Public Ecological Construction and Benefit Mechanism Research Report* in May 2006, which advocates a program of financial transfers from the lower watershed areas in Zhejiang to the upper watershed areas in Anhui to increase conservation and watershed protection funding.<sup>19</sup> The Xin’an River, which is a key headwater of the Xin’an River Reservoir, and the Qiantang River are important water sources for the more developed north and eastern regions of the Zhejiang Province. About 55.7% (644,000 hectares [ha]) of Xin’an River’s total watershed area is inside Anhui, with Huangshan City and Xuan City, Jixi County comprising key upper watershed areas. The average annual flow through rate within Anhui (the Jiekou section) for 1990–2004 was 7.3 billion cubic meters (m<sup>3</sup>), more than 68% of the Xin’an River Reservoir’s average annual inflow. The *Xin’an Research Report* estimates that Anhui Province invested a total of CNY1.95

billion in both direct and indirect watershed protection during 1996–2004.<sup>20</sup> Huangshan City has also promoted conservation and watershed management, with forest cover rates currently over 75%. As a result of these and other major conservation efforts, Xin’an is the healthiest of the PRC’s few relatively healthy watersheds, with upper watershed water quality currently up to national Class II ~ III standards. However, upper watershed areas also significantly lag behind lower watershed areas economically, and thus face challenges in continuing to meet lower watershed water quality demands. The *Xin’an Research Report* thus advocates the development of a policy framework and pilot watershed eco-compensation program between downstream Jiande City and Chun’an County in Hangzhou Municipality, Zhejiang Province, and upstream Anhui Province’s Tunxi District, Huizhou District, Xi County, Xiuning County, and Yi County of Huangshan Municipality, and the Qimen County section of Huangshan District and Jixi County of Xuan Municipality. The report provides suggestions on the necessary management frameworks, subsidy standards, and accompanying policies for the development of an eco-compensation program. Planning work is currently being conducted by the Ministry of Environmental Protection and the Ministry of Finance.

In March 2008, the Anhui Provincial Environmental Protection Bureau and the Bureau of Finance, with the cooperation of the College of Resources and Environment, Hefei University, produced the *Wanxi Dabie Mountain-Pishihang Irrigation District Eco-compensation Mechanism Pilot Research Report*. The report advocates the development of an eco-compensation

<sup>19</sup> Leaders of the Standing Committee of the National People’s Congress initially suggested developing a Xin’an River watershed eco-compensation mechanism in 2004 during a review of the Thousand Island Lake (also known as the Xin’an River Reservoir) in Zhejiang Province.

<sup>20</sup> This includes afforestation and reforestation work, water and soil conservation investments, water pollution prevention, restrictions on industrial development, agriculture and industrial water savings, and ecological migrants programs.

mechanism to increase funding, via lower-to-upper watershed financial transfers, for conservation and watershed protection in the upper watershed areas of the Pishihang Irrigation District in Anhui's central western region. Pishihang is the largest of the PRC's three huge irrigation districts consisting of 10,000-channel irrigation system with five large reservoirs and three large diversion headworks, and providing flood control, hydropower, and scenic amenities for tourism, as well as being a critical water source for irrigation, industry, and drinking water for over 10 million people downstream. The district provides drinking water for Lu'an City, as well as for the cities and/or counties of Jinzhai, Huoshan, Lujiang, Shucheng, Feixi, and Feidong, and has also gradually become the key source for Hefei City, since Chao Lake (the city's other main water source) has in recent years increasingly suffered from serious pollution. The district's five reservoirs all receive their water from the 633,000 ha Dabie Mountain area, which has an annual water retention rate of 3.7 billion m<sup>3</sup> and an outflow rate of 5 billion m<sup>3</sup>. While the Dabie Mountain area has a long history of watershed protection (including conservation work and restrictions on the development of pollutive industries), which has helped maintain perennial water quality for the five reservoirs at Class II and at Class III or better for key irrigation channels and rivers, these upper watershed areas are relatively less developed, with poor financial resources, and

face increasing challenges providing watershed services. The *Wanxi Research Report* thus advocates an eco-compensation mechanism to improve conservation and management funding in the Dabie Mountain areas, and provides a preliminary management framework and subsidy standard estimates. It is currently under review by the provincial government.

Anhui Province's Huai River watershed is the most important of the PRC's "Three Rivers and Three Lakes" key watersheds of concern.<sup>21</sup> Despite ongoing efforts to manage water quality,<sup>22</sup> the watershed still faces significant challenges, with inequitable water resource distribution and severely limited per capita water resources. Monitoring data indicates that from 2007 to 2008, nitrogen and potassium permanganate levels exceeded standards in 20 out of 234 quality checks in 18 river subsections (this does not count the contribution of upper watershed pollution). In 2008, Anhui's Environmental Protection Bureau produced the *Anhui Province Huai River Watershed Water Quality Over Section-Target Penalty Charge Eco-compensation Policy Pilot Program*.<sup>23</sup> This clearly maps out the scope of the pilot, river section definitions, section water quality targets, fee assessment standards and procedures, funds use, and certification measures. Anhui's Environmental Protection Bureau is currently conducting program environmental assessment, and soliciting input from participating cities before reporting to the provincial government.

<sup>21</sup> These are the Huai River, the Hai River, the Liao River, Tai Lake, Chao Lake and Dianchi Lake.

<sup>22</sup> By the end of 2008, 17 city and township water pollution plants have been built and put into operation and 10 are under construction, for a potential total daily water pollution treatment capacity of 1.32 million tons; and industrial enterprises have all installed pollution control facilities and are achieving emissions targets. As part of the country's 4 years of ongoing focus on pollution management in the river, Anhui has added 10 automatic stations in addition to the state-controlled stations for monitoring water quality across city boundaries.

<sup>23</sup> 《安徽省淮河流域水质断面目标超标扣缴生态补偿金政策试点方案》

## Case Study 8: Chongqing

Chongqing has been actively laying the groundwork for the development of provincial eco-compensation pilot programs. The *Decisions on Several Issues Concerning Improving Environmental Protection*, issued by the Chongqing Municipal Party Committee and the Chongqing Municipal People's Government in 2006, expressly requests that the province expedite the development of ecological compensation mechanisms to protect the watershed environment of the Three Gorges Reservoir Area. The *Implementation Proposal on the Campaign of Greening Chongqing (2006–2010)*, issued by the Chongqing Municipal People's Government in 2006, also asks for the establishment of eco-compensation mechanisms, while the *Opinions on Balancing Urban and Rural Reform and Development in Chongqing*, issued by the State Council in 2009, regards the development of multilayer eco-compensation mechanisms as a key component for strengthening environmental protection in Chongqing, and provides policies for the development of pilot work in the province.

Chongqing has been developing mining eco-compensation pilots as well as environmental migration policies. Based on the Ministry of Environmental Protection's 2007 *Guiding Opinions for Developing Eco-compensation Pilot Work*, which outlines mineral development zones as one of the four target areas for the development of eco-compensation pilots, Chongqing issued in 2007 the *Chongqing Environmental Management and Ecological*

*Restoration Security Deposit Provisional Management Measures*, which stipulates that mining enterprises set aside monetary deposits in advance of initiating mining operations for specific use in mine environmental management and restoration. To date, CNY26.25 million has been collected in security deposits.

In 2008, the provincial government issued *Opinions on Expediting Ecological and Poverty-Alleviation Migration Work*. Moreover, the Chongqing Development and Reform Commission is preparing the *Chongqing Ecological Migration Program Plan*, which plans to invest CNY11 billion through 2015 for subsidies and support to relocate households and communities as a means to remove pressure on fragile ecosystems. Chongqing is also integrating ecological migration work with other programs, including "work for the dole" and poverty reduction. It is also consolidating the gains of the Conversion of Cropland to Forest and Grassland (CCFG). To date, Chongqing has invested a total of CNY200 million in these programs and completed the relocation of 50,000 migrants; and since 2008, CNY50 million has been invested and 10,000 migrants relocated via the program to consolidate the gains of the CCFG. Ongoing work in Chongqing is focusing on setting up eco-compensation pilots for watershed ecosystem services and pollution control, and developing a proposal for Global Environment Facility funding to support pilot work, learn from international experience, and conduct ongoing research.



## Case Study 9: Gansu

Gansu Province faces a range of difficult environmental challenges, the most important of which is water scarcity. The province contains 75% of the PRC's arid and semiarid land; local water sources provide on average only 28.94 billion cubic meters (m<sup>3</sup>)/year, while average annual rainfall is only 300 millimeters (mm), with some areas receiving less than 40 mm and evaporation claiming 1,259–3,522 mm. As a result, per capita water consumption is one-half of the national average, and agricultural irrigation per unit area one-fourth. Gansu is also classified in the PRC as one of the provinces most seriously affected by desertification, which affects 28.26% of the province, with 97.63% of this occurring in the Hexi Corridor along the Yellow River. The province's lakes and wetlands have also been severely impacted, with 102,000 hectares (ha) of a key water retention area for the Yellow River—the Maqu Wetlands—having dried up. Recent research by the Chinese Academy of Sciences also shows that the Qilian Mountain area glacier, which is the origin of the Hehei, Shiyang and Shule rivers, key tributaries to the Yellow River, and supplies 950 million m<sup>3</sup>/year of water to these three main watersheds (13.1% of their total volume), is melting at increasing rates due to global warming. Added to this, about one-third of Gansu's usable grassland area, and 80% of its natural grasslands, is degraded. About 91% of the province is also affected by serious soil erosion, which contributes about 9.7% and 30.7% of the total suspended sediment volume of the Yangtze and Yellow rivers, respectively. The province's biodiversity has also been seriously impacted, with growing populations of pests such as rats due to decreases in natural predators, and an expansion of grassland area overrun by poisonous weed species.

Due to these challenges, Gansu has been the target of a number of major central government programs to combat desertification, restore and protect key ecosystems, and improve water management. A total of 758,500 ha of public benefit forest area have been established, and

3.9573 million ha of forest resources are being effectively managed under the Natural Forest Protection Program (NFPP) through 2008, while the CCFG program has enrolled 1.7455 million ha of cropland. The “Three Norths”<sup>24</sup> Shelterbelt Program for fighting desertification is currently afforesting 337,300 ha of land and has established 25,000 kilometers of green corridors. The Forest Ecosystem Compensation Fund (FECF) has enrolled 2.5065 million ha of key public benefit forest area and is afforesting an additional 5.7147 million ha. Added to this, the Ministry of Agriculture's Returning Grazing to Grasslands Program is currently protecting and restoring 3.92 million ha of grassland; and soil erosion control and prevention is being implemented on 7.68 million ha under the Ministry of Water Resources' Integrated Small Watershed Management Program. These programs are being used to target some of Gansu's key watershed and wetlands areas, for example the Shiyang River watershed and the south Gansu key Yellow River water source area.

Gansu has also been promoting efficient water use and water rights reform via “Water-Saving Society” work. So far, a total of 43 counties and districts are implementing pilot programs, which involved reforms in water pricing, water use rights and distribution regimes, and investment in water-saving technology. For example, in the first pilot area of Zhangye County, 153,300 ha of basic and 44,000 ha of hi-tech water-saving irrigation has been built, reducing agricultural water consumption from 88% to 81% of total water use. Of the newest pilot programs, Dunhuang municipality is focusing on groundwater level and extraction monitoring and reducing agricultural water use, while Wuwei municipality has established a blueprint for promoting water-saving agriculture around the key Shiyang River basin. As a result of such work, water-saving irrigation now comprises 62% of the province's total irrigation infrastructure, with annual savings of 110 million m<sup>3</sup>.

<sup>24</sup> North PRC, Northeast PRC, and Northwest PRC.

## Case Study 10: Jiangxi

Jiangxi Province and the national government have placed significant emphasis on managing the province's important "Five Rivers One Lake" Poyang Lake watershed<sup>25</sup> (Poyang is the largest freshwater lake in the PRC), as well as the Dong River headwaters area (a key drinking water source for downstream Guangdong Province) and Jiangxi's rich forest resources.<sup>26</sup> In terms of forest and biodiversity protection and management, Jiangxi has been strengthening financial support for its 176 nature reserves. It is currently lobbying to upgrade a number of provincial-level protected areas to national-level status to increase national financial support for its conservation activities. From 2007 to 2008, the Jiangxi Provincial Finance Bureau earmarked CNY6.7 million to support the establishment of 27 new provincial-level protected areas. The *Opinions Regarding Accelerating the Establishment of Provincial-Level Protected Areas* provides subsidies to newly established national-level and provincial-level protected areas of CNY200,000 and CNY100,000, respectively, as well as subsidies of CNY30,000–CNY50,000 to provincial-level and above protected areas that have established specialized management authorities and management plans. The province has also been steadily increasing subsidy standards for the management of ecological public benefit forest area under the central and provincial-level Forestry Ecosystem Compensation Fund programs. In 2009, the annual subsidy rate for ecological public benefit forest area reached CNY150 per hectare (ha), with subsidies paid for the protection of 3.5 million ha of forest area. In addition to this, Jiangxi has been focusing on post-program financial support for land enrolled in the national Conversion of Cropland to Forest and Grassland (CCFG) program, and has put significant effort into afforestation work, including annual funding for the provision of saplings.

In terms of watershed protection, Jiangxi has recently established and demarcated

protected areas in the Poyang Lake watershed and Dong River upper watershed area in *Some Views on Strengthening Environmental Protection of the "Five Rivers One Lake" and Dong River Source*, and *Notice Regarding the Establishment of the "Five Rivers One Lake" and Dong River Headwaters Protected Areas*, issued in April 2009. To ensure that sufficient funding is provided for ecological restoration and protection in these areas, Jiangxi has also produced the *"Five Rivers" and Dong River Headwaters Protected Area Ecological Environmental Protection Award Management Measures*, which earmarks CNY130 million in funds for the operation of these protected areas. Of this amount, 30% will be distributed based on area, while 70% will be distributed based on the degree to which the water quality of water leaving these zones achieves or surpasses national Class II, with awards curtailed if water quality fails to achieve this criteria. At present, the province is exploring how to increase provincial financial support, and quicken the promotion of subsidies for the protection buffers surrounding Poyang and its nearby lakes.

In 2008, the province endorsed a strategy for the "Poyang Lake Ecological Economy Zone," involving the strengthening of environmental protection, development of a modern industrial system, improvement of infrastructure, development of an ecological civil society, and promotion of balanced development. With the guidance and collaboration of the State Council, Jiangxi is currently formulating the *Poyang Lake Ecological Economy Zone Plan*, and will submit this to the State Council for approval as a national strategy and project for national funding. As part of this work, Jiangxi has selected 80 counties, cities, and/or districts—the first 13 of which are in Poyang's northern composite lakes—for the construction of 85 wastewater treatment facilities. To provide regulatory support for this and other initiatives, the province has produced *Poyang Lake Wetlands Regulations* for the development of eco-compensation

<sup>25</sup> This consists of Poyang Lake, and five of its key tributaries: Gan, Fu, Xin, Rao, and Xiu rivers. Poyang Lake is also an important part of the middle Yangtze River watershed.

<sup>26</sup> Jiangxi has the second highest forest coverage rate in the PRC, at 60.05%.

mechanisms in the Poyang Lake watershed and is currently developing the *Jiangxi Province "Five Rivers One Lake" and Dong River Source Environmental Protection Regulations*.

In addition to Poyang Lake, the Dong River watershed has also long been of significant concern, and the provincial government has been gradually exploring the use of eco-compensation mechanisms as part of its evolving management framework over this key watershed. In 2003, the provincial government issued the *Decisions Regarding Strengthening Dong River Source Ecological Environmental Protection and Development*. This was followed, in February 2004, by the *Implementation Plan to Strengthen Dong River Source Area Eco-Environmental Protection and Development*, which promotes conservation and environmental restoration of the Dong River source area—via general afforestation work and the development of watershed protection forests, CCFG implementation, ecological migration, rural household biogas development, and mine renovation and ecological restoration—and has also established subsidies for ecological protection, with the relevant local governmental units to focus on developing funding sources. In November 2004, the *Jiangxi Province Dong River Source Area Eco-Environmental Protection and Development 11th Five-Year Plan Program* was issued, which focuses on exploring the development of paid natural resource use

and eco-compensation mechanisms for the Dong River upper watershed area, and has laid out plans for the use of CNY1.42 billion in funds for environmental initiatives, as well as for development of the necessary policy and legal support by the relevant bureaus and local governments. The program also endorses the principle of “who develops protects, who damages manages, who benefits subsidizes.”

In March 2007, the then State Environmental Protection Administration listed the Dong River Headwaters within the first batch of national eco-compensation pilot areas. The national government has subsequently been developing multiple survey research activities for the development of a cross-provincial eco-compensation mechanism between Guangdong and Jiangxi provinces for the management and protection of the Dong River headwaters area. This has involved in-depth research on behalf of the National People's Congress and the relevant national and provincial departments, with a report produced providing suggestions. The National Development and Reform Commission also organized a research group of 25 ministries to conduct in-depth research in April 2009, and produced its own suggestions on an eco-compensation program. In September 2009, Jiangxi produced the *Dong River Source Eco-Environmental Compensation Pilot Work Plan*. The provincial government has also been encouraging the participation of nongovernment organizations in this work.



## Case Study 11: Ningxia

An intersection between three deserts—the Tengger, Maowusu, and Ulan Buh—in the north-central region of the PRC, Ningxia Province faces significant environmental and socioeconomic development challenges. With few significant watersheds apart from the Yellow River, and limited local sources, it has annual per capita useable water resources of only about 680 cubic meters ( $\text{m}^3$ ), the lowest of any province in the PRC. Average annual precipitation is only about 289 millimeters (mm) (200 mm in many areas), with the evaporation rate being 1,800 mm, while useable groundwater resources are about 150 million  $\text{m}^3$ . Only about 4 billion  $\text{m}^3$  of water can be drawn from the Yellow River annually as per State Council stipulated sharing rates among the relevant provinces.<sup>27</sup> Long-term overgrazing and extensification of agriculture in the face of these harsh conditions and arid climate have seriously degraded 36% of the province's grasslands, making it prone to desertification and soil erosion. In 2000, 57.4% of Ningxia's land area was desertified, and 22.8% was under threat of desertification, with only 9.8% of the province forested. Soil erosion is a serious concern, since Ningxia is as an important upper watershed area for the Yellow River. It is estimated that the 397 kilometer stretch of the river running through north-central Ningxia receives 100 million tons of soil runoff each year. As a result, the province has been at the forefront of the national anti-desertification campaign in north PRC, and an important target for central government funding for key forestry and watershed management programs.

The national Natural Forest Protection Program (NFPP) and the Conversion of Cropland to Forest and Grassland (CCFG) program are both being implemented in Ningxia. Through 2008, the NFPP has conducted “mountain closure”<sup>28</sup> natural reforestation on 198,333 hectares (ha), and aerial seeding of 66,573 ha. The CCFG program currently involves 155 townships

and 1,463 administrative villages, and work to date has included the retirement and afforestation of 314,000 ha of cropland, 472,000 ha of wasteland, and closed-mountain reforestation of 33,333 ha. The national and provincial governments are also both implementing major policies to protect and rehabilitate the province's grasslands, which cover 47% of the province. As a complement to the national government's Conversion of Grazing to Grassland (CGG) program, Ningxia's party committee and people's government prohibited grazing on provincial grasslands beginning in May 2003. To date, the CGG program has invested CNY717 million in Ningxia to construct 1.48 million ha of enclosed grazing pens and to replant and rehabilitate 262,000 ha of degraded grassland, and has invested CNY13.30 million to reduce and prevent rodent and pest infestation and disease on 2 million ha of grassland. Almost 4 million sheep have been moved off of fragile grasslands and mountain areas and are now raised in pens. As a result of these various programs, the forest coverage rate has increased from 8.4% to 10.5% since 2000, the area threatened by desertification has been reduced by 2,584 square kilometers ( $\text{km}^2$ ) over the past 5 years, and about 233,000 ha of desertified land has been rehabilitated. The grassland vegetative coverage rate has also increased by 30%, and grass yields have increased by over 100%. The province has also focused on improving and expanding its nature reserve system, as important protective buffers to watershed services and biodiversity. The province currently has 13 nature reserves with a total area of 8.206 million mu. Six of these are national-level reserves, covering 7.1925 million mu.

Ningxia has also been focusing on reducing and preventing soil erosion and water pollution and improving water conservation. Soil erosion prevention work has involved the development and implementation of an integrated planning

<sup>27</sup> While total surface water and groundwater resources are 949 million  $\text{m}^3$  and 214 million  $\text{m}^3$ , respectively, these are affected by high rates of mineralization. The Yellow River use rate assumes that it is not a drought year.

<sup>28</sup> Mountains are closed to prevent animal grazing and economic activities in order for the vegetation to recover.

framework, and, as of 2008, some 414 rivers and streams are under small watershed integrated management, about 1,000 soil protection silt dams have been constructed, and soil erosion prevention measures and installations have been completed on a total of 19,500 km<sup>2</sup>, thereby reducing soil runoff into the Yellow River by an estimated 40 million tons annually. Since the 10th Five-Year Plan, Ningxia has also been implementing a range of water conservation projects, including the Shapoutou Key Water Control Project, the Poverty Alleviation Yellow River Protective Irrigation Phase I Project, and the Irrigation District Rehabilitation Project.<sup>29</sup> As part of this work, the province has repaired and reinforced 27 unsafe reservoirs in the southern mountain area, and has resolved water shortage problems for 1.1 million people and unsafe water problems for 500,000 people. The province has also been implementing a range of measures to combat water pollution, such as

closing pollutive factories—including 60 family-run paper mills, 1,700 potato starch processing enterprises and households, and 45 crude oil dehydration plants during 2007–2008—and the completion of 13 urban sewage treatment plants across 19 municipalities and/or counties, with a daily treatment capacity of 65.5 million tons and a per capita processing capacity twice that of northwest PRC. As a result, the treatment rate of urban sewage in the province has reached 68.9%. Ningxia has also been developing an on-line automatic emissions statistics monitoring system for 78 national-level key pollution sources. As a result of these efforts, water quality along Ningxia's stretch of the Yellow River has remained stable at national Class III, 100% of urban central drinking water supplies have achieved quality standards, and from 2005 to 2008 emissions of chemical oxygen demand in the province have decreased 7.81%, while those of sulfur dioxide have dropped by 9.05%.

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<sup>29</sup> 沙坡头水利枢纽工程, 扶贫扬黄灌溉一期工程, 灌区续建配套工程.

## Case Study 12: Qinghai

Qinghai Province is ecologically important, rich in valuable biodiversity and encompasses a key portion of the Tibet-Qinghai Plateau that is the source area of the Yangtze, Yellow, and Mekong rivers. Due to human impacts and climate change, the province faces a range of serious environmental threats. Land area affected by desertification and soil erosion has seen a steady increase, and the province's rivers and lakes, glaciers, and tundra ecosystems are under threat from global warming. In response, the central and provincial governments have made significant efforts on conservation and environmental protection. The provincial and national government have established 15 ecological function pilot protected areas, totaling 217,600 square kilometers (km<sup>2</sup>), or 30.12% of the province's land area. These include the important Three Rivers Source Area, which is the headwaters of the Yellow, Yangtze, and Mekong (Lancang) rivers, and the Qilian Mountain Area, which is the upper watershed of the Hei River. Establishment of these protected areas has been accompanied by bans on mining of gold dust, excessive forest harvesting and wildlife hunting, and has included implementation of programs such as the banning of aquaculture and creation of a buffer zone around the important Qinghai Lake, and the Conversion of Grazing to Grassland (CGG) program and ecological migrants program to reduce the pressure of husbandry operations and human population on key grassland areas. Other measures aimed at reducing water pollution have included the closure of pollutive small cement, ironworks, and paper mills, and the construction of garbage and water pollution management facilities along the Huangshui River watershed, a tributary of the Yellow River.

The CGG program currently bans grazing on 3.33 million hectares (ha) of grassland in Qinghai, and provides subsidies to households to remove their husbandry operation from open grasslands to enclosed pens. Subsidy standards will be increased, with livestock feed subsidies to be increased from CNY37.12/ha to CNY75/ha and fence enclosure construction subsidies to be increased from CNY300/ha to CNY600/ha, while an annual environmental

protection fee of CNY75/ha will be paid to participating households. Herders in the Three Rivers Source Area are also given an annual household fuel subsidy of about CNY3,000, and financial support for education and health care. For the ecological migrants program, beginning in 2009, the provincial finance bureau has started to provide living and fuel expense subsidies to those farmers and herders who face difficulties during the implementation of ecological resettlement from the Three Rivers Source Area, and the provincial government is currently focusing on increasing housing and living subsidies so that migrants can have the same living standards as city and township residents in Qinghai. The provincial finance bureau has also earmarked a special fund of CNY30 million to establish an ecological migrant entrepreneur fund and provide job training support.

A number of other national-level programs are also being implemented in Qinghai, including the Conversion of Cropland to Forest and Grassland (CCFG), Natural Forest Protection Program (NFPP), the "Three Norths" Shelterbelt Forest program to fight desertification, soil erosion prevention work under the Ministry of Water Resources, and the Forest Ecosystem Compensation Fund (FECF). Provincial area enrolled in the CCFG currently stands at 193,333 ha, and subsidy standards are to be increased one-time sapling subsidies will be increased by CNY750/ha, annual grain subsidies by 750 kilograms/ha, and livelihood subsidies by CNY300/ha. For "Mountain Closure" reforestation work under these programs, subsidies are set at CNY1,500–CNY2,250/ha, for a contract length of 15 years. Starting from the basis of the FECF's standards, the annual management and protection portion of subsidies will be increased from CNY21/ha to CNY75/ha, while the forest ecosystem benefit portion of subsidies will be increased from CNY75/ha to CNY150/ha. The National Tax Administration and the Ministry of Finance have also jointly issued the *Notice Regarding the Tax Collection Policy for Enterprises or Units Involved in Implementing the Natural Forest Protection Program*. This policy cancels real

estate, city and township land-use, and vehicle and boat use taxes for land and vehicles used by enterprises in the implementation of the NFPP. It also cancels real estate and land use taxes for lands that have been afforested under the NFPP and left idle for at least a year. To date, some 4,000 km<sup>2</sup> of land area is being effectively managed to prevent soil erosion, and 578,000 ha of land has been manually afforested. As a result, Qinghai's forest coverage rate has increased from 3.1% in 1999 to 5.2% in 2008.

In terms of eco-compensation policies, the Qinghai Provincial Government and the National Development and Reform Commission have organized in recent years large-scale survey research projects that have produced a number of research outputs, including the *Three Rivers Source Ecosystem Service Function Valuation Research* and the *Qinghai Province Three Rivers Source National Ecological Protection Integrated Test Zone Eco-compensation Mechanism Research*. In 2007, the provincial government endorsed the *Proposal to Lead Establishment of an Eco-compensation Test Zone within the Three Rivers Source Area* at the National People's Conference and the National Committee of the Chinese People's Political Consultative Conference. In response, the State Council

stated in November 2008 that "Starting with the ecologically important and unique Tibetan areas such as Qinghai Province, [the national government] should establish rational eco-compensation mechanisms, integrate ecological theme and function land zoning, improve overall methods of financial transfers, and increase the subsidy coefficient for banned and restricted development areas ...". In support of this, the Qinghai Provincial Government in May 2009 submitted to the State Council the *Three Rivers Source National Ecological Protection Integrated Test Zone Comprehensive Experiment Blueprint*.

Remaining challenges include the lack of an established system of legal guarantees regarding protected areas, including a lack of clear laws and regulations regarding the configuration of natural resources, land use rights, and the rights and interests of rural households in ecological protection and restoration. Qinghai is also unduly burdened with the costs of managing its nationally important upper watershed areas—the province only uses 2.15% of its annual water flow—and thus continues to press the national government for further help in promoting and improving financial transfer mechanisms for these services from lower watershed beneficiaries.

### Case Study 13: Shanxi

Shanxi's development of eco-compensation policies has focused primarily on its coal industry which, while economically important for both the province and the PRC, faces serious environmental challenges. At present, the industry's current high rate of extraction, driven by the PRC's voracious energy demands, is unsustainable and contributes to inefficient and pollutive production practices. An average of 2.5 tons of coal resources are wasted to extract each ton of coal, besides 8 tons of other co-minerals (e.g., Bauxite, Pyrite, Kaolin, and Fire Clay) and 2.48 tons of water are wasted or used. Furthermore, about 6 billion cubic meters (m<sup>3</sup>) of coal bed gas is discharged annually due to mining, about half of the quantity transferred via the West-East Natural Gas Transmission Project. Furthermore, while total mining area in the province is 5,000 square kilometers (km<sup>2</sup>), the area affected by subsidence is increasing annually by 94 km<sup>2</sup>, and up to 2,940 km<sup>2</sup> of land area in the province is threatened by potentially significant geological hazards due to mining, endangering millions of people across some 1,900 villages. Mining operations cause severe surface water pollution, affecting about 3,753 kilometers of river. They also produce some 50 million tons of waste rock annually, for a cumulative total to date of 1.14 billion tons. This constitutes a significant hazard, contributing to wastewater runoff into local watersheds and groundwater and releasing harmful gas due to spontaneous combustion. Despite these problems, restructuring the industry—which will involve shifting redundant works to other sectors—will be difficult given the sector's prominence in Shanxi's economy.

In the face of these challenges, Shanxi has advocated that central government intervention is necessary to effectively internalize the environmental externalities of the coal industry, to make it economically and environmentally sustainable. Beginning in 2003, Shanxi launched policy research to encourage the State Council

to focus on the resource, environment, safety, and restructuring issues of the coal sector to find feasible measures to make it sustainable and to develop a long-term system of compensated resource use and ecological restoration, starting with the development of pilot projects. Based on the State Council's recommendations, a working group consisting of the Shanxi Provincial Government and relevant national government agencies, including the National Development and Reform Commission and the Ministry of Energy, produced the *Views Regarding the Piloting of Policy Measures for the Sustainable Development of Shanxi Province's Coal Industry*. Pilot work under this was formally approved during the State Council's 133rd executive meeting in April 2006. The provincial government has since established a leading group for pilot development, with an office to oversee daily work located in the Shanxi Development and Reform Commission. Work to date has consisted of developing the necessary supporting policy and regulatory frameworks, establishing a "sustainable development fund"<sup>30</sup> for use in eco-environmental restoration and industry restructuring, and pilot implementation.

Based on the State Council views expressed in its approval of the aforementioned pilot work, Shanxi has developed an overall implementation plan and has established 10 supporting regulations, including the *Shanxi Province Coal Industry Sustainable Development Pilot Work Comprehensive Implementation Plan*, *Views on Implementing Shanxi Province Coal Industry Management System Rationalization*, *Shanxi Province Coal Industry Sustainable Development Fund Collection and Use Management Measures (Try Out)*, *Shanxi Province Coal Industry Sustainable Development Fund Allocation and Use Management Regulations*. Shanxi has also established a range of policies and systems to promote safe production; accelerate industrial transformation and upgrade; promote rational

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<sup>30</sup> Fund to collect money for restoring the mining areas.

resource use and industry consolidation; and strengthen coal industry eco-environmental protection, management, and restoration.<sup>31</sup>

Pilot work has focused on six key aspects. One has been the promotion of more market-based systems of resource management. This involved reforming the coal mining rights licensing system so that newly established rights or preexisting unpaid rights owned by non-state mines, or those managed at a sub-municipal level, have been converted to rights obtained via purchase, such as through auctions, direct bids or registries.<sup>32</sup> These reforms have helped to increase coal recovery rates of enterprises from 40% to 47%. Another focus has been to gradually establish a mining compensation mechanism for eco-environmental restoration of coal mines. From 2007 to 2009, Shanxi earmarked CNY1.13 billion for a sustainable

development fund for use in cross-district eco-environmental integrated management. Emphasis has been on the environmental management, restoration, and protection of the Fen River Watershed, on integrated ecological management of the Taiyuanxi Mountain Area and within its 10 associated cities, and on a range of other projects concerning water conservancy, afforestation, energy saving and emissions reduction, elimination of outdated production capacity, and circular economy projects. Other key focuses of the pilot work have been establishing a system of financial assistance to restructure coal enterprises and shift the industrial structure of coal cities to improve economic and environment sustainability, strengthen management of the coal sector, improve industry safety, and deepen reforms of coal enterprises.

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<sup>31</sup> Eight systems for safe production have been developed, including Unified Law Enforcement System for Shanxi Province Safe Production, Shanxi Province Safe Production Accident and Hazard Investigation and Governance System, and Shanxi Province Safe Production Accident Interview System; the Shanxi Province Coal Production Adjustment and Revitalization Plan details measures to accelerate industrial transformation and upgrade, while Views on Accelerating and Promoting the Mergers and Acquisitions of Coal Enterprises, Notice on Issues Regarding Further Acceleration of the Mergers, and Acquisitions and Integration of Coal Enterprises, among others, detail measures to promote rational resource development and use and industry consolidation; measures promoting eco-environmental protection, management, and restoration are detailed in Fen River Watershed Eco-Environmental Management and Restoration Plan, and Views on Accelerating and Promoting Development of the 1+10 Program for the Service Industry, among others.

<sup>32</sup> These reforms are detailed in Views on Promoting Coal Enterprise Resource Integration and Paid Use, issued by the Shanxi Provincial Government in June 2005, in response to State Council Views on Promoting Healthy Development of the Coal Industry (State Council Issue [2005] no. 18).



# Issues and Options in the People's Republic of China: Views on the Payments for Ecological Services from Chinese Policy Makers and Experts

This section contains selected speeches by Chinese officials and papers of domestic experts from the conference. These include the keynote speeches of Vice Chairman Du Ying of the National Development and Reform Commission; Director General Zhuang Guotai of the Department of Nature and Ecological Protection, Ministry of Environmental Protection (MEP); and Vice Chairman Xiaoping Zhao of Ningxia Hui Autonomous Region. Academic papers include those by Wenhua Li and Moucheng Liu from the Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences; Vice President Jinnan Wang of the Chinese Academy of Environmental Planning, MEP; Leshan Jin and Wanjuan Zuo of the College of Humanities and Development, China Agricultural University; Zhifeng Kong of the Research Institute of Fiscal Science, Ministry of Finance; Yaxiong Zhang of the Economic Forecasting Department, National Information Center; and Huiyuan Zhang of the Chinese Academy for Environmental Planning.

A common thread running through much of the current academic and policy discourse on eco-compensation is that it is primarily for the purpose of better incorporating the value of ecosystem services into economic activities, to balance economic growth with social equity, conservation, and environmental protection. Wenhua Li, a prominent Chinese

expert who headed the China Council for International Cooperation on Environment and Development Taskforce on Eco-Compensation, has argued that it is a form of public regulation to adjust the relationship between the different actors and stakeholders affecting ecosystem services and the environment on the basis of ecosystem service values, cost for ecological conservation, opportunity cost, and via means of the government and market mechanisms, to protect and sustainably use ecosystem services. Eco-compensation refers to both incentives (i.e., compensation for a right that is foregone in order to maintain a certain ecosystem service, or a “reward”) and disincentives (i.e., charges for the loss of or damage to ecosystems and natural resources).

The papers herein examine eco-compensation from a variety of angles and perspectives. The paper by Jin and Zuo provides an excellent introduction to the background and context of eco-compensation, looking at how eco-compensation is positioned within the People's Republic of China's environmental policy tool kit. It concludes by encouraging the government to think carefully about whether the term “eco-compensation” should encompass a broad range of different policy instruments, or should rather refer to more specific environmental policy tools, such as the payments for ecological services (PES). Li and



Liu explore the broader context and range of considerations in developing eco-compensation policy, including its meaning, techniques for ecosystem service valuation, and how the degree to which eco-compensation is market-based versus public-sector-driven depends on a range of considerations. Wang, et al. takes a similarly comprehensive look, with the focus being watershed eco-compensation programs, and discusses the considerations and potential methods for determining what mechanism types would be most appropriate for particular situations. Zhifeng Kong's paper focuses on the rules, principles, and guidelines that will be needed to effectively incorporate funding for eco-compensation within the government's overall fiscal system. He particularly highlights the need for improving the intergovernment financial transfer system, which will be necessary for greater adoption of horizontal-payment forms of eco-compensation. Huiyuan Zhang's paper focuses specifically on methods for the calculation of eco-compensation subsidy

rates for watershed eco-compensation, which is currently a topic of significant interest to the central government. Finally, the paper by Yaxiong Zhang discusses the potential use of computable general equilibrium models to estimate the macroeconomic and environmental impacts of government-implemented eco-compensation policies. Such quantitative tools are becoming increasingly useful for Chinese policy makers in their search for the optimal mix and structure of economic and environmental policies.

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## Conference Speech 1: Vice Chairman, National Development and Reform Commission

### Establishing and Improving Eco-Compensation Mechanism, Promoting Harmonious Development between Humans and Nature

Speech at the International Conference on Payments for Ecological Services  
By Du Ying, Vice Chairman, National Development and Reform Commission  
(6 September 2009, Ningxia Hui Autonomous Region, People's Republic of China)

Distinguished Chairman Wang Zhengwei, guests, comrades, and friends:

I am very glad to meet you all in Shizuishan, Ningxia, and take part in the International Conference on Payments for Ecological Services. On behalf of the National Development and Reform Commission, I would like to extend our warm welcome to all participants, international and domestic experts, and express our sincere gratitude to the Ningxia Hui Autonomous Region Government and Shizuishan Municipal Government for their efforts in organizing the conference.

Eco-compensation is an institutional arrangement with the goal of environment protection and harmonious development between man and nature. It focuses on adjusting the relationships among stakeholders with both command-and-control and market instruments based on ecosystem services value and conservation costs. The Party Committee and the State Council attach high importance to promoting ecological civilization and establishing eco-compensation mechanisms. The Party's 5th Plenary Meeting of the 16th Committee proposed "eco-compensation mechanisms should be established soon based on the principle of *the developer protects, and the beneficiary compensates*." General Secretary Hu Jintao urged in his report to the 17th Party Committee to "implement a fiscal and taxation system which favors scientific development,

establish and improve the system of paid resource use and ecological and environmental compensation mechanisms." It has strategic importance to establish and improve eco-compensation mechanisms in carrying out the scientific development view doctrine.

First, eco-compensation is an institutional arrangement for promoting ecological civilization. It is the PRC's development goal in building a "Xiaokang Society"<sup>1</sup> to promote ecological civilization, to have a resource-saving and environmentally-friendly industrial structure, growth pattern, and consumption model, and to promote the harmonious relations between Man and ecosystems. The PRC has made significant achievements in ecological rehabilitation and environment protection in recent years after many years of large scale construction and conservation. But in general, the PRC's ecosystems are still fragile and weak. There are still much to do to restore them. Stakeholder relationships in ecological protection need to be clarified. Establishing eco-compensation mechanisms will internalize environmental externalities and have beneficiaries pay, damagers compensate, and protectors receive compensation. This mechanism could help raise the environmental awareness of the public, transform the economic development pattern, mobilize the public to conduct ecological conservation, and contribute to the construction of a resource-saving and environment-friendly society.

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<sup>1</sup> "Xiaokang Society", in its modern usage in the PRC, denotes the goal of achieving a society of modest means wherein most people have achieved moderately well-off middle class, and where economic growth is not the sole focus of society, but rather is balanced with the goals of social equity and environmental protection.

Second, establishing eco-compensation is necessary for promoting development zoning. The PRC's 11th Five Year Plan stated that the national land is to be divided into four types of functional zones, namely: optimized development zones, key development zones, development restricted zones, and development prohibited zones. This zoning is based on (i) resource and environmental capacity, (ii) existing development density and potential, (iii) population distribution in the future, and (iv) economic, land, and urbanization planning. The National Development and Reform Commission is leading this development zoning work. According to the zoning plan, development restricted zones include natural forestland that is important for national ecological security, the Conversion of Cropland to Forests and Grasslands program area, grassland area affected by the "three desertifications",<sup>2</sup> important water source protection areas, and serious soil erosion areas. All nature reserve areas are development prohibited zones. Development restricted zones and prohibited zones contribute to national ecological security, so they should be given compensation. This requires the establishment of an eco-compensation mechanism, which is key to promoting development zoning and implementing the 11th Five Year Plan.

Third, eco-compensation mechanisms are important in promoting harmonious regional development. The PRC's western regions are its ecological shield. Most of the PRC's water source areas, water and soil conservancy areas, desertification prevention areas, and biodiversity protection areas are in the western regions. To make sure the western regions achieve the goal of a "Xiaokang Society" at the same time as the other parts of the PRC, western regions have to develop their featured industries. However, the central government will establish eco-compensation mechanisms, provide more transfer payments to them in order to protect the ecosystem and increase people's income, and close the development gap with other parts of the PRC. This will promote a harmonious development between regions.

The PRC attaches much importance to environmental protection, and has achieved positive results in establishing eco-compensation mechanisms.

First, the PRC has begun to build a policy system for eco-compensation. The *Forestry Law* revised in 1998 stipulates that "The state establish a forest ecological benefit fund for planting, growing, protecting and managing the forests with ecological benefits and special forests." The State Council issued the *Sloping Land Conversion Regulation* in 2002, stipulating funds and grain for farmland conversion to forest land. The *Law on Prevention and Control of Water Pollution*, which was revised and passed in 2008, is the landmark of river basin eco-compensation. It is the first time in Chinese laws that the provision for water ecological compensation has been put forward, i.e., "The state establishes eco-compensation mechanisms, with public transfer payments, for environmental protection in drinking water source areas and the upstream of rivers, lakes and reservoirs." Local governments also have issued policy papers on eco-compensation for watersheds, nature reserves, and mining resources. As an example, Zhejiang Provincial Government issued its "Opinions on Further Improving Eco-compensation Mechanisms" in 2005, and is the first province to do eco-compensation in the PRC.

Second, the PRC has carried out eco-compensation pilots. The central government has launched its pilots on the Forest Ecological Benefit Compensation Fund during 2001–2004. The central government formally established its Forest Ecological Benefit Compensation Fund in 2005, indicating the formal establishment of the PRC's Forest Ecological Benefit Compensation Fund. The PRC has invested CNY22 billion on 0.7 billion mu of ecological forests. In 2006, government agencies issued guiding opinions on restoring mining environment using eco-compensation. The central government has increased its environment protection payments and transfer payments to the Three River Source areas in Qinghai, water source

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<sup>2</sup> These are desert encroachment, alkalization, and land degradation.

areas of the middle route of South to North Water Diversion Project, and natural forest protection. Zhejiang, Shanxi, Hubei, and Guangdong and other provinces have piloted eco-compensation.

Third, investment in ecological and environmental protection has increased by a large margin. In the past 10 years, the PRC has launched the Sloping Land Conversion Program, Rangeland Conversion, Natural Forest Protection, Mitigation of Sandstorm Source Areas, Southwestern Region Stone Area Treatment, Three River Source Nature Reserve in Qinghai, Gansu Yellow River Source Area Rehabilitation, and other ecological projects. The total investment amounts to CNY700 billion, among which CNY300 billion are subsidies. Water pollution abatement has been carried out on a large scale. Environmental protection infrastructure has been strengthened. CNY200 billion has been invested into river basin water pollution mitigation and urban wastewater treatment plants. All of these investments are kinds of eco-compensation.

Establishing and improving eco-compensation mechanisms is a new and strategic task. The work has just begun. There are problems such as (i) the compensation scope is not clear, (ii) compensation rates are not scientifically based, (iii) compensation types need to be enriched, (iv) fund sources are short, and (v) policy and legal systems lag behind. As next step, we will learn from experiences in the PRC and abroad, study the lessons accumulated, and work on the following.

First, further carry out the eco-compensation pilots. In addition to the existing eco-compensation pilots in the Three River Source Areas in Qinghai, water source areas of the middle route of South to North Water Diversion Project, and other central government supported projects, more pilots will be carried out such as trans-provincial river basin eco-compensation, mining environment eco-

compensation, important ecological function area eco-compensation, and Tibetan grassland eco-compensation. Forest ecological benefit compensation will be expanded with higher compensation rates. Various compensation methods are encouraged such as financial subsidies, special aid and targeted aid.

Second, formulate a regional policy system compatible with eco-compensation. The public fiscal and investment policies will be improved to promote development zoning and equalize basic public services. Transfer payments at the central and provincial levels will be increased for ecological protection. Infrastructural investment in important ecological areas will be supported in the national budget system. Private and social investments in ecological protection are encouraged. The PRC will also improve its industrial policy, land policy, population policy, taxation policy and technological standards which promote eco-compensation.

Third, an eco-compensation legal system will be set up. An eco-compensation regulation will be drafted based on lessons learned. It will stipulate the principles, main fields, compensation methods, responsibilities, and obligations of each party. Implementation details will be supplemented for watershed, forest, grassland, wetland, and mining eco-compensation.

This is a complex and systematic program to establish eco-compensation mechanisms. It needs the government's promotion, regional coordination, and social support. This conference pools experienced specialists and practitioners on eco-compensation. I hope all of the participants and specialists discuss this topic, and give contributions to the establishment of eco-compensation. I believe that there will be the expected achievements from the conference.

Finally, I wish the conference a great success.

## Conference Speech 2: Director General, Department of Nature and Ecological Protection, Ministry of Environmental Protection

Speech at the International Conference on Payments for Ecological Services

By Zhuang Guotai, Director General, Department of Nature and Ecological Protection, Ministry of Environmental Protection

(6 September 2009, Ningxia Hui Autonomous Region, People's Republic of China)

Distinguished leaders, guests, ladies, and gentlemen:

Today, in this beautiful city of Shizuishan in Ningxia Hui Autonomous Region, the International Conference on Payments for ecological services is being held by the National Development and Reform Commission, the Ministry of Environmental Protection, and the Asian Development Bank. We would like to express our warm congratulations to the conference and welcome all of our friends from the People's Republic of China (PRC) and overseas.

Environmental issues are receiving increasing attention by the international community. Many countries have adopted eco-compensation as an important measure to protect the environment, which has yielded highly desirable results. For almost half a century, eco-compensation has been studied in theory and put into practice. Some experiences have been documented and lessons can be learned from around the world. Today, international and domestic experts and specialists will exchange ideas and discuss those issues that are important for the PRC to establish eco-compensation systems.

The essence of eco-compensation is to fix responsibilities, make clear stakeholders' relationships, protect the environment through economic incentives, safeguard national ecological security, and realize the harmonious development between humanity and nature. Establishing and improving eco-compensation mechanisms will be important for implementing the Scientific Development View doctrine and constructing an ecological civilization. It will help to accelerate a shift in environmental management from mainly command-and-control administrative measures to

comprehensive application of legal, economic, technical, and administrative measures. It will promote the construction of a resource-saving and environmentally friendly society, and promote the harmonious development of different regions and stakeholders. The government of the PRC has explicit requirements for establishing eco-compensation systems. The Decision of the State Council on Implementing the Scientific Development View and Strengthening Environmental Protection issued and distributed in 2005, proposed that "we will improve eco-compensation policy by establishing compensation mechanisms as soon as possible. Eco-compensation should be taken into account in transfer payments by the government at central or local levels. Eco-compensation pilot projects should be launched at national and local levels." The 11th Five-Year Plan for National Economy and Social Development issued by the National People's Congress in 2006, explicitly proposed to "establish eco-compensation mechanisms according to the 'Developer Pays Principle' and 'Beneficiary Pays Principle'." The Report of the Seventeenth National Congress of the Communist Party of China in 2007 required "establishing and improving the system of paid resource use and eco-compensation systems." The Law on Prevention and Control of Water Pollution revised in 2008 is first to contain clear-cut provisions on watershed eco-compensation in the form of legislation. The issue of eco-compensation has also been a matter of social concern. In recent years, the suggestions and proposals on establishing eco-compensation have shown a trend of substantial growth in acts proposed by representatives of the National People's Congress and the National Committee of the Chinese People's Political



Consultative Conference, which have strongly advocated the establishment of an eco-compensation system.

Establishing an eco-compensation system is a complex systematic project, which covers a wide range of subjects and research areas and multiple benefits coordination. It has been explored actively in recent years by central and local government, and research and academic institutions, which has yielded some outcomes. First, in 2005, the State Council decided to launch a pilot project for sustainable development of the coal industry in Shanxi Province, which has included experiments in environmental restoration of coal mining areas. These experiments include the following: (i) designing the programs for environmental restoration and treatment, (ii) improving the system of environmental evaluation and supervision, and (iii) establishing mechanisms for comprehensive compensation in coal mining. Second, in 2006, the Ministry of Finance, the State Environmental Protection Administration, and the Ministry of Land and Resources jointly issued the Guiding Opinions on Gradually Establishing the System of Mine Environmental Treatment and Ecological Recovery, which clearly defines the duties of the three departments in establishing an eco-compensation system for coal mining and promoting implementation of eco-compensation policy pilot work in local areas. Third, in 2007, the then State Environmental Protection Administration issued the Guiding Opinions on Establishing Eco-compensation Pilots, which summarized the experiences of eco-compensation policy research and pilot work in local areas, and guided local environmental administrations to promote eco-compensation pilots in the fields of nature reserves, important ecological function zones, coal mining and watershed ecosystem protection. Fourth, in 2008, based on local practices, the Ministry of Environmental Protection listed a number of eco-compensation pilot regions, and encouraged pilot regions with experience to extend the scope of pilot work, deepen the content of pilot work, and accumulate experience for promoting eco-compensation in other regions and serve as a model. Fifth, government agencies have been organizing

legislation research on eco-compensation, and have set up eco-compensation research projects within the national research project for the Water Pollution Control and Management, which will summarize related domestic and international experience, and choose some typical watersheds to conduct on-the-ground research. Such research will propose standards and mechanisms of eco-compensation, and provide technical support for formulating related policies and legislation.

Some local governments are formulating policies and measures for eco-compensation and establishing related eco-compensation pilots. For example, a series of policies and measures for environmental restoration compensation pilots in coal mining are being formulated and implemented in Shanxi Province. Ecological function zones receive significant financial support in places such as Fujian, Guangdong, Liaoning, and Zhejiang for the conservation of water resources in upper watershed areas. Jiangsu Province has issued its compensation methods for environment and resource areas. Hebei Province is trying out its policy on withholding eco-compensation funds for the Ziya River watershed. Tibet is carrying out pilots for grassland ecological protection rewards. All of this work provides instructive experience for establishing and improving eco-compensation mechanisms.

In general, however, legislation and policies for eco-compensation in the PRC lag behind. Breakthroughs have yet to be achieved for some key issues of eco-compensation, such as standards, compensation methods, and funding sources. A reasonably systemic and complete policy system for eco-compensation has yet to be established.

Now, there is a healthy social atmosphere and a theoretical and practical basis for the establishment of eco-compensation mechanisms. Much useful exploration has been conducted at local levels. Next, the Ministry of Environmental Protection will continually strengthen the cooperation with line agencies, conduct intensive research on eco-compensation systems, deepen eco-compensation pilot work, constantly review related experience, and continue to promote pilot work. I hope we can pool our ideas in this

conference, further enrich eco-compensation theories and practical experience, discuss how to establish and improve eco-compensation systems and policy and legal frameworks with Chinese characteristics, and make new contributions to promote overall coordinated

and sustainable development of country and region, and enhance the harmony between man and nature.

Last but not least, I wish the international conference great success.



## Conference Speech 3: Vice Governor, Ningxia Hui Autonomous Region

Speech at the International Conference on Payments for Ecological Services

By Zhao Xiaoping, Vice Governor, Ningxia Hui Autonomous Region

(6 September 2009, Ningxia Hui Autonomous Region, People's Republic of China)

Distinguished Deputy Director Du Ying, Director General Klaus Gerhaeusser, Academic Li Wenhua, ladies and gentlemen, comrades and friends:

Good morning. In this golden autumn, outside the Great Wall, we are happy to welcome our distinguished guests to the International Conference on Payments for ecological services. First, please allow me, on behalf of the Ningxia Government, to extend our warm welcome to all honored guests. We wish to take this opportunity to extend our thanks to the National Development and Reform Commission, Ministry of Environmental Protection, other relevant ministries, the Asian Development Bank, and fraternal provinces and cities for the support and help they have given Ningxia for years.

Ningxia is located in the middle reaches of the Yellow River in northwest People's Republic of China, with the total area of 66,400 square kilometers (km<sup>2</sup>). With a population of 6.18 million, ethnic Hui accounts for 35% of the population. There are 5 cities and 22 counties (cities and districts). The whole region can be divided into three big areas geographically. First, the northern irrigation area along the Yellow River, stretching over 397 kilometers (km), has been regarded as a place north of the Great Wall that is as beautiful as the south of the Yangtze River. Second, the central dry area, belonging to desert or semi-desert grasslands, is an ecologically vulnerable area. Third, the southern mountain area, with many hills and gullies, wet and cold, is one of the nation's poverty alleviation and development areas.

In the 50 years since the establishment of the autonomous region, especially since the introduction of the western regions development

strategy, with the full support of the Communist Party of China Central Committee and the State Council, and with the support of relevant departments, Ningxia has grasped opportunities, worked hard with a pioneering spirit, and entered its economy and society into the fast lane of sustainable and healthy development. Economic growth has exceeded the national average for 9 years. Ningxia has entered its period of fastest economic and social development, seen its largest urban and rural changes and its most tangible benefits for its people. In 2008, the gross domestic product of Ningxia surpassed CNY100 billion, total installed capacity of electricity surpassed 10 million kilowatts, highway length surpassed 1,000 km, grain output hit a record high, and urban and rural per capita income increase reached a historic high in the past 30 years. While accelerating economic and social development, we have been paying more attention to environmental protection and construction, and are exploring eco-compensation.

In forestry development, two major ecological projects—the Natural Forest Protection Program and the Conversion of Cropland to Forest and Grassland Program—have been implemented in Ningxia since 2000. In 2008, as part of the Natural Forest Protection Program, 2.98 million mu of hills have been closed for reforestation and 1 million mu have been afforested via aerial seeding.<sup>3</sup> In the Conversion of Cropland to Forest and Grassland Program, the national goal of returning 12.29 million mu of farmland to forests has been met. Of this, 4.71 million mu of farmland and 7.08 million mu of wasteland has been afforested, and 0.5 million mu of hillsides have been closed off

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<sup>3</sup> 1 mu = 1/15 ha.

for reforestation. By the end of 2008, Ningxia's forest area was 29.50 million mu, accounting for 38% of total land area. The forest coverage has risen from 8.4% in 2000 to 10.5% in 2008. The area of sandy, desertified land has decreased by 2,584 km<sup>2</sup> over 5 years. Desertified land area has decreased by 3.5 million mu, meaning that Ningxia has taken a lead in achieving the historical change of desertification control that is faster than the desertification rate.

In terms of grasslands, among the region's 36.65 million mu of grassland, 54% is moderately degraded and 36% is seriously degraded according to the National Land Resources Survey in 2001. In various degraded grassland areas, about 25% is desertified. In the central dry area, more than 28 million mu of desert and semi-desert grasslands and dry grasslands are degraded and desertified, which is one of the dust storm sources affirmed by the State Environmental Protection Administration and the Chinese Academy of Sciences. In order to control degradation and desertification of natural forests, and restore grassland vegetation, Ningxia has sealed hills in the whole region to prohibit grazing since 1 May 2003. Meanwhile, an ecological grassland project has been implemented, in which 22.2 million mu of grasslands have been fenced, and 3.93 million mu of degraded grasslands have been improved by over drilling. As a result, vegetation coverage in the region has increased by more than 30%, grass yields have increased by 100%, and grassland ecosystems have been improved.

In terms of wetlands, the *General Plan for Ningxia Yellow River Wetlands Protection* and the *Ningxia 11th Five-Year Plan for Wetlands Protection Projects* have been issued, which list 28 demonstration plots including wetlands protection and restoration plots, wetlands protection communities, and wetlands zoos. The State Forestry Administration has approved the establishment of a National Wetland Zoo of Yuehai and Cuiming Lake in Yinchuan, which is the third one of the PRC and the first national wetlands zoo in northern PRC. At present, the area of wetland in the region is 0.256 million ha, accounting for 5% of the region's total area.

In solving the problem of subsidence and cave-ins around exhausted mining areas, Ningxia has implemented projects for controlling these problems in the Lingwu Mining Area and Shiyazui City, renovating 34 km<sup>2</sup> of subsidence area in Shizuishan City and 15 km<sup>2</sup> of subsidence area in Lingwu, with the support of the National Development and Reform Commission and relevant departments. Based on the level of damage and the basic infrastructure in mining subsidence areas (e.g., residential, school, hospital, water supply, and road areas), using the combined methods of building new houses and relocating, compensating for demolition, and reinforcing and repairing, over more than 3 years, 0.93 million square meters (m<sup>2</sup>) of housing area was built, 15,503 households were resettled, 611 rural households were compensated for resettlement, and 0.24 million m<sup>2</sup> of houses were subsidized for repair and reinforcement, all involving 4,864 households, while more than 0.1 million m<sup>2</sup> of support facilities were constructed, including schools, hospitals and kindergartens. The implementation of these projects has not only relaxed social conflicts in subsidence areas, but also improved living conditions while also providing the foundation for ecological restoration and construction in this area.

Although we have done much work in environmental protection and rehabilitation, and have also obtained some achievements, the task of environmental protection in Ningxia is still overwhelming due to Ningxia's unique geographic situation and long-established economic structure of heavy industry. We should say, a good environment in Ningxia not only has a great significance for Ningxia's sustainable development, but also has an important role in maintaining the Yellow River's healthy life, building the western ecological barrier and promoting the development of the regional economy and society. Together with comrades from fraternal provinces and cities, with the support of national relevant ministries and commissions, with the help and guidance of experts and scholars, and in accordance with the Scientific Development View, we would like to learn from successful domestic and international experiences and effective methods for eco-compensation, discuss and

research effective systems of environmental compensation together, and do our best to build important ecological barriers in western PRC. Meanwhile, we also deeply hope every leader and expert has a chance to visit Ningxia, give your wise ideas and thoughts for the

improved and accelerated development of Ningxia's economy and society, and give your suggestions and opinions.

Finally, I wish the international conference great success.

Thank you.

## Conference Paper 1: Eco-Compensation in the Environmental Policy Tool Kit

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**Abstract:** The People's Republic of China's (PRC) environmental management instruments have evolved from the traditional command-and-control "Eight Systems," to various new environmental economic instruments and public participation, and to a new concept known as eco-compensation, which provides environmental administrators an increasing collection of policy tools from which to choose. When we look at eco-compensation, we find it is closely linked with many other policy tools such as charges, taxes, and subsidies, which leads to the question of "Is eco-compensation a name for a handful of policy tools that are closely related to each other, or is it just a specific policy tool similar to the payments for ecological services (PES)? The authors believe it to be more of the latter.

Environmental management instruments have been developed along with increasing environmental awareness and emerging new environmental issues. In the 1970s, the PRC's environmental management instruments consisted mainly of the so-called "Traditional Three Systems"—namely: environmental impact assessment, "Three Simultaneities" system, and pollutant-discharge fee. After the 1980s, environmental management instruments added five new systems, and the PRC has adhered to these "Eight Systems" of environmental management for a long time. After the 1990s, especially since the year 2000, new environmental economic management instruments have been constantly emerging—e.g., "Green Credits," "Green Insurance," tax leverage and subsidies, "Regional Restricted Approval," public Participation, environmental information disclosure, corporate social responsibility, community-based co-management—which have effectively enriched the environmental

policy tool kit. As a new environmental policy tool, eco-compensation has several advantages, which have captured much attention from policy making departments throughout the PRC.

After reviewing the policy tools in the environmental policy tool kit, this paper will focus on the relationship between eco-compensation and other policy tools.

### 1 The PRC's Traditional Environmental Management Instruments: Eight Systems

The PRC is actively exploring environmental management instruments, and found "Eight Systems" with Chinese characteristics. They are composed of three old and five new systems as follows: environmental impact assessments; "Three Simultaneities" system; pollutant-discharge fees; target-related responsibility systems in environmental protection; urban environment comprehensive improvement examination system; cap controls on pollution; abatement deadlines; and applications and permits for pollution discharges.

**Environmental impact assessments** (EIA) are an important legal system that implements the principle of "prevention first" in controlling environmental pollution and ecological destruction, and protecting the ecological environment. Major construction projects, plans, or other development and construction activities that have possible effects on the environment (i) require prior investigation, prediction and evaluation; (ii) propose environment protection measures; and (iii) formulate environmental management programs. The construction projects and plans that fail to pass the system are not allowed to be launched and implemented.

The “*Three Simultaneities*” system denotes the idea that for projects under construction, renovation, or expansion, and for technological transformation projects and regional development and construction projects, pollution-treatment facilities must be designed, constructed, and put into use at the same time as the other parts of the projects. The process of “Three Simultaneities” should be checked during project supervision, inspection, and midterm evaluation.

**Pollutant-discharge fees** are paid according to the national regulations and standards by any unit or self-employed individual that discharges pollutants. Since the PRC first implemented this system in 1982, pollutant-discharge fees have been collected throughout the country. Now, five types of pollutant-discharge fees exist: those for sewage, exhaust, solid waste, noise, and radioactive waste.

The **Target-Related Responsibility System in Environmental Protection** denotes the system where government at all levels and units that have caused environmental pollution accept responsibility for environmental protection by signing a letter of responsibility. The system clarifies the regional, departmental, and unit responsibilities for environmental protection, clarifies the relationships in terms of environmental protection within government at all levels and different departments, and details the tasks that should be implemented at each level.

The **Urban Environment Comprehensive Improvement Examination System** was created based on the PRC’s experience and practice of urban environmental protection. It is an environmental management system that manages and adjusts the government’s activities in urban environmental comprehensive governance via quantitative appraisal.

**Cap Control on Pollution** denotes that the system whereby—based on reports submitted by all provinces, autonomous regions and municipalities, and after comprehensive weighting at the national level—national environmental management authorities establish plans for national total amount of pollutant discharge, and then divide the discharge amount of key pollutants into quotas and allocate these to every province, autonomous

region, and municipality as state-controlled pollution indicators. Each province, autonomous district, and municipality then assigns the province-controlled plans to localities. Total amount control, plan control, the preparation of the annual pollutant reduction plans, and annual inspection and examination should be implemented on a step-by-step basis.

**Abatement deadline** denotes enforceable measures that restrict governance deadlines, governance content, and governance effect that should be adopted for pollution districts that have caused serious pollution hazards and aroused intense scrutiny.

**Application and register of pollution discharge** denotes a system where polluters must report and register their existing discharge and treatment facilities for pollution and the categories, quantities, or concentrations of the pollutants discharged under normal operating conditions. **Pollutant discharge permits** target improvement of environmental quality, based on total amount of allowable pollution, and regulate unit-permitted categories, quantities, concentrations, and ways that pollutants are discharged.

The “Eight Systems” of environmental management in the PRC, which are mainly command-and-control instruments, are mandatory legal and administrative measures.

## 2 New Environmental Management Instruments

With economic development and society advancement, the PRC has explored and applied additional environmental management instruments, including new environmental economic instruments, such as public participation, environmental information disclosure, corporate social responsibility, and community-based co-management.

### 2.1 Pollutant-discharge permit trading

Pollutant-discharge permits that are unused due to pollution treatment or technology advancement can be sold. Conversely, enterprises that need more pollutant-discharge permits to expand their production can buy permits.

In 2001, funded by the Asian Development Bank and supported by Chinese and United



States experts, the PRC first piloted sulfur dioxide (SO<sub>2</sub>) discharge permit trading at Taiyuan City of Shanxi Province. It is expected to decrease the total cost of SO<sub>2</sub> emission reduction by 30% (Cao et al. 2002).

In 2007, the Ministry of Finance and the State Environmental Protection Administration spearheaded the piloting of permit trading in Tai Lake watershed of Jiangsu Province. The pilot project primarily includes the (i) establishment of an original price of main water pollutant discharge rights in the Tai Lake Watershed and implementation of an initial paid allocation by taking pollutant-discharge indicators as a resource; (ii) implementation, in 2008, of an initial paid offer for sale of chemical oxygen demand (COD) pollutant-discharge rights and establishment of primary markets for COD pollutant-discharge rights; and (iii) piloting, in 2009, of paid use of pollutant-discharge rights regarding NH<sub>3</sub>-N and total phosphorus (TP).

## 2.2 Deposit funds

When purchasing some commodities or developing some projects, consumers or investors should make some deposit payments to ensure that indiscriminate disposal of product wastes is prevented or that development activities will not adversely affect the ecological environment. This system also is used in the field of beer bottles and bottled water in the PRC.

The PRC has been trying to apply the deposit system to the mining sector. In 2002, Jiangsu Province established the *Interim Measures of Jiangsu Province for the Collection and Management of Deposits for Mining Environmental Restoration and Management*, which assigns various administrative levels of the land and resources department to collect deposits, hold these deposits in special financial accounts, and use retained deposit for environmental restoration and treatment. Mining enterprises that meet the standards of acceptance prior to mine closure will get their deposits back in the process of mine environmental treatment; but those who fail to meet the standards will forfeit their deposit and corresponding interest. Environmental treatment costs in excess of the forfeited deposits will be charged to the erring mining enterprises.

In 2006, the State Council decided to launch a pilot project for the sustainable development of the coal industry in Shanxi Province, and drafted the *Eco-Environmental Recovery and Management Plan for Coal Mining in Shanxi Province from 2007 to 2015*. Under the plan, a total of CNY177.4 billion will be collected, for the next 10 years, primarily for environmental treatment and restoration of mining areas. The deposit fund for eco-environment recovery and treatment can be collected from the coal sales of mining enterprises, at the standard rate of CNY10/ton.

In 2006, the Ministry of Finance, the State Environmental Protection Administration and the Ministry of Land and Resources jointly issued the *Guiding Opinions on Gradually Establishing the System of Mining Environmental Treatment and Ecological Recovery* (Document No. 205 [2006] of the Ministry of Finance) and piloted it in eight provinces. According to this document, the deposit system for environmental treatment and ecological recovery was established successively by various other provinces.

## 2.3 Green credits

“Green Credits” is a policy whereby banks that provide loans to enterprises should consider enterprise environment performance. In 2007, the State Environmental Protection Administration, the People's Bank of China, and the China Banking Regulatory Commission jointly issued the *Opinions on Implementing Environmental Protection Policies and Rules and Preventing Credit Risks*, which required that projects that have failed to pass the examination and approval of environmental assessment or the inspection and acceptance of environmental protection facilities cannot be supported with any new forms of credit. Banks are also inhibited from providing credit to firms for restricted or rejected new projects. According to the unified standards made by the State Environmental Protection Administration and the People's Bank of China, environmental protection departments at various levels should provide the relevant information, including enterprises' illegal environmental activities, the examination and approval of their environmental protection activities, authentication of their environmental protection, and their clean production audit,

which can be included in the database of enterprises and personal credit information.

#### 2.4 Environmental liability insurance

Environmental liability insurance is insurance purchased by enterprises to offset the risk of environmental accidents. The insurance agent compensates pollution victims. In 2008, the State Environmental Protection Administration and the China Insurance Regulatory Commission jointly issued the *Guiding Opinions on the Work of Environmental Pollution Liability Insurance*. Using insurance instruments in the management of environmental pollution accidents is beneficial to (i) disperse the management risks of enterprises so that they can resume production as soon as possible after accidents; (ii) bring the function of an insurance mechanism into social management, so as to use the usage rate leverage mechanism to push enterprises to reinforce and improve their level of environmental management; (iii) enable victims to get economic compensation promptly, to stabilize social economic order and reduce the government's burden, and to promote the transformation of government functions.

#### 2.5 Differentiated taxation

In recent years, the PRC has protected the ecological environment via taxation. This includes reducing or giving tax exemptions for environmentally friendly business activities, increasing taxes for economic activities that seriously destroy the ecological environment, and adopting tax rebates or regulated tax rates for the export of energy-intensive or highly pollutive production activities.

The PRC implements a preferential value-added tax (VAT) policy for enterprises that comprehensively use resources. In 2008, the Ministry of Finance and the State Tax Administration jointly issued the *Notice of Comprehensive Utilization of Resources and Value-added tax Policies for Other Products*,<sup>4</sup> stipulating that (i) service of sewage disposal,

utilization of waste tires, retreaded tires, etc., shall be exempt from VAT; (ii) VAT refund upon levy shall be applicable for electric power from rubbish fuel, recycled bitumen, etc; (iii) VAT refund 50% upon levy shall be applicable for power generated from wind or coal refuse; and (iv) VAT refund upon levy shall be applicable for diesel oil made by waste animal oil and vegetable oil.

The PRC implements a preferential corporate income tax (CIT) for enterprises that comprehensively use resources. This is according to the *Catalogue of Resources for Comprehensive Utilization Entitling Enterprises to Income Tax Preferences* (2008)<sup>5</sup> issued by the Ministry of Finance, the State Tax Administration, and the State Development and Reform Commission.

At the end of December 2006, the State Council required that the catalogue of high pollution and high environmental risks production and policies system for controlling the export of "double high production" would be established by the State Environmental Protection Administration with other departments concerned. In 2008, the State Environmental Protection Administration published the first catalogue<sup>6</sup> (Catalogue of "double high" production), involving 6 sectors, 141 items in total.

#### 2.6 Subsidies

Though tax preferences are, in reality, a kind of subsidy, the PRC also directly subsidizes environmental protection and treatments measures. The special environmental fund of the central government, which is collected from pollution charges, offers annual subsidies amounting to billions of dollars for a range of activities, including water pollution treatment in important lake basins (three rivers and three lakes), rural non-point source pollution treatment, protection and treatment of water source centralized pollution, and SO<sub>2</sub> control technology upgrade for power plants.

<sup>4</sup> See [www.zhb.gov.cn/law/gz/bmhb/gwygf/200812/t20081215\\_132383.htm](http://www.zhb.gov.cn/law/gz/bmhb/gwygf/200812/t20081215_132383.htm)

<sup>5</sup> See [www.zhb.gov.cn/law/gz/bmhb/gwygf/200809/t20080911\\_128550.htm](http://www.zhb.gov.cn/law/gz/bmhb/gwygf/200809/t20080911_128550.htm)

<sup>6</sup> See [www.sepa.gov.cn/xcyj/zwhb/200802/t20080226\\_118672.htm](http://www.sepa.gov.cn/xcyj/zwhb/200802/t20080226_118672.htm)



## 2.7 Carbon emission trade

The PRC is one of 118 signatories to the Kyoto Protocol that controls greenhouse-gas emissions and actively participates in the “Certified Emission Reduction” (CERs) trade of the Clean Development Mechanism (CDM) based on the Kyoto Protocol.

By 19 September 2008, 1,539 CDM projects have been approved in the PRC, involving carbon emission reduction trade of 0.308 billion tons carbon dioxide (CO<sub>2</sub>) per year, of which 269 projects have been registered with the CDM executive board, accounting for 23% of the executive board's total registered projects. These 269 registered CDM projects were expected to reduce CO<sub>2</sub> emission by 0.116 billion tons per year, accounting for 52% of the total estimated annual emission reduction of the executive board's CDM registered projects (National Development and Reform Commission Climate Change Task Force 2008).

## 2.8 Environmental labeling

The PRC Environmental Labeling is a type of certification system for products or their packaging. This label allows consumers to easily distinguish products that are beneficial to the environment. Through consumer choice and market competition, this system can push enterprises to adjust their production structure and adopt clean technology to produce products beneficial to the environment.

The PRC actively introduced the internationally accepted Environmental Management System certification and Environmental Labeling products certification, and also promotes the certification of Green Food and Organic Food. The China Green Foods Development Center is responsible for the certification and management of the PRC's green food. It has established 42 local green food management institutions over the country, and has delegated 38 qualification examination institutions on green foods and 71 environmental monitoring institutions in green food production areas.

## 2.9 Public participation

The Government of the PRC encourages public participation and environmental protection. Nongovernment environmental protection organizations (ENGOS) account for a significant proportion of the PRC's total nongovernment organizations. Nongovernment environmental protection organizations play significant and varied roles—e.g., Friends of Nature protects *Rhinopithecus bieti*; Global Village promotes increasing air-conditioning temperatures in summer; Green Home protects ecology in the development of water power. The leaders of ENGOS, Liang Cong Rong and Liao Xiao Yi, were appointed as environmental consultants for the Beijing 2008 Olympic Games Bid Committee.

To encourage and regulate public participation in environmental impact assessments (EIA), the State Environmental Protection Administration issued, in 2006, the *Provisional Measures on the Public Participation in Environmental Impact Assessment*,<sup>7</sup> which require EIA information disclosure and ask for public feedback in the process of preparing environmental impact reports by construction units or their delegated EIA institutions, and in the process of approval or reexamination of environmental impact reports by environmental protection administration directives. The EIA information disclosure includes the possible environmental impacts of construction projects, strategies and measures to prevent or reduce adverse environmental impacts, and concludes with a set of proposals.

## 2.10 Information disclosure

One policy tool of environmental management is information disclosure, which receives significant attention from governments or corporations because it affects their image and interests. Environmental information disclosure includes releasing corporation environmental information (such as environmental protection performance), opening environmental information obtained by the government to the public and corporations (such as river water quality), and disseminating environmental information obtained by

<sup>7</sup> See [baike.baidu.com/view/516278.htm#1\\_1](http://baike.baidu.com/view/516278.htm#1_1)

government departments. In 2007, the State Environmental Protection Administration issued the *Measures for the Disclosure of Environmental Information (trial)*,<sup>8</sup> mandating government to voluntarily and in a timely fashion disclose laws, regulations, rules, standards, and other regulatory documents with respect to environmental protection; environmental protection plans; environmental quality status; environmental statistics and environmental investigation information; etc.

### 2.11 Corporate social responsibility

Corporate social responsibility (CSR) means that enterprises voluntarily undertake social responsibility including community commitment, environmental protection, and elimination of inferior products and discriminatory practices. All levels of government in the PRC encourage CSR. Some multinational corporations, like Shell, are conducting environmental trainings and project funding activities in the PRC.

### 2.12 Community-based co-management

In environmental protection, especially regarding nature reserves, community-based co-management is receiving increasing attention as a new environmental management tool. Community-based co-management implies that nature reserve management departments and local communities build a partnership based on mutual trust. Nature reserve management departments help local communities to improve their use of natural resources and to involve community residents in the management of nature reserves, such as patrolling of mountain areas and preventing fires. The development of community-based co-management usually needs some economic instruments so that society can provide multiple forms of support to local communities whose residents are actively engaged in the development of nature.

Since 1995, the Global Environment Facility (GEF) has conducted a 6-year nature reserves management project in the PRC, covering 10 nature reserves in 5 provinces. An important aspect of this project is the conduct of community-based co-management practices in the PRC's nature reserves that allow

communities to join in the decision making, implementation, and evaluation of protection plans, and to manage natural resources together with the nature reserve management authority.

In 1998, the Forest Conservation and Community Development Project (FCCDP), funded by the Government of Holland, was implemented in Yunnan Province. The project included the six nature reserves of Laiyang River, Nuozechadu, Wuliang Mountain, Gaoligong Mountain, Xiaohei Mountain and Tongbiguan, which cover the prefectures and cities of Maosi, Baoshan, Nujiang, and Dehong. Similarly, community co-management of resources was an important part of the FCCDP project.

The World Wide Fund for Nature (WWF) implemented community co-management of natural resources in many of its protection and development projects—e.g., in the White Horse Snow Mountain and Zhongdian in Yunnan Province; the Qinling area of Shaanxi Province; wetlands in Sichuan Province on the middle reaches of the Yangtze River; and Tibet Autonomous Region. In addition, the provisions and content of community-based co-management of natural resource are included in the wetland protection regulations of several provinces in the PRC. Such developments have clearly promoted the use of this environmental management tool in the PRC.

### 2.13 Regional restricted approval

The Regional Restricted Approval System is a system where, if environmental protection rules are seriously violated by an enterprise or region, environmental protection departments have the right to suspend the operations of all new construction projects by this enterprise or region in question until the enterprise or region has conducted rectification and reform.

On 10 January 2007, the State Environmental Protection Administration used the Regional Restricted Approval tool for the first time. In that case, the State Environmental Protection Administration suspended all construction projects except for Circular Economy projects in the administration areas of Tangshan City of Hebei Province, Luliang City of Shanxi Province, etc.

<sup>8</sup> See [www.zhb.gov.cn/info/gw/juling/200704/t20070420\\_102967.htm](http://www.zhb.gov.cn/info/gw/juling/200704/t20070420_102967.htm)

### 3 Eco-compensation

In the PRC, eco-compensation is a widely used term in the areas of polluter and beneficiary payments. At the Sixth National Conference on Environmental Protection, held on 17 April 2006, Premier Wen Jiabao highlighted, "China will improve eco-compensation policies and establish eco-compensation mechanisms according to the principles of 'Developers protect, damagers restore, beneficiaries compensates, and polluters pay'." The PRC's eco-compensation pilot programs mainly involve four areas: forests and grasslands, mining, watersheds, and nature reserves.

#### 3.1 Forest and grassland eco-compensation

The PRC invests the largest amount of funds in forest and grassland eco-compensation. The state launched several big forest eco-compensation projects successively, as follows:

- The Natural Forest Protection Project focuses on serious water and soil erosion, river, and lake sedimentation caused by the destruction of natural forests in the middle-upper Yangzi River and Yellow River basins; planned investment is CNY96.2 billion during 2000–2010;
- The Grain for Green Project focuses on water and soil erosion of sloping farmland in western PRC; planned investment is CNY337 billion during 2001–2010;
- The Forest Ecosystem Compensation Fund: Pilot projects were initiated in 2001. The central government pays CNY1 billion annually to subsidize 13.33 million hectares (ha) of ecological forests that provide environmental benefits in forest farms and natural reserves. Since 2004, the central government pays CNY2 billion annually to subsidize 26.67 million ha of public benefit forest that is individually or community managed.

#### 3.2 Mining eco-compensation

Compensation charges on mining have been collected in the PRC since 1994, and are used for mineral resource exploration, conservation, and rational development. In some areas in the PRC, compensation is used for treating and restoring the ecology in the development of mineral resources.

Since the late 1980s, the provinces and municipalities of Fujian, Gansu, Guangdong, Guangxi, Heilongjiang, Inner Mongolia, Jiangsu, Shaanxi, and Shanxi have levied eco-compensation fees to resolve the ecological and environmental problems caused by the development of mineral resources such as coal and oil. Eco-compensation fees have been collected based on a proportion of mineral resource sales, and are used for eco-environment restoration. By 2002, 17 provinces, cities, and municipalities collected eco-compensation fees. For example, in 1993, Baotou City of Inner Mongolia, and the contiguous areas shared by Shanxi, Shaanxi, and Inner Mongolia carried out a policy of eco-environmental compensation with the approval of the State Council, and started large-scale pilot works on eco-compensation. The Shenhua Group pays environmental protection charges of CNY0.45/ton of coal.

In 1997, Shaanxi Province issued the *Management Measures of Shaanxi Province for the Collection of Eco-environmental Compensation Charges in the Area of Yulin and Tongchuan*, which requires firms and individuals engaged in the development of mineral and energy resources to pay monthly eco-environmental compensation charges. In 1999, Guizhou Province charged CNY5/ton of coal for vegetation recovery.

In 2003, Anhui Province issued the *Management Measures of Anhui Province on the Collection and Use of Deposit Fund for Restoration and Control of Mining Environment*, stipulating that a deposit fund be placed in a special financial account at the relevant governmental level. Interest payments shall be capitalized, and the fund should only be used for environmental restoration and control of the mine in question.

In 2004, the provinces of Fujian and Guangzhou issued and revised the *Measures*

on *Mining Environment Management*, clearly expressing the intent to establish and improve the system of mine environmental assessment and restoration deposit.

### 3.3 Watershed eco-compensation

Due to the importance of the Three Rivers Source Region in Qinghai Province for the PRC, from 2004 to 2010, the national government plans to invest CNY10 billion, of which CNY7.5 billion will be for the protection of this region in Qinghai, and CNY2.5 billion will be for the protection of Qinghai Lake, all of which will involve an implementation plan on natural ecosystem protection and ecological construction for the Three Rivers Source Region and Qinghai Lake, and the implementation of 10 major projects, including the Conversion of Grazing to Grassland, key wetland protection, black soil beach treatment, and ecological migrant relocation programs.

On 24 November 2000, after five rounds of discussion between Yiwu and Dongyang cities in Zhejiang Province, downstream Yiwu City spent CNY200 million to purchase the use rights to 50 million cubic meter of water annually from the Hengjin reservoir of upstream Dongyang City. After these water rights were transferred, the former ownership did not change; Dongyang City was still responsible for reservoir operation and engineering maintenance, while Yiwu City paid general management fees including water resource fees of CNY0.1/m<sup>3</sup> of actual water supply annually.

Hangzhou City established a special fund for eco-compensation, and integrated and optimized the structure of financial subsidies. Since 2005, the provincial government has returned CNY80 million to Hangzhou City, while the municipal government has added CNY56 million to the existing CNY150 million for the above-listed original eco-compensation policies, which included CNY16 million for eco-compensation to upstream areas.

In 2003, the government of Fujian Province decided to establish an eco-compensation mechanism for three watersheds in the province. During 2003–2007, the government of Xiamen City on the lower reaches of the Jiulong River watershed annually provided CNY10 million for watershed ecosystem improvement in the

upper watershed areas, of which CNY5 million was for Zhangzhou City and CNY5 million was for Longnian City. Zhangzhou and Longnian cities also annually contributed CNY5 million in matching funds. These special funds were mainly used for treatment projects of animal farm pollution, rubbish, and sewage in the Jiulong River.

In 2005, Fujian Province launched the second phase of the Min River protection project. During 2005–2010, the government of Fuzhou City is to annually provide CNY10 million, while upstream Sanming and Nanping cities contributed CNY5 million each. These special funds are established and managed by the provincial finance bureau for watershed treatment in Sanming and Nanping. The Provincial Finance Department and the Provincial Environmental Protection Administration jointly issued the *Management Measures for Environment Protection of Min River Watershed*.

### 3.4 Natural reserve eco-compensation

At present, sources of investment in nature reserves are from the central government, local governments, and the public. The related authorities in charge of national nature reserves, such as the Ministry of Environmental Protection, the State Forestry Administration, the Ministry of Agriculture, the State Oceanic Administration, and the Ministry of Land and Resources have channels of funds to invest in nature reserves. The State Forestry Administration invests CNY0.2 billion–CNY0.3 billion in key nature reserves every year.

## 4 Relationships between Eco-compensation and Other Environmental Management Instruments

Eco-compensation is closely linked to many other policy tools; hence, it is important to examine the role of eco-compensation in the policy tool kit.

### 4.1 Eco-compensation and pollution charges

Pollution charges, which is a traditional environmental management measure that



follows the principle of polluter pays, have had a remarkable impact on the treatment of point source pollution, and are applied throughout the world. In fact, pollution charges are an important component of the PRC's eco-compensation designs. In 2008, for instance, the *Notices of Hebei Province on Carrying out the Target Responsibility for Water Quality of Multi-city River Sections in Ziyahe River System and Trying out the Policy of Withholding Eco-compensation Funds*, directs Hebei's Provincial Financial Department to withhold CNY0.1 million–CNY3 million of eco-compensation funds from the expenditure of related cities for the fiscal year based on how much they exceed standard rates according to the water quality assessment of river sections, supplied monthly by the environmental protection departments. Since April 2008, CNY10.8 million of eco-compensation funds have been withheld from five cities in the Ziyahe river watershed: CNY5.6 million was withheld from Shijiazhuang, CNY0.1 million was withheld from Handan at the river source and Cangzhou on the lower reaches, CNY3 million was withheld from Hengshui, and CNY2 million was withheld from Xingtai (Zhang 2008).

Some eco-compensation designs include both polluter pays and beneficiary pays principles. For example, according to Fujian Province, measures on establishing eco-compensation funds based on payments by the upper and lower watershed areas states that the upstream areas, as polluters, must pay, while eco-compensation funds are decreased for upstream areas that fail to pass river section assessments.

#### **4.2 Eco-compensation and deposits**

The PRC has implemented a deposit system for the environmental restoration of mines, which is usually regarded as a resource development eco-compensation mechanism. Before beginning mineral exploration, mining rights holders must pay deposits according to set standards, which are only to be used for the environmental restoration of the exploited areas.

Eco-environmental destruction caused by mineral exploration is similar to the point source pollution of industries. Thus, deposits for environmental restoration are equivalent

to pollution charges applied to point source pollution control.

#### **4.3 Eco-compensation and environmental liability insurance**

The Environmental Liability Insurance is one of market solutions following the principle of polluter pays. Some eco-compensation designs in the PRC try to contain the content of environmental liability insurance, such as the design framework of Fujian Province's Min River eco-compensation program.

#### **4.4 Eco-compensation and differentiated taxation**

Differentiated taxation, preferential and resource taxes are viewed as a part of eco-compensation policies in the PRC. The *2007 Work Outline of the State Council* focused on "improving the policy system of energy-saving and emissions reductions; improving fiscal, price and financial policies; deepening reforms of the price of important resource products and pollution charges; perfecting the system of resource taxation; strengthening the paid-use system of mineral resources; and accelerating the construction of eco-environmental compensation mechanisms."

#### **4.5 Eco-compensation and carbon emission reduction trade**

Reafforestation and/or afforestation, reducing deforestation, and wind power generation can increase carbon sinks and reduce greenhouse gas emissions. According to the CDM mentioned in the Kyoto Protocol, all of these activities can be compensated for open market instruments. Carbon emission reduction trade is regarded as a typical form of eco-compensation.

#### **4.6 Eco-compensation and environmental labeling**

When a product has been labeled as "environmentally friendly," such as the PRC's Green, Organic, Sustainable Production, and Environmentally Friendly labels, its market value is high. Environmentally friendly activities are rewarded and compensated by the market. If farmers use less harmful substances (like

pesticide), with the certification of green food or organic food, their activities that are good for the environment are compensated for by consumers via a higher price. Hence, environmental labeling or eco-labeling actually is a type of market eco-compensation.

#### 4.7 Eco-compensation and corporate social responsibility

Some enterprises emphasizing their social image invest in environmental protection activities or provide financial aid for environmental protection projects. The consumption of natural resources by enterprises also causes environmental pollution and ecological destruction. In this case, the enterprises' social responsibility behavior has practical linkages with eco-compensation.

#### 4.8 Eco-compensation and community-based co-management

In the community-based co-management, local communities help nature reserves protect the environment. Meanwhile, nature reserves usually help community residents with road development, firewood-saving stove improvements, and drinking water projects. These economic and social supports for residents are similar to eco-compensation, especially nature reserve land belonging to local collectives. Without an economic relationship between communities and nature reserve authorities, community-based co-management cannot be practiced in the PRC. Thus, the core of community co-management is eco-compensation.

#### 4.9 Definition of eco-compensation

When eco-compensation is closely linked with the above policy tools, people need to think about these questions: Is eco-compensation a name for a handful policy tools which are closely related to each other, or it is just a specific policy tool which is similar to payments for ecological services (PES)?

PES, so called in the international communities, has its own particular connotations. For example, Rewarding Upland Poor for Environmental Services (RUPES) (van Noordwijk et al. 2005) considered four conditions that needed to be met for economic instruments of

eco-environmental protection to be regarded as PES:

- (1) **Realistic.** PES mechanisms should be based on certain real relationships (such as tree planting, which has the function of carbon sequestration and greenhouse effect mitigation) and realistically balanced opportunity costs.
- (2) **Voluntary.** Any behavior of payers and payees under this mechanism should be voluntary, and based on sufficient information.
- (3) **Conditionality.** Payment is conditional on the services provided. The conditions of payment should be monitored and should also be verifiable.
- (4) **Pro-poor.** The mechanism should promote equal distribution of resources and avoid adversely impacting the poor.

The Center for International Forestry Research (Wunder 2005) has a similar definition of PES.

The relatively narrower term of PES in the world is different from the concept of eco-compensation in the context of the PRC. Thus, the PRC needs to reflect on whether to adopt the narrower term of PES, which is a specific environmental instrument, or to adopt a broad definition of eco-compensation, wherein it is a name for a handful of policy tools.

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## Conference Paper 2: Reflections on the Development of Eco-compensation Mechanisms in the People's Republic of China

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### 1 Definition of Ecological Compensation and Principles for Its Design

Ecological compensation, or eco-compensation, has become the focus of attention both at home and abroad. Foreign eco-compensation or payments for ecological services (PES) has been developed, and its policy and institutional framework has, to some extent, been put in place especially in the use of market mechanisms and multichannel financing systems. Many types of PES have been developed, such as one-to-one deals, public sector schemes, rationed trading markets, charitable payments, and eco-certification. Foreign eco-compensation is comprised of a series of measures that encourage people's participation and exploration of the international market, and has important lessons learned regarding watershed management, ecosystem restoration, biodiversity conservation, and carbon trading. However, it should be noted that the payments for ecological services in developed countries is still at an early stage. Given that the PRC and other countries have many differences in natural conditions, history, society, economy, culture, and management systems, our ecological compensation mechanisms should not only be based on international experience, but should also be adapted according to the PRC's specific context and conditions.

#### 1.1 The definition of eco-compensation

At present, no consensus in the academia exists on the definition of eco-compensation. After synthesizing scholars' views both at home and abroad and combining with the PRC's actual situation, we hold that eco-compensation is a management mechanism that aims to protect the sustainable use of ecosystem services and regulate stakeholders' benefits with

economic incentives. More specifically, eco-compensation is a public mechanism for protecting the ecosystems and the environment and for promoting a harmonious development between man and nature. It uses regulatory and market instruments, values ecosystem services, calculates costs of ecological protection, and explores potential development opportunities to adjust relationships among ecological protection stakeholders.

Eco-compensation can be defined both in narrow and broad terms. In narrower terms, ecological compensation refers to rewards for protecting the environment and natural resources. In broader terms, it covers not only rewards, but also includes environmental pollution charges. In the PRC, the "polluter pays" principle is enforced with considerable success. What is urgently needed is an eco-compensation mechanism that is based on ecosystem service provision.

#### 1.2 The principles for the establishment of eco-compensation mechanisms

The subject of eco-compensation should be defined by the stakeholders' responsibility and position regarding ecological protection or destruction. In general, payments for ecological services or eco-compensation should be determined according to the following principles:

*Destroyer pays principle.* Destroyers of ecological systems compensate for the degradation of the functions of the ecosystem services caused by their harmful activities. This principle is suitable for regional ecological problems.

*User pays principle.* Ecological resources are public in nature and are usually scarce. Thus, users of eco-environmental resources should provide compensation on behalf of national and public interest. This principle can be

used in resources management, such as the management of farmland, forest resources, and mineral resources.

*Beneficiary pays principle.* This principle applies in eco-compensation between regions or between upper and lower watershed areas, whereby beneficiaries pay for eco-environmental services. All beneficiaries of public resources should take responsibility to compensate.

*Protector is compensated principle.* Groups or individuals that have contributed to the protection of ecological systems should be compensated for their inputs, including direct costs and benefits foregone.

## 2 Eco-Compensation Standards and Approaches

### 2.1 Methods for determining eco-compensation standards

The determination of eco-compensation standard is based on the following valuation methods:

*Valuation based on the direct inputs and opportunity costs of ecological protectors.* Inputs of ecological and environmental protectors in terms of manpower, material, and financial resources are taken into account in calculating compensation. Opportunity costs should likewise be included. This is the most feasible among the valuation methods.

*Valuation based on the benefits that beneficiaries acquire.* This is often referred to as positive externality if beneficiaries do not pay. When market exists, eco-compensation can be calculated using market transaction prices and trading volumes of products or services.

*Valuation based on restoration costs.* Resource exploitation activities cause destruction of vegetation, degradation of soil and water resources, decrease in biodiversity, and a consequent reduction in social welfare. Costs for restoring the ecological system are taken as the reference for eco-compensation.

*Valuation based on the value of ecological system services.* Ecosystem services include soil and water resource conservation, climate regulation, and protection of biodiversity and landscape amenities. These services can be attained through environmentally friendly production and management processes. In this case, eco-compensation is calculated based on the ecological services functions, but such can only be a theoretical reference for the upper bound.

In practice, eco-compensation is calculated through negotiation and game playing based on estimates from the valuation methods above. It has to be sufficiently rational, and should account for regional contexts—especially levels of economic development and environmental destruction—when determining the current compensation standard. At the same time, eco-compensation is a dynamic process, which evolves along with ecological protection techniques, the economy, and society.

### 2.2 Eco-compensation approaches and methods

There are many eco-compensation approaches and methods. Eco-compensation methods include fund compensation, material compensation, policy compensation, and intellectual compensation. These can be classified into vertical and horizontal forms of compensation. They can be further categorized into eco-environmental factor compensation, watershed compensation, regional compensation, and international compensation. Eco-compensation, however, is more generally categorized according to the implementing body or operating mechanism used—i.e., as government compensation or as market-based compensation.

*Government compensation.* In the PRC, government compensation mechanisms are the most important form of eco-compensation, and also the easiest to implement. Government compensation mechanisms are a form of compensation in which upper levels of government (e.g., the national government authorities) implement or compensate lower levels of government or individual rural

households (e.g., farmers, ranchers). The objectives of government compensation are national ecological security, social stability, and coordinated regional development. Means for compensation include financial subsidies, preferential policies, targeted project implementation, tax and fee reforms, and technical support. Government compensation also includes financial transfer payments, different regional policies, project implementation of ecological protection, and environmental taxes and fees.

*Market-based compensation.* Environmental rights, ecosystem functions, or pollution permits can be traded in markets. Environmental values are realized through market transactions. The typical market-based compensation mechanism includes public payments, one-to-one transaction, trading, and eco-labeling.

### 3 The General Framework and Key Areas of Eco-Compensation

Eco-compensation involves many sectors and areas, and it has different compensation types,

targets, contents, and methods. Therefore a strategic, comprehensive, and long-term framework is needed. Eco-compensation issues can be divided into international and domestic issues. International issues cover problems in the areas of global forests and biodiversity protection, pollution transfers (industry, product, and pollutant), and transnational water resources. Domestic issues generally concern compensation that is interregional in scope and covers ecosystem service function or resource exploitation (Table1).

#### 3.1 International eco-compensation

International eco-compensation includes compensation for water quantity and quality of international rivers, compensation for damage to the downstream caused by hydraulic engineering construction upstream, and compensation for ecological disasters and damages caused by international exploitation and utilization of resources. Other types include carbon trading, ecological certification, and the regulated eco-compensation of multilateral and bilateral agreements for the protection of biodiversity.

**Table 1 The Framework of Chinese Eco-Compensation Mechanism**

Scale	Compensation type	Compensation contents	Compensation means
International compensation	Ecological and environmental issues in the global scale, between regions or countries	Global forests and biodiversity protection, pollution transfer, emission of greenhouse gases, transboundary river	Global buying under multilateral agreement; Compensation under regional or bilateral agreement; Market trading in the world, between regions and countries
Domestic compensation	Compensation between regions	Eastern areas' compensation to western areas	Financial transfer payment; local government's mediation, market trading
	Watershed compensation	Trans-provincial watershed compensation; local watershed compensation	Financial transfer payment; local government's mediation, market trading
	Ecosystem compensation	The services from ecological system, like forest, grassland, wetland, ocean, and farmland	National (public) compensation of financial transfer payment, eco-compensation funds, market trading, participation of enterprises and individuals
	Resource exploitation compensation	Mining, land reclamation, vegetation restoration	Payment by beneficiary, by destroyer, and exploiter

Source: The authors.

### 3.2 *Interregional eco-compensation*

Regions that play unique and important roles in national ecological security, or that have higher rates of poverty and are also seriously degraded and damaged by human activities should be compensated. Western PRC is a case in point. The PRC's western areas are ecologically fragile, while also being an important eco-environmental buffer for the eastern PRC's water resource conservation areas. They are thus crucial for the PRC's ecological security. Long-term unsustainable development activities, combined with climate change, have resulted in increasingly apparent ecological degradation of these areas. Thus, the establishment of a western area eco-compensation mechanism will benefit the western PRC's eco-environmental protection and help improve people's living standards. It would also be good for achieving the goal of harmonious development of a green Chinese economy.

Firstly, it is necessary to scientifically estimate the value of ecosystem products and services in western areas and to analyze the economic loss from ecological destruction due to the long-term resource utilization process.

Secondly, we need to integrate existing eco-compensation measures and funds to improve outcomes. For many years, the central government has subsidized western ecological protection and economic development via a series of national programs and financial transfer payments. This includes, for example, the Conversion of Cropland to Forests and Grassland program, the Natural Forest Protection Program, and the Sandstorm Source Control program. These projects have elements of eco-compensation. We need to integrate these projects and funds and comprehensively manage them to avoid wasteful redundancy and to improve efficiency.

Thirdly, based on the gap between the level of ecological degradation and the input of ecological restoration in the western area, and on PRC's financial situation, we should take planned action to progressively intensify financial transfer payments to the PRC's western areas, and to compensate these regions for past environmental degradation caused by the PRC's economic development, thereby reducing gaps in regional gross domestic product.

Governments should take the lead, given the difficulty for markets to fully capture the value of ecosystem services, and given the actual situation of Chinese ecological protection and level of market development. We should close the gap by providing more transfer payment to western regions based on the difference between the value of the ecosystem services in the western regions and the financial revenue in the same region.

### 3.3 *Watershed eco-compensation*

For many years, to ensure watershed ecological security and the sustainable use of water resources, the upstream areas of most rivers have invested substantial amounts of manpower, materials, and financial resources in ecological construction and environmental protection. The upper watershed areas of most rivers in the PRC are usually areas with relatively low levels of economic development and higher levels of poverty; and since ecological conditions of these areas are relatively fragile, the pressure to protect the ecosystem, coupled with a strong interest to reduce poverty, creates a serious conflict. Establishing watershed eco-compensation and putting into practice compensation mechanisms from the central and downstream areas to the upper watershed areas can accelerate socioeconomic development in these upstream areas and effectively protect their ecological environment, and thus promote the whole basin's sustainable socioeconomic development.

Multichannel compensation should be explored, though water resources compensation could be the first. Western regions are important water sources of the Yangtze River, Yellow River, and other large rivers. With the coordination and guidance of the central government, it is necessary to actively explore interprovincial watershed compensation mechanisms, and to establish a bi-directional responsibility compensation mechanism, wherein downstream pays the upstream for the water resources and watershed environmental protection, while the upstream compensates the downstream if it discharges pollutants beyond a set standard. This will help to promote the harmonious development between upper and lower watershed areas.



In watershed eco-compensation, responsible parties should be clarified. With the coordination of the higher level environmental protection departments and the requirement of sufficient river basin water ecosystem service functionality, such compensation needs to involve the establishment of watershed environmental agreements, which clearly define each administrative region's responsibilities for water quality in cross-administrative sections, and which set compensation rates based on water quality.

The PRC already has pilot programs and successful eco-compensation cases at different scales, including those between Guangdong and Jiangxi in the Dong River watershed, Zhejiang's Yiwu—Dongyang water resource compensation, and Beijing and Hebei province's water resource compensation. All of these programs are good examples of the establishment of lower to upper watershed eco-compensation mechanisms.

### 3.4 Ecosystem compensation

Ecosystems not only provide food, raw materials, energy resources, and numerous kinds of products, but they also provide important ecosystem functions for human beings. However, most of the value of ecosystems cannot be captured by markets. Ecosystems can be better and more sustainably used only by internalizing the external economy of ecosystem benefits with proper measures, practically realizing the value of ecological benefits. Ecosystems consist, among others, of forests, grasslands, wetlands, oceans, and farmland. The stability of ecosystems and the continuous supply of ecological service play an important role in preserving national ecological security and improving regional sustainable development.

Forests are the main part of land ecosystem. In cases of ecosystem compensation in the PRC country, forest eco-compensation is the earliest example. Experience with forest eco-compensation provides a reference point for work on eco-compensation for other types of ecosystems. The PRC has promulgated many policies for the forest ecosystems, such as the compensation for the ecological forest based on the *Administrative Rules on the Forest Ecosystem Compensation Fund*, which was jointly issued by the State Forestry Administration and Ministry of Finance. These policies play a guiding role in the

implementation of the Natural Forest Protection Program and the Conversion of Cropland to Forests and Grassland Program. However, these cannot sustain participants' enthusiasm for forest protection and ecological construction without long-term mechanisms in place. It is important to integrate existing multiple compensation systems, to keep in mind different forest types, and to consider the direct inputs of participants. Other factors that should be considered for a successful forest eco-compensation are the opportunity costs of conservation, regional factors, forest type, tree species, afforestation methods, and local economic conditions.

### 3.5 Resource eco-compensation

Mineral resources are the essential material base for socioeconomic development. The exploitation and utilization of mineral resources not only help economic development, but also have significant adverse ecological and environmental impacts. Determining how to adjust the relationship between ecological degradation and protection, and to accelerate the ecological restoration of mining areas, has become an important task for the PRC.

In eco-compensation for mineral resources exploitation, the targets, responsibilities, and limitations of environmental restoration and management of mining areas should be clarified. Past environmental degradation (historical damages or environmental impacts of abandoned mines) should be differentiated from new environmental impacts (newly created damage), as they are addressed separately. The eco-environmental compensation of abandoned mining areas and old mining areas should depend on the government's establishment of the *Funds of the Eco-environmental Restoration and Management of Abandoned Mines* (hereafter referred to as *Restoring Funds*). The main sources of *Restoring Funds* are government finance resources and mining enterprise production charges and donations. The fund is collected by local environment and land departments and then handed to the state. It has a special account and is earmarked for specific purposes. Enterprises in question are then wholly responsible for managing environmental restoration. New mining should be permitted only when such an eco-compensation mechanism is established.



## 4 Some Suggestions on Promoting the Establishment of Eco-Compensation Mechanisms

### 4.1 Agree on the definition of eco-compensation and improve the general framework for eco-compensation

The various insights on eco-compensation have made implementation difficult. The definition of eco-compensation should thus be clarified and unified. The ecological protection projects on the ground need to be integrated and be brought into the eco-compensation framework gradually. Under the guidance of a unified guiding framework and policy, governments at all levels and relevant departments should extensively carry out eco-compensation pilot projects according to the actual conditions. Only through such extensive practice can we establish an eco-compensation framework and system suitable for the PRC's complex situation.

### 4.2 Implement development of each zone based on the zone's unique set up

The division of major development zones is the basis for regional eco-compensation. In key development zone and preferred development zone areas, under the supervision of financial and environmental protection departments, enterprises set aside funds for management of environmental pollution and ecological restoration. These funds are owned by enterprises with special account management and are earmarked for special use.

For the restricted development zone and prohibited development zone areas, preferential policies and more public transfers should be applied. The public services of education, health care, social security, public management, ecological conservation, and construction should be provided for at the same level as in other areas. Government performance should be evaluated based on ecological accomplishment. Ecological programs should be integrated based on the ecological function protection zone. The protection of ecological functions with multisector coordination should be set as the goals for this work.

### 4.3 Improve financial policy for eco-compensation and explore more channels to finance eco-compensation

First, the central government's financial transfer payments should be increased. Financial transfers are the most direct and practicable method for eco-compensation. The weight of eco-environmental factors in public transfers should be increased to strengthen the support for ecologically fragile areas and key ecological protection areas, so that financial transfer payments to central and western regions are increased. The state could purchase important ecological areas (like nature reserves) or ecological components (national ecological public forests) and establish a mechanism for long-term inputs.

Second, local governments should strengthen their support and cooperation for eco-compensation. In addition to the responsibilities of establishing eco-compensation programs in their own jurisdiction, local governments should also support and cooperate with central government eco-compensation programs.

Third, a multichannel financing mechanism should be set up for eco-compensation. Government subsidies should not be the only source of funds for eco-compensation. Public demand for ecosystem services should be identified, as well as the public's willingness to pay. Incentives should be given to members of the private sector to encourage them to enter the ecosystem service markets. Eco-compensation funds should be set up to receive grants for eco-compensation from foreign nongovernment organizations to diversify the sources of eco-compensation.

### 4.4 Manage the relationships in the operation of eco-compensation policy

*Relationship between central and local governments.* The main task of the central government is to provide policy guidance, legal foundations, and certain financial support for the establishment of eco-compensation mechanisms. It is also responsible for the establishment of national and regional eco-compensation mechanisms. Local governments are the main body of the implementation of eco-compensation mechanisms. Ecological beneficiary areas should pay related fees to

the providers of eco-environmental functional services, while these key ecological functional areas should be compensated for the foregone development opportunities associated with their conservation and environmental protection activities.

*Relationship between the government and market.* Given the practical situation of ecological protection and market development, governments play a key role in the establishment of eco-compensation. The government not only formulates eco-compensation policies and rules, guides the formation and development of markets, but also provides large-scale funding for eco-compensation. Where the buyers and sellers are clear, market should play an active role.

*Relationship between “blood-creation” versus “blood-transfusion” eco-compensation.* Under “blood-creation” compensation, the local capacity of development is improved through the compensation. Whereas, under “blood-transfusion” compensation, the service providers receive the compensation but their capacity of development is not improved. As eco-compensation should be a way for localities to enhance their development capacity, “blood-creation” compensation should be encouraged.

*Relationship between new and old obligations.* The eco-compensation policy should deal with new obligation first. Old obligations will be dealt with only when the new ones are resolved. Local governments are responsible for new obligations. Central government will have more responsibility over the old obligations.

#### **4.5 Create the legal framework for eco-compensation and improve its management**

Government guidance could be issued in the near future such as the *State Council’s Guiding Opinion on the Policies and Measures*

*of Eco-Compensation*, which establishes a regulatory framework governing the scale, targets, methods, standards, operations, and supervision criteria of eco-compensation.

Given the present situation, coordination should be strengthened among sectors and regions to integrate various eco-compensation works in different departments and administrative districts. Higher levels of government should help promote inter-sectoral, and inter-regional eco-compensation. The State Council should set up an eco-compensation leading group, which is responsible for the coordination of national eco-compensation. Other duties include supervising, arbitrating, rewarding, and implementing sanctions in eco-compensation work. A technical advisory committee should be established to support the leading group.

#### **4.6 Strengthen eco-compensation research and pilot work**

Eco-compensation is a new research field. The establishment of eco-compensation mechanisms is a complex and long-term project. It involves numerous aspects, such as ecological protection and construction, fundraising, and fund use. Eco-compensation should be a subject of national key scientific research plans to strengthen research on key eco-compensation issues, such as the valuation of ecosystem services functions; the targets, standards, approaches and methods of eco-compensation; resource exploitation; and ecological impact assessment of major activities.

Eco-compensation pilot work is needed as soon as possible. Key issues and problems could be revealed in pilot activities. This could help improve the design of eco-compensation. Each sector could have its own pilot projects based on their eco-compensation focus. With these efforts, eco-compensation mechanisms could be established with matching policies.

## Conference Paper 3: A Framework Design of River Basin Ecological Compensation Policy and Its Mechanism for the People's Republic of China

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**Abstract:** The River Basin Ecological Compensation (RBEC) is a market-based instrument for internalizing the costs of water pollution and ecological destruction in river basins, which accords with “polluter pays” and “user pays” principles to promote sustainable, healthy, and harmonious management of river basins. This paper puts forward a framework for RBEC for the People's Republic of China (PRC) based on current legislation and local piloting programs, which covers the identification of main stakeholders of RBEC, compensation criteria and rate, methods and types of RBEC, financing mechanisms, and institutional arrangements for implementation.

**Keywords:** river basin ecological compensation, ecological compensation, People's Republic of China

Establishing river basin eco-compensation mechanisms can encourage beneficiaries to assume their share of the costs—incurred by upstream communities—in watershed protection and upstream watershed management, and guarantee the rights of the various stakeholders to equitably enjoy river basin water resources. The development of watershed environmental protection eco-compensation mechanisms is a current trend in both international and domestic environmental management. It is also an urgent and important topic in environmental management.

### 1 Concept Analysis of River Basin Eco-Compensation

Starting with concept analysis of river basin eco-compensation, this paper tries to clarify the concept and policy scope of river basin eco-compensation. The concept of river basin eco-compensation can be interpreted as follows: When (i) river basin water resources are enough, (ii) pollutants emission can be controlled within the corresponding total quantity control standard, or (iii) cross-border water quality is up to standard—then if the upstream has abundant water quantity and environmental capacity that can be used by the downstream, a positive externality occurs. In this case, if the upstream foregoes significant development opportunities and increases significant additional ecological and environmental protection costs to provide high quality water for the downstream, the downstream should compensate for the additional water ecological services provided by the upstream areas. Conversely, when water quantity or water quality fails to meet standards, the upstream causes the downstream to incur more water treatment costs and other economic losses, which is a negative externality. In this case, the upstream should offer certain financial compensation to the downstream. Thus, “lower-to-upper” and “upper-to-lower” river basin eco-compensation is an economic behavior, which is instrumental to balancing upstream and downstream conditions, and economic development with environmental protection.

## 2 The Policy, Legal, and Practical Basis for Establishing River Basin Eco-Compensation Mechanisms

### 2.1 Policy and legal basis

#### 2.1.1 The party and government are giving eco-compensation significant attention

Since issuing the *State Council Decision on Applying the Scientific Development View to Strengthen Environmental Protection* (State Council [2005] No. 39) in December 2005, the PRC's central government and the State Council have explicitly required the establishment of eco-compensation mechanisms in numerous policy documents. The PRC's 11th Five-Year Plan states that the government will "establish eco-compensation mechanism with the principles of the developer protects and the beneficiary compensates," which has become an important strategic measure in protecting and restoring ecosystems, and in building a resource-saving and environmentally friendly society. Party General Secretary Hu Jintao specifically pointed out that "ecological and environmental compensation mechanism should be established" in the Seventeenth National Congress of the CPC in October 2007. Premier Wen Jiabao said at the Second Session of the Eleventh National People's Congress in the government report in March 2009 that the "establishment of a system of paid mineral resource use and eco-compensation mechanisms should be accelerated." The PRC's central government and the state council are devoting significant attention to accelerating the establishment of eco-compensation mechanisms, and made it an important part of applying the Scientific Development View and the accelerated transformation of the PRC's economic development mode.

#### 2.1.2 Relevant laws and regulations

Since the 1970s and 1980s, environmental protection has been intensified along with aggravated river basin environmental pollution. The national government and relevant ministries and departments have introduced more than

70 laws, regulations, and policy documents, which call for the strengthening and greater input into river basin environmental protection. Although the provisions of river basin eco-compensation have not yet been explicitly proposed, the content of eco-compensation is already implicitly part of relevant laws and regulations.

The *Water Law of the People's Republic of China*, which has existed since 1988, has stipulated that "the miners or the construction unit shall take restoration measures and compensate those negatively affected because of water drainage, lowering of groundwater levels, and depletion of groundwater or subsidence." This provision is implicitly a form of eco-compensation. The *Law of the People's Republic of China on the Prevention and Control of Water Pollution*, which was revised and passed in 2008, is a milestone for river basin eco-compensation. It is the first time in a Chinese law that the provision of water ecological compensation is put forward. This law also clearly requires the responsibility of watershed environmental protection. These law and regulations have provided very strong support for the establishment of river basin eco-compensation mechanisms. However, the development of river basin eco-compensation still lacks a complete policy framework at the national level.

### 2.2 Practical basis

In recent years, local governments have actively developed various river basin eco-compensation initiatives, and the PRC has accumulated practical experience. By initial classification, the typical models of river basin eco-compensation practices in the PRC are as follows: (i) water rights trading, with a representative case being the Dongyang–Yiwu water rights trading scheme; (ii) river basin environmental agreements, with representative cases in Zhejiang Province, the Min River in Fujian Province, Tai Lake in Jiangsu Province, and the Ziya River in Hebei Province; (iii) the joint development and sharing of watersheds, with a representative case being the Zhejiang–Anhui Xinjiang River Basin program; (iv) *Ex situ* development options, with a representative case being between Zhejiang's



Jinhua City and Pan'an County; and (v) the eco-compensation fees, which have been collected since the 1990s in some regions. All of these models have laid solid practical foundations for the establishment of Chinese river basin eco-compensation policy mechanisms.

### 3 Design of the PRC's River Basin Eco-Compensation Policy: Principles

#### *3.1 Developer protects, destroyer restores, beneficiary compensates, and polluter pays*

It is necessary to clarify the responsible parties in river basin eco-compensation and determine its targets and scope. Developers and users of watershed environmental and natural resources should pay for their environmental externalities, and have the obligation to protect the environment of the watershed and compensate for their adverse impacts. They should also pay for the use of river basin environmental capacity (upstream compensates the downstream), while the beneficiaries of river basin ecological protection have the responsibility to compensate river basin ecological protectors (downstream compensates the upstream).

#### *3.2 Guarantee compensation is required once one party has been compensated*

River basin eco-compensation involves multiple stakeholders and interests. Extensive stakeholder investigation is needed to clarify the responsibilities and obligations in both vertical and horizontal relationships. It is also needed to scientifically evaluate the direct and indirect costs of maintaining ecosystem services; study and draw up reasonable eco-compensation standards, procedures, and supervision mechanisms; ensure the integration of stakeholder responsibilities, rights, and obligations; and guarantee compensation once one party has been compensated.

#### *3.3 Joint growth and sharing of benefits for win-win development*

Stakeholders in river basin ecological protection should fulfill their environmental protection

duties, strengthen coordination in river basin ecological protection and environmental management, actively enhance cooperation in economic development, improve river basin ecological environmental quality, expand development space, and promote sustainable development in river basins.

#### *3.4 Government guides and involves the market*

The government should guide the process of river basin eco-compensation mechanism establishment, improve its public fiscal system for environmental protection, regulate the resource use and environmental protection activities of economic actors, and encourage multiple financing sources to invest in environmental protection. Market mechanisms should be established.

#### *3.5 Pilot first, replicate later*

River basin eco-compensation pilots should be carried out in typical river basins. Lessons learned from these pilots and other parts of the world should be fed into the national eco-compensation policy framework. Various eco-compensation methods should be encouraged.

### 4 Typology of the PRC's River Basin Eco-Compensation Mechanism

River basin eco-compensation mechanisms are mainly classified based on watershed characteristics. Three watershed characteristics are considered.

#### *4.1 Watershed function*

There are three types of watersheds based on function: (i) Water sources for centralized drinking water supply, such as the Dahuofang Reservoir which is the centralized drinking water source for Shenyang and other cities. In these areas, economic compensation pilots of centralized drinking water source areas could be developed; (ii) Headwaters conservation areas, such as in the Xin'an River, Dong River, and the middle route of South-North Water Diversion Project; and (iii) Transboundary rivers, such as the Liao River, Xiang River, Min River, and Huai River—with these

being possible pilot sites for transboundary river eco-compensation programs.

#### **4.2 Watershed size**

There are two levels of eco-compensation. One level is inter-provincial eco-compensation, and another level is inter-municipality eco-compensation within a province. Inter-provincial watersheds include large river basins and watersheds that extend across 2–3 provinces. Based on this category, the Xin'an River, Dong River, the middle route of South-North Water Diversion Project, and the Liao River all have inter-provincial river basin eco-compensation issues. The Dahuofang Reservoir, Xiang River, and Min River basin have inter-municipality eco-compensation issues. The Yangtze River and Yellow River have too many beneficiaries and stakeholders. They are too complex to be considered.

#### **4.3 The watershed's outstanding environmental and development issues**

There are two kinds of watersheds based on water quality. One is watersheds with clean water, which need to be protected during the economic development process. The other is watersheds with polluted water that need to be improved during the economic development process. Of the several above-mentioned watersheds in the PRC, the Dahuofang Reservoir, the middle route of South-North Water Diversion Project, the Dong River headwaters and the Xin'an River are watersheds that maintain sustainable economic and social development under the premise of protecting "clean water" sources. This is a case for downstream-to-upstream eco-compensation. The Xiang River, Min River, and Liao River effectively protect their "clean water" while managing "dirty water" simultaneously with economic development. These not only involve downstream-to-upstream eco-compensation, but also upstream-to-downstream.

### **5 Framework Design of the PRC's River Basin Eco-Compensation Policy**

Based on the above analysis, the framework design of Chinese river basin eco-compensation

policy should contain the following important elements:

#### **5.1 Identification of stakeholders in river basin eco-compensation**

There are three kinds of river basin eco-compensation stakeholders: (i) owners of river basin resources, (ii) developers and users of river basin resources, and (iii) managers of river basin resources. From this point of view, three kinds of river basin eco-compensation payers also exist: local, provincial, and national. The types of stakeholders that should be considered depend on the range of ecosystem services produced by these watersheds. Different compensation levels are realized by different means and mechanisms.

River basin eco-compensation targets are the land area involved or individuals that conduct conservation work and contribute to ensuring sustainable utilization of water resources. These usually include upper watershed water resource protection measures for ensuring sustainable supplies of water for downstream. Upstream areas invest significant manpower, materials, and financial resources, often at the expense of local economic development. For these areas that have contributed to the protection of river watershed protection, beneficiaries—lower watershed areas and perhaps the country as a whole—should be responsible for compensation. At the same time, river basin eco-compensation targets should also include areas that are polluted due to excessive pollution discharges in upper watershed areas. River basin eco-compensation targets include not only river basin ecological protectors, but also the victims of river basin environmental pollution.

#### **5.2 Determination of river basin eco-compensation rate**

By establishing river basin eco-compensation mechanisms, we can achieve a relatively equitable relationship between upper and lower watershed areas. It is essentially a redistribution process of portions of financial incomes between upper watershed and lower watershed governments. The purpose is to establish an equitable and reasonable incentive-based system to improve the whole watershed. When upstream areas compensate downstream



areas for losses caused by their emissions of pollutants that exceed limits, the compensation rate is decided by the types of pollutants, their concentration, water quantity, and time. The calculation of compensation rates includes three aspects:

- (i) **Assessment of the protection costs of upper watershed areas.** To achieve water quality and quantity standards, the upper watershed needs to invest in water conservation, comprehensive upgrade of polluting facilities, management of agricultural non-point source pollution, construction of city and township sewage treatment facilities, and construction of water conservation facilities;
- (ii) **Assessment of development opportunity cost.** To achieve water quality and quantity standards, the upper watershed must also incur indirect inputs, such as the input of water conservation, resettlement, and the foregone revenue associated with restrictions on industrial development;
- (iii) **Assessment of water quality and quantity protection criteria.** Eco-compensation relationships can be analyzed based on (a) the variation of water quality and quantity, (b) watershed planning, (c) water resource use restrictions, and (d) water quality and quantity standards at trans-boundary water sections. The eco-compensation rate (i.e., the mitigation costs of improving water quality by one grade), could be estimated with a univariate or multivariate model.

### 5.3 Choice of river basin eco-compensation measures

#### (1) Compensation via a fund

A river basin eco-compensation fund is the most common approach to compensation. Its contributors are the lower watershed governments, while upper watershed areas are both the beneficiaries of ecological construction and one of the targets of eco-compensation.

Lower watershed areas need to adjust the price of water. Water price usually consists of engineering, management, and resource costs. Generally speaking, engineering and management costs are relatively fixed. The margin by which resource costs can rise is usually larger. Thus, downstream areas can accordingly increase the levy standard of the water resource fee, and put part of this into river basin eco-compensation funds. This method is comparatively flexible and feasible. Similar to downstream, upstream areas can also feasibly increase upper watershed water consumption prices by area, and put parts of the rising water resource fees into river basin eco-compensation funds. This will help to make the funding sources for river basin eco-compensation more sustainable. These fund compensation methods are suitable for river basin eco-compensation mechanism at all scales.

#### (2) Compensation via preferential policies

Policy compensation consists of the power and opportunity provided via regulations to a lower level government from a higher level government. Upstream areas have some authority to create preferential policies for investment, industrial development, and fiscal and taxation arrangements to promote economic development. Thus, it is very important to compensate with policies and institutional resources, especially in poor upstream areas. Examples of policy compensation include, among other things, preferential fiscal policies, market compensation policies, and technological transfer policies.

#### (3) Compensation via industrial development

There is an industrial development ladder that some industries are able to scale. This might be used in eco-compensation. Some component of eco-compensation to the upstream areas could be realized via industrial development. This is a feasible option.

Expanding and developing upper watershed industry and strengthening its “blood-creation” functions are the best methods to narrow the development gap between upper and lower watershed areas, and to improve the lives of local

people. Upper watershed areas, in developing its industry base, should adhere to the idea that “providing services to the downstream is development itself,” whereby a platform for industrial transformation is established to accept and consolidate labor-intensive, resource extractive, high-tech, and pollutive industries from both upstream and downstream areas, so as to form industrial clusters and manufacturing districts.

#### (4) Compensation via markets

The preconditions for forming river basin eco-compensation market mechanisms are as follows: (i) significant mismatch between the supply and demand of ecological services between upper and lower watershed areas; (ii) public recognition of watershed ecological services and values; (iii) clearly defined property rights, coupled with individual and public sector entrepreneurial spirit; and (iv) good cost-benefit analysis estimates.

As the PRC becomes increasingly market-oriented, it is likely that the development of market-based compensation mechanisms will become the trend for river basin eco-compensation in the country. We can thus draw lessons from international experiences in payments for ecological services and gradually explore models involving both direct contracts and market-based eco-labeling.

### **5.4 Channels of finance for river basin eco-compensation**

Given the government’s predominant role, channels of finance for river basin eco-compensation mainly include taxes, non-tax public-sector revenues, the intergovernmental transfer system, and government special funds.

#### (1) Tax and non-tax public sector revenue policies for river basin eco-compensation

These policies should be made with market participation. Such policies include—under present policy permissions—preferential taxes for enterprises, individuals, and nongovernment organizations that participate in river basin eco-compensation, such as exemptions from

or reduction in value-added tax, consumption taxes, enterprise income taxes, individual income taxes, and related local tax categories and non-tax income fees. There are large gaps in economic development in the PRC. The management of tax and non-tax income is relatively strict, and the PRC has numerous non-tax revenue items. It is necessary to design preferential tax and non-tax income policies that comply with present policy permissions.

The holistic support of upstream areas by the downstream is encouraged, and so tax and non-tax income policies should be part of river basin eco-compensation. Downstream areas could provide downstream industrial zoning options to upstream areas, and utilize upstream labor, resources, and agricultural products so as to promote financial transfers between downstream and upstream.

Fiscal subsidy policies should be created for river basin eco-compensation. Market resources and subsidy policies should be included in river basin eco-compensation. There are many ways for market resources to contribute to eco-compensation, some of which do not involve capital investments, but rather in development opportunities (e.g., employment, education, and market access). The pricing of market resources and eco-compensation rate should be studied.

Enterprise accounting policies that promote river basin eco-compensation should be established. Enterprise costs, prices, labor, and other aspects should be adjusted to include eco-compensation and internalize environmental externality.

#### (2) Inter-governmental financial transfers for river basin eco-compensation

The fiscal system should be reformed to take account of eco-compensation. Environmental responsibility should be classified into two categories: base standard and compensation standard. The base standard would consist of what ecosystem services the upstream is required to apply to the downstream. The compensation standard would then refer to the additional watershed services that the upstream provides to the downstream. Based on these standards, the responsibilities of up- and downstream governments could be defined.

The financial obligations could be set based on the definition of responsibilities. A policy framework could then be designed. Eco-compensation from higher levels or the central government could be based on the base standard, while eco-compensation between downstream and upstream governments could be based on the compensation standard.

### (3) Special funds for river basin eco-compensation

Apart from transfer payments, government-dominant river basin eco-compensation mechanisms also include two types of special funds. The first type is government river basin eco-compensation special funds, which are predominantly managed and used by higher levels of government for both upper and lower river basins, while other relevant stakeholders (e.g., upstream and downstream local governments, eco-compensation specialists, and rural households) participate in an eco-compensation committee, which would be responsible for negotiating compensation volumes and rates. The second type is special government funds, where downstream or higher levels of governments provide funds for specific projects, which would need to be managed and used following specific budgeting procedures. Use of such project funds should be governed by strict management codes to ensure that they can contribute to the improvement of watershed services.

## 5.5 Institutional arrangements for river basin eco-compensation

### (1) Mechanisms for verifying water quality at trans-boundary river sections

**Verification of water quality at trans-provincial river sections.** Monitoring sections would be set up by the Ministry of Environmental Protection, Ministry of Water Resources, and related provincial and municipal governments. The provincial governments should fulfill the water quality targets defined by the *11th Five-Year Plan for Total Water Pollutant Reduction Target Responsibility*. The agencies responsible for monitoring sections should be clarified. The Ministry of Environmental Protection would

make annual evaluations of water quality target achievements at monitoring sections. Provincial governments would be fully responsible for water quality, and would evaluate water quality quarterly. Monitoring results would be certified and issued by the Ministry of Environmental Protection. If the upstream province fails to meet water quality targets, it will compensate the downstream provinces based on management costs. If the upstream province meets its water quality goals, the central government will reward it.

**Verification of water quality at trans-municipal river sections within a province.** The provincial environmental protection administrative departments, together with the provincial water administration department and municipal governments, would delineate river sections. The water quality goal would be defined based on national, provincial, and municipal plans for preventing and controlling water pollution. Municipal governments would be responsible for meeting water quality targets. The provincial environmental protection agency would verify and issue the monitoring results monthly. If upstream municipalities fail to meet water quality targets, they would be required to compensate downstream municipalities. If water quality meets targets, the downstream municipality would compensate the upstream. The compensation rate would be decided based on the environmental protection costs.

### (2) Online pollution monitoring systems for river basin eco-compensation

The provincial environmental protection administrative department would be responsible for organizing sectional water quality monitoring. The provincial water resource department would be in charge of organizing sectional water quantity and flow direction monitoring. Automatic monitoring would be used in monitoring water quality, quantity, and flow direction. The provincial environmental protection department would verify monitoring results. In cases where no automatic monitoring facilities exist, provincial and municipal environmental monitoring agencies would conduct manual monitoring together.

### (3) Institutional Arrangements

According to the features of different scale river basins and watershed protection issues, and to the policy framework for eco-compensation implementation, the roles and responsibilities of all levels of governments in eco-compensation should be clearly defined. For example, government departments at the provincial levels should build platforms for eco-compensation within the province. The function of different government departments should be clarified and coordinated.

The key to effectively conducting river basin eco-compensation pilot work is good coordination between departments, especially between the administrative departments of environmental protection and water resources, as well as project and fund use coordination with development and reform, and financial, departments.

### (4) Arbitration systems

Arbitration systems for interregional river basin environmental protection should be established. Interregional water pollution disputes should be settled by the relevant governments, which are organized by upper level environmental protection administrative departments via consultation. If disputes cannot be resolved through negotiations, either side can go to river basin water pollution control institutions for solutions through consultations. When these cannot be settled via negotiation, the river basin water pollution control institutions of each party should report to the upper level government for judgment (trans-provincial administrative area water pollution disputes are reported to the State Council). Disputes regarding compensation liability and payments for water pollution are settled via negotiations between the relevant parties. If this fails, these parties can ask the related environmental protection administrative departments to arbitrate, or can ask for a legal judgment via relevant legal procedures.

Compensation liability and payments caused by trans-provincial water pollution should be settled according to the Water

Pollution Prevention and Control Law. Disputes regarding water quality monitoring, quantity, and flow direction data in provincial trans-municipal river basins should be taken up to the provincial environmental monitoring institution and hydrological resources survey institution for arbitration. If one government department fails to report and issue the monitoring data on time, or reports false or erroneous data, the officials responsible should be investigated.

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## Conference Paper 4: Intergovernmental Fiscal Relationships for Eco-Compensation in the People's Republic of China

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Eco-compensation is a social economic activity. Stakeholders include the government, enterprises, social groups, and individuals in the exchange process between people and ecosystems. Market-based eco-compensation mechanisms and government-dominant eco-compensation mechanisms occur in different social economic systems. In different eco-compensation mechanisms, the management methods of each stakeholder's economic relationships are different. Under market-based eco-compensation modes, each stakeholder's economic relationships in eco-compensation are mainly adjusted via price and other market tools. Under government dominant modes, each stakeholder's economic relationships are mainly adjusted through financial transfer payments, financial subsidies, and other government regulatory tools. Under the socialist market economic system, the People's Republic of China (PRC) chooses the government-dominant mode, in which intergovernmental fiscal relationships in eco-compensation have become the key to promote the PRC's eco-compensation system.

### 1 Economic Relationships in Eco-Compensation

There are two levels of economic relationships in the eco-compensation mechanism. One is the exchange relationship between people and ecological systems for profit maximization. The other is the harmonious development between man and nature on the basis of environmental social responsibility. The core of the compensation mechanism is to adjust stakeholders' profit maximization motivation by increasing each stakeholder's environmental responsibility and to realize the harmonious development between man and nature. Under

the government dominant mode, the adjustment of these economic relationships depends on government's overarching control. There are several economic relationships as follows.

#### *1.1 Intergovernmental economic relationships*

Intergovernmental economic relationships are generally fiscal relationships. Fiscal relationships for eco-compensation should be established on the basis of (i) the division of responsibility and financial power at all levels of governments, and (ii) the existing financial system. With this adjustment, each level of government can have the financial capacity to conduct eco-compensation. Financial transfers take place if responsibility does not match with financial power.

#### *1.2 Economic relationships within the government*

The PRC government is divided into five levels, with the eco-compensation responsibility for each level of government different from the other. The central government is responsible for international environmental obligations such as greenhouse gas emission reductions and prevention of desertification. The central government is also responsible for eco-compensation for large river basins, national nature reserves, and national ecological function zones. Regional (provincial) governments are responsible for environmental information disclosure, environmental pollution abatement, and provincial-level ecological function zones. Local governments (prefecture and county) are responsible for environmental rehabilitation and small watershed management.

Each level of government has its own responsibilities in ecological compensation.



Based on this, each level of government needs to build its internal government economic relationships and standardize the responsibility and financial power among departments of environment protection, development and reform, agriculture, water resources, and other related departments. For example, the development and reform departments upgrade outdated production capacity, allow greening market access, support circular economy development, compensate resource-depleted cities, and develop policies for new energy sources. Agricultural departments are responsible for green production, the Conversion of Cropland to Forests and Grassland Program, grassland protection, and environmental policies in new rural policy. Science and technology departments are responsible for technical innovation.

The apportionment of environmental social responsibility among government departments reflects internal divisions between government departments in performing eco-compensation. This type of division of tasks is ultimately reflected in the budget system of governments at their corresponding levels.

### **1.3 Economic relationships among government, enterprises, and individuals**

In a market economy, the economic relationships between government and enterprises are mainly in the form of taxes, charges, and subsidies. Financial instruments are applied in this relationship. Some of the financial instruments are to internalize externalities, such as pollutant discharge fees and eco-compensation fees, through which the economic relationships are adjusted and environmental goals are met. In government dominant eco-compensation, the economic relationships between government and enterprises are adjusted with financial instruments.

### **1.4 Economic relationships within an enterprise**

Enterprises have a social responsibility for the environment. Economic relationships within an enterprise must reflect the principle of using resources with a cost, and green production and green trade are encouraged. Under the government-dominant mode, enterprise

environmental social responsibility cannot be realized without government guidance. Green accounting, corporate social responsibility accounting, and environmental compensation accounting can be used to promote enterprises to fulfill their environmental social responsibilities. Green credit, green insurance, green trade, green products, and green exports could be introduced to promote enterprise investment into the environment.

From the above analysis, we can find that financial tools are very important under government dominant eco-compensation modes. However, among these relationships, intergovernment relationships not only define the responsibility and financial power of governments at all levels regarding eco-compensation, but also affect other economic relationships (like the relationship between government and enterprises, which is influenced by the amount of government financial resources). With the government dominant mode, the key economic relationships in eco-compensation are intergovernmental financial relationships. In some less developed regions, these intergovernmental financial relationships even take the place of eco-compensation (like the eco-compensation in the Three Rivers Source Area).

## **2 Transforming Eco-Compensation Factors into Financial Factors**

At present, the PRC's eco-compensation is often categorized on the basis of ecosystems, such as watershed eco-compensation, eco-compensation in ecological function zones, nature reserve eco-compensation, mineral resource eco-compensation, and forest resource eco-compensation. This classification is obviously difficult to apply for the financial arrangements of intergovernmental relationships. Each ecosystem is not mutually exclusive, and each ecosystem is not only interactive with others in providing ecosystem services but also overlaps regionally (such as forests in watershed, mineral resources in forests). Moreover, ecosystems produce not only ecosystem services but also economic outputs. To establish intergovernmental financial relationships for eco-compensation, we have

to transform eco-compensation factors into financial factors.

From a financial perspective, eco-compensation can be seen as the internalization of environmental externalities. Calculating eco-compensation rates, theoretically, is based on the value of ecological services. But the results can hardly be the base for eco-compensation (for example, according to the calculations from the relevant departments of Qinghai Province, the ecosystem services provided by the Three Rivers Source Area nature reserve have reached CNY11.6 trillion because of the big differences in estimated values from different methods of calculation. So, eco-compensation rates should be calculated based on direct and indirect costs and opportunity costs. In estimating cost, elements such as current fiscal policy in land area (especially for areas not suitable for human housing), ecological function zones, attitudes, population density, and climate could be considered. Other factors can be transformed into fiscal factors, such as regional level of development, farm and herdsman populations in ecological function zones, farmer net income, government-supported population, and government ecological construction capacity (such as monitoring). The above eco-compensation factors can feed into the fiscal design. In public financial frameworks, intergovernmental fiscal relationships of eco-compensation include the following layers.

### 3 Financial System: The Core of Fiscal Relationships for Ecological Compensation

The 17th Party Congress and the super-ministry reforms passed by the latest “two assemblies” have systematically reorganized the powers and responsibilities of ministries and local governments. With this change in department function, the fiscal system will correspondingly be adjusted, and ecological social responsibility will probably be brought into the scope of the obligations of governments and departments at all levels.

In market economies, government power at all levels is defined by public interest. All pure public goods of national scope and impact are the responsibility of the central government.

All quasi-public goods with provincial scope and impact are the responsibility of provincial governments. The essence of eco-compensation is to compensate for the external ecological effects. Government responsibility in eco-compensation can be defined according to the extent of these externalities.

Generally speaking, externalities take place on five scales: global, national, central government level, local government level, and private sector (enterprises and individuals). Thus, eco-compensation responsibility can be classified into three groups: (i) international eco-compensation mechanisms, whose compensation subjects are nations or international organizations; (ii) intergovernmental eco-compensation mechanisms; and (iii) enterprise or individual eco-compensation mechanisms.

#### 3.1 The government's ecological and social responsibility

In eco-compensation mechanisms, the government is not only the subject of eco-compensation but is also the designer of eco-compensation systems. This dual identity determines the following powers of government in ecological social responsibility.

- (1) **Ensure ecological balance.** Whether it is the central or local governments that have the responsibility to protect ecosystem, governments must apply funds to ensure ecological balance.
- (2) **Promote the harmonious development between man and nature.** Governments need to ensure the use of ecosystems in a way that maximizes their benefits to the public. In economically underdeveloped regions with healthy ecosystems, the government should protect these ecosystems to ensure functionality and regional sustainable development.

These two government responsibilities are the basis for eco-compensation. The responsibility of each government to keep a natural balance implies that each level of government must protect the environment. The responsibility of each level of government to ensure the harmonious development between man and nature implies that a specific level

of government has the right to decide how to use ecosystems. If governments choose ecosystems to provide ecological services rather than economic production, they should be compensated.

### **3.2 The eco-compensation responsibility of the government**

The above two responsibilities are inseparable. Eco-compensation responsibility is based on the two responsibilities of the governments. One typical case is that in watershed eco-compensation. Due to their first responsibility of ensuring ecological balance, upstream governments are responsible for providing basic ecological services for downstream governments (for example, class III water), while downstream governments do not have to pay eco-compensation funds for this. When downstream governments demand more ecological services from upstream governments (class II water), and when upstream governments transform parts of the ecosystem from economic functions areas into those that supply ecosystem services, downstream governments are obliged to provide necessary eco-compensation funds to these upstream governments as per their second responsibility of promoting harmonious development between man and nature. Thus, these two responsibilities allow us to define government responsibility in eco-compensation mechanisms as follows:

- (1) **Ensure local ecological balance, and hold corresponding rights and duties for the external ecological effects in local areas.** Governments have the rights to claim for eco-compensation if it is a positive externality, and have obligation to provide eco-compensation if it is a negative externality.
- (2) **Guarantee the government's multi-goal balanced development, ensuring the harmonious development between man, nature and society**

so as to realize the “five balances.”<sup>9</sup>

In this responsibility, governments are entitled to weigh ecosystems to insure harmonious economic and environmental development.

- (3) **Ensure the development orientation of local areas under the guidance of higher levels of government.** The development of a district is significantly restricted by upper-level governments. For example, the PRC has planned to conduct ecological function zoning for the whole country. Under this, governments that are located in ecological protection zones will not be able to ignore important ecosystems when they pursue socioeconomic development.
- (4) **Promote ecological protection and eco-compensation mechanism by strengthening the market-oriented process of ecological factors and ecological effects.** The market-type transaction of ecological resources must be conducted under government regulations. Otherwise, with profit maximization, all environmental resources might be quickly transformed into economic outputs. Hence, ecological resources must be managed under government guidance.

These four above-mentioned responsibilities are suitable for governments at various levels according to the extent of the environmental externalities they produce. For instance, under the first responsibility, the central government not only must compensate local governments, but also has the right to receive eco-compensation fees from local governments. At the same time, the central government has the duty to develop eco-compensation with the international community. In contrast, county-level governments only decide to receive or pay eco-compensation according to county-level externalities.

<sup>9</sup> The five balances are balanced development (i) between urban and rural areas; (ii) between different regions (such as eastern and western PRC); (iii) between economic and social development; (iv) between humans and nature; and (v) between domestic development and foreign affairs.

### 3.3 Implications of defining the government's responsibility on eco-compensation

In establishing eco-compensation mechanisms, it is important to define the responsibilities of governments at each level. Financial transfer payments are based on responsibility. Personnel and expenses related to eco-compensation will need to be developed and earmarked.

The match between responsibility and financial power is the basic principle of the fiscal system. Each level of government has its responsibility for eco-compensation, which has to be matched with corresponding fiscal authority. In general, the responsibility of each level of government is supported by its general budget revenue (mainly composed of government tax and non-tax revenue). When the general budget revenue is insufficient, transfer payments will be necessary.

Two government entities are involved in eco-compensation mechanisms. One receives eco-compensation funds while the other pays eco-compensation fees. There are four aspects involved in the arrangement of government eco-compensation funds.

- (1) **Earmarking eco-compensation funds at specific levels of government.** All levels of government have their own responsibilities for eco-compensation. An important consideration should be how financial resources for eco-compensation responsibilities can be obtained within government. Currently, item “211” has been set in the government's budgeting system. According to the principle of matching responsibility with fiscal authority, governments at relevant levels need to use revenues in this fiscal item from taxes to carry out their eco-compensation responsibilities.
- (2) **Government entities that have to pay eco-compensation fees.** If governments at the appropriate levels enjoy ecological benefits from other governments, then these governments have the social responsibility to pay eco-compensation to these other governments. Government funds can be used to pay compensation, which is a horizontal transfer payment.

- (3) **Governments that receive eco-compensation.** When governments at appropriate levels find it difficult to meet their responsibilities regarding eco-compensation, higher level governments will have to ensure—via a system of intergovernmental transfer payments—that these lower level governments fulfill these responsibilities. This arrangement is a vertical transfer payment system.
- (4) **Responsibility implementation after receiving eco-compensation.** Eco-compensation responsibilities need to be fulfilled on the ground through government earmarking of general funds and project budgets. Two complete systems need to be in place: a general budgetary system and a project budgetary system.

All these arrangements guarantee environmental social responsibility of all levels of government, and follow the principle of matching responsibility with fiscal authority. This is government eco-compensation. The core of this mechanism is the definition of responsibility. To promote ecological compensation mechanisms, the responsibility of each level of governments has to be defined in the government's reforms for “big ministries.”

## 4 Central Government Financial Transfer Payments to Local Governments

Transfer payment systems are the core of eco-compensation mechanisms, which attract much attention. Currently, the PRC's transfer payment system includes a general transfer payment system and a special transfer payment system. The general transfer payment system is a better choice for local governments since it can be used with greater autonomy.

Ecological criteria were not counted in the fiscal and taxation reforms in 1994. To accommodate the policy needs of eco-compensation, the Ministry of Finance earmarked transfer payments for the “Three Rivers Source” and other ecologically important regions in 2008. These transfer payments were increased by adjusting the coefficients used in the general transfer payment system. They will be used



for the Natural Forest Protection Program, the Qinghai Three River Source Area Rehabilitation, and the Yangtze River Middle Section of the South-North Water Diversion Project. This is to provide central government support to ecologically important counties. Provincial and municipal governments are also urged to increase their level of subsidies for ecological protection, and to improve their management and provision of public services.

The policy in 2008 was the first to reflect the needs of eco-compensation in general transfer payments, and it could be the basis for further action in this regard. In general, this policy is for offsetting the financial losses borne by local governments resulting from the ecological conservation investments. Although it counts ecological criteria, it is not a complete eco-compensation. To do this, it would be necessary to use all ecological criteria to adjust the fiscal coefficients. As such, we propose to incorporate the following components into the central government's general transfer payments to local governments.

#### 4.1 Altitude

Altitude is an important factor that not only affects the ecosystem but also the costs of social and economic development. The world average altitude of land is 830 meters, while the PRC's is 1.8 times this, at 1,495 meters. It increases the PRC's overall development costs to 1.25 times the world average cost. Counting altitude into the transfer payment criteria is a way to equalize public services.

#### 4.2 Land area

Territorial resources are the biggest ecological criteria. A province with a large territory that could provide ecological services will contribute more than others. The ecological function zone area of a province should be a criterion in the central government's transfer payment system. This would also help the local government to fulfill their environmental responsibilities.

Different ecological function zones provide different ecological services, even with the same land area. Thus, theoretically, the rate of transfer payment should be different in different regions. But this calculation could start with population density and distinguish human inhabited and

uninhabited areas. Human inhabited areas provide economic functions, while human uninhabited provide ecological functions. The fiscal coefficients for transfer payment could thus incorporate these criteria.

#### 4.3 Ecological function zones

The PRC is categorizing its territory into different ecological and economic zones. The territories that are designated as the ecological function zone will have restrictions on economic development. The government should thus provide transfer payments to these territories. Each zone could correspond to one coefficient, to be used for estimation of transfer payments.

#### 4.4 Modernization index

The modernization index not only reflects a region's level of economic development, but also its opportunity costs for ecological conservation. It reflects the difference between "ecological industry structure" and "economic industry structure". It could be an index of opportunity costs for ecological protection. The Chinese Academy of Sciences estimates the modernization index of every province in the PRC annually and this could be used to calculate a coefficient for transfer payment.

#### 4.5 Farm and husbandry populations in ecological functional zones

Farmers and herdsmen who are in ecological function zones face farming and grazing restrictions, forcing them to leave agriculture. They should be compensated. In the establishment of the PRC's rural social security system, these farmers and herdsmen should be included into this system first. They could have a higher social security benefits based on their contributions to ecological protection.

### 5 The Transfer Payment System of Provincial and Local Governments

Transfer payments from the central government to provincial and local governments aim to provide basic eco-compensation. However, the implementation of environmental responsibility lies with provincial and local governments. This is obvious, especially in watershed eco-compensation. There are certain differences in

economic development between upstream and downstream areas. Upstream areas provide watershed services, which is one of the reasons why upstream areas are often less developed. Thus, these upstream areas are entitled to ask for eco-compensation. But in eco-compensation negotiations between upstream and downstream areas, downstream governments often complain that they have already paid taxes to the central government. Thus, demands for eco-compensation by upstream areas should be met by the central government.

Our investigation shows that the general transfer payments provided by the central to local governments compensate for upstream government provision of basic watershed services such as Class III quality water. Transfer payments within a province deal with upstream watershed services that are in addition to this. For example, if a downstream government asks for the cleaner Class II water quality, then it should compensate the upstream government. In watershed eco-compensation, transfer payments are the main payment for eco-compensation. Transboundary water quality is monitored to assure water quality targets are met. The central government provides general transfer payments to upstream governments for the provision of these basic watershed services, while downstream governments give additional transfer payments to the upstream for higher levels of watershed service provision as based on downstream requirement for water quality, quantity and flow regulation.

The PRC's territory is vast, making the general transfer payment system to subprovincial levels take various forms. It could take into account similar eco-compensation criteria (e.g., water quality, water quantity, chemical oxygen demand, sulfur dioxide (SO<sub>2</sub>) emissions and other environmental pollution control indexes) in the calculation of the fiscal coefficient. This would be the main payment form for eco-compensation in this case.

## **6 Special Transfer Payment System: Guarantee of Government's Specific Ecological Responsibility**

In addition to general transfer payments, the government should also provide special

transfer payments to deal with urgent or large-scale ecological issues. The existing system of special transfer payments includes the Forest Ecosystem Compensation Fund and the Conversion of Cropland to Forests and Grassland Program. These payments are in the form of project funding, which is provisional and unsustainable. There is thus a need to integrate all special transfer payments related to eco-compensation and establish a sustainable fiscal relationship based on this.

### ***6.1 Strengthening ecological construction and ecological protection projects through standardized special transfer payments***

In addition to the existing Forest Ecosystem Compensation Fund, special transfer payments should also be given to projects concerned with economic forest development, nature reserve management, water resources protection, and watershed management. A system of special transfer payment for ecological conservation needs to be established.

With the acceleration of the construction of an ecological civilization, the PRC's government investment in the field of ecological construction will increase. Occasional special transfer payments are no longer suitable for dealing with all the ecological issues. It becomes necessary to establish a special transfer payment system for eco-compensation, in which all of the existing and forthcoming special transfer payment related to the ecological protection will be combined together to make it sustainable.

### ***6.2 Considering eco-compensation in other project budgeting***

In existing special transfer payments, eco-compensation is not considered except in ecological projects. In infrastructure projects, the following items need to be considered: (i) corporate and personal losses from land lost, including direct and indirect economic losses; (ii) government losses in the project site; and (iii) the ecological externality from project areas post-development.

This has great potential to strengthen eco-compensation through the existing special transfer payment system. For example, in current real estate development projects, urban green



space loses out over real estate development, and these losses need to be compensated. Environmental impact assessment currently does not take such losses into account. Combining all special transfer payments related to eco-compensation is another important way to improve eco-compensation capacity.

## 7 An Eco-Compensation Fund Proposal: The Horizontal Transfer Payments System

Ecological compensation also has horizontal dimensions between governments. In the existing fiscal system, horizontal transfer payments cannot be listed in vertical transfer payments, nor listed in the budget of specific levels of government. There are thus difficulties in conducting horizontal transfer payments within the present fiscal system. The pension funds of the Government of Norway, the Alaskan permanent funds, and other international experience could serve as models to establish an eco-compensation fund to solve the problem of horizontal transfer payments between governments.

### 7.1 What is an eco-compensation fund?

This would be a government fund for eco-compensation, which is established by the governments at various levels. The fund is from the government's budget, not from other sources.

### 7.2 Sources of the fund

Sources of a fund could be as follows:

- (i) Eco-compensation horizontal transfer payments from the governments of beneficiary regions;
- (ii) Financial inputs of governments that provide ecological services;
- (iii) Donations from government departments, institutions, individuals, and domestic and foreign donors;
- (iv) Income (such as the revenue from water treatment plant that gets clean water) from the provision of ecological services;
- (v) The investment margin and interest of the fund; and
- (vi) Other income sources.

### 7.3 Fund management

Eco-compensation funds would be supervised by an eco-compensation fund management committee organized by higher levels of government. It would be subject to inspection from all involved branches and levels of government involved. Its management framework could follow the Guideline of Fund Management for funds run by nongovernment organizations, which is issued by the Ministry of Civil Affairs and Ministry of Finance.

### 7.4 Fund application

Eco-compensation funds could be used for the following: (i) ecological protection, (ii) ecological monitoring, (iii) eco-compensation research, and (iv) other activities endorsed by the eco-compensation fund management committee.

### 7.5 Procedures for fund application

Eco-compensation funds should first be applied for by the user (mainly the governments in ecologically affected production areas), followed by the approval of individual projects by the eco-compensation fund management committee. The fund would be disbursed according to a project's progress.

## 8 The General Budgetary System: Fiscal Relationships for Eco-Compensation within a Specific Level of Government

The general budgetary system is used to define the responsibility and financial power of all departments and bureaus within a specific level of government. The following budgetary items should be taken into consideration in doing eco-compensation.

### 8.1 The fund for eco-compensation capacity building

Eco-compensation must be conducted under the guidance of government, so the following money should be provided in the budget of the government:

- (i) Costs and expenditures of personnel and agencies involved in eco-compensation, such as the eco-compensation fund

management committee, ecosystem managers and staff; and

- (ii) The necessary capacity building expenditures such as costs for ecological monitoring, information collection and management.

### **8.2 Expenditures for eco-compensation**

Eco-compensation fund from both vertical and horizontal transfer payments could be included in the government's budget before being distributed to ecological protection project sites. It is necessary to have a series of eco-compensation expenditure items in the government's budgetary system. These expenditures can then be used in ecological intervention projects for an ecological objective. The following expenditure items need to be included in the budget items:

- (i) Expenditures for changing local people's livelihood mode, such as providing subsidies to herdsman who are restricted from using grasslands. Farmers and herdsman should also be included in the rural social security system,
- (ii) Expenditures for improving ecosystem capacity, such as ecological rehabilitation projects, and enhancing nature reserves,
- (iii) Expenditures to compensate for the opportunity costs of protecting ecological functions, such as subsidies to residents living in drinking water source protection zones,
- (iv) Management costs such as support for enterprise participation in the clean development mechanism projects,
- (v) Expenditures to offset the losses of government workers in ecological function zones. A controversial issue that has arisen in the research of eco-compensation is whether eco-compensation funds can be used to pay civil servant salaries. We would argue that when change in classification of a region from being an economic to an ecological

function zone adversely impacts economic development and thus reduces the financial revenues of the region will also impact the salary of civil servants. Therefore, when ecological compensation funds are used to compensate farmers and herdsman in these areas, we should also give civil servants an "ecological compensation subsidy," so as to make up for their losses and acquire the support of other government agencies.

### **8.3 Expenditures for improving eco-compensation capacity**

The above-mentioned two types of expenditures are used in eco-compensation. These need government effort to increase fund efficiency. Along these lines, it will be necessary to include the following items in the government's budget:

- (i) **Expenditures on eco-compensation advocacy.** Eco-compensation needs social support, and so it is important to raise the public's awareness.
- (ii) **Expenditures on ecological compensation research.** Local ecological conditions and resources need to be investigated to implement any eco-compensation project. Much research is needed on ecological functions and valuation.
- (iii) **Expenditures for performance evaluation of ecological compensation.** A performance evaluation system is needed to guarantee that (a) ecological goals are met, and (b) fund use is efficient. A significant amount of information will be needed to conduct evaluations, and this costs money. This is especially important for horizontal transfer payments. Governments that receive eco-compensation should submit a performance report to the government that provides the eco-compensation to make the mechanism sustainable.

## Conference Paper 5: Estimation of Rates for River Basin Eco-compensation

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**Abstract:** Establishing eco-compensation systems for river basin environmental protection is the trend for the development of environmental management both in the People's Republic of China (PRC) and abroad. Formulating river basin eco-compensation rate estimation methods using a scientific basis is not only a popular research topic in the field of natural resources and the environment, but is also a difficult technical issue that needs to be resolved in environmental management. Based on three types of eco-compensation—upstream-to-downstream in trans-jurisdictional river basins, downstream-to-upstream in trans-jurisdictional river basins, and eco-compensation for water sources protection—this paper puts forward three types of eco-compensation rate estimation methods. Specifically, eco-compensation is based on targeting water quality and quantity, the cost of ecological protection and pollution control, and opportunity costs. The Dong River basin is chosen as the pilot program to carry out this eco-compensation rate estimation exercise so as to provide a reference for establishing local eco-compensation methods, and provide a reference for the PRC to establish a rational, scientific eco-compensation policy framework.

**Keywords:** River basin eco-compensation, compensation scheme, charge rate, Dong river basin

The concept of river basin eco-compensation is when (i) river basin water resources are enough; (ii) pollutant emission can be controlled within the total quantity control standard; or (iii) there is a positive externality, such as when cross-border water quality is up to standard, and the upstream area has abundant water quantity and environmental capacity that can be used

by the downstream area. In case (iii), if the upstream area foregoes significant development opportunities and increase significant additional ecological and environmental protection costs to provide high quality water for the downstream area, the downstream area should compensate for the additional water ecological services provided by the upstream areas. Conversely, when water quantity or water quality fails to meet standards, the upstream area causes the downstream area to incur more water treatment costs and other economic losses, which is a negative externality. In this case, the upstream should offer certain financial compensation to the downstream.

### 1 Typology of River Basin Eco-Compensation

According to the different features and outstanding problems of river basins in the PRC, river basin eco-compensation can be grouped into three types: (i) upstream-to-downstream eco-compensation in trans-jurisdictional river basins; (ii) downstream-to-upstream eco-compensation in trans-jurisdictional river basins; and (iii) eco-compensation regarding water source protection areas (Table 1).

Based on the different river basin features, the proper river-based eco-compensation rate estimation methods will be chosen.

### 2 Eco-Compensation Rate Estimation Methods for River Basins

#### 2.1 Rate estimation based on water quality and quantity

Eco-compensation rate estimation based on water quality and water quantity takes into account (i) river basin water quantity and water

**Table 1** Typology of River Basin Eco-Compensation

Type	Main problems	Relationship among stakeholders
Eco-compensation from an upstream area to the downstream in the trans-jurisdictional river basin	Serious problems of basin-wide water pollution and outstanding problems of trans-jurisdictional influence	The local government in each river basin should make their compensation responsibilities clear based on the environment objective of trans-jurisdictional water quality
Eco-compensation from a downstream area to the upstream in the trans-jurisdictional river basin	The river basin ecological protection and the influence on the development opportunity in the upstream areas	The local government in each river basin is responsible for river basin ecological protection
Eco-compensation to the water source protection area	Less socioeconomic development in water source areas and deficiency input in water source protection	The clear relationship between water source areas and water use areas

Source: The authors.

quality and its change, (ii) river basin integrated planning, (iii) limits on water resource utilization, (iv) water quality and quantity protection targets, and (v) the relationship between use and protection of water resources. Field surveys in the Ziya River basin in Hebei Province and the Liao River basin in Liaoning Province show that both Hebei and Liaoning provinces use water quality protection at trans-jurisdictional sections of rivers for their eco-compensation schemes.

Compliance evaluations of water quality protection targets at these trans-jurisdictional sections follow the “polluter pays principle.” The polluter, which is usually the upstream area, will compensate, while the downstream receives compensation. Upstream and downstream areas are represented by their respective governments. River basins have three types: trans-provincial, trans-municipal, and trans-county.

### 2.1.1 Selection of water quality indicators

In general, the permanganate index is selected as an indicator of surface water quality. Chemical oxygen demand (COD) is selected as an indicator for point source pollution monitoring (Liu and Yu 2009). The Ziya River and Liao River basins use COD as a water quality indicator in assessing trans-jurisdictional sections, for example. According to the Surface Water Environmental Quality Standard (GB3838-2002) of the PRC, water quality indicators

mainly include the permanganate index, COD, ammonia nitrogen, total phosphorus, and heavy metals. Based on the specific situation, different river basins can choose among these indicators for the basis of evaluations. They could choose a single indicator (usually COD), or multiple indicators.

### 2.1.2 Compensation basis

The PRC’s Surface Water Environmental Quality Standard stipulates that the target of achieving Class III water quality applies for centralized drinking water source areas (surface water sources, second protection zones), fish and shrimp over-winter areas, aquatic migration channels, aquaculture areas and some fishery watersheds, and swimming areas. Based on the economic situation of the PRC, it is thus reasonable to use measures of Class III water quality as the main reference for examining whether trans-jurisdictional water quality reaches targeted standards or not (Hu 2009). If the upstream supplies Class III water to the downstream, there is no compensation between upstream and downstream. If the water quality is better than Class III, downstream areas should compensate upstream areas. If the water quality is worse than Class III, upstream areas should compensate downstream areas (Zheng and Zhang 2006).

### 2.1.3 Rate estimation models

#### 2.1.3.1 Single indicator model

Liu and Yu (2007) estimate the trans-jurisdictional eco-compensation rate, and take COD as the indicator. Based on the cost data of 26 wastewater treatment plants, they calculate the costs to abate 10 milligrams of COD at different concentrations of COD (Table 2).

If river water quality is worse than the standard, compensation is calculated as the costs that are incurred by the downstream area to improve water quality by one class,

$$P = T / 10 \times C \times Q,$$

where P is the compensation amount when water quality is upgraded by one class. T is the reduced COD content when the water quality is upgraded by one class, C is the total cost or direct cost value, and Q is the volume of water flow downstream.

The costs calculated above are compensation from upstream to downstream areas. If the inflow of the upstream is worse than the water quality standard, it will be deducted from the costs. The costs of abating 10 mg of COD include depreciation, interest, and pipeline and maintenance costs. It is suggested that total costs are set as the upper limit of compensation. Direct costs include electricity fees, chemical expense, workers' salary, and other elements. The direct costs could be set as the lower limit of compensation. The actual compensation rate should be negotiated by the upstream and downstream areas (Liu et al.

2006). However, most upstream areas in the PRC are economically backward, and so we suggest using direct costs to set the rate of compensation.

#### 2.1.3.2 Multi-indicator model

Zheng and Zhang (2006) take downstream water diversion as the basis for compensation. They propose that compensation to the downstream should be

$$P = Q \times \sum (Li \times Ci \times Ni)$$

in which P is the total compensation, Li is the number of grades by which the level of pollutant i is reduced, Ci is the cost incurred when the level of pollutant i is reduced by one class, Ni is the multiple that the level of pollutant i is over standard, while Q is the downstream water diversion volume.

If water quality of upstream inflow is below the targeted standard, it will be deducted in the compensation of outflow estimation. Cost data comes from downstream enterprises and domestic wastewater treatment plants.

When the water quality is better than the targeted standard, the above two methods also apply and the compensation is from the downstream to the upstream areas. The multi-indicator model does not consider the difference of costs of different inflow pollutant concentrations, which is less accurate than the single model. But it is easier to obtain the data needed for the multi-indicator model. However, when there is only one indicator, the multi-indicator model can also be applied.

**Table 2 Costs of Abating 10 mg of COD with Different COD Concentration**  
(Unit: mg/m<sup>3</sup>, CNY)

Influent COD concentration	Total cost estimate	Direct cost estimate
50 (below class V water quality)	0.3429	0.1204
40 (class V water quality)	0.3694	0.1294
30 (class IV water quality)	0.3980	0.1391
20 (class III water quality)	0.4287	0.1495
10	0.4619	0.1606

COD = chemical oxygen demand, m<sup>3</sup> = cubic meter, mg = milligram.

Source: Liu et al. 2007.



## 2.2 Rate estimation based on costs of ecological protection and pollution control

Costs include those of upstream ecological protection, and downstream pollution treatment costs. They also include both direct and indirect costs. Direct costs take into account the direct inputs of labor, materials, and financial resources for afforestation, soil erosion prevention, and pollution control. Indirect costs are for the protection of water conservation and ecological function maintenance in river-basin upstream water conservation areas. Indirect costs include revenue losses associated with foregone development due to local government restrictions on particular types of industrial development, which include costs of closure, production halts, consolidation, or enterprise transfer. Indirect costs also include the resettlement costs for ecological conservation.

### 2.2.1 Compensation basis

First, the costs of ecological protection in the upstream are estimated. Secondly, water quantity and quality, and benefit coefficients are introduced. Thirdly, the downstream-to-upstream compensation is calculated. If the upstream pollutes the river, the compensation should be deducted from the costs incurred by the downstream for pollution treatment.

### 2.2.2 Estimation model

(1) **Upstream ecological protection costs.** These could be estimated based on fieldwork and financial data as follows:

$$C_t = D_{Ct} + I_{Ct},$$

where  $C_t$  is the total cost of ecological construction and protection,  $D_{Ct}$  is total direct costs and  $I_{Ct}$  is total indirect costs.

(2) **Calculation of the water quantity coefficient.** The upstream not only provides national economic and residential water use supplies for both the upstream and downstream, but also guarantees ecological water use in upstream and downstream areas. Thus, the water quantity coefficient is,

$$KV_t = W_{\text{Downstream}} / W_{\text{Total}},$$

where if  $0 < KV_t < 1$  the downstream should bear the upstream ecological construction and protection costs  $C_t \times KV_t$ , wherein water withdrawal includes agriculture water withdrawal, industry water withdrawal, domestic water withdrawal and ecological water withdrawal. These data can be obtained through downstream surveys. If the data are incomplete, water withdrawal of 272 cubic meters ( $m^3$ ) in 2006 for each CNY10,000 of gross domestic product (GDP) (using current prices), which is provided by the Water Resources Bulletin in 2006, could be used to calculate the water quantity coefficient.

(3) **Calculation of the water quality coefficient.** In water use, water quality is vital for consumption. The water quality coefficient is

$$KQ_t = 1 + P_t \times M_t / C_t \times KV_t,$$

where  $P_t \times M_t$  is the downstream-to-upstream subsidy, or the upstream-to-downstream compensation. The calculating method is the same as that in the previous paragraph.

(4) **Determination of the benefit coefficient.** To attract investment, the benefit coefficient must be greater than 1 ( $KE_t > 1$ ). The value of this is obtained by rule of thumb. Therefore, downstream compensation is,

$$CD_t = C_t \times KV_t \times KQ_t \times KE_t,$$

where  $CD_t$  is the downstream compensation,  $C_t$  is the ecological construction and protection costs,  $KV_t$  is the water quantity coefficient,  $KQ_t$  is the water quality coefficient, and  $KE_t$  is the benefit coefficient.

### 2.2.3 Case study

We take the Dong River basin, which runs across Guangdong and Jiangxi provinces, as an example. Rate estimation is based on the costs of ecological protection and pollution control.

#### 2.2.3.1 Calculation of the total costs $C_t$ of ecological protection and pollution abatement

In this case, the upstream area consists of three Jiangxi counties and the Heyuan County in Guangdong Province. The downstream area is set by the Guangdong Dong River



Basin Water Resources Distribution Scheme—issued by Water Resources Department of Guangdong Province in 2008—and so consists of Guangzhou, Shenzhen, Shaoguan (Xinfeng), Meizhou (Xingning), Huizhou, and Dongguan. The data in Xinfeng and Xingning is insufficient, so we use Shaoguan and Meizhou as units for calculation. The base year is 2008. The upstream costs Ct for ecological protection and pollution abatement are shown in Tables 3 and 4.

These two tables show that the ecological protection costs in three Jiangxi source counties in 2008 reached CNY226.41 million, and that the ecological protection costs in four Guangdong counties in 2008 totaled CNY524.90 million. Thus, total costs of ecological protection (Ct) amounted to CNY751.30 million.

### 2.2.3.2 Calculation of water quantity coefficient

Total upstream water withdrawal and total downstream water withdrawal data are needed to calculate the water quantity coefficient. Total upstream water withdrawal includes upstream water withdrawal, annual outflow from the upstream, and downstream water withdrawal. According to the 2006 *Water Resources Bulletin* data, water withdrawal can be calculated using the 2006 water withdrawal of 272 m<sup>3</sup> per CNY10,000 of GDP (using current prices). Tables 5 to 7 detail upstream and downstream water withdrawals.

Tables 5 to 7 show that total water withdrawals in upstream areas ( $W_{\text{Upstream}}$ )—which is the sum of withdrawals in the three Dong River counties of Jiangxi and the four Heyuan

**Table 3 Total Costs of Ecological Protection and Pollution Abatement in the Three Jiangxi Counties in 2008**  
(Unit: CNY10,000)

Item		Dingnan	Anyuan	Xunwu	Subtotal
Wastewater treatment plant	Construction cost	2,427.18	4,845.72	2,405	9,677.9
	Pipeline cost	2,429.36	2,455.9	2,938	7,823.26
	Operation cost/year	0	0	0	0
Solid waste landfill site	Investment	0	0	0	0
	Operation cost/year	0	0	0	0
Medical waste disposal center management cost/year		0	0	0	0
Monitoring capacity building investment		27.1	10.13	35	72.23
Environmental department capacity building cost		0	87.3	0	1,400
Ecological agricultural demonstration area investment		0	1,400	0	1,400
Forest investment		1,708	0	1,852	3,560
Grassland investment		0	0	20	20
Wetland protection		0	0	0	0
Total		6,591.64	8,799.05	7,250	22,640.69

Source: Authors' field survey.

**Table 4 Total Costs of Ecological Protection and Pollution Abatement in Heyuan, Guangdong Province in 2008**  
(Unit: CNY10,000)

Item		Dongyuan	Heping	Longchuan	Zijin	Subtotal
Wastewater treatment plant	Construction cost	0	0	0	4,000	4,000
	Pipeline cost	0	0	0	500	500
	Operation cost/year	0	0	0	0	0
Solid waste landfill site	Investment	370	550	16,200	600	17,720
	Operation cost/year	308	200	180	50	738
Medical waste disposal center management cost/year		45	0	0	0	45
Monitoring capacity building investment		169	47.719	76.65	10.5	303.869
Environmental department capacity building cost		387	12	57	5.79	461.79
Ecological agricultural demonstration area investment		14,800	0	7,100	3,200	25,100
Forest investment		0	900	500	2,221	3,621
Grassland investment		0	0	0	0	0
Wetland protection		0.12	0	0	0	0.12
<b>Total</b>		<b>16,079.12</b>	<b>1,709.719</b>	<b>24,113.65</b>	<b>10,587.29</b>	<b>52,489.779</b>

Source: Authors' field survey.

counties of Guangdong—is 809 million m<sup>3</sup>. Water withdrawals in downstream areas ( $W_{\text{Downstream}}$ ) is 59,947 million m<sup>3</sup>. The Dong River's average annual outflow in Jiangxi is 2.920 billion m<sup>3</sup>. Total water withdrawal is 63.676 billion m<sup>3</sup>. The water quantity coefficient is therefore  $KVt = W_{\text{Downstream}}/W_{\text{Total}} = 94.14\%$ .

### 2.2.3.3 Estimation of compensation amount

The compensation that the downstream Guangdong needs to pay for the upstream areas in 2008 is  $CDt = CtKVt = \text{CNY}707.28$  million (Table 8). The compensation amount in upstream areas should be divided by input ratios of the ecological protection cost. The three Jiangxi counties and four Heyuan counties in Guangdong Province account for 30% and 70% of ecological protection costs, respectively.

So the three Jiangxi counties should get CNY212.18 million, and the four Heyuan counties in Guangdong Province should get CNY 495.09 million.

## 2.3 Rate estimation based on development opportunity cost

### 2.3.1 Estimation model

Upstream areas have to close, limit, or refuse some pollutive enterprises, which impact economic development in these areas. The development opportunity cost for the upstream could be estimated with a comparison of per capita disposable income in counties and cities adjacent to these upstream areas. The formula is as follows:

**Table 5 Water Withdrawal of Three Jiangxi Counties in 2008**

Item	Dingnan	Anyuan	Xunwu	Total
Gross domestic product (CNY100 million)	23.263	23.74	24.27	71.273
Water withdrawal (10 <sup>4</sup> cubic meter)	6,327.536	6,457.28	6,601.44	19,386.256

Sources: Guangdong statistical network. [www.gdstats.gov.cn/](http://www.gdstats.gov.cn/); Shenzhen statistical bureau. [www.szjtj.com/main/](http://www.szjtj.com/main/)

**Table 6 Water Withdrawal of Four Heyuan Counties in Guangdong Province in 2008**

Item	Dongyuan	Heping	Longchuan	Zijin	Total
Gross domestic product (CNY100 million)	52.3	37.64	82.8	53.43	226.17
Water withdrawal (10 <sup>4</sup> cubic meter)	14,225.6	10,238.08	22,521.6	14,532.96	61,518.24

Sources: Guangdong statistical network. [www.gdstats.gov.cn/](http://www.gdstats.gov.cn/); Shenzhen statistical bureau. [www.szjtj.com/main/](http://www.szjtj.com/main/)

**Table 7 Water Withdrawal of the Downstream Areas in Guangdong in 2008**

Item	Guangzhou	Shenzhen	Shaoguan	Meizhou	Huizhou	Gongguan	Total
Gross domestic product (CNY100 million)	8,215.82	7,806.54	545.87	477.884	1,290.4	3,702.53	22,039.04
Water withdrawal (10 <sup>8</sup> cubic meter)	223.47	212.34	14.85	13.00	35.10	100.71	599.47

Sources: Guangdong statistical network. [www.gdstats.gov.cn/](http://www.gdstats.gov.cn/); Shenzhen statistical bureau. [www.szjtj.com/main/](http://www.szjtj.com/main/)

**Table 8 Compensation from Downstream Areas in Guangdong in 2008**

Item	Guangzhou	Shenzhen	Shaoguan	Meizhou	Huizhou	Dongguan	All
Water withdrawal amount (10 <sup>8</sup> cubic meter)	223.47	212.34	14.85	13.00	35.10	100.71	599.47
Water withdrawal ratio (%)	37.28	35.42	2.48	2.17	5.85	16.80	100
Compensation amount (CNY10,000)	26,367.33	25,051.80	1,754.05	1,534.79	4,137.58	11,882.27	70,727.82

Source: Authors' field survey and calculation.

Annual compensation amount = (the reference county's per capita disposable income of urban residents – per capita disposable income in upstream areas) × urban population in upstream

areas + (the reference county's per capita net income of rural residents – per capita net income in upstream areas) × rural population in upstream areas.

### 2.3.2 Case study

Take the Dong River basin as an example. Since the data of four counties in Heyuan is insufficient, Heyuan data is used to calculate the development opportunity costs of these four counties. The reference level is the national average. Opportunity costs can be seen in Tables 9 and 10.

Estimation shows that the upstream areas should get CNY0.42 million, from which

Jiangxi gets CNY0.22 million, and Heyuan gets CNY0.20 million.

## 3 The Applicability of the Three Estimation Methods

The three methods can be used to calculate the three kinds of river-based eco-compensation. The selection of estimation method should be based on the major issues of a specific river basin (Table 11).

**Table 9 Opportunity Costs of Three Counties of Jiangxi in 2008**  
(Unit: CNY10,000)

Item	Dingnan	Anyuan	Xunwu	Total
Urban residents' per capita income	0.926	0.6353	0.7807	1.3785
Urban residents' population	3.95	6.29	6.50	
Rural residents' per capita income	0.3122	0.25	0.24	0.4140
Rural population	16.26	30.20	26.93	

Note: Urban residential per capita income in Anyuan and total data is from 2007. Urban residential per capita income in Xunwu is the mean value of the same index between Dingnan and Anyuan.

Sources: Jiangxi statistical information network. [www.jxstj.gov.cn/tjsj/bsjdsj/default.htm](http://www.jxstj.gov.cn/tjsj/bsjdsj/default.htm); National Bureau of Statistics. [www.stats.gov.cn/tjsj/nds/](http://www.stats.gov.cn/tjsj/nds/)

**Table 10 Opportunity Costs of Heyuan, Guangdong in 2008**  
(Unit: CNY10,000)

Item	Dongyuan	Heping	Longchuan	Zijin	Heyuan	Total
Urban residents' per capita income			0.83		1.1343	1.3785
Urban residents' population	6.3413	7.06	16.02	16.92	83.02	
Rural residents' per capita income	0.5209	0.4273	0.4556	4403	0.4729	0.4140
Agricultural population	47.41	42.78	76.34	64.64	281.62	

Note: National data are for the year 2007.

Sources: China economic information network. [www.cei.gov.cn/](http://www.cei.gov.cn/); National Bureau of Statistics. [www.stats.gov.cn/tjsj/nds/](http://www.stats.gov.cn/tjsj/nds/); the statistical bulletin of Heyuan national economy and social development in 2008; the statistical bulletin of Guangdong national economy and social development in 2008.

**Table 11 Typology of Eco-Compensation and Their Rate Estimation Methods**

Type	Main issues	Preferred method
Upstream-to-downstream eco-compensation in trans-jurisdictional river basins	Serious problems of basin-wide water pollution and outstanding problems of trans-jurisdictional influence	Estimation based on water quality and water quantity protection goal
Downstream-to-upstream eco-compensation in trans-jurisdictional river basins	The river basin ecological protection and development opportunity costs in the upstream areas	Estimation based on ecological protection and pollution control costs
Eco-compensation to water source protection areas	Less socioeconomic development in water source areas and deficient input of water source protection	Estimation based on development opportunity costs

Source: The authors.

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## Conference Paper 6: Economic Impacts of Eco-Compensation: A Framework for Quantitative Simulation

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### 1 Eco-Compensation and Ecosystem Evaluation

#### 1.1 The definition of eco-compensation

According to the China Council for International Cooperation on Environment and Development (CCICED), eco-compensation is an institutional arrangement that aims to protect and use ecosystems in a sustainable way and regulate the stakeholders with economic instruments. Eco-compensation consists of (i) compensating the costs incurred in ecosystem protection or destruction, (ii) internalizing externalities with economic instruments, (iii) compensating opportunity costs for preserving ecosystem, and (iv) investing in the conservation of areas with significant environmental value.

#### 1.2 Eco-compensation in the People's Republic of China and abroad

The definition of eco-compensation in the People's Republic of China (PRC) is similar to the internationally used payments for ecological services (PES). There are two types of PES: government-led public payments, and market-oriented PES schemes. Government-led public payment systems are the main form of PES in terms of both value of payments and extent. Typical cases are America's Conservation Reserve Program and the compensation for forest services in Mexico.

However, market-oriented PES schemes have become increasingly popular internationally. *Silver Bullet or Fool's Gold* by Landell-Mills and Porras (2002) documents 287 PES cases of forest ecosystem service payments. The European Union has also been successfully leading the world in greenhouse gas emissions trading systems.

In contrast, eco-compensation in the PRC is still in its early stages. The development of

regulations and policies for eco-compensation has lagged. Many issues remain to be addressed, such as eco-compensation standards, methods, and funding sources. Eco-compensation system in the PRC is currently not yet systematized.

In the PRC, ecosystem services are owned by the state. It is also difficult to use market instruments in eco-compensation when property rights are not clearly defined. Government-dominant eco-compensation is thus the most feasible option in the PRC at present. The usual method is to appropriate government financing for conducting these programs.

At the same time, however, public payments for eco-compensation compete with other government budgetary items that are important for the economy. Funding sources for eco-compensation will also have important distributional impacts. Regions that are given compensation are generally in the PRC's less developed west. Thus, eco-compensation impacts on the economic development of these regions. It will be critical to investigate the national and regional economic impacts of eco-compensation in developing and selecting appropriate eco-compensation mechanisms for the PRC.

### 2 The Computable General Equilibrium Model and Its Application to Environmental Issues

#### 2.1 The framework for computable general equilibrium models

The computable general equilibrium (CGE) model is based on the Walrasian Equilibrium theory and aims to simulate the economy via mathematical modeling. Compared with "partial equilibrium," "general equilibrium" is where all sectors of an economic system



**Table 1 Basic Structure of the Computable General Equilibrium Model**

Item	Supply	Demand	Supply and demand relationship
Subject	Producer = industrial sectors	Consumer = households + enterprises + governments	Market
Behavior	Producer: profits maximization	Consumer: utility maximization	Price maintains market equilibrium
Equation	Production function Production factors supply Optimized equation	Consumer utility function Demand equation Optimized equation	<ul style="list-style-type: none"> <li>·Product market equilibrium</li> <li>·Factor market equilibrium</li> <li>·Domestic balance of payments</li> <li>·Government balanced budget</li> <li>·International balance of payment</li> </ul>
Variable	Production capacity and price, factors of production and prices, macroeconomic indicators, variable rates of technology, policy and other exogenous variables		

Source: The author.

obtain simultaneous equalization of supply and demand. The basis of the CGE model is general equilibrium theory, which takes into account the behavior of all economic actors, and links together the various economic activities of the economy, such as business, production, administration, the public sector, and individual households. It quantitatively analyzes the interaction of economic subjects' economic behavior. The CGE model takes the economic system as a whole, studies the complicated interactions and interdependencies of its various elements, investigates the process of change of economic variables—from price changes caused by unbalanced supply and demand relationships, to the equalization of supply and demand.

The CGE model combines input-output analysis, linear programming, econometrics, and other macroeconomic quantitative analysis methods. It can analyze direct or indirect influences on the whole economy, and so is widely applied as a policy modeling approach.

According to the general equilibrium theory, every actor in an economic system optimizes its economic behavior. For instance, consumers buy commodity portfolios—given an income constraint—to maximize their own utility. With constraints on the input of production factors, producers pursue profits maximization. The expense and supply of products and production factors can realize equilibrium by adjustments in relative prices in the market.

When an economic system in equilibrium is given a policy shock, each actor will adjust its choices based on the principle of optimization, and find a new equilibrium point for the economy via a change in relative prices.

## **2.2 Application of the CGE model in environmental protection**

The CGE model takes the whole economic system as an object, and it can describe the impacts of policies at every level. It can be flexibly expanded. Since late 1970s, the application range of CGE models has expanded gradually, from the energy sector to environmental protection. In environment protection, the primary scope of CGE models encompasses environmental impact assessment, subsidy policy impacts on the environment, and eco-compensation.

## **3 SIC-GE Model for Eco-Compensation**

The National Information Center and Australian Monash University developed a multidepartment dynamic CGE model—SIC-GE. With its detailed simulation and analysis function on economic system, an ecological module could be embedded in it via secondary development, which describes the impact of economic behavior on the ecosystem. It can simulate ecosystem changes and the influence of eco-compensation mechanisms on the economic system.

### ***3.1 SIC-GE model as an analysis tool in empirical research***

The CGE model can be applied in fields such as environmental protection and eco-compensation. In policy evaluation, two aspects are important in using these models: attention to detail and ample consideration of non-market elements. The CGE model originated from the Walras Equilibrium theory, which requires extensive economic data. For reliable results from the CGE model, sufficiently precise estimates of non-market elements are needed.

The SIC-GE model is very detailed in its analysis of production behavior, consumption behavior, international trade, and the tax regime. The present model uses the PRC's 2002 input-output tables, which include 137 sectors, 5 labor categories, various technical advancement parameters, consumption preference parameters, revenue parameters, and the non-market variables that influence production and consumption behavior. Given these careful considerations, the PRC's economy can be reasonably simulated. This, in turn, is helpful for simulating the various policies favorable for market and non-market orientations, so that effective support can be furnished during the government's decision-making process.

### ***3.2 CGE model application to environmental analysis***

There are many CGE models used in environment analysis, which can be grouped into two categories: (i) models simulating only the impacts of economic activities on the environment, but with no feedback; and (ii) models that simulate the interaction between the economy and the environment. First, a pollution emission coefficient was used to calculate total pollution emissions of economic activities (Blitzer et al. 1992; Lee and Roland-Holst 1993; Beghin et al. 1994). Next, pollution control costs were added into production costs (Jorgenson and Wilcoxon 1990), and then the impact of environmental quality on productivity was incorporated into production functions (Bergman 1993; Gruver and Zeager 1994). Finally, environmental quality was entered into utility functions for the analysis of the impacts of pollution emissions on consumers (Robinson 1990; Piggott et al. 1992; Bergman 1993).

In addition to these changes, some models make pollution management an explicit economic sector. Environmental protection becomes endogenous in the economic system. In this aspect, Xie Jian and Sidney Saltzman (2000) in Cornell University put forward the environmentally extended social accounting matrices (ESAM). They analyzed the effectiveness of the PRC's environmental pollution management and its influence on the economy. Nugent and Sarma (2002) at the University of California, Los Angeles also developed an environmental CGE model—called environmentally extended computable general equilibrium model (EECGE)—and analyzed India's environmental pollution.

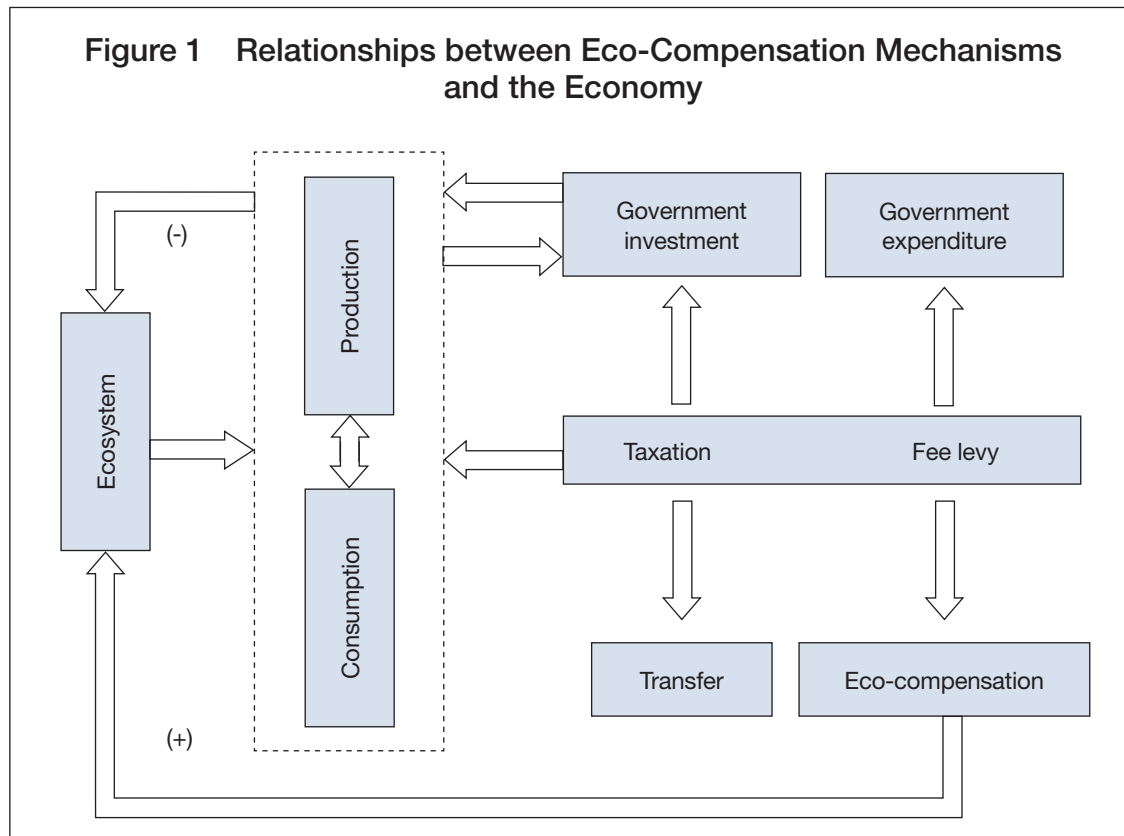
Famous environmental CGE models, such as the energy environmental extension of the GTAP (Global Trade Analysis Project) Model (GTAP-E), have considered various substitution relationships in energy production and direct substitution relationships between energy production and other production factors, calculating carbon dioxide emissions per unit of energy consumed, and simulating the international transactions of carbon dioxide emission reduction permits. Ecological systems always have regional attributes. Environmental impacts have economic and distributional dimensions. Professor Philip Adams of Monash University has developed the Australian multiregional CGE model—the Monash Multi-Regional Forecasting (MMRF)—which analyzes the impacts of climate change on Australia's various regions.

### ***3.3 SIC-GE model application in eco-compensation analysis***

SIC-GE model can be used to simulate the interaction between the economy and the environment in the context of eco-compensation. Since the fund source is largely from the government, much attention should be paid to its impacts.

#### ***3.3.1 The support effect of ecosystems in economic activities***

Ecosystems can provide various services for people, which include “product supply services,” “regulatory services,” “cultural services,” and “support services” (Li Wenhua



Source: The author.

et al. 2008). Economic systems use “product supply services” via some sectors to obtain raw materials to produce goods for consumption. For instance, the forestry sector obtains timber from forestland. Agriculture gets food from farmland. Animal husbandry uses grasslands to raise cattle and sheep. The mining sector obtains mineral resources directly from underground. Water, power, and transportation sectors harness rivers to produce electricity and for transport. If ecosystems degrade and “product supply services” are consequently reduced, these sectors will have to invest more manpower and capital to obtain the same quantity of products.

These are not all the types of ecosystem services. Other services include climate regulation, air purification, water conservation, and carbon sink services. These services have impacts on all sectors of economic systems, but are difficult to measure. These services are reduced with the degradation of ecosystems, which then impact people’s production and consumption activities, so that they have to pay

more to get the same amount of products and the same level of quality of life.

These direct impacts pass through the entire economic system. For example, exhausted coal resources will lead to increased coal production costs and thus increased prices, which will increase production costs in the whole economic system. It will also change the prices of coal-intensive products relative to those of other products. A substitution reaction will follow, which will ultimately change an economic system’s production structure. Price changes will also have other impacts, such as shifting the structure of consumer demand.

### 3.3.2 Impacts of economic activities on the ecosystem

This paper focuses on the degradation of ecological system resulting from production behavior, and related compensation issues. The impacts of economic activities on the ecosystem mainly exist in the sectors which use ecosystem “product supply services,” such as

forestry, animal husbandry, agriculture, water and hydropower, and navigation. Although only “product supply services” of the ecosystem are used in the production activities of these sectors, other ecosystem services are weakened as well.

### 3.3.3 Impacts of eco-compensation on ecosystems and the economy

There are two kinds of compensation to ecosystems. One is introducing human activities to restore ecosystem by investment, such as afforestation. The other is reducing human interference with ecosystems, such as the Conversion of Cropland to Forests and Grassland Program, and ecological migration programs. This paper does not distinguish between these two methods when discussing their economic impacts. Their ecological impacts are of concern. As ecosystems are restored, their service provision will increase. It is assumed that environmental investment leads to the increased capacity of ecosystems to support economic production and human consumption.

Eco-compensation needs significant funding. Irrespective of funds sources, eco-compensation will affect other areas of the economy. If funding comes from the national treasury, government expenditures to other sectors will inevitably be crowded out. If funding comes from local governments that benefit from ecosystem services, this transfers income from one place to another. If funding comes from taxes, it is then a transfer payment from society as a whole to a particular group of people. Thus, these different funding sources have different impacts on the economy. Good compensation mechanisms should not only have ecological benefits, but should also avoid adversely impacting other sectors, if possible. A win-win solution without problematic side-effects is preferred.

### 3.4 Ecosystem valuation from the scientific perspective

Evaluating the PRC’s ecosystems and eco-compensation mechanisms with the SIC-GE model depends on the results of natural

**Table 2 Ecosystem Services and Functions**

Item	Product supply services	Regulatory services	Cultural services	Support services
Forest ecosystem	timber, NTFP	Regulate climate, carbon fixation, conserve water sources, conserve soil and water, purify environment, maintain nutrient cycling, windbreak, and sand fixation	Cultural diversity, leisure entertainment	Maintenance function of species diversity
Grassland ecosystem	Animal husbandry	Carbon sink services, soil conservation services, climate regulation services, water conservation services, nutrient cycling services	Cultural diversity, leisure entertainment	Maintenance function of species diversity
Farmland ecosystem	Food supply	Maintain water quality and quantity, nutrient supply, biological management, global climate regulation	Cultural diversity, leisure entertainment	Ecology carrying, biology and genes maintain
Wetland ecosystem	Water supply, hydropower, inland shipping, aquatic product producing	Flood storage and regulation, river sediment transport, water resource accumulation, soil withholding, purify services, carbon fixation	Cultural diversity, leisure entertainment	Water circulation, biodiversity

NTFP = non-timber forest product.

Sources: Li Wenhua et al. 2008.

science research of the PRC's ecosystems. A collection of scientific research on the valuation of ecosystems exists, which serves as the foundation. Ecosystem can provide many services, and it is the value of these that are used to assess ecosystems. Li Wenhua et al. (2008) systematically analyzed the PRC's various ecosystem service functions, and did a quantitative study on various service function values, with the result presented in Table 2.

### 3.5 Extended study: Multiregional CGE model for the analysis of regional impacts

Income from other parts of the PRC is transferred to the western regions through eco-compensation funding, which supports economic development in the western PRC. This could be simulated with a CGE model.

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# International Experiences in Markets for Ecosystem Services and the Asian Development Bank's Perspectives

This section contains selected speeches and papers from the international experts that participated in the Conference. This includes a keynote speech by Director General Klaus Gerhaeusser of the Asian Development Bank's (ADB) East Asia Department, and papers from the following: Robert Crooks, ADB consultant, formerly of the World Bank; Eva Abal, Chief Scientist for the International Water Centre; Hasan Moinuddin and Xi Jiao of the Environmental Operations Center of ADB's Greater Mekong Subregion; Michael T. Bennett, Senior Researcher of Forest Trends; Sara Scherr, President of Ecoagriculture Partners; and Qingfeng Zhang, Frank Radstake, and Tun Lin of the ADB's Agriculture, Environment and Natural Resources Division, East Asia Department.

In general, these papers highlight the potential wealth of insights and knowledge that international experience in payments for ecological services (PES), market-based environmental policy instruments, and environmental, conservation and economic development policy in general can provide the People's Republic of China (PRC). The paper by Robert Crooks provides an introduction by detailing how the PRC's development process to date has already given policy makers an important range of lessons learned that can be applied to eco-compensation policy development, such as by helping to identify key issues to address and pitfalls to avoid. The

paper by Zhang and Radstake discusses ADB's perspective on PES, and how ADB has been promoting greater inclusion of PES mechanisms into current projects in the PRC, such as for the Sanjiang Plain Wetlands Protection Project, payment for watershed services in the Yudongxia watershed in Guiyang, and carbon sequestration PES in the Jiangxi Province Sustainable Forest Ecosystem Development project. The paper by Moinuddin and Xi looks at the development in PES in Southeast Asia. Examples of developing innovative PES programs in Viet Nam and Cambodia are discussed, and a detailed case analysis for the development of a conservation corridor PES in Xishuangbanna, PRC, is presented. The paper by Bennett and Scherr looks more generally at the role of government in ecosystem service markets. It concludes that far from being unique, the PRC's current government-led eco-compensation drive accords with international trends, wherein the public sector remains the key buyer and driver of these markets. The paper by Eva Abal provides a look at Southeast Queensland, Australia's evolving management framework for comprehensive management of the Moreton Bay watershed, including the specifics of how management strategies are developed, watershed ecosystem service values and cost scenarios are estimated, and how PES can serve as one of many policy instruments that can be used within this broader framework. Finally, Tun Lin's paper provides a policy maker's

guide to designing PES scheme, with focus on watershed. It highlighted six basic elements that need to be considered in a PES design, namely: (i) identification of the providers and beneficiaries, (ii) choices of compensation

methods, (iii) sources of compensation funds, (iv) agreement on the basis of compensation calculation, (v) management and supervision mechanisms, and (vi) monitoring and evaluation systems.

## Keynote Speech: Klaus Gerhaeusser, Director General, Asian Development Bank

### Opening Remarks at the International Conference on Payment for Ecological Services

Klaus Gerhaeusser

Director General, East Asia Department, Asian Development Bank

(6 September 2009, Ningxia Hui Autonomous Region, China)

Honorable Vice Chairman Du Ying,  
Vice Governor Zhao Xiaoping,  
Director Zhuang Guotai, Mayor Li Wenzhang,  
Distinguished guests, ladies and gentlemen:

It is a privilege for me to address this International Conference on Payments for Ecological Services. On behalf of the Asian Development Bank (ADB), I would like to congratulate the National Development and Reform Commission, the Ministry of Environmental Protection, and the Ningxia Hui Provincial Government for organizing this conference. We are pleased to be here and co-sponsor this event.

This conference is not only very timely, it also highlights the increased importance of payments for ecological services or PES schemes as a way of creating incentives for sustainable development, addressing livelihood issues for the rural poor, and providing sustainable financing for protected areas.

Today, we are here to discuss and learn from international experience as well as the experience in different provinces and sectors in the People's Republic of China (PRC) on the design and implementation of PES systems, and further strengthen PRC-ADB cooperation in their application.

Over the past 3 decades, rapid socioeconomic development of the PRC has lifted hundreds of millions of people out of poverty. Yet, this success has been achieved at a significant cost to the environment—rapid industrialization and urbanization have been accompanied by accelerated exploitation of natural resources and a massive increase in discharge of pollutants.

To address these environmental problems, the PRC has developed a fairly comprehensive policy and institutional framework for environmental and natural resource management. But the function, structure, and coverage of the framework are increasingly challenged by the widening scope of pollution and ecological deterioration, the growing scale of environmental issues, and the continuous transformation of the market-oriented economy.

One of the key reasons for environmental degradation is the absence of proper instruments and pricing mechanisms for the services that are provided by ecosystems—leading to unequal distribution of ecological and economic benefits between protectors and beneficiaries.

The government is strongly committed to resource-efficient and environmentally friendly development, as reflected in the 11th Five-Year Plan. The plan requires establishment of eco-compensation mechanisms based on the principles of “who exploits conserves” and “who benefits compensates.” The government has made extraordinary efforts in establishing some of the largest public payment schemes for ecosystem services in the world. To date, over CNY50 billion has been spent on the Sloping Land Conversion Program, and more than 7 million hectares of cropland have been enrolled.

Numerous local and regional interventions and experiences are also taking place throughout the PRC such as

- (1) Water rights trading schemes in Zhejiang Province;
- (2) Effective eco-compensation schemes in Fujian Province among Min, Jiulong and Jin rivers; and

- (3) A framework for integrated watershed management and payments being developed between Beijing, Tianjin, and local governments in the upper watershed of the Miyun Reservoir.

These samples suggest widespread interest and significant potential for eco-compensation schemes.

To date, PES has mainly focused on four areas: (i) watershed management, (ii) carbon sequestration, (iii) biodiversity conservation, and (iv) landscape improvement.

In the PRC, the traditional approach to providing environmental services has been through payments made directly by the government to those managing the natural system.

There is increasing interest in exploring market-based tools and regulatory innovations, as well as efforts to develop equitable standards and appropriate guidelines to better address the PRC's environmental challenges. ADB is assisting the government in addressing some of these issues. Allow me to give you a few examples.

PES schemes are being introduced in the forthcoming Guiyang Integrated Water Resources Management Project to encourage pollution reduction in the environmental protection zone of Yudongxia watershed of Guizhou Province. Direct payments will be made from water tariff collection in Wudang District in Guiyang City for compensating the upstream Longli County government for (i) restricted development and land use, and (ii) water quality improvements of the inflow to the reservoir.

The Jiangxi Sustainable Forest Ecosystem Development Project will explore possibilities for certification of carbon emission reduction through afforestation.

ADB's Sanjiang Plain wetlands protection, cofinanced with the Global Environment Facility (GEF), includes a payment scheme wherein local farmers benefit from converting farmlands to wetlands and conserving other biodiversity services.

The ongoing PRC-GEF Partnership on Combating Land Degradation in Dryland Ecosystems supports innovative studies to introduce PES as a mechanism to augment investments that are needed to strengthen

sustainable land management in the north western region.

Particular focus is given to valuation and cost-benefit analysis for land degradation control, the potential of carbon sequestration of drylands, development of public-private partnerships, and the implementation of pilot studies to demonstrate such mechanisms.

Through technical assistance, ADB is also supporting central government agencies in preparing the National Guidelines for a Market-based Watershed PES System. This includes support for (i) assessment methods of ecological value in typical river basins, (ii) standards for various types of ecological services, and (iii) necessary adjustments of the financial and tax system as well as the regulatory framework.

In the past 2 decades, the PRC and ADB have become true partners in development. Guided by its country partnership strategy, ADB's assistance has included lending, technical assistance, and policy advice in support of the government's development priorities. We are pleased to be a part of PRC's PES initiative, and to be able to contribute to promoting and improving conservation and the livelihoods of the rural poor, particularly in the western regions.

ADB's long-term strategy focuses its support on three distinct but complementary development agendas of the region: (i) inclusive economic growth, (ii) environmentally sustainable growth, and (iii) regional integration. Supporting PES schemes in the PRC will significantly contribute to all three of these strategic agendas.

Related to the PES program, ADB has targeted various initiatives, including:

- (1) The water financing partnership facility, which provides support for conserving watershed services, and promotes an integrated ecosystem management approach to conserving biodiversity;
- (2) The carbon market initiative, which provides upfront financing and technical support for projects with greenhouse gas mitigation benefits, including carbon sequestration service; and
- (3) The climate change adaptation program, which provides support for capacity building to conserving ecosystem

services for strengthening resilience to climate change.

I am looking forward to productive discussions on these and other issues over the next 2 days. I am sure that this conference will deepen our understanding and will provide important lessons.

Let me again express my sincere gratitude to the National Development and Reform Commission, the Ministry of Environmental Protection, and the Ningxia Hui Autonomous Region government for their great contributions in the preparations. Thank you very much.

## Conference Paper 1: Promoting Payments for Ecological Services Approach in the People's Republic of China

### Some Practical Issues that Will Need to be Addressed

Robert Crooks

#### 1 Introduction

Eco-compensation and payments for ecological services (PES) are two terms used in the discussion of environmental services in the People's Republic of China (PRC) that are often conflated. PES is a subset of eco-compensation. Eco-compensation is a broad and flexible term, even though it has been used in various high-level government documents. One definition is that eco-compensation "is a type of institutional arrangement to protect and (ensure) sustainable use of ecosystem services and to adjust the distribution of costs and benefits between different actors and stakeholders, mainly through economic measures" (China Council for International Cooperation on Environment and Development (CCICED 2006). Eco-compensation covers concepts as varied as the payment by mining companies to repair the damage that they do during the course of their operations, or payments made by an upstream province or county to a downstream province or county for excess water pollution flowing across provincial or county boundaries. Eco-compensation payments may be imposed or agreed to, the financial terms of the transaction may or may not be based on an objective assessment of the value of the service being maintained or protected, and there may not necessarily be any conditionality to the agreement.

PES is a somewhat narrower concept, although it too is rather vague and ill-defined. It has been described as a scheme that seeks to ascribe "a certain value to environmental services and establish appropriate pricing, institutional and redistribution systems that will lead to sustainable and socially optimal...use" of the land delivering those services (Mayrand and Paquin 2004). More specifically, PES has

been defined as: a voluntary transaction where a well-defined environmental service (ES) (or a land-use likely to secure that service) is being "bought" by at least one ES buyer from at least one ES provider on a conditional basis (i.e., that the transaction(s) continue only so long as the service continues to be provided) (Wunder 2005).

This paper addresses the specific topic of PES, not the broader topic of eco-compensation. The paper approaches the topic, not from the point of view of an expert in designing and implementing PES projects, but from the perspective of someone who has spent a considerable amount of time assisting in the design, appraisal, and/or supervision of rural development and natural resources management (NRM) projects in the PRC. The objective, by approaching the topic from this perspective, is to offer some suggestions on practical, operational issues that may need to be addressed to fully capitalize on the potential contribution that the PES concept may be able to make to the Government of the PRC's past and continuing efforts to deal with the interrelated problems of rural poverty, rural land degradation, and the general deterioration in the quality of all natural resources across the country.

First, the paper provides some perspectives, from a foreign counterpart's point of view, on the government's rural development and NRM investment programs, including aspects that are considered to be real strengths that have resulted in some notable and undeniable successes, but also factors that have prevented some government programs from even greater and more sustainable successes. The discussion is notably World Bank-oriented, reflecting the background and experience of the author, but it is believed that many of the World Bank's



experiences have been shared by other development partners.

Second, the paper briefly summarizes some conclusions drawn from a brief review of the PES literature as to the possibilities for long-term, sustainable PES projects in the PRC and key elements that need to be in place to increase the chances of project success.

Third, insights are provided on some operational issues that may need to be addressed to underwrite further expansion of the PES concept in the PRC.

Finally, it should be noted that this paper focuses entirely on activities that would be underwritten, mediated, or facilitated by agencies of the government. The topics of private sector and nongovernment organization (NGO)-driven PES projects are somewhat separate although not entirely unrelated issues which, if addressed at all, are done so only in passing.

## 2 Operational Perspectives on Rural Development and Natural Resources Management Projects in the PRC

As far as is known, there has never been a fully comprehensive, cross-cutting review of the success and effectiveness of foreign-assisted rural development and NRM projects in the PRC. However, taking the experience of one donor as a proxy for the experience of all of the PRC's development partners, it is probably not unreasonable to say that the country's performance in terms of both project outcomes and the sustainability of outcomes ranks in the highest levels of international performance, if not at the pinnacle.<sup>1</sup>

Nevertheless, it is equally true to say that, in the opinion of many Chinese and foreign analysts, the long-term sustainable development effectiveness of many of these programs is nowhere near as good as it could be, given the government's capabilities, or as it needs to be, given the magnitude of the rural development

and natural resources management confronting the country.

Looking first at the positive side, the PRC's relative success in implementing rural development and NRM projects stems from several factors:

1. **History and ownership.** The nomination of projects for inclusion in external assistance programs is very strongly driven by the PRC government and the investments and/or activities included in project designs usually, or at least often, fit into or are consistent with some larger scheme of domestic sectoral or thematic investments (e.g., regional rural development programs, national forestry programs, national water resources management programs, etc.). This has two implications: (i) project conceptualization and design usually began long before the project entered into the foreign assistance pipeline, meaning that the preparation process is a lot longer than the preparation process followed under the donor's procedures; and, (ii) because the activity tends not to be an "add on" driven by the donor's preferences and priorities, it is more likely to have the attention of senior political leaders and administrators during the implementation phase than might otherwise be the case (i.e., there is a high level of local "ownership").
2. **Administrative competence.** The government's administrative system works very well in comparison with those of other recipients of foreign assistance, notwithstanding the continual flow of analytical papers arguing that it needs to be significantly reformed.
3. **Cost recovery.** Project cost-sharing arrangements (in particular, the "who borrows pays" principle), including provisions requiring that direct beneficiaries accept some responsibility

<sup>1</sup> The World Bank's most recent comprehensive review (Findlay, Christopher. 2005. *China: Country Assistance Evaluation Agriculture Sector*. The World Bank Operations Evaluation Department. Washington, DC: World Bank) reported that 93% of all rural development projects over 1982–2002 were rated as satisfactory in terms of outcomes while 78% were rated as being sustainable. These ratings are very high by international standards.

for cost reimbursement, focus the attention of all participants on getting the project implemented and operating as quickly as possible. There are many who would argue that the “who borrows pays” principle may have contributed more to project success than any other single factor.

4. **Simplicity of design.** Projects tend to be conceptually simple, involving a relatively small number of components, even though they may be implemented in a large number of locations (townships, counties, and sometimes even provinces) at the same time. This is characteristic not only of foreign-assisted projects, but also of domestically funded projects, and more particularly, some of the huge, campaign-style investment programs implemented over the last 10 years such as the “Grain for Green,”<sup>2</sup> the Three North Shelterbelt program, and others.

Turning to the question of why rural development and NRM projects in the PRC, while successful in the narrow sense, have not been as successful as they could be, given the quality of local capacity or given the significance of the issues being faced, two broad groups of issues can be identified. The first group comprises the “flip side” of the four factors listed above. The second group comprises a series of other issues, most of which are factors external to the project but which impinge significantly on effectiveness.

## 2.1 “Flip-side” issues

1. **History and ownership.** The fact that many projects have a long development history before they enter into the foreign assistance pipeline is good, in terms of local ownership, but can

also be counterproductive in terms of development innovation in so far as too much ownership sometimes results in a considerable degree of reluctance by proponents to seriously consider development alternatives. As the project concept is developed, the proponent (e.g., a ministry, a provincial government, a municipal government, etc.) will decide on fundamental aspects of project design (such as the investment activities to be included in the project, the planned division of project funds between different investment components, the planned division of operational funds between different implementing units), all of which tend to raise expectations and make counterparts very reluctant to significantly alter their plans, even when it can be convincingly demonstrated that a different mix of components and activities might produce much better outcomes.

The challenge in this regard is not to destroy project ownership, but to provide more time during preparation to permit joint review of the problem being addressed, the options available for dealing with it, and how best to proceed.

2. **Administrative competence.** In terms of project success, there really is not much obverse issue relating to administrative competence, although administrative “rigidity” can at times be a constraint on the development of innovative project components, particularly those involving “beneficiary-driven” development and the participation of nongovernment actors (e.g., nongovernment organizations, community groups) in program delivery.<sup>3</sup>

<sup>2</sup> The “Grain for Green” or Sloping Land Conversion Program is the quintessential “one big idea” project; the central idea being to convert about 15 million hectares (ha) of fragile cropland to forests in 25 provinces and 2000 counties (J. Xu, T. Ran, Z. Xu, and M.T. Bennett. 2006. *China’s Sloping Land Conversion Program: Does expansion equal success?* Background Working Paper for S. Scherr, M.T. Bennett, M. Loughney, and K. Canby. 2006. Developing Future Ecosystem Services Payments in China: Lessons from International Experience. A report prepared for the China Council for International Cooperation on Environment and Development Taskforce on Eco-compensation, Forest Trends.)

<sup>3</sup> A shortcoming that applies equally to donor bureaucracies.

3. **Cost recovery.** There is little doubt that the “who borrows pays” principle has been a major contributing factor to the tendency for projects to focus inordinately on physical investments that produce financial returns in the short to medium term, at the expense of activities that produce intangible benefits (e.g., institutional development and/or change, training, etc.) or very long-term benefits (Findlay 2005). The effects of this show up in both the design of rural development and NRM projects in the PRC compared to regional comparators as well as post-hoc development effectiveness assessments. Regarding project design, a World Bank internal review of NRM projects implemented in the Southeast Asian region during the 1990s (Crooks et al. 1999) showed that projects in the PRC were much less likely to address underlying factors influencing the way natural resources were managed or decisions were made about their use, and much more likely to fund the symptoms or manifestations of the underlying problems (usually hardware investments and physical activities). Specifically, projects intended to address fundamental underlying NRM issues, entirely or at least partially, accounted for 36% of the value of all NRM projects in the Southeast Asian region (excluding the PRC) but only 17% of the value of projects in the PRC.<sup>4</sup> Perhaps this situation has changed in the intervening years, but perhaps not. In terms of project performance assessments, the effect is manifest in the relatively low number of World Bank-financed rural development projects in the PRC that were assessed as having had any substantial effect in terms of institutional development (56% during 1982–2002; a number that is completely out of line with the other measures of development effectiveness).<sup>5</sup>
4. **Simplicity of design.** The corollary of project design simplicity in the PRC is that the design process tends to be almost completely “top-down.” To the extent that there might occasionally be a bottom-up or “needs-based” component in a project, the “bottom” is typically represented by the officials of a county or township government, rather than an individual farmer, farmer’s group or other direct beneficiary. An excessively top-down approach tends to minimize the opportunities for and effectiveness of beneficiary participation and it may also perversely affect targeting effectiveness (e.g., an objective to reduce poverty through targeted investments might be negated by the use of targeting criteria that has been designed more to suit the problems of project administration than to actually solve problems “on the ground”).<sup>6</sup> Two survey studies highlight some of these issues:
  - (i) In 2004, the Chinese Center for Agricultural Policy (CCAP) undertook a pilot study of the way in which development decisions were made at the village level, as a prelude to a planned much larger study that was intended to provide a basis for promoting a more comprehensive approach to rural investment planning.<sup>7</sup> Surveys of development project beneficiaries and government officials were

<sup>4</sup> As with everything, there was a flip side—the PRC’s implementation performance ratings were the best in the region.

<sup>5</sup> Findlay, 2005. (Table 4.1).

<sup>6</sup> As to the positive benefits of participation, it is common to hear accounts of farmers’ opinions on forest types and species selection being ignored in the design of large-scale, government-sponsored afforestation programs. Surveys have shown that where there was adequate participation of farmers in planning, less deforestation has occurred (Shi, P., and J. Xu. 2000. *Deforestation in China*. Beijing: Chinese Academy of Sciences and Chinese Academy of Agricultural Sciences.

<sup>7</sup> Zhang, et al. 2005. The larger survey never took place due to lack of funding.

undertaken in 143 villages in 12 counties in Ningxia and Anhui.<sup>8</sup> The surveys were designed to identify how projects were conceived and designed and what factors could be associated with different levels of project success. Regarding the issue of targeting, the surveys suggested it seemed to be influenced by a range of factors other than the basic development and poverty alleviation objectives including: (a) per capita land area,<sup>9</sup> (b) connections in the township (i.e., whether the project participant or a relative worked for the township government), (c) distance to the township offices, and (d) the education attainment of the party secretary.

In terms of the level of participation, 55% of beneficiaries said that they were not consulted in the design of the investment projects in their villages. The village leaders, interviewed separately, actually concurred with this figure.

- (ii) An even larger survey of participants in the Sloping Land Conversion Program (SLCP), which is also a notably “top-down” campaign-style program, suggested somewhat similar outcomes (Xu et al. 2004). Among

other things, the survey results suggested that (a) participation levels in the survey communities were very low;<sup>10</sup> (b) considerable areas of land that ought not to have been included in the program (since it was of medium to high productivity and/or did not satisfy the slope criteria governing the program) were actually included; (c) for approximately 25% of surveyed households, the monetary and/or in-kind compensation for land taken out of production was insufficient to offset earnings reductions attributable to the project due mainly to the fact that the project compensation criteria were too rigid to fully take account of local variability in conditions (Xu et al. 2004); and, (d) there was evidence that some participants had not received the full level of compensation due to them for various reasons unrelated to the project or outside the capacity of the participant to control.<sup>11</sup>

That having been said, however, some analyses of other factors relating to the SLCP suggest that a number of targeting aspects of the program were effective,<sup>12</sup> providing a reminder that these issues can be very nuanced.

<sup>8</sup> Projects included both domestically funded and foreign co-financed projects initiated during 1995–2001.

<sup>9</sup> It could reasonably be expected that the size of a household's land entitlement, in general, would be inversely correlated with household income, and hence poverty. The positive correlation may be due to the desire of the project managers (e.g., village or township officials) to select participants most likely to be able to meet the financial obligations arising out of participation in the project.

<sup>10</sup> Among 243 survey participants in three provinces (Gansu, Shaanxi, Sichuan), an average of only 15% said that they were consulted before commencement of the project (ranging from 8% in Gansu to 24% in Shaanxi) and an average of only 36% said that they had any input into the selection (ranging from 22% in Sichuan to 46% in Shaanxi).

<sup>11</sup> For example, some survey respondents reported that parts of payments due were withheld by village officials to cover unpaid taxes (unpaid taxes should be recovered through the channels prescribed for doing so, not by making arbitrary interventions in programs not intended to solve a government's fiscal problems). It is possible also that lower level governments have withheld some payments to cover their own costs in administering the program; for the first 4 years (1998–2002), no funds were provided to cover the costs of local governments in administering the program. Thereafter, funds were provided but it is claimed that they are insufficient to cover actual costs and/or that they are “shaved” in the process of being handed down from the state government to the villages via provinces and counties (Xu et al. 2004).

<sup>12</sup> The selection criteria were designed to favor the inclusion of poorer villages with fewer environmental endowments and the analysis showed that, at least in the areas surveyed, it was successful in achieving this objective (Davis 2006).

## 2.2 Other issues

In addition to the four “flip-side” issues mentioned above, there are some other recurring issues that should be reflected upon:

1. **The financial situation of local governments.** Notwithstanding many years of reform, the PRC's fiscal system is beset by difficulties which, particularly as a result of reforms introduced during the mid to late 1990s, have resulted in substantial fiscal surpluses at the state level but, equally if not more, substantial fiscal deficits at the provincial, prefectural/ municipal, county and township levels.<sup>13</sup> These fiscal deficits are most extreme at the county and township levels, particularly in rural and/or poor areas (Shen and Zhou 2006; Park 2008). The net effect of this is that many counties and townships are chronically short of money to pay for such basic needs as staff salaries, to say nothing of meeting necessary development expenditures in their jurisdictions. The problem is exacerbated by the relatively high level of tied funding (on average for all lower levels, including provinces, about 22% of State transfers are in the form of tied grants) that counties and townships receive plus the fact that many of these tied grants are operationally unfunded or under-funded; that is, the state may dictate that a transfer must be used for a certain designated purpose but provide no funds for the county or township to actually manage the obligation imposed upon it.<sup>14</sup>

The practical consequence of this situation, at least as observed from the perspective underlying this paper, is that local governments, particularly counties and townships in rural and/or poor areas, are often prone to see the design and implementation of projects through a lens that is distorted by their fiscal problems. In simple terms, this means that they may often be inclined to

- (i) be very “hungry” for investment projects regardless of their ability to actually implement them;
- (ii) favor projects that provide the promise of quick and substantial financial returns over those that promise longer term and only quasi-financial returns;
- (iii) be tardy or completely remiss in meeting their counterpart funding obligations;
- (iv) be tempted at times to redirect project funds passing through their hands to meet other pressing local needs (e.g., paying overdue salaries); and
- (v) not always live up to cost and revenue sharing agreements agreed during project negotiations.<sup>15</sup>

2. **Cross-sectoral coordination and collaboration can be challenging.** As in most countries, coordination and collaboration between different line ministries in the PRC, or their counterparts at lower levels, can be difficult. At the lower levels, and due to the tight fiscal conditions applying in the lower tiers of government, it

<sup>13</sup> It should be noted that most tax authorities seems to be of the view that the reforms during the 1990s were necessary but they didn't go far enough or adequately deal with some of the foreseeable consequences, such as the resultant change in vertical deficit balance.

<sup>14</sup> This was reportedly a significant problem during the 1999–2002 trial period of the Grain for Green Program, when no funds were provided to cover administrative costs; a problem that was only partially alleviated by the provision of some, but still inadequate management funds after 2002 (Xu, et al. 2004).

<sup>15</sup> As an example, the author has personal knowledge of an economic tree crop development activity that was developed on the basis of a county, township, and/or beneficiary revenue-sharing arrangement with the shares proportional to the planned financial contributions of each of the parties. During implementation, neither the county nor township made their agreed contributions, the farmers invested more than twice what they had originally agreed to because they wanted to see the project successfully completed, but the revenue sharing agreement was never changed to reflect the changes in contributions.



can be a particular problem when questions of money are involved. This is an issue even for the Government of the PRC itself, which often finds it necessary to establish extra-bureaucratic mechanisms (e.g., a project leading group) to facilitate collaboration and expedite cooperation on priority programs.

3. **Local political commitment is an essential element for the success of most projects.** A recent review of successes and failures in the PRC's efforts to restore aquatic ecosystems concluded, among other things, that a key feature distinguishing successful restoration projects was "the commitment of political leaders who understand the seriousness of the problems and have the ability to encourage and, if necessary, require cooperation for cross-sectoral and cross-jurisdictional coordination" (Zhang et al. 2008). The importance of the political dimension, particularly the influence of leaders like Jiang Zemin and Zhu Rongji, in the planning and launching of the Grain for Green program is often commented on,<sup>16</sup> and anybody who has been involved in preparing and supervising projects in the PRC would understand the significance of this dimension of project development and implementation. Political support is particularly important in projects involving the participation of, or dependent on the cooperation of, different bureaus and/or spreading across different jurisdictions.

The practical implication is that, in the preparation of any proposed project, time and effort need to be put into the education and awareness of significant local political figures throughout the course of the preparation process. It is also important to understand the political and/or administrative dynamics

in the local government and the fact that both political and administrative leaders usually have a much greater sense of upwards allegiance than they do downwards to their "constituents."

4. **Contractual agreements are not always viewed as binding by governments, avenues for appeal are not always readily available, and there is often considerable asymmetry of understanding between the parties to contracts or agreements.** Over the last 25 years, the PRC has passed nearly 400 laws to lay the foundations of a modern legal system. There has been considerable development in commercial law to facilitate trade and protect investment and in administrative law. The constitution has also been amended to improve protection of human rights and private property rights (Pei 2005). People are increasingly making use of the legal system to protect their rights and some citizens have also begun to sue local governments for abuse of power. Nevertheless, and in the opinion of many legal commentators, the legal system needs much further improvement. In the context of this presentation, the major issue of concern is the independence of the judiciary—i.e., whether disputes over contracts and agreements that might be entered into with regard to activities such as PES projects and are adjudicated at the local government level are likely to get a fair hearing. Judges in county courts are appointed by local level officials and are dependent on local governments for funding. Since local courts are effectively part of the local bureaucracy, there is, at the very least, the appearance of partiality. There is also some question as to whether court judgments can be enforced if they are resisted by local authorities.

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<sup>16</sup> For example, among others, in Guo, 2009.



5. **It is very important to fully understand the policy framework within which a project is being developed and implemented.** This observation is true of any project in any country, but it is particularly true in the PRC where so much of what is observed regarding the state of the environment can be traced back to the perverse side effects of national policies intended to deal with other problems.

For example, it has been argued that one of the most important underlying reasons for the land degradation is that the PRC, given its state of economic development, is significantly under-urbanized which, in turn, is due to the diverse and intertwined effects of policies relating to food self-sufficiency, personal mobility (the hukou system), taxation policy (which, for many years favored urban areas at the expense of rural areas), and even past national development policies (“while the east gets rich, the center and west will wait”). National grain policy, particularly the food self-sufficiency objective, has also been singled out as an important driver of land degradation due to the effect it has had in pushing grain production into agro-ecological areas not well suited to it and/or encouraging excessive land reclamation (World Bank 2001). These problems were made more complex by a series of very significant changes in grain policy, which led to radical shifts in production patterns and further compounded by the fact that grain policy was directed at resolving too many issues, often leading to internal contradictions.<sup>17</sup>

6. **It is very important to understand what is motivating the behavior of**

**farmers.** This, in part, is a corollary of the preceding point.<sup>18</sup> There are always good reasons that farmers behave the way they do and if the objective of an investment is to generate a change in their behavior (e.g., to promote a switch to more environmentally sustainable land preparation practices), a change in cropping pattern (e.g., from cash crops to tree crops), or a change in animal husbandry techniques (e.g., from free range to tethered, etc.). In which case, it is first necessary to understand what is motivating their present behavior. A persistent feature of rural development projects in the PRC (and many other countries for that matter) is that the project design, more often than not, hinges solely on an expert-based problem analysis with little or no serious consultation with the farmers themselves (as noted previously).

### 3 Key Features of the PES Approach

This section is not meant to be a primer on PES, a subject being more than adequately handled by other presentations. The purpose is merely to touch on a few salient features of the PES concept to provide a basis for the discussion in the concluding section.

There is probably no better measure of both the attractiveness of the PES concept and the difficulty of converting the concept into a practical reality than the number and diversity of published articles and guidelines on the topic, to say nothing of the number of research centers and knowledge sharing groups that have been established to promote it.

For the purposes of this presentation, the main source of guidance in thinking about the key elements required to underwrite

<sup>17</sup> Findlay, 2005. p.10. “...grain policy...has usually aimed to meet a number of targets (including)...the security of the supply of grain...the security of levels of incomes for farmers...the resolution of fiscal burdens...(satisfying) consumer interests...the mix of grain output...the effect of changes in grain production on the output of other agricultural products, such as fruit and vegetables... (and) the efficiency of the grain marketing system... these goals are sometimes in conflict with each other...It is difficult to keep all these targets in balance...”

<sup>18</sup> That is, many behaviors of farmers are responses to policy-driven changes in their operational environment.

a PES approach in the PRC was a recent comprehensive report prepared on behalf of the China Council for International Cooperation on Environment and Development (CCICED) by a consortium of experts from the NGOs, the Forest Trends and Ecoagriculture Partners, and the College of Environmental Services at Beijing University (hereafter referred to as the CCICED report) (Scherr et al. 2006).

As a prelude, it is perhaps worth stating that the basic concept underlying PES programs (namely, that one party pays another party, in cash or kind, to deliver an environmental service), at least in the opinion of this writer, is not new. There are numerous examples of the basic PES concepts being applied in both the distant past and the present in the PRC and other countries. For example, historians have found examples in Medieval England of villagers being levied taxes for the specific purpose of maintaining commons areas;<sup>19</sup> the United Kingdom government pays money to certain English farmers to modify their practices so as to protect designated Sites of Scientific Interest (Spash and Simpson 1994); the United States government has a long history of offering payments in the form of tax benefits to farmers who do certain things that are perceived as improving the environmental services attributable to their land (e.g., creating conservation easements, applying certain soil conservation strategies in their farming operations, etc.); for over a decade, the Indian Forest Service has been making payments in the form of community development investments in (technically illegal) communities inside National Parks in return for the beneficiaries undertaking certain environmental protection activities to sustain the environmental services the parks provide;<sup>20</sup> and, lastly, the PRC itself has substantial experience through programs such as the Sloping Land Conversion Program (SLCP), which has been described as one of the largest PES schemes in the world.<sup>21</sup>

What is new is that the combination of certain external developments (most notably, the now widespread and growing buy-in by governments and the private sector to issues covered by and consequent to the United Nations Framework Convention on Climate Change), the theoretical work of analysts, and the applied experience of practitioners is leading to a significant elaboration of the ways in which the PES concept can be applied and the factors that need to be incorporated into designs to maximize the chances of success.

Although there remains a diversity of often-nuanced ideas about what actually constitutes a PES scheme, there seems to be a growing convergence around the idea that it has five main characteristics (Wunder 2005): It involves voluntary transactions where, a well-defined environmental service (or a land-use likely to secure that service), is being 'bought' by a buyer (or buyers), from one or more environmental service providers, subject to, conditionalities to ensure the continued provision of the environmental service.<sup>22</sup>

Four dominant groups of potential environmental service are most commonly referred to (carbon sequestration, biodiversity protection, watershed protection, and landscape maintenance or restoration) (Wunder 2005), all of which are considered in the CCICED report to have some potential in the PRC context.

Buyers could include (i) philanthropists (who may be motivated by non-use values); (ii) governments procuring environmental services on behalf of the public at large; (iii) private businesses and/or organizations acting on their own initiative and for their own reasons; (iv) private buyers acting in response to regulatory obligation (e.g., to offset some other adverse environmental effect); and (v) consumers of eco-certified products, who are motivated by both use and non-use values.

Payments may be made in a variety of ways including the direct or indirect exchange

<sup>19</sup> For example, there are records in early England of payments being exacted from villagers for the purposes of protecting village land (Langdon and Maesschaele 2006).

<sup>20</sup> Including "watch and ward" activities, establishing and maintaining fire-breaks, reporting on wildlife poachers, etc.

<sup>21</sup> Scherr et al. 2006. p.2.

<sup>22</sup> The CCICED report (Scherr et al. 2006. p.5) takes a slightly less stringent approach defining a PES arrangement as anything that involves the voluntary provision of an environmental service by a land steward in return for a payment or benefit, the continued receipt of which is contingent on the continued supply of the service.

of money (an indirect method of exchanging money would be the provision of subsidized credit), payment in kind, a reduction in financial obligations (e.g., a tax deduction), and the provision of access to an alternative or substitute resource.

#### 4 Some Challenges that May Need to be Addressed in Pushing the PES Concept Further

Based on a review of the available literature conducted as background reference to this report, and most significantly, of a very recent report that provides the most up-to-date inventory of PES and PES-like projects that have already been carried out in the PRC (Bennett 2009), it is clear that more than 100 “PES flowers” have already blossomed in the PRC, and many more can be expected to bloom in the future. Nevertheless, it seems that the vast majority of activities currently underway in the PRC could best be described as “PES-like” schemes with the following key characteristics:

- most of the running is being made by agencies of government (various ministries, provincial, and local governments) with local governments being particularly active and innovative, but mostly tending to modify and adapt ideas being pushed down from the top;
- at the lower levels of government, many PES-like arrangements are essentially inter-governmental agreements (e.g., between two counties);
- there is more activity in eastern regions rather than in the center and the west where the need may be most critical and the potential benefits greatest;
- most payments are made in the form of transfers of state funds to pay farmers for environmental stewardship of their land;
- private sector participation is fairly low at present but has potential for future development;

- programs, in general, tend to be top-down and project-centric (meaning that the payments are channeled through a project or program, and that the duration of the payments system is determined by the life of the project; no cases were found of open-ended payment systems, under which payments would continue indefinitely depending on continuation of delivery of the contracted service, or of payments being made directly to individual households or communities).<sup>23</sup>

Clearly, there is a lot of activity. But equally clearly, there are opportunities to increase the geographical spread of activities and to diversify the designs of projects to address a wider variety of situations and conditions. There may also be opportunities to improve efficiency through exchanges of information and experience.

Following are some notes on issues that, from a purely practical point of view, may need to be taken into account to promote continued growth and diversification of PES programs in the PRC:

1. **What needs to be done to promote greater use of open-ended, condition-based PES schemes?** One of the most interesting findings of the latest PES inventory for the PRC (Bennett 2009) is that, thus far, there have been no non-project centered, open-ended PES arrangements reached in the PRC. This suggests that the continued viability of the current arrangements will be heavily dependent on the continuation of the relevant government programs, and that the problem of the “one size fits all” approach may still prevail. Also, the possibilities for opening up new lines of financial resources (e.g., through private participation), which would free up government resources for other uses, are not being fully realized. To promote further development, it seems that several issues need to be worked on:

<sup>23</sup> Bennett 2009. pp. 69–71.

- (i) **Participation.** Notwithstanding the already high level of PES or PES-like activity in the PRC, one wonders what role an individual person (as opposed to a local government or bureau that may be acting in their place) is actually playing.<sup>24</sup> Voluntary participation of the actual providers of environmental services is mentioned as the essential design consideration in virtually all the literature on PES projects. The unspoken corollary is that it must be an informed voluntary participation, which means that there must be a process of information dissemination during project conceptualization and design. And finally, given that many of the concepts involved in a PES agreement may be completely alien to potential participants, consideration needs to be given as to how they can access independent and unbiased advice about the potential consequences of their participation and the reasonableness of the terms and conditions of any agreements being proposed. These characteristics may not be forming part of the development of PES or PES-like projects to date, but may have to be if the full potential of the concept is to be realized.

How can this issue be dealt with? In many countries, NGOs step in to fill these gaps and work with potential beneficiaries during the negotiation process. Several international environmental NGOs with relevant expertise are already working in the PRC, and there is also a number of domestic universities

and academic institutes which have written on PES and related topics, and could form the basis for developing local capacity. In addition, there are many local universities and institutes which, while perhaps having no direct experience with PES, have had a lot of experience in social research and surveys, thereby making them a useful resource for developing participation plans. Certainly, if PES is to spread and diversify beyond its current dependence on a project-centric approach, this would seem to be essential. It perhaps goes without saying, that a failure to consult affected people and ensure that they have an input into the final project design could actually exacerbate rural tensions which, at least in some places, are already high as a result of disputes arising out of land use and land tenure issues.

- (ii) **Land tenure and security.** Another key element essential to the success of a PES program, according to the literature, is that the sellers of the environmental service need to have confidence that they will have a continuing right to sell that service, which means, in effect, that they must have confidence in their long-term security of tenure.<sup>25</sup> In theory, the Village Land Contract Law provides de facto tenure rights for farmers. But, as is widely known, there are many cases each year of farmers having these rights expropriated, often with no notice or only very short notice, and often without sufficient compensation.

<sup>24</sup> As just one example, nearly every example of current watershed eco-compensation arrangements listed in Table 2.1 of Bennett (2009) involves intergovernmental agreements, but many of them would require individual land users to change or, in some cases, completely cease current activities. It is not stated whether the individual land users directly affected by these agreements were actually consulted about the proposals, whether the compensation arrangements were even agreed to by affected people or were adequate, and whether individuals affected have any avenues for appeal or review.

<sup>25</sup> Presumably this is not yet emerging as an issue because none of the PES or PES-like projects carried out in the PRC to date involve long-term, open-ended commitments (Bennett, M.T. 2009. *Markets for Ecosystem Services in China: An Exploration of China's "Eco-compensation" and Other Market-Based Environmental Policies*. Washington, DC: Forest Trends.).

It is difficult to imagine any farmer being prepared to make or adhere to long-term land use commitments without being provided with a high degree of confidence in the security of his tenure. As noted in the CCICED report, "...lack of stable tenure and enforcement... will not only hinder the ability of PES mechanisms to improve local livelihoods, but could actually worsen the situation by creating incentives for local and provincial government seizure of valuable ecosystem service flows. Similar to some experiences from other countries, these types of outcomes have, in fact, already occurred under the SLCP..." (Scherr et al. 2006). The long-term solution, of course, is the continued strengthening of the basic legal framework and of the judicial system's capacity to act as an independent and impartial arbiter of disputes. In the meantime, consideration needs to be given to ways of supporting and strengthening the hand of farmers and farmer groups during the negotiation process.

- (iii) **Security of contractual agreements and equal protection of the rights of all sides to an agreement.** As previously discussed, the PRC's legal system is in a continual state of improvement and refinement and there has been considerable development in commercial law to facilitate trade and protect investment, and in administrative law. There are continuing concerns about the partiality of lower level courts however, and the question arises whether steps will need to be

taken to strengthen the security of contractual agreements agreed to in PES projects.

Again, the long-term answer is continued strengthening of the legal system. But, in the interim, a first step might be to start drafting "model contracts" for use by individuals and organizations thinking of entering into a PES scheme arrangement.

- 2. **What can be done to promote information exchange on PES?** As mentioned, there already appears to be a lot of PES-like activities in the PRC, and virtually all of it is "home grown." There seems to be a degree of overlap between programs being driven by different line ministries, and there does not seem to be a lot of collaborative or cooperative work. Clearly, if the government wants to push the concept, it should promote the creation of some kind of actual or virtual central clearing house that can facilitate information exchanges, provide technical advice, tap into sources of international knowledge (e.g., various institutes of the Consultative Group on International Agricultural Research, such as the Center for International Forestry Research and the World Agroforestry Center, and raise awareness about the possibilities for projects that could produce marketable credits to be fed into international carbon markets. In a way, a lot of the initial work is being done spontaneously by various collaborative groups that have already started producing essential source documents on PES in the PRC.<sup>26</sup> With a modicum of regular funding from the government, this might represent a cost-effective way of meeting the information challenge.

<sup>26</sup> For example, Bennett (2009) was produced through a partnership comprising Forest Trends (an international NGO), the Katoomba Group (a partnership of international experts with a shared interest in promoting markets for environmental services), Beijing University's College of Environmental Science and Engineering (a research institute), the Policy Research Center for Environment and Economy of the Ministry of Environmental Protection (a government research institute), the National Capital Project (a partnership between Stanford University and two international environmental NGOs), and the Environment for Development Initiative (an international capacity-building program funded by the Swedish International Development Cooperation Agency). Scherr et al. (2006) was produced by Forest Trends (already mentioned), Eco-agriculture Partners (an international NGO) and Beijing University's College of Environmental Science and Engineering (already mentioned).



3. **Policy framework.** The PES concept is not going to solve the intertwined problems of land degradation and rural poverty any more than huge campaigns like the Grain for Green, Three North Shelterbelt, etc. All of these strategies are essentially attacking the manifestations or symptoms of much more fundamental, underlying problems, most of which are policy-driven. The ultimate answer to rural poverty is to create opportunities for the rural poor to change the opportunities available to them through (i) in the short term, improvement of their access to markets, improvement of their knowledge about markets, improvements in health and education, improvement in their access to new technologies; and, (ii) in the longer term, for a significant number of them to move off the land and out of primary production, thereby providing the opportunity for the much smaller number remaining on the land to increase their economies of scale, make much better use of the other factors of production available, and create for themselves a more sustainable and higher quality standard of living. It is always more difficult to treat the underlying causes of problems and easier to treat the symptoms. The enthusiasm for huge campaigns of rural environmental improvement and now for PES programs ought not to be permitted to divert attention from the fundamental need to keep reforming national policies that are exacerbating the problems being observed.

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## Conference Paper 2: Payments for Ecological Services: Future Prospects for the Asian Development Bank Operations in the People's Republic of China

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### 1 Introduction: Ecological Services and Payment

Natural ecosystems provide a wide range of ecological services,<sup>27</sup> including (i) provisioning services, such as food and water; (ii) regulating services, such as regulation of floods, drought, land degradation, and diseases; (iii) supporting services, such as soil formation and nutrient cycling; and (iv) cultural services, such as spiritual, religious, recreational, and other nonmaterial benefits (ADB 2009a). Collectively, the value of global ecological services has been estimated at \$33 trillion, higher than the gross national product of the entire world (Constanza 2005).

Internationally, a key driver to establish environmental sustainability is to provide the right incentives for conserving ecological services.<sup>28</sup> While the benefits of ecological services are public goods, the cost of ensuring their provision often falls on local communities and/or land owners. Establishing adequate compensation mechanisms will enable stakeholders to conserve ecological resources in a win-win situation. Eco-compensation, or internationally better known as payments for ecological services (PES), aim at providing these financial incentives.

#### Need for PES in the People's Republic of China.

As a large and densely populated country, the People's Republic of China (PRC) faces major challenges to properly conserve and manage its ecological services. To some extent, the economic growth in the eastern PRC has been achieved at the expense of natural resources in the less developed regions. The forest, mineral, and hydropower resources in the western PRC have been excessively developed leading to problems such as biodiversity loss, soil erosion and deforestation that reinforce natural disasters and poverty. Industrial and urban expansion has deprived many farmers, particularly the poor, of the most productive arable land as their basic means of living.

Many different conservation measures are being tried in different parts of the country. In addition to the use of the Polluter Pays Principle approach to control pollution, the Government of the PRC has also made massive direct investments and incentive payments to promote soil and water conservation. Both the broader use of Ecological Compensation Mechanism approach and the targeted Green for Grain program are being used to provide incentives for improved land use (World Bank 2007).

The Asian Development Bank (ADB) recognizes that being a financial organization

<sup>27</sup> Also known as ecosystem services or environmental services.

<sup>28</sup> *The Millennium Ecosystem Assessment* (2005) stated that nearly two-thirds of the world's ecological services are under threat.

and development bank, it can play an important role in supporting developing member countries to mainstreaming PES into its development activities. PES mechanism supports ADB's strategic priorities in its long-term strategic framework 2008–2020 (Strategy 2020) (ADB 2008a), which aims to promote inclusive economic growth, environmental sustainability, and regional integration.

## 2 Status of the PRC's PES Program: Progress and Gaps

Despite the environmental challenges it faces, the PRC has already been driving some of the largest public PES schemes in the world. Over CNY130 billion has been spent since 1999 on the Conversion of Cropland to Forests and Grassland Program—which pays farmers to retire and afforest or plant grasses on sloping or marginal cropland—with over 9 million hectares (ha) of cropland enrolled.<sup>29</sup> More than CNY13.34 billion has been spent since 2001 on the Forest Ecosystem Compensation Fund, a program that pays households, communities, and local governments to protect key forest areas, and which currently covers 44.53 million ha of forest across 30 provinces in the country (State Forestry Administration [SFA] 2008; SFA 2007; *Economic Daily* 2007).<sup>30</sup> The number and variety of payments for watershed services (PWS) schemes in the PRC have escalated in recent years, from eight in 1999 to more than 47 in 2008, with an estimated transacted value of roughly \$7.8 billion, impacting some 290 million ha (Stanton et al. 2010).

While various initiatives are being developed within provinces (particularly in richer provinces) to create frameworks for cross-district programs, the central government has an important role to play in developing the legal and regulatory frameworks necessary to allow and encourage cross-provincial coordination and cooperation. Without strong and persistent support from the central government, a huge gap in conserving the ecological services in the poor province

and headwater of river basin in the PRC exists because of two important reasons: (i) the close poverty–environment linkage, and (ii) many poor and rural regions are unable to finance ecological services mandated by national plans.

## 3 PES and the Asian Development Bank's Strategy 2020

Capturing economic benefits from ecological services can directly contribute to poverty reduction. A recent ADB study (Steele et al. 2007) shows that ecological services support the livelihoods and health of poor people who often depend on natural systems for their welfare.

The first country environmental analysis prepared by ADB for the PRC also indicates that the poorer an area is, the higher the dependency of its inhabitants on the environment and natural resources. The poorest people also tend to live in areas where the environmental regeneration capacity is lowest and the environmental degradation is most severe. The officially designated national poverty counties can be found in six poverty zones: (i) desertified poverty zone in the south-eastern fringes of the Inner Mongolia Plateau, (ii) water and soil erosion poverty zone in the gully areas of the Loess Plateau, (iii) ecological degradation zone in Qinling-Daba Mountains, (iv) environmental crisis poverty zone in the Guizhou karst plateau and hills, (v) canyon-locked poverty zone in the Hengduan Mountains, and (vi) desert-mountainous zone in the west.

Experts agree that poverty can create and accelerate the emergence of many environmental problems. At the same time, environmental problems can broaden and deepen the impacts of poverty (Department for International Development of the United Kingdom 2004). Livelihoods of most people in the rural areas rely heavily on the environment and so the rural poor become more vulnerable when the environment degrades. The economic growth in the eastern PRC has been achieved, to some extent, at the expense of the natural

<sup>29</sup> This program is also known in the international literature as the Sloping Land Conversion Program or Grain for Green.

<sup>30</sup> Provincial-level Forest Ecosystem Compensation Fund programs cover an additional 76.7 million ha, and in 2006 contributed CNY 1.2 billion in complementary subsidies.

resources in the less developed regions. The forest, mineral, and hydropower resources in the western PRC have been excessively developed leading to such problems as biodiversity loss, soil erosion and deforestation that reinforce natural disasters and poverty. Industrial and urban expansion has deprived many farmers, particularly the poor, of the most productive arable land as their basic means of living.

Under the current PRC system, the local government has full responsibility to manage its pollution and conserve its natural resources. Compared to the rich area, the poor regions have fewer resources and choices to cope with environmental degradation and to pay for ecological services that may benefit the downstream richer.

**The Asian Development Bank's role.** In 2008, ADB launched Strategy 2020. The strategy comprises three key strategic areas: (i) inclusive economic growth, (ii) environmental sustainability, and (iii) regional integration. Strengthening ecological conservation and improving ecological services complements all three strategic agendas for ADB's Strategy 2020. Similarly, in line with Strategy 2020, one of the strategic priorities in the country partnership strategy (2008–2010) of ADB's operations in the PRC (ADB 2008b), is promoting environmental improvement by reversing natural resource degradation.

#### 4 Types of Ecological Services, Examples of the Asian Development Bank's Programs, and Potential

Although the establishment of full PES mechanisms has different definitions and gradations, the key elements that are considered include:

- (i) Who are requesting for improved ecological systems? In other words, who would be the buyers of the ecological service?
- (ii) Who can contribute to establish the required improved ecosystems? In other words, who are the potential sellers of these ecological services?
- (iii) How should the PES mechanism practically work? There is a need to

define in detail, for example, the type of activity, performance measures, and payment amount and mode.

- (iv) How is the PES mechanism established? What legal, financial, and institutional arrangements need to be in place to guide the ideally voluntary process of providing the agreed ecological services?

The link between ecological service providers and service users or beneficiaries varies from very direct and immediate (e.g., local watershed and drinking or irrigation water supply) to very distant (e.g., carbon sequestration and biodiversity conservation). It is easier to set up a PES system when the "distance" is small, and harder to do so when the "distance" is large.

ADB has been proactive in promoting PES as part of its lending and nonlending support. Recent examples of PES elements are integrated into loan projects including the Guiyang Integrated Water Resources Management Sector Project (watershed services), the Sanjiang Plain Wetland Protection (biodiversity conservation), and the Jiangxi Sustainable Forest Ecosystem Development Project (carbon sequestration).

Additionally, ADB provided technical assistance to promote and establish mechanisms that will enable national and local governments in PRC to strengthen the protection of ecological services. Recent examples are the PRC–Global Environment Facility (GEF) Partnership to Combat Land Degradation in Dryland Ecosystems (GEF-supported) and the preparation of national eco-compensation guideline in the key river basins. Outside of the PRC, ADB's experiences are described in the Asian Development Bank Institute 2009 publication, *Lessons from PES in Asia (Indonesia, Philippines, India, PRC and Viet Nam)*, PES Practices in Greater Mekong Region, and the recent regional technical assistance on Payment for Ecosystem Carbon Sequestration and Sink Services.

All of the above experiences suggest that the following type of PES models are promising for the PRC and ADB future operations: (i) watershed services; (ii) biodiversity, wetland and landscape restoration; (iii) carbon sequestration; and (iv) emission trading.

### Box 1 Institutional Side of Watershed Services Payments Has Yet To Be Developed

Although there is much interest in payments for watershed services (often seen as a potentially financing answer to improved environmental conservation in poorer area), by 2008, the sewage treatment investment was still concentrated in wealthy cities along the lower reaches of major rivers, while wastewater management was underinvested in poorer cities along the middle and upper reaches of rivers. This finding suggests that, in many of the key river basins, the link between watershed management and downstream water supply quality has yet to be established, and the institutional side of the watershed services payments is not well developed.

The midterm review of the 11th Five-Year Plan concludes that the sewage treatment ratio varies widely among different regions particularly between the east (rich) and west (poor) regions, and between urban and rural areas. According to the national 11th Five-Year Plan for environmental protection, the sewage treatment rate for all cities should reach 70% by 2010 (the mandatory target is 80% for provincial capital cities, 60% for prefecture-level cities, and 60% for county-level cities).

However, by 2007, the urban sewage treatment rate stayed at above 70% for Beijing, Shandong, Shanghai, and Tianjin, whereas less than 20% for Guangxi. Guizhou, Hunan, Jiangxi, Jilin, and Qinghai provinces had urban sewage treatment rate at below 30%. It suggests that the poorer provinces, even though situated at the headwater of river basins, have lower urban sewage treatment rates. This finding suggests that water quality in the cross-provincial river basins may not have really been improved even though huge money has been invested in the downstream wealthier cities.

Source: ADB. 2010. *The final report of technical assistance: market-based instruments for water pollution control* (TA 4967-PRC). Consultants's report. Manila.

#### 4.1 Watershed services

**Background.** This type of scheme is straightforward since it is relatively easy to identify the users or beneficiaries of watershed services: municipal water suppliers, hydroelectric facilities, industrial users, and irrigation systems. They have a defined and direct interest in maintaining water flow and quality. Also, the linkages between land management practices and outcomes are clear.

**Examples.** Though not well documented, numerous local and regional experiences on payments for watershed services appear to be taking place throughout the PRC, with varying degrees of success. Some better-known examples include (i) a water rights trading scheme between Yiwu and Dongyang cities in Zhejiang Province; (ii) an effective eco-compensation scheme established among Min, Jiulong, and Jin rivers in Fujian Province, taking some shape and

achieving a significant result; and (iii) the evolving framework of integrated watershed management and payments being developed between Beijing, Tianjin, and local governments in the upper watershed of the Miyun reservoir.

Main activities under an ADB technical assistance focus on drafting national guidelines for PES in watersheds (ADB 2007a), which will include (i) identification of rights and responsibilities among the stakeholders involved; (ii) recommendation of “best practices” and standards for various types of ecological compensation; (iii) implementation arrangements and procedures; and (iv) establishment of a management, monitoring, and evaluation system. Moreover, recommendations will be formulated for necessary adjustments in financial and tax systems as well as regulatory frameworks.

As part of the ADB-financed Guiyang Integrated Water Resources Management Sector



Project (ADB 2009b), payments for watershed services are introduced to encourage pollution reduction in the environmental protection zone of water supply reservoir subprojects, particularly for Yudongxia Watershed. Buyers of improved water quality are the water users in Wudang district of Guiyang Municipality. The sellers of improved water quality (or reduced pollution and restricted development) are the upstream townships and communities. A PES agreement between Guiyang Municipal Government and Longli county will be ensured. The payments are to be included in the water tariff in Wudang district. Assessment of the performance will be through water quality monitoring in Yudongxia watershed.

The introduction of a PES mechanism in the Yudongxia watershed will require close attention to (i) balancing the demand side—their affordability and willingness-to-pay—and the supply side—costs of maintaining a certain level of water quality and opportunity costs (such as forgone development benefits), (ii) ensuring financial sustainability by minimizing the government's subsidies, and (iii) introducing a result-based compensation.

**Potential.** Experiences in watershed services payment in the PRC indicate that (i) schemes need to be scaled up with fair mechanisms and monitoring systems; (ii) the whole society, particularly the private sector, needs to be gradually involved; and (iii) property rights should be better defined, markets enabled, legal and institutional systems supported, and environmental services appraised.

## 4.2 Emission trading

**Background.** Emission trading is a market-based approach used to control pollution by providing economic incentives for achieving reductions in the emissions of pollutants (Stavins 2001).

The PRC, which aims to cut emissions of major pollutants by 10% during 2006–2010, initiated a pilot sulfur dioxide (SO<sub>2</sub>) emissions trading trial program in 2002. The program allows companies in the provinces of Henan, Jiangsu, Shandong, and Shanxi, as well as the cities of Liuzhou, Shanghai, and Tianjin,

to exchange emission credits with the China Huaneng Group, the country's largest power producer.

Jiangsu's provincial government announced in November 2009 that a full buy-and-sell water pollution emissions trading system would come into effect at the beginning of 2010. Some 266 enterprises that discharge pollutants into Tai Lake, which is notorious for serious pollution problems, must buy permits from other firms if they exceed their emission quotas. Initial pollution permit prices are set at CNY10.5 (\$1.58) per kilogram of chemical oxygen demand (COD), a measurement of water pollution, for chemical firms; CNY5.2 (\$0.78) for printing and dyeing mills; and CNY1.8 (\$0.27) for paper mills.<sup>31</sup>

**Examples.** ADB has recently supported the Ministry of Environmental Protection (MEP) to implement a technical assistance to design market-based water pollution control instruments. This technical assistance aims to design a system to trade the emissions between point sources and between point and non-point sources, and the Tai Lake basin was used as a case study. This study will help promote institutional and legal reforms that are needed for developing emission trading system in the PRC.

**Potential.** A recent conference (Stanton et al. 2010) indicated that the significant boost to payment for watershed services at both the provincial and national levels could come from the water pollution emissions trading program. Activities on the ground, including the establishment of a pollution permit trading platform, suggest that such a system may soon debut in various locations across the PRC.

## 4.3 Biodiversity, wetland and landscape restoration

**Background.** Communities on the border of nature reserves can benefit from PES through compensation for the negative welfare effects that the creation of some reserves has had on their sources of livelihood. At the same time, PES can also reduce encroachment and improve the monitoring and protection of biodiversity.

<sup>31</sup> \$1 = CNY6.66261 average currency equivalents for the month of November 2010.



**Examples.** To promote biodiversity conservation in the Sanjiang Plain Wetlands, ADB provides support to the Heilongjiang Provincial Government to restore farmlands back to wetland under an innovative financial framework. Land compensation and village development plans using compensation funds made available by the government enables to provide for (i) alternative livelihoods for farmers, and (ii) ultimately lower the government's financial burden by turning sunk costs of land compensation into profitable investment opportunities.

The sellers of improved biodiversity in wetland areas (i.e., conversion from farmland to wetland, and related conservation activities) are the farmers and communities in Sanjiang Plains. The improved wetland biodiversity services are purchased by the GEF and local governments. Measuring performance is based on the project performance monitoring system, as agreed between the GEF, ADB, and local governments.

**Potential.** Significant potential also exists to improve and build upon current schemes for land degradation prevention including water and soil erosion prevention. The PRC-GEF Partnership on Land Degradation in Dryland Ecosystems was initiated in 2002 as a long-term cooperation agreement between the PRC, GEF, ADB, and other development partners to promote the introduction of an integrated ecosystem management approach to combating land degradation in the PRC. It contributes to the PRC's New Countryside Program (2006–2010) and plays a key role in the efforts to improve the western PRC dryland ecosystems and alleviate poverty in the PRC's western regions, home to approximately 75% of the PRC's rural poor. It will strengthen the legal and institutional systems for conserving ecological services and introduce total economic value approach to pricing natural resources.

#### 4.4 Carbon sequestration

**Background.** Carbon sequestration has become widely known through the Kyoto Protocol. The idea is that growing vegetation absorbs carbon dioxide, so that countries that have

large areas of forest (or other vegetation) can deduct a certain amount from their emissions, thus making it easier to achieve the desired emission levels. Some countries want to be able to trade in emission rights in carbon emission markets, to make it possible for one country to buy the benefit of carbon dioxide sinks in another country. It is said that such a market mechanism will help find cost-effective ways to reduce greenhouse emissions.

According to the 2005 Global Forest Resources Assessment, the PRC had a forest area of 197.3 million ha, carrying a stocking volume of 13.26 billion m<sup>3</sup>. Compared to its status in 1990, PRC's forest area gained by over 40 million ha and stocking volume by 2.77 billion m<sup>3</sup> in 2005. Given one cubic meter of stocking volume is equivalent to 1.05 tons of biomass—above- and below-ground as well as deadwood—and a biomass-to-carbon conversion factor of 0.5, this volume increment amounts to a woody biomass of 2.91 billion tons and a carbon stock of 1.45 billion tons (Food and Agriculture Organization of the United Nations 2005). As a whole, PRC's forests stored about 7 billion tons of carbon in 2005. While an ambitious goal, it is very likely that PRC will be able to add another 40 million ha of forests over the 15 year period (2006–2020). The potential of carbon sequestration will be astonishing.

**Examples.** In 2003, ADB approved a technical assistance on Carbon Sequestration through the Clean Development Mechanism in Indonesia (ADB 2003). The experiences learned from this technical assistance implementation will be transferred to other countries including the PRC for the design of new carbon sequestration PES activities. The provincial government of Jiangxi Province requested ADB for support to demonstrate financially sustainable forest carbon sequestration and climate change mitigation through an ecosystem-based forest development and management approach.<sup>32</sup> In Jiangxi Province, reducing emissions from deforestation is not the predominant option as the forest cover is annually increasing. Enhancement of carbon stocks (REDD+)

<sup>32</sup> The theoretical background for the approach is given by the internationally acknowledged concept of Reducing Emissions from Deforestation and Degradation (REDD). REDD principles were discussed during the United Nations Climate Change Conference in Bali and adopted as part of the Bali Action Plan (UN-REDD Program 2008).

however, is a good way of intervention fostering good agricultural practices to minimize carbon loss and optimizing carbon increment by mixed sustainable forest stands.

The sellers of an ecological carbon sequestration service (i.e., tree planting and forest conservation) are the local communities and the Jiangxi forestry administration. Buyers of the sequestered carbon will still need to be determined, but are likely to be channeled through voluntary carbon markets that are being developed internationally and in the PRC. The performance will be sequestered carbon probably to be traded as voluntary emission reductions. ADB will support the establishment of the baseline, methodology, purchase agreement between the sellers and buyers, and monitoring arrangements.

**Potential.** Carbon sequestration, in particular, is likely to play an increasingly important role in post-2012 global climate change efforts. Reducing Emissions from Deforestation and Degradation (REDD) systems have the potential to become an effective tool for climate change mitigation if their design and implementation maximize benefits to poor communities dependent upon forest resources for their livelihoods. The challenge is to establish mechanisms that will enable the many potential sellers—including governments, private companies holding forest concessions, and community forestry groups—to complete REDD applications and validation processes. Portions of the Sloping Land Conversion Program (SLCP) and the Forest Ecosystem Compensation Fund (FECF) area could be considered for entry into carbon sequestration PES. Significant potential also exists for domestic carbon trading schemes for PRC to meet its climate change objectives.

## 5 Lessons from Mainstreaming PES into ADB Operations

### *5.1 Right financing arrangements with local counterparts is essential to success*

The most important lesson learned from ADB operations is that current loan repayment and cost sharing approach is far from enough to enable effective ecological conservation.

Due to the existence of the “who borrows, who repays” principle, regardless of the project nature, there was a common phenomena on the part of the local governments for the use of international financial institutions loans on income-generating projects. Recent reviews (ADB 2008c) on reviving Tai Lake which were partially financed through the World Bank, and Baiyangdian and Sanjiang Plain wetlands which were co-financed through ADB, have identified the effective financing engineering as a key factor to the successful restoration of lakes and wetlands. Some of these water conservation programs in the past have failed due to the inability of county governments to raise adequate counterpart funds, or have been distorted due to the need to focus on activities that create short- and medium-term revenues. The major ecological services related to ecosystem rehabilitation, river courses dredging, agricultural non-point source pollution control were always under-invested because their vital values are not well recognized.

For the Tai Lake restoration program during the 10th Five-Year Plan Period (2001–2005), the most significant under-expenditures were for activities that have no revenue-earning potential—ecosystem rehabilitation, dredging, agricultural non-point source pollution control, and water resources protection. These activities have no revenue-earning potential for repaying loans and other financial obligations incurred from implementing the planned activities. This highlights the recurring problem of placing too much financial obligation on lower levels (particularly the county level) of government, which under the Chinese fiscal system have little revenue generating potential, making it difficult, if not impossible, for them to finance investments in local government infrastructure.

For the Baiyangdian lake ecosystem restoration, a comprehensive plan prepared calls for 27 new wastewater treatment plants in the watershed to treat all urban sewage in Baoding City and about 60% in the 22 counties by 2010. The plan also calls for a comprehensive range of other actions, including rehabilitation of the Baiyangdian Lake Wetland Reserve, reduction in the number of

people without access to safe drinking water, and reversing the environmental degradation of Baiyangdian Lake and its watershed. Despite the comprehensive range of activities proposed, some gaps remain—most notable is the lack of any plan to deal with the problem of “in-lake” pollution, such as the domestic wastewater emissions from about 100,000 people whose houses are located in the lake or right on the waterfront. It is noted that the Anxin county, where the in-lake population belongs to, is a poorer one and doesn't have ability to raise adequate counterpart funds and repay the loans from ADB and other development banks.

### ***5.2 Payments offered to sellers for ecological services must be competitive***

As illustrated by Pagiola and Platais (2002), the key to success for PES is that payments offered to sellers for ecological services must exceed the additional benefits they would receive from alternatives (e.g., alternative land use). However, with the overwhelming importance of the food security in the PRC, this can be difficult.

In some areas under the Sanjiang Plain Wetlands Protection Project, which is being financed by ADB and GEF, farmers receive CNY5 per mu to protect the wetland area, but can get CNY320 per mu in agricultural revenue, of which CNY130 per mu comes from direct agricultural subsidies.<sup>33</sup> This situation made the PES mechanism irrelevant, and it is therefore possible in some cases, that adjusting policies in other sectors might be more effective in achieving targeted environmental outcomes than directly targeted eco-compensation programs.

Allocation of fiscal funds among departments or sectors is sometimes driven by some particular urgent issues or emergency. As the priority for state financial expenditure changes, environmental expenditure would become unsustainable or even dissipated without achieving the expected environmental effects. For instance, the financial investment for the SLCP was adversely affected after

the fiscal priority of the central government changed to focusing on rural fiscal reform.<sup>34</sup>

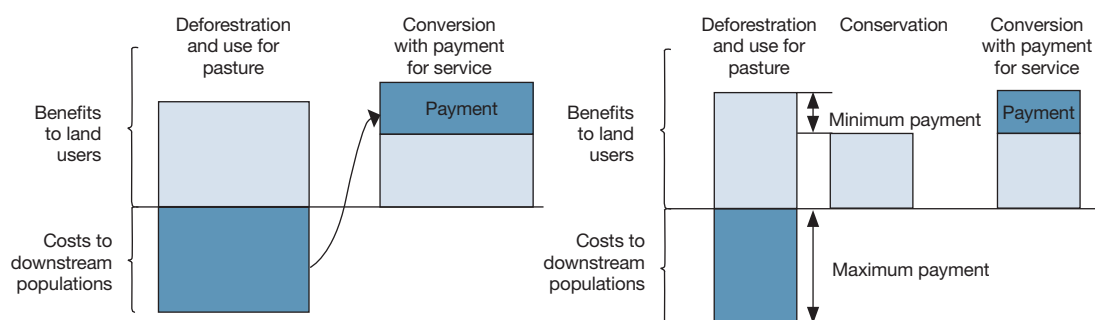
### ***5.3 Stronger institutional coordination and monitoring capacity must accompany PES program***

Multiple agencies share the responsibility of environmental protection and natural resource management in the PRC. While MEP is the focal agency for pollution control and ecological protection, the Ministry of Water Resources, Ministry of Land and Resources, Ministry of Housing and Rural-Urban Development, Ministry of Agriculture, State Forestry Administration, and State Oceanic Administration are each responsible for the management of their particular resource sector. Moreover, the National Development and Reform Commission (NDRC) plays a lead role in resource pricing and in formulating the national socioeconomic development plan that covers natural resources and environment. The involvement of the State Administration of Taxation and Ministry of Finance is also required for matters related to pollution levies and financing of environmental infrastructure projects. In fact, the formulation and implementation of policies that have possibly the greatest impact on environmental protection and natural resource management, such as those related to structural change, resource pricing, and pollution levies, are beyond the mandate of MEP or any other single ministry. Under such an arrangement, strong cross-sectoral coordination is necessary. This coordination was originally facilitated through the Environmental Protection Committee of the State Council but it was abolished in 1998. The lack of an effective cross-sectoral coordination mechanism will be a major factor contributing to the difficulty of achieving the full potential of PES program.

By 2005, on average the PRC's 3,064 environmental enforcement agencies possessed only 1.4 vehicles and 27 items of evidence-collecting equipment each. These agencies monitor and supervise 230,000 industrial

<sup>33</sup> A mu is a unit of measurement in the PRC (1 mu = 1/15 hectare).

<sup>34</sup> Ma Zhong, China's Fiscal Expenditure for Environmental Protection, September 2010.

**Figure 1 The Logic of Payments for Ecological Services**

Source: Pagiola and G. Platais 2002.

enterprises, 700,000 service enterprises and hundreds of thousands of construction sites, as well as undertake ecological inspections, collecting CNY7 billion of environmental levies, and processing more than 60,000 pollution investigations each year. Of the 109 water quality parameters prescribed in drinking water supply source standards, only 29 are regularly monitored (ADB 2007b). This weak capacity also jeopardizes the promising effectiveness of PES program.

## 6 Prospects for Asian Development Bank Assistance in the PES Program

Since March 2009, NDRC was requested by the State Council to lead the eco-compensation program in the PRC. This offers a promising option for cross-sectoral and cross-provincial coordination and cooperation on PES program.

In March 2010, the State Council decided to include the eco-compensation regulation in its legislation plan. A leading group and a working group for drafting the regulation have been set up with the NDRC as the leading agency and other 10 line ministries as member agencies. A technical consulting committee has also been established with 25 specialists.

During a recent midterm country programming mission, the government requested ADB to provide technical assistance to support the preparation of the PRC's eco-compensation regulation. It was agreed during the discussions to (i) include this technical assistance in the 2010 standby pipeline; and

(ii) jointly organize the conference on PES, with focus on payments of watershed services and the related legislation framework. This intended conference aims to strengthen PRC's eco-compensation legal foundations governing rights and responsibilities over watershed services.

### 6.1 Comparative advantages and recommended areas of possible interventions

Of the two international financial institutions active in the PRC, ADB's comparative advantage lies with its location within the region and hence, better comprehension of regional concerns, the availability of concessional loans, and its access to own-managed and financed TA resources. These advantages make it possible for ADB to exert strong policy leverage in areas of critical concern to the international community. ADB is in a better position to continue or initiate dialogue with the highest level of the PRC government on the country's economic, social, and environmental policies.

ADB is similarly well placed compared to bilateral donors. In view of the PRC's growing economic strength, the vast majority of bilateral donors active in the PRC have plans to graduate the country in the coming years or so. The few donors planning to remain for the longer haul will seek to transform the donor-recipient relationship to one based more on mutual benefits which will obviously influence the types of assistance they provide and the types of activities they support. In addition,

most bilateral donors do not have mechanism to support their interventions with downstream financing. In comparison, ADB offers the combination of loans with technical assistance that best respond to the domestic needs.

ADB can support the PES program by integrating PES schemes into proposed loan projects and establishing linkages with possible grant funding sources, including the Water Financing Partnership Facility, Carbon Market Initiative, Climate Change Adaptation Program, and GEF.

Possible ADB interventions may include (i) helping mainstream global conventions through PES mechanisms, (ii) promoting cross-provincial cooperation in management of water resources in river basin context, (iii) building strategic linkages between biodiversity conservation and poverty alleviation, and (iv) placing vulnerability and adaptation at the core of poverty-focused, PES approaches.

## 6.2 Strategic directions

As the PRC economy continues to expand, the need for foreign currency will become less obvious than for advanced technologies and management skills. Moreover, the fast-expanding private sector has gradually taken over the commercial sectors where there are vast opportunities for profits, and moved into some public infrastructure sectors where the potential for profits has begun to emerge (e.g., urban sewage treatment). This raises the question whether ADB should continue to finance the types of conventional income-generating projects, in competition with the private sector, or reorient its lending toward low- or non-income-generating environmental and social services areas. The latter reorientation, together with the continued provision of knowledge products that respond to the priority policy and capacity building needs of the country, would enhance ADB's relevance and value-added to the economic and social development of the PRC.

The enhancement of ADB's relevance and value-added to the fast evolving economic and social situation rests with being (i) responsive to the priority needs of the PRC for building a harmonious, resource-efficient,

and environment-friendly society; (ii) innovative to mobilize financing for non-income-generating and low-income-generating environmental and social services; (iii) catalytic to lead the way for downstream private sector investments; and (iv) demonstrative for replication, including the use of ADB funds to demonstrate the effectiveness and efficiency of using public funds on environmental and social services (ADB 2007b).

In view of the above, the authors identify the following three areas for consideration by ADB.

***Increasing assistance to environmental and natural resource management.*** The PRC will face enormous challenges in achieving the goal of building a "resource-efficient and environment-friendly society." Under the Chinese fiscal system, many poor areas in the western regions have little revenue-generating potential to meet with their responsibilities and obligations of conserving ecological services. ADB is well-positioned to offer assistance in the development of effective financing mechanisms and supportive policies and in capacity building. It is recommended that ADB increase its environmental assistance in both total lending and total nonlending. ADB may also create a fast-track umbrella environmental technical assistance that can respond to emerging policy priorities during the 5-year plan period.

***Intensifying dialogue with government on PES.*** The PRC government is increasingly willing to borrow money to pay for ecological services. ADB may want to intensify its dialogue with the PRC government in this regard, including a reform of the present loan payment approach such that ADB financing will be used increasingly for non-income-generating ecological services in the form of transfer payments, especially to compensate the poverty-stricken western regions that historically have supplied large proportions of the natural resources to fuel the economic growth in eastern PRC but have borne the costs of environmental degradation. At the same time, however, the government would need to align its own subsidy programs in project areas to remove contradictions with project objectives.



ADB may continue the policy dialogue by updating its *PRC Country Environmental Analysis* and engage in discussions for the preparation of the 12th Five-Year Plan. As part of this process, together with central and provincial government agencies, ADB may want to map out a framework for deepening the cooperation through a possible ADB-PRC Partnership on PES.

***Promoting regional cooperation and knowledge sharing on PES in Southeast Asia countries.***

A conference held in Hanoi, Viet Nam on 24-26 June 2010 recognized that experiences from the PRC where payments for watershed services have rapidly advanced in recent years, could offer valuable lessons for other Southeast Asian countries. PES activity across Southeast Asia is anchored by projects created and supported by Rewarding Upland Poor for Environmental Services (RUPES), a research effort whose mission is to develop practical environmental services schemes. This practice also offers a chance to share knowledge and experiences with other countries (Stanton et al. 2010). ADB may want to promote regional cooperation and knowledge sharing on PES in ASEAN plus three (the PRC, Japan, and Republic of Korea) countries. A mechanism for this cooperation is under discussion between ADB operational departments (East Asia and Southeast Asia departments) and the participating countries.

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## Conference Paper 3: Payments for Ecological Services in the Greater Mekong Subregion

### The case for payments for ecological services in the Biodiversity Corridor in Xishuangbanna, People's Republic of China

Hasan Moinuddin<sup>35</sup> and Jiao Xi<sup>36</sup>

Payments for ecological services (PES) have increasingly received attention in the People's Republic of China (PRC) (Xing and Jun 2009; Ting, Leshan, and Xiaoyun 2006) and across the world.<sup>37</sup> One of the fundamental arguments promoting PES is the need to sustain downstream services, such as provision of water in quantity and quality from upstream sources.<sup>38</sup> Although PES has been advocated by multilateral development institutions for some time now,<sup>39</sup> governments in the Greater

Mekong Subregion (GMS) have been slow<sup>40</sup> in promulgating policies conducive to PES, particularly for forest ecosystems.

#### 1 The Greater Mekong Subregion and the Core Environment Program

The GMS is one of the fastest-growing regions in the world, which entailed significant economic and social changes transforming economies, countries, and natural landscapes in the

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<sup>37</sup> Several PES-related studies have recently highlighted lessons learned. See Rewarding Upland Poor for Environmental Services (RUPES), project completion report by the World Agroforestry Centre (ICRAF) at: [www.worldagroforestry.org/sea/networks/rupes/download/CompletionReport.pdf](http://www.worldagroforestry.org/sea/networks/rupes/download/CompletionReport.pdf); and a series of publications by the International Institute for Environment and Development (IIED) on developing markets for watershed services and improved livelihoods: Fair deals for watershed services in Bolivia, Caribbean, India, and South Africa; apart from watershed services, studies also document environmental services from wildlife, see Frost, Peter, and Ivan Bond. 2006. *CAMPFIRE and payments for environmental services*. London: IIED, and examples from agroforestry (jungle) rubber, see: Wulan Y.C., S. Budidarsono, and L. Joshi. 2008. Economic Analysis of Improved Smallholder Rubber Agroforestry Systems in West Kalimantan, Indonesia—Implications for Rubber Development. *Sustainable Sloping Lands and Watershed Management Conference Linking research to strengthen upland policies and practices*, 12–15 December 2006. Lao PDR, Laos. World Agroforestry Centre—ICRAF, SEA Regional Office.

<sup>38</sup> See one of the earlier cases presented by Albert Appleton. 2002. How New York City Used Ecosystem Services Strategy Carried out Through an Urban-Rural Partnership to Preserve the Pristine Quality of its Drinking Water and Save Billions of Dollars. A paper for Forest Trends. [www.katoombagroup.org/documents/events/event7/NYC\\_H2O\\_Ecosystem\\_Services.pdf](http://www.katoombagroup.org/documents/events/event7/NYC_H2O_Ecosystem_Services.pdf); see also another recent example of a Public Utilities Company of Heredia (ESPH) in Costa Rica by Luis Gamez, Participation of Utilities, Private and Public Sectors in Environmental Services in Costa Rica in Economic policy and Financial innovation for Investments in Forest Environmental Services. UNESCAP. Bangkok. 28–29 May 2007.

<sup>39</sup> See World Bank for a list of PES Projects completed (Costa Rica, Colombia, Nicaragua), under implementation (South Africa, Lesotho, Mexico, Kenya, and Panama), and under preparation (Brazil, Ecuador among others). Available: [web.worldbank.org](http://web.worldbank.org) (search: PES).

<sup>40</sup> One of the few exceptions in the GMS is the Decision of the Prime Minister on the Pilot Policy for Payment for Forest Environmental Services April 2008, applicable to Lam Dong and Son La provinces Viet Nam; a similar example is from Yunnan, PRC Provincial Government's Position on Enhanced Biodiversity Conservation in Northwest Yunnan (No.43, 26 February 2008), which explicitly mentions implementation of PES.

subregion, inevitably affecting the environment. In 2004, recognizing this development challenge, the GMS Working Group on Environment (WGE), facilitated by the Asian Development Bank (ADB), initiated a review of the GMS economic program from an environmental sustainability and management points of view. Both the Environment Ministers Meeting in Shanghai (May 2005) and the second GMS Summit of Leaders and Heads of State held in Kunming (July 2005) endorsed the Core Environment Program (CEP) and its flagship component, the

Biodiversity Conservation Corridors Initiative (BCI), for implementation.

The GMS BCI identified nine key biodiversity conservation landscapes (BCL) representing ecological networks, with natural and/or semi-natural landscape elements of high biodiversity value in which six pilot sites were selected for launching the BCI implementation from 2006 to 2009 (Figure 1). The long-term vision of BCI is that by 2015, GMS countries will have established priority biodiversity conservation landscapes and corridors for maintaining the quality of

**Figure 1 Biodiversity Conservation Landscapes and Biodiversity Conservation Corridors Initiative Pilot Sites in the Greater Mekong Subregion**



Source: Greater Mekong Subregion Environment Operations Center 2008.

ecosystems, ensuring sustainable use of shared natural resources, and improving the livelihoods of people. The BCI has five subcomponents: (i) poverty alleviation through sustainable use of natural resources and development of livelihoods, (ii) clear definition of optimal land uses and harmonized land management regimes, (iii) restoration and maintenance of ecosystem connectivity, (iv) capacity building in local communities and government staff, and (v) sustainable financing mechanisms and structures integrated with government planning and budgeting procedures.

## 2 Payments for Ecological Services in the GMS

The GMS CEP-BCI, currently being implemented under ADB regional technical assistance (RETA) 6289, explicitly mentions PES as a mechanism for securing sustainable financing (component 5) for the program, which is planned to cover 10 years. The ADB technical assistance paper, *Proposed Technical Assistance Core Environment Program and Biodiversity Conservation Corridors Initiative in the Greater Mekong Subregion* (ADB 2005)<sup>41</sup> mentions the “endeavor to initiate a system whereby the hydropower and tourism sectors systematically pay to conserve non-marketed ecosystem services.” (ADB 2005, p.3). The GMS Biodiversity Conservation Corridor Initiative’s “*Strategic Framework and Technical Assessment 2005–2014*” (ADB 2005)<sup>42</sup> specifically mentions exploration of “transfer payments for environmental services such as watershed protection” (ADB 2005, p.6) under the sustainable financing mechanism. Under capacity building (component 4), the GMS CEP-BCI has supported PES capacity-building activities undertaken by various organizations to sensitize policy makers, government officials, technical managers, and implementers on the need for initiating and institutionalizing

PES measures in the GMS. Some important developments supported by the government can be reported from Viet Nam at a macro level, while non-state agency activities contributing toward conservation and development in Cambodia have made some visible inroads on a micro scale.

### 2.1 The development of PES in Viet Nam

Article 74 of the Biodiversity Law of Viet Nam, which was adopted on 13 November 2008 and came into effect on 1 July 2009, regulates environmental services related to biodiversity by stating in paragraph 1: “Organizations and individuals using environmental services related to biodiversity shall pay charges to service providers.”<sup>43</sup> The environmental services related to biodiversity should be specified by the government. Since 2008, the Prime Minister’s Decision No. 380/QĐ-TTg of 10 April 2008, purports to pilot test within a period of 2 years “development of the legal framework for a national policy on payments for forest environmental services (FES) to be applied in the whole country, where the responsibilities and benefits of the payers and payees of forest environmental services...are clearly defined and...gradually establishing sustainable economic basis for protecting the environment and ecosystems, improving quality of service provision, especially ensuring water supply for electricity production, for clean water production, and ecotourism business activities” (Art. 1).<sup>44</sup>

This Pilot PES Policy is applicable to areas of Lam Dong, Son La, Dong Nai, Hoa Binh, Binh Thuan, Ninh Thuan, and Ho Chi Minh City (Art.2 [2]). The target foci of application of this PES/FES Decision in Viet Nam are laid out in Art. 3: Dai Ninh Hydropower plant in Binh Thuan province; Da Nhim Hydropower plant in Ninh Thuan province; Hoa Binh Hydropower Plant of the Viet Nam General Electricity Company;

<sup>41</sup> Available online: [www.adb.org/Documents/TARs/REG/39025-GMS-TAR.pdf](http://www.adb.org/Documents/TARs/REG/39025-GMS-TAR.pdf)

<sup>42</sup> Available online: [www.adb.org/Documents/Reports/GMS-BCI/gms-bcci-execsum.pdf](http://www.adb.org/Documents/Reports/GMS-BCI/gms-bcci-execsum.pdf)

<sup>43</sup> (The) National Assembly of the Socialist Republic of Viet Nam, 2008. Biodiversity Law. Law No. 20/2008/QH12. Available [www.grain.org/brl/?docid=82017&lawid=3198](http://www.grain.org/brl/?docid=82017&lawid=3198)

<sup>44</sup> Prime Minister of Viet Nam, 2008. Decision on The Pilot Policy for Payment for Forest Environmental Services. No. 380/QĐ-TTg. Available online at [www.vietnamforestry.org.vn/NewsFolder/Decision%20380%20On%20The%20Pilot%20Policy%20for%20Payment%20for%20Forest%20Environmental%20Services\\_EN.doc](http://www.vietnamforestry.org.vn/NewsFolder/Decision%20380%20On%20The%20Pilot%20Policy%20for%20Payment%20for%20Forest%20Environmental%20Services_EN.doc)

Suoi Sap Hydropower Plant situated in Phu Yen district of Son La province; the Water Supply Company of Ho Chi Minh City (SAWACO); the Water Supply Company of Bien Hoa City of Dong Nai province; Phu Yen and Moc Chau branches of the Son La Water Supply Company, Son La province; organizations and individuals conducting ecotourism business in the areas of the special use forests and protection forests within the administrative boundaries of Lam Dong and Son La provinces; all forest owners in the headwaters areas of the Dong Nai and Da river watersheds within the administrative boundaries of Lam Dong and Son La; and government agencies relevant to the collection, submission, management, and use of money collected from payments for forest environmental services having headquarters based in Lam Dong, Son La, Dong Nai, Ninh Thuan, Binh Thuan, and Hoa Binh provinces and Ho Chi Minh City.

Art. 8 of the Prime Minister's Pilot PES Decision regulates norms of payment for PES (i) for hydropower plants, the norm of payment is fixed for the pilot period at D20/kilowatt hour (kwh) of commercial electricity; (ii) for the water production and supply establishments, the norm is D40/cubic meter (m<sup>3</sup>) of commercial water; for organizations and individuals conducting tourism business, the norm for payment for use of the forest environmental services is 0.5–2.0% of the tourism revenue of the period. The People's Committees of Lam Dong and Son La and the Management Board of Protection Forests and Management Board of Special Use Forests may adjust and/or charge tourism and/or tourist fees, which are to be approved by the People's Committees in the respective provinces. The Government of Viet Nam is expected to issue a decree on PES by 2013.

Currently, several pilot PES schemes implementing the Pilot PES Decision are underway in Viet Nam, the most prominent among which are hydropower schemes and water supply companies. One of the classic payers of forest environment services in Lam Dong province is the Dai Ninh Hydropower Company, a government-owned service sector operation under Electricity Viet Nam (EVN), managing a 300-megawatt plant, producing 1.2 billion kWh of electricity that requires

750 million m<sup>3</sup> of water. The operation started generating electricity in January 2008 and by January 2009 started paying for ecosystem services. In the first quarter of 2009, Dai Ninh had paid D6.0 billion equivalent to \$337,000 and is expected to contribute up to \$1.35 million annually. Payments are made into the Forest Protection and Development Fund (FPDF) of Lam Dong Province, which makes payments to forest owners and/or sellers of the ecosystem services. Payments are being made indirectly to forest "owners" and service providers through the FPDF and this may require close monitoring so that funds are used for protection of soils and maintenance of forest cover in the watershed. It is expected that within 1 year of its operation, the Provincial FPDF of Lam Dong would have collected D55 billion (equivalent to \$3.089 million), of which D48 billion is expected to flow from hydropower plants, D6 billion from water supply businesses, and D1 billion from ecotourism businesses. The payments to households from collections of ecosystem service fees is currently estimated at D200,000/hectare (ha)/year whereas this amount will be in addition to payments under ongoing government schemes such as (i) payments for forest protection from the government's budget under the 5-million ha forest program (Project 661) of D100,000/ha/year based on the area of forest contracted to the households by the forest management boards; (ii) payments for forest protection from the government's budget under the program for supporting poor communes (program 135) of D100,000/ha/year, based on the area of forest managed by the commune people's committees and forest management boards; (iii) the support to the poor ethnic households in the mountainous area from the government's budget (Program 304) for their participation in forest protection of D100,000/ha/year and 15 kilograms (kg) of rice per individual per month; and (iv) the support for forestry production and forest protection from the government budget under the Program 30A of D200,000/ha/year and 15 kg of rice per individual per month for a maximum of 84 months. Payments per ha currently amount to less than \$40 per ha per household at current exchange rates and seems quite low. It may be argued that for pure protection of forest



and plantations, the amount may be adequate. Whether it is a sufficient incentive for the forest owners, once state law enforcement is cut back, is yet to be seen. It may be premised that an increase in sense of ownership and commercial value in protection by forest owners (individually and collectively) reduces concomitantly state expenditure and effort on law enforcement measures.

## 2.2 Examples of PES from Cambodia

In the Northern Plains in Cambodia, the Wildlife Conservation Society (WCS) in collaboration with the Forestry Administration is supporting micro-scale PES for (i) biodiversity payments, (ii) agro-environment payments, and (iii) community-based ecotourism payments. Under biodiversity payments, the target species are globally threatened bird species, which are heavily threatened by hunting and need to be protected. Individual contracts with sellers, who are local people, having de facto control of nest sites is entered into by the buyer, WCS, with an average payment of \$120/protector. Monitoring and verification is carried out by WCS. Starting out with 4 villages in 2002, the number has risen to 21 villages, with over 1,550 nests of critically-endangered, endangered, and vulnerable species protected, and 74% of payments going to local people. While this kind of conservation-work-for-cash payment is very useful on a small scale, the system of payments is not based on a sustainable source of funding or a service that is marketable (abundance of buyers) as external funding has enabled the system to be set up.

In the case of agri-environment payments, sellers are local farmers, who agree to limit field boundaries, i.e., not extend and convert forest for agriculture, and, in return, the buyers are about 15 hotels and restaurants in Siem Reap and Phnom Penh, which guarantee a product price (e.g., Ibis Rice) for rice products being wildlife friendly. On average, a farmer receives \$160 and a village community for common projects gets \$500 per village. A cooperative has been set up for monitoring conservation agreements and trade prices.

Again, the question would be how long will buyers continue to pay a premium price, or will it just be a corporate social responsibility approach for conservation?

In the community-based eco-tourism case, tour groups enter into contracts with villages that have key bird species to bring bird watchers; in return villages sign up for “no hunting” agreements and implement land-use planning with government per WCS. Tourist groups contribute \$30 per tourist to a conservation fund if a diversity of birds is seen (ecosystem intact and/or functioning). On average \$2,000–\$4,000 may be earned per village and employed staff may receive up to an average of \$160 per year. There has been a large increase in income since 2005, as villages engage in service provision, contributing significantly to rural income.

## 3 Importance of Xishuangbanna, Yunnan in the GMS

The tropical forests of Xishuangbanna, Yunnan in Southwest PRC are unique because of the transitional geographic location and climatic features crossing the tropics and subtropics, which harbor some of the richest fauna and flora and provide habitats for various animal species. While the initial BCI focal area identification takes a long-term approach toward establishing linkages in the fragmented ecosystem, identifying eight potential corridors, BCI implementers in phase I (2006–2009) prioritized establishing connectivity between (i) Nabanhe to Mangao; and (ii) Mengla to Shangyong (wild elephant sanctuary), which is also a transboundary Nature Reserve bordering Lao People’s Democratic Republic (Figure 2).

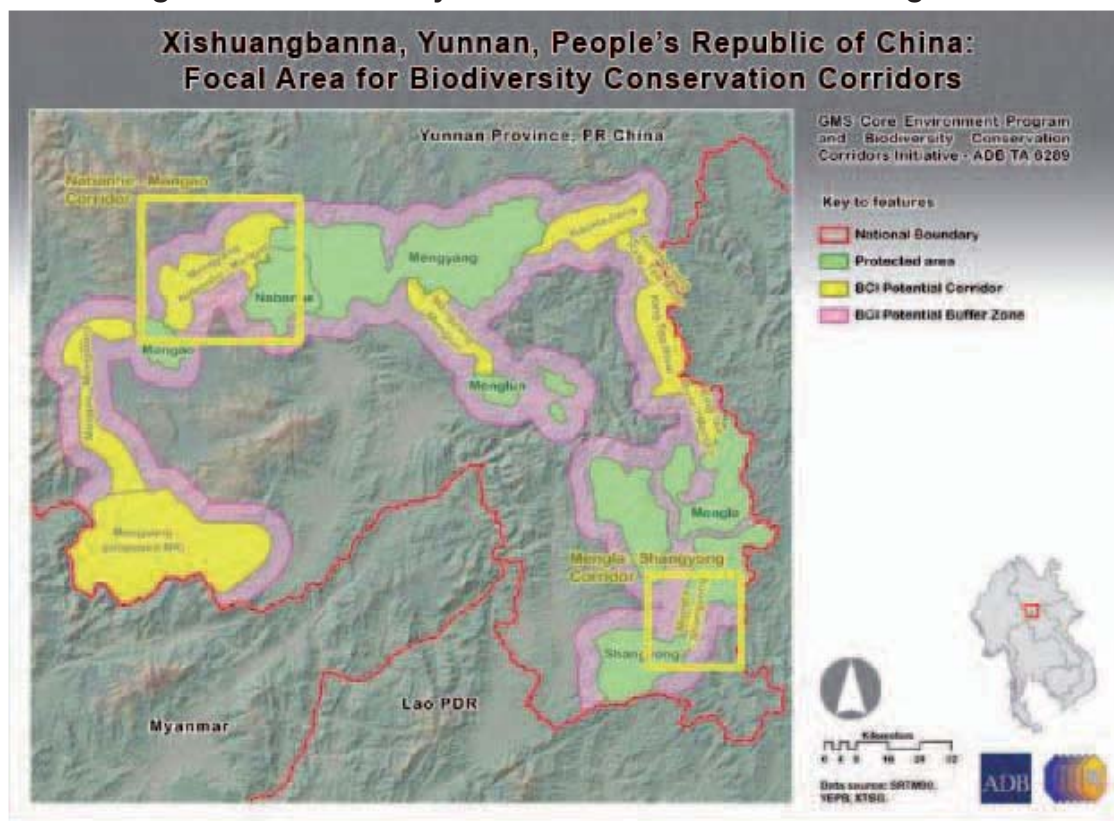
### 3.1 Nabanhe—Mangao Biodiversity Corridor Segment<sup>45</sup>

The proposed corridor area between Nabanhe Nature Reserve and Mangao Subreserve is estimated at 15,446.74 ha with an outer perimeter and an inner core having a linear forest connectivity stretching to roughly 25 kilometers (km). This corridor covers 40 natural villages in three administrative

<sup>45</sup> For detailed information on the corridor segments mentioned herein, see ADB (2008), Annex 1–3.



Figure 2 Biodiversity Corridors Selection in Xishuangbanna



Source: Greater Mekong Subregion Environment Operations Center 2005.

villages of Menghai and Mengsong townships in Menghai County. Within the corridor, a linear forested “core” strip has been identified that is dissected in the north and the south by two roads. This area also has the weakest link in the forest cover and requires stabilization and restoration measures. However, if we add the area of both Nabanhe and Mangao Nature Reserves, the total area amounts to 51,718 ha. The corridor belongs to the south subtropical area and the natural vegetation is seasonal evergreen broadleaf forest dominated by *Castanopsis* sp, *Schima wallichii*, etc. Wild boar is common, while *Bos gaurus* roam occasionally in this area. Animals like tigers, bears, and red deer disappeared from the corridor because of habitat destruction and impact of increasing human activity. On the other hand, population of *Bos gaurus* and wild boar increased because of in-migration and propagation after the hunting ban.

### 3.2 Mengla—Shangyong Biodiversity Corridor Segment

The biodiversity corridor strip between Mengla-Shangyong Subreserves covers a total area of 2,471.43 ha. It is a narrow strip of forest connectivity that still remains between Mengla and Shangyong. However, if we add the area of both Mengla and Shangyong Nature Reserves, the total area amounts to 152,076 ha. Wild animals such as tigers (in Shang Longyin village), monkeys, bears, boars, and wild elephants used to be in the corridor area but cannot be found anymore because of denudation of forests and replacement with large areas of rubber plantation. Since the construction of the Xiao Mo expressway started in 2003, there has been no elephant sighting in this area except near the corridor border areas such as Dalongha, Manfen, Chachang, and Huilang villages. Currently, besides rubber plantations all around the villages, there are few remaining species

such as teak, *Anthocephalus chinensis*, *Cassia siamea*, and some fruit trees.

While the importance of Xishuangbanna, as one of the last remaining tropical rainforests of the GMS, is well known, it has put tremendous pressure on land, and fast changing land use, with a high rate of conversion of forests to rubber plantations. The decline in rainforest area and degradation of watersheds are bound to affect ecosystem services in Xishuangbanna as well as the water flow downstream for the lower Mekong countries of the GMS. While the real or true value of the ecosystem (e.g., source of water supply, pollination, medicinal herbs, essences, oils, and cosmetic ingredients, food and food supplements through non-timber forest products) for local people need to be considered as an opportunity cost vis-à-vis those (e.g., rubber plantations of high economic value due to market demand—high price and/or return) gained from human-induced, and irreversible changes in the Xishuangbanna tropical forests ecosystem, anticipated negative impacts of climate change will also likely take their toll

unless mitigation and adaptation measures are put in place. Amid the large-scale land use change that replaces forest ecosystems with commercial agricultural crops like rubber, the state may have to regulate more vigorously to protect watersheds to guarantee essential ecosystem services such as a sustainable supply of water or soil conservation. These impacts are not captured in decision making because some of the ecosystem goods and services affected are not sold in markets or attached with an economic value for society at large.

#### 4 Summary Values of Ecosystem Services in Selected Biodiversity Corridors of Xishuangbanna

The total value of ecosystem services assessed in the Xishuangbanna biodiversity corridor segments<sup>46</sup> of (i) Nabanhe–Mangao (including nature reserves), and (ii) Mengla–Shangyong (including nature reserves) amounts to \$1.162 billion annually (Table 1), which translates

**Table 1 Overview of Summary Value of Tropical Forest Ecosystem Services in Xishuangbanna (\$ million)**

Ecosystem Services	Mengla-Shangyong (135,932 ha)	Nabanhe-Mangao (28,981 ha)	Total Value	Unit Value (\$/ha/yr)
1. NTFP	0.2	0.8	1.0	...
2. Carbon Sequestration	303	59	362	2,195
3. Oxygen Generation	130	25	155	938
4. Watershed Protection (Storage/Quantity)	74	15	89	540
5. Water Quality Regulation	156	29	185	1,123
6. Soil Erosion Protection	32	7	39	234
7. Nutrient Cycling	146	36	182	1,104
8. Air Purification	122	29	151	913
<b>Total</b>	<b>962</b>	<b>200</b>	<b>1,162</b>	<b>7,047</b>

... = not available, ha = hectare, NTFP = non-timber forest products, yr = year.

Source: Xi, J. 2009.

<sup>46</sup> For details of the Assessment see: Xi, Jiao 2009.

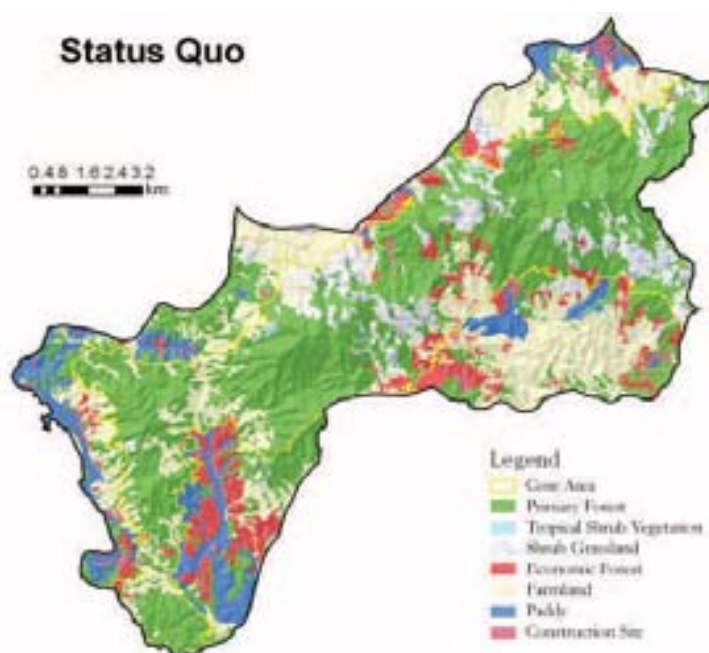
into just over \$7,047 per ha, if we take into account the total forested area of both corridor segments and nature reserves to be 164,913 ha. However, the result is very sensitive to carbon pricing. If we take a range from \$20 to \$50 per ton of carbon dioxide, the total value will reach \$1.524–\$2.610 billion annually with a unit value of \$9,421–\$15,827 per ha.

The carbon sequestration service of the forest provides the highest value followed by water quality regulation and nutrient cycling. Non-timber forest products (NTFP) come in low because several highly potential products such as oils, aromatic essences, and orchids are not well processed for value addition and also collected by fewer households in limited areas. Medical herbs and some bamboo types are assumed to be overexploited, which may need some domestication and production outside the forest for commercial use.

## 5 Case for PES in Xishuangbanna BCI Pilot Site, PRC

In Section 4, we can see that a significant value is provided by the tropical forest ecosystem services in Xishuangbanna BCI pilot site. However, driven by the high market demand and economic incentives, rubber plantation and expansion remain the major threat to the forest conversion and fragmentation. Doubts are raised on the questions of “are the rainforests providing ecosystem services valuable enough to justify conservation? And which development pattern is more beneficial to the society as a whole, business as usual or conservation?” Therefore, it is essential to analyze the trade-offs between the forest conservation and other competing land use options. Two scenarios of the BCI corridor development, namely (i) development scenario (without BCI), and (ii) conservation scenario

**Figure 3 Vegetation of Status Quo 2007  
(Nabanhe–Mangao Corridor)**



Source: Xi, J. 2009.

(with BCI), are developed and simulated for comparison together with the status quo in terms of their net present value (NPV) together with the economic analysis of the costs and benefits of different land use options.

The scenarios' specifications for simulation are summarized in Table 2, and the vegetation areas data and corridor scenarios maps are generated from a geographic information system (GIS) modeling.

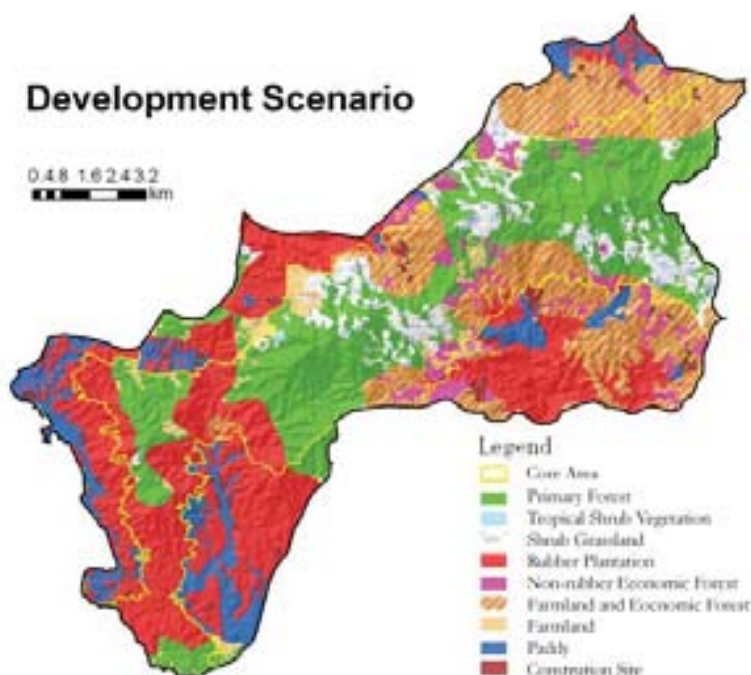
### 5.1 Scenario design

The development of Xishuangbanna biodiversity corridor area may meet various constraints, regardless of the establishment of biodiversity conservation corridors in the area. The future development will be limited by a combination of factors, namely geographic conditions, market mechanism, existing forestry and land use policy, and other land use and human factors. Therefore, restrictive factors must be considered in designing the scenarios.

### 5.2 Development scenario (without BCI)

The development scenario simulates the maximum development activity in a corridor area with proper conditions such as market driven, enabling policies, and suitable growth conditions, assuming no corridor is constructed. Driven solely by economic interests, people will choose plantation projects in the following priority areas: rubber forest, other economic forest, and agricultural production. Under the current forest right policy, farmers are permitted to autonomously manage collective forest allocated to individuals, and those without allocation are not allowed to make use of state-owned forest. Keeping in mind growth conditions, rubber plantations can only be grown at an altitude below 1,500 meters (m) (Jiang 1982), and their growth will be affected above the 1,500 m altitude; there are suitable economic forest and crops for areas at any altitude. However, this option is not a conducive one and runs against the current BCI philosophy.

Figure 4 Vegetation under Development Scenario (Nabanhe–Mangao Corridor)



Source: Xi, J. 2009.



### 5.3 Conservation scenario (with BCI)

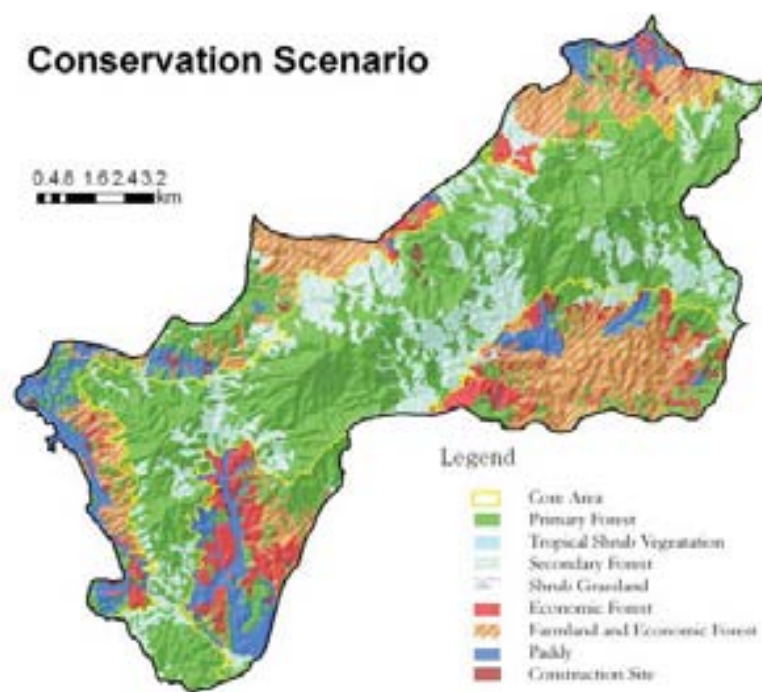
Under the conservation scenario, the corridor area is divided into core area and buffer area. In the core area, all non-forest area will turn into secondary forest in core area. The buffer area will have the following changes:

- (i) state-owned forest will remain the same;
- (ii) collective forest—natural forest and other commercial crops remain; other forest at altitude greater than 900 m rubber plantation will be converted to economic forest; forest at altitude less than 900 m rubber forest remain unchanged;
- (iii) all shrub land will be converted to secondary forest;
- (iv) farmland—can be considered to be converted to economic forest at steep slope (non-rubber forest); and
- (v) paddy fields built up and other land use remain unchanged.

### 5.4 Scenario analysis

The NPV of the costs and benefits associated with each scenario is calculated based on a 35-year timeframe (a life cycle of rubber plantation), and with a 10% discount rate that has been commonly used in other valuation studies (International Institute for Environment and Development 2007; De Lopez 2003; Mohd Shahwahid 1999). The higher bound of the prices and yields are taken into calculation for agricultural products, rubber, and other commercial plantation. To simplify the model, three broader category of vegetation are considered for valuation, namely (i) forest, (ii) rubber plantation and/or other commercial plantation, and (iii) agriculture, where rubber plantation and rice are selected for calculation as representatives for category (ii) and (iii) as they are the dominant vegetation within the category and generate the highest benefits, which follow the equations below:

**Figure 5 Vegetation under Conservation Scenario (Nabanhe – Mangao Corridor)**



Source: Xi, J. 2009.

**Table 2 Summary of Scenario Design**

Item	Development Scenario (Without –BCI)	Conservation Scenario (With –BCI)
1. Natural forest		BCI comprises of core area and buffer zones. All non-natural forests turn into secondary forests in core areas; buffer area will have the following changes
1.1 State-owned forest	1. Altitude >1,500 m converted to commercial plantation or farmland 2. Altitude <1,500 m converted to rubber plantation	Unchanged
1.2 Collective forest	1. Altitude >1,500 m converted to commercial plantation or farmland 2. Altitude <1,500 m converted to rubber plantation	1. Natural forest and other commercial crops remains 2. Altitude >900 m rubber plantation converted to other economic plantation 3. Altitude <900 m rubber plantation remain unchanged
2. Shrub land	1. Altitude >1,500 m converted to commercial plantation or farmland 2. Altitude <1,500 m converted to rubber plantation	All converted to secondary forest (while shrub land belong to collective forest can be converted to other commercial plantation)
3. Commercial plantation	1. Altitude >1,500 m unchanged 2. Altitude <1,500 m non-rubber plantation converted to rubber plantation	Unchanged
4. Farmland	1. Altitude >1,500 m unchanged 2. Altitude <1,500 m converted to rubber plantation	Some are considered to be partially converted to commercial plantation
5. Paddy	Unchanged	Unchanged
6. Built-up and others	Unchanged	Unchanged

> = greater than, < = less than, BCI = Biodiversity Conservation Corridors Initiative, m = meter.

Source: Xi, J. 2009.

$$NPV = NPV_{\text{Forest}} + NPV_{\text{Rubber}} + NPV_{\text{Agriculture}}$$

$$NPV_{\text{Forest}} = \text{Forest area (ha)} * NPV_{\text{Forest}} (\$/\text{ha})$$

$$NPV_{\text{Rubber}} = \text{Rubber area (ha)} * NPV_{\text{Rubber}} (\$/\text{ha})$$

$$NPV_{\text{Agriculture}} = \text{Agriculture area (ha)} * NPV_{\text{Agriculture}} (\$/\text{ha})$$

The vegetation areas of two scenarios compared with the status quo and NPV results of the two corridor segments are presented in Tables 3 and 4.

The results of both corridor segments show that the conservation scenario can better

preserve the value of the status quo even with further improvement, while the development scenario may incur a huge loss of value compared with the status quo. The NPV of the forests contribute to the biggest proportion and variance of the values under different scenarios.

A summary of NPV (\$/ha) under a 10% discount rate and 35-year timeframe is presented in Table 5. It demonstrates that maintaining forests or even restoring the degraded forests and/or reforestation provides much more value than other alternative land use options. However, the values of forest ecosystem services are not well recognized and received by people due to its environmental externality nature, rather the high economic return of rubber plantation



**Table 3 Scenario Analysis of Mangao-Nabanhe BCI Corridor Segment**  
(NPV Unit: \$ Million)

Vegetation Area	Status Quo	Development Scenario	Conservation Scenario
Forest area (ha)	7,517	4,111	10,255
Change (ha)		-3,406	+2,739
NPV_forest	511	279	591
Rubber/other commercial plantation (ha)	1,377	5,414	1,074
Change (ha)		+4,037	-303
NPV_rubber	25	97	19
Agriculture (ha)	6,380	5,749	3,944
Change (ha)		-631	-2,436
NPV_agriculture	81	73	50
Total NPV	617	449	660

ha = hectare, NPV = net present value.

Source: Xi, J. 2009.

**Table 4 Scenario Analysis of Mengla-Shangyong BCI Corridor Segment**  
(NPV Unit: \$ Million)

Vegetation Area	Status Quo	Development Scenario	Conservation Scenario
Forest area (ha)	1,409	416	1,589
Change (ha)		-992	+180
NPV_forest	96	28	101
Rubber/other commercial plantation (ha)	1,007	2,053	838
Change (ha)		+1,046	-169
NPV_rubber	18	37	15
Agriculture (ha)	64	10	53
Change (ha)		-54	-11
NPV_agriculture	0.813	0.127	0.637
Total NPV	115	65	117

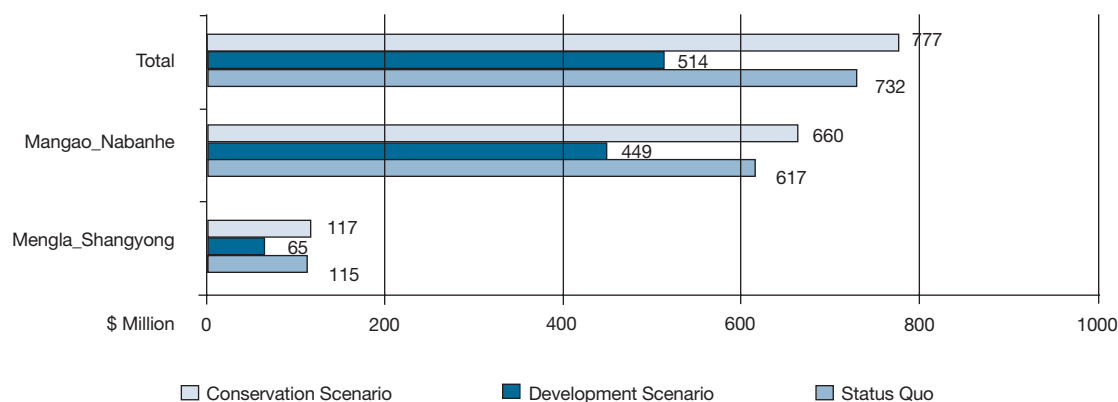
ha = hectare, NPV = net present value.

Source: Xi, J. 2009.

(internal rate of return = 23.05%–34.91%) drives the rapid expansion of rubber plantation in Xishuangbanna. Although the economic value of agriculture is relatively lower, it plays a very important role in local livelihoods in terms of source of food and income.

### 5.5 Sensitivity analysis

A number of variables and data sources are used in the valuation and scenarios analysis. To deal with the uncertainty of the results, four key variables are selected to conduct the sensitivity analysis: (i) discount rate, (ii) prices of

**Figure 6 Results of Scenario Analysis**

Source: Xi, J. 2009.

**Table 5 Summary of Net Present Values of Land Use Options in Xishuangbanna Biodiversity Conservation Corridors Initiative Pilot Site**

Land use options	Net Present Value (\$/hectare) (10% discount rate, 35 years)
Forest conservation	67,962
Forest restoration	29,294
Rubber plantation	6,386–17,923
Rice	3,558–12,708
Corn	8,895
Sugarcane	6,777
Tea	1,431–12,953

Source: Xi, J. 2009.

**Table 6 Selected Variables for Sensitivity Analysis**

Variable	Base case	Alternative value (range)	Descriptive
Discount rate	10%	8%, 6%	Lower discount rate (10% discount rate is regarded to be high for calculation)
Rubber prices	CNY20/kg	CNY10–25/kg	Lower bound of rubber price: CNY10/kg (2009); higher bound of rubber price: CNY25/kg (2007)
Carbon prices	\$10/ton	\$20–50/ton	IPCC Fourth Assessment Report 2007 suggests real prices of \$20–\$50/ton carbon dioxide.
Rice yields	9 ton/ha	5.4–12 ton/ha	According to the field consultation, the range of rice yield is from 5.4–12 ton/ha.

ha = hectare, IPCC = Intergovernmental Panel on Climate Change, kg = kilogram.

Source: Xi, J. 2009.

Table 7 Sensitivity Analysis of Scenarios Analysis (NPV: \$ Million)

Scenarios	Base case	Discount rate		Rubber Price		Carbon Price		Rice Yield	
		8%	6%	CNY10/kg	CNY25/kg	\$20/t	\$50/t	5.4 t/ha	12 t/ha
Mangao-Nabanhe Biodiversity Conservation Corridors Initiative Segment									
Status Quo	617	749	938	601	624	776	1,253	558	665
		21.43%	51.95%	-2.65%	1.22%	25.73%	103.10%	-9.53%	7.81%
Development Scenario	449	559	717	387	481	537	798	397	493
		24.59%	59.80%	-13.81%	7.06%	19.49%	77.64%	-11.62%	9.86%
Conservation Scenario	660	816	1,038	648	667	848	1,412	624	690
		23.62%	57.34%	-1.82%	1.00%	28.53%	113.92%	-5.41%	4.62%
Mengla-Shangyong Biodiversity Conservation Corridors Initiative Segment									
Status Quo	115	142	180	103	120	144	234	114	115
		23.07%	56.58%	-10.45%	4.71%	25.61%	103.42%	-0.85%	0.08%
Development Scenario	65	85	114	42	77	74	100	65	65
		30.70%	75.17%	-36.15%	18.51%	13.85%	54.49%	0.15%	0.41%
Conservation Scenario	117	145	184	107	122	148	244	116	117
		23.52%	57.59%	-8.51%	3.88%	26.87%	108.19%	-0.66%	0.10%
Total									
Status Quo	731	891	1,118	704	745	920	1,487	672	780
		21.85%	52.89%	-3.74%	1.90%	25.88%	103.43%	-8.04%	6.74%
Development Scenario	515	644	831	428	558	611	898	462	559
		25.12%	61.43%	-16.80%	8.29%	18.55%	74.37%	-10.30%	8.46%
Conservation Scenario	777	960	1,223	755	788	997	1,655	741	808
		23.60%	57.38%	-2.82%	1.43%	28.28%	113.05%	-4.69%	3.94%

ha = hectare, kg = kilogram, NPV = net present value, t = ton.

Source: Xi, J. 2009.

rubber selling in the primary market, (iii) prices of carbon dioxide trading under United Nations Framework Convention on Climate Change (UNFCCC), and (iv) yields of the rice productivity.

The results of the sensitivity analysis (Table 7) show that the value of NPVs are quite sensitive to the carbon prices and discount rate, and less sensitive to the rubber prices and rice yields. If the price of carbon dioxide is set at \$50/ton, the NPV values reach double the values in the base case. Six percent of the discount rate leads to approximately 50% incremental NPVs increase. However, the incremental changes in NPVs by adjusting the values of selected variables do not affect the outcomes of the scenario analysis. In all the cases, NPVs of conservation scenarios remain the highest values in the comparisons with status quo and development scenario.

## 6 Conclusion: Policy Implications and PES Establishment

### 6.1 PES policy implications

Given that a significant value of over \$1 billion annually is provided by the tropical forest ecosystem services in Xishuangbanna BCI pilot site, the value should be well considered and reflected into decision making in land use, forest management, and BCI development.

The scenario analysis shows conservation scenario preserves the value with improvement, while development scenario causes huge invisible loss of benefits in ecosystem services. Therefore, it is essential to apply regulatory and economic instrument in the policy making for providing (i) incentives for forest conservation, restoration and watershed protection; and (ii) disincentives for uncontrolled expansion of rubber and forest conversion on marginal soil and steep slopes. The Tenth Meeting of the Standing Committee of the Xishuangbanna Prefecture People's Congress proposed an amendment to the existing Regulation on

Rubber Management, which prohibits rubber plantation above 900 m (950 m for the sun facing slopes) or slope more than 35 degree.<sup>47</sup> According to Li Zhongqing, deputy director of the Forestry Bureau, Xishuangbanna Prefecture, the local government is planning to purchase the undeveloped natural forest and farm land from the farmers, with total area covering over 500,000 mu (33,000 ha) at approximately CNY500 per mu (\$1,098/ha). An ecological compensation charge will be imposed on rubber industries in Xishuangbanna and it is proposed at 9% of gross sales every year.<sup>48</sup> The prefecture government has set a target of 15 million mu (1 million ha) of natural forest area as a bottom line for forest protection and restoration.<sup>49</sup>

To secure and capture payments for ecosystem services of Xishuangbanna BCI Site, several policy changes could be considered:

1. Formulate legal framework and biodiversity corridor management guidelines that include:
  - a. Regulations on natural forest protection and restoration of degraded forest areas for maintaining important ecosystem services (i.e., watershed protection, soil erosion control, nutrient cycling, etc.)
  - b. Zoning the corridor area
    - i. Core area – reforestation and restricted development to ensure ecosystem connectivity and biodiversity conservation
    - ii. Buffer zone – sustainable forest management and livelihood activities (i.e., NTFP, fuel wood, agro-forestry, livelihood plantation, etc.)
  - c. Regulation on rubber plantation expansion and conversion back to agroforestry rubber, also known as “jungle rubber” or rubber-natural forest-mix (geographic location, slope, altitude, etc.).

<sup>47</sup> Source: [cxmd.xxgk.yn.gov.cn/canton\\_model38/newsview.aspx?id=697138](http://cxmd.xxgk.yn.gov.cn/canton_model38/newsview.aspx?id=697138)

<sup>48</sup> Source: [www.chinaenvironment.com/view/ViewNews.aspx?k=20070612113736227](http://www.chinaenvironment.com/view/ViewNews.aspx?k=20070612113736227)

<sup>49</sup> Source: [www.xsbn.gov.cn/jinri/ShowArticle.asp?ArticleID=9415](http://www.xsbn.gov.cn/jinri/ShowArticle.asp?ArticleID=9415)

2. Establish incentive and payment for ecosystem service schemes, such as:

- a. PES for watershed services, conservation and biodiversity contracts for maintaining natural forests and its fauna;
- b. Incentives for conversion of monoculture rubber to “jungle rubber” (mixed agroforestry system) based on similar schemes like the National Natural Forest Protection Program and the Sloping Land Conversion Program (SLCP);
- c. Transfer payments from eco-tourism and/or nature-based tourism or sharing of tourism taxes with communities for maintenance of ecosystem services;
- d. Afforestation and reforestation clean development mechanisms (A/R CDMs), payments for reduced emissions from deforestation and land degradation, carbon credit trading, and carbon offsets (nationally);
- e. NTFP: eco-certification and eco-labeling of organically produced goods; and
- f. Livelihood interventions and/or incentives, including promotion of agro-forestry and livelihood plantations and public reforestation program with payments for rural greening and promotion of wood based industries.

It is imperative to have a sound PES policy as an overarching national framework but with practical applicability in the provinces (locally). The PES policy framework must be flexible to allow for various types and/or models of PES across different sectors. PES schemes need to be closely related to market mechanisms (demand and supply for ecosystem services) to be sustainable. PES schemes must be based on “fair” compensation and market price; dictated pricing is rarely an incentive. To work as an incentive, payments should be in cash and directly channeled to grass root levels, and could use mechanisms such as revolving funds managed and controlled by beneficiaries.

Verification and performance based rewards and/or sanctions must be in place.

### 6.2 PES establishment in Xishuangbanna

Modifying monoculture rubber plantations in Xishuangbanna with an agroforestry mix called “jungle rubber”<sup>50</sup> provides cash income for the farmer as well as a range of non-rubber products and ecosystem services. As far as incentives for such a change is concerned, we need to consider the market value and “fair” compensation for farmers. To encourage farmers and/or owners of rubber plantations to change to a mixed agroforestry system, incentive compensation packages may be proposed, which reflect opportunity cost of foregoing rubber income. The principle to be applied may be comparable with the national Sloping Land Conversion Program (Grain for Green).

Considering the market risk, we may take CNY10/kg of rubber price as compensation basis, 100 kg/mu (1.5 ton/ha) as the average rubber productivity in Xishuangbanna, and deducting the input and labor costs of rubber plantation, the gross margin for the rubber benefit would roughly be CNY10,000/ha/year.

Under option 1, a 100% conversion of monoculture rubber on farmer’s land would not only be an expensive compensation package at CNY10,000/ha/year but also highly unrealistic. Similarly, at an initial stage, when rubber was being introduced in Xishuangbanna, use of compensation package of SLCP in option 5 might have been an incentive to convert farmland to rubber plantation. As rubber prices have gone up over the recent years, and there is some fluctuation in the market, the objective of re-conversion from rubber back to forest or to a mixed agroforestry system needs to be undertaken gradually. Hence, we believe that a conversion of up to 30% of mixed areas on one hectare of farmland at a compensation of CNY3,000/ha/year may be a bit low but nevertheless conducive to start the PES; and then gradually, as the incentive package works, move to a more ambitious 50% target as in option 3. While compensation packages are

<sup>50</sup> For jungle rubber agroforestry, see Joshi, et al. 2003.

**Table 8 Incentive Compensation Packages for Rubber Conversion**

Options	Conversion Packages	Compensation Scheme Year 1–8 (CNY/ha/year)	Compensation Scheme Year 9–16 (CNY/ha/year)
1	100% Conversion	10,000	5,000
2	70% Conversion	7,000	3,500
3	50% Conversion	5,000	2,500
4	30% Conversion	3,000	1,500
5	SLCP (GFG)	3,150 (210/mu)	1,875 (125/mu)

GFG= Grain for Green, ha = hectare, mu = 1/15 ha, SLCP=Sloping Land Conversion Program.

Source: The authors.

important for households owning farmland, the re-conversion of state land under monoculture rubber plantation to restoration of forest must be pursued rigorously.

To convert monoculture rubber to jungle rubber using a PES scheme, the following steps are important:

1. Valuation of ecosystem services;
2. Determining market value as a basis for compensation and incentives;
3. Determining contractual obligations within a conducive, enabling PES policy framework;
4. Setting up performance standards and monitoring methods;
5. Identifying funding source (compensation);
6. PES contract execution with growers, land users and local administration;
7. Channeling compensation funds through grassroot-based village revolving funds; and
8. Evaluation, ecosystem check, adjustments.

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## Conference Paper 4: Buyer, Regulator, and Enabler— The Government's Role in Ecosystem Services Markets

### International Lessons Learned for Payments for Ecological Services in the People's Republic of China

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#### 1 Introduction

The People's Republic of China (PRC) is at an exciting stage in the development of its national environmental policy framework. The fast-paced economic growth of the past 3 decades, while having lifted hundreds of millions of rural denizens out of poverty, has unfortunately also greatly multiplied the environmental challenges faced by policy makers at all levels of government, increasing pressures on fragile ecosystems, creating a range of new pollution and environmental safety issues, and further straining the country's already limited per capita natural resource base. At the same time, economic growth has also created opportunities, since the PRC's "economic miracle" is giving the government the financial wherewithal to improve its capacity to monitor and enforce existing environmental laws, and to fund new environmental initiatives and policies. At the nexus of these countervailing trends, policy makers have been experimenting with new approaches to environmental management, resulting in a wide range of policy and program innovations, many under the broad heading of "eco-compensation." Many of these incorporate, or provide a framework for, market-based approaches to environmental policy, and in particular for payments for ecological services (PES) (Bennett 2009).

PES is gaining traction internationally as a valuable new approach to conservation that uses direct payments, either in cash or other forms of compensation, from ecosystem

services beneficiaries (e.g., private businesses, communities and society as a whole) to land stewards (i.e., those who can influence the provision of ecosystem services) to encourage ecosystem conservation and restoration (Wunder 2005). In general, four types of 'market' or 'market-like' instruments exist for ecosystem services provision:

- Private payments for private benefits (that may or may not have public benefits);
- Public payments (on behalf of the public interest) for public benefits;
- Private payments motivated by cap-and-trade or floor-and-trade regulatory systems; and
- Eco-certification where ecosystem services provision is included as a characteristic of a standard market good (e.g., "green" and organic agricultural products in the PRC).

In the backdrop of PES is the broader vision of creating the institutional foundations necessary to engender ecosystem service markets. According to economic theory, under the right conditions (e.g., appropriate institutional and legal frameworks, and sufficiently low transactions costs) markets can function more effectively than government "command-and-control" regimes to identify and align the social costs and benefits of ecosystem services provision. International interest in PES has been growing in recent years due to a number

of factors, including the increasing value of ecosystem services due to their growing economic demand, the need to tap into new sources of finance for conservation, growing corporate interest in making environmentally responsible investments, and supportive changes in the governance of natural resources (Scherr et al. 2006). As a result, these direct payment schemes have been flourishing, expanding beyond government-funded initiatives to real market transactions between beneficiaries and providers of services. In 2007, it is estimated that annual payments under all payment schemes and markets for ecosystem services totaled around \$77 billion worldwide, and these total payments are expected to increase to approximately \$300 billion by 2020 (Carroll and Jenkins 2008). Currently, the biodiversity and certified agriculture (i.e., eco-labeling) markets are the most active in terms of volumes of monetary transactions.<sup>51</sup> In the foreseeable future, markets for carbon and certified agricultural products are expected to account for a significant proportion of the growth in payments and markets for ecosystem services.

In comparison to PES, the Chinese term “eco-compensation” is broader, encompassing PES-like policies as well as a range of other policies and programs types, both with and without market-based elements (Bennett 2009). The PRC’s national government has been playing a central role in promoting ecosystem service market development through its various eco-compensation programs and policies; it has made extraordinary efforts in driving some of the largest public payment schemes for ecosystem services in the world, having spent over CNY130 billion on the Conversion of Cropland to Forest and Grassland (CCFG) program to date, under which over 9 million hectares (ha) of cropland has been afforested,

and more than CNY13 billion since 2001 on the Forest Ecosystem Compensation Fund (FECF), which currently covers 105.2 million ha of forest area across 30 provinces in the PRC (State Forestry Administration [SFA] 2007; Economic Daily 2007; SFA 2008a).<sup>52</sup> On-going interest in improving the effectiveness, efficiency, and financial sustainability of these efforts has meant that policy circles have been abuzz with debate on how to improve these programs as well as how to explore and develop other market-based tools and regulatory innovations to better address the country’s environmental and development challenges.

At this critical stage, the PRC has the opportunity to both benefit from and provide innovative examples for international developments in PES. In particular, the PRC’s experience highlights an important point often implicitly overlooked in the international discourse on ecosystem service markets and PES: the central role of the public sector. Current international literature on PES tends to emphasize its private-sector and voluntary aspects, since one of the exciting promises of PES is to broaden and deepen sources of conservation finance by directly engaging a wider array of economic actors as buyers of ecosystem services. In contrast, much discussed amongst policy circles in the PRC is the concept of “combining market mechanisms with government guidance,” indicating a predominantly public-sector driven approach.<sup>53</sup> At first glance, the PRC’s situation thus appears to be unique. It is not. The public sector is still very much the dominant player in ecosystem service markets worldwide. Excluding eco-certified products markets, the public sector contributes roughly 70% of annual ecosystem services payments internationally by value (Milder et al. 2009).<sup>54</sup>

<sup>51</sup> Milder *et al.* (2009) estimates these to comprise roughly 58% of all PES annual transactions by value.

<sup>52</sup> It could be argued that the PRC has been tentatively experimenting with PES programs and market-based instruments for environmental policy for decades. This includes experiments of the Ministry of Water Resources’ (MWR) with leasing “wasteland” in small watersheds beginning in the early 1980s (later formalized in law)—whereby leaseholders could keep the economic gains of land development activities (e.g., horticulture, agriculture, etc.) in return for the obligation to protect against soil erosion and degradation—as well as pilots for emissions trading schemes that have been ongoing since the mid-1980s (MWR 1991; Liu 2005; Wang et al. 2008).

<sup>53</sup> This expression in Chinese is 政府主导与市场机制相结合 (zhengfu zhudao yu shichang jizhi xiang jiehe).

To provide insights for the PRC's policy makers in the development of a national eco-compensation policy framework, this paper discusses the public sector's role in PES internationally. In general, the public sector's role in these markets is both critical, and evolving. As will be discussed in the paper, its roles are evolving in three distinct ways:

- Government as buyer of ecosystem services (a strategy to replace or complement government regulation);
- Government as regulator, mobilizing private demand for ecosystem services through environmental compliance rules, or setting up cap-and-trade systems; and
- Government as enabler, facilitating the growth of private voluntary transactions.

In the remainder of the paper we detail these different roles, provide some key examples, and discuss what insights international experience and trends have for the PRC, as it continues to modify and refine the government's role in conservation and environmental policy.

## 2 Government as Buyer

The public sector has historically been the largest purchaser of ecosystem services (Food and Agriculture Organization of the United Nations [FAO] 2007a). Government-created ecosystem services programs have been important catalysts for the development of ecosystem services markets, with many examples in places such as the United States (US), European Union (EU), Australia, Mexico, Costa Rica, and South Africa. Government watershed payment schemes have been set up in many Latin American countries, including Colombia and El Salvador. (Natural Resources Conservation Service [NRCS] 2008; EU 2008; Forest Trends *et al.* 2008). This is hardly surprising. A review of the history of the federal government's innovation policy, for example, finds that the state's most effective role has been in "stimulating or providing demand,

particularly in the industry's early stages" (Henderson and Newell 2010). Often, where a clear public or financial benefit is present, but is one that does not flow to a sufficiently distinct and concentrated set of beneficiaries, the government steps in as the major buyer of hard-to-value ecosystem services. An example of this is in biodiversity conservation services, where public and quasi-public agencies are currently the largest buyers with payments totaling at least \$3 billion annually.

The PRC aside, the largest public biodiversity PES programs are the US and EU's agri-environmental payment programs, which pay farmers for providing a variety of conservation-friendly land-use and management practices. At a cost of about \$1.5 billion, around 20% of the farmland in the EU is under some form of agri-environmental program to reduce the negative impacts of modern agriculture on the environment (although much of this land is managed for ecosystem services other than specifically biodiversity conservation). Seven programs in the US are authorized under the 2002 Farm Bill to pay land owners for habitat protection and restoration, or for the presence of wildlife on farms, so as to encourage the provision of fish and wildlife habitat on private lands, with payments over \$4.5 billion in 2005 (Scherr *et al.* 2007).

Public PES schemes internationally are struggling with improving design and implementation to increase efficiency and effectiveness, and are developing new tools and methods to do so. This section briefly touches upon some of the important considerations in PES design and efficiency that has resulted from this experience.<sup>54</sup>

### 2.1 Targeting and monitoring

Better targeting and monitoring are central to improving ecosystem services delivery under PES. Pagiola *et al.* (2002) identify the lack of good information over land uses and services as the 'Achilles heel' of payment schemes. Technical experts, producers and buyers must agree on the biophysical linkages between

<sup>54</sup> With eco-certified products markets included, the public sector contributes roughly 29% of total annual payments, with eco-certified products markets contributing roughly 58% (Milder *et al.* 2009).

<sup>55</sup> For a more in-depth discussion of these design issues as they pertain to the PRC, please refer to Scherr *et al.* 2006.



land uses and ecosystem service benefits, and develop suitable methods for measuring and monitoring provision of the service. Lack of reliable data on this might argue for the use of some other instrument than PES. Though absolute precision and certainty are not required, when ecosystem services are highly bundled or poorly targeted, this will be reflected in higher program costs for service provision, and could overlook important tradeoffs and complementarities between the different ecosystem services provided by the same land area. Most public PES systems, when initially set up, have had quite inefficient targeting of funds, in that many payments went to landowners or land uses that actually did not produce the desired ecosystem services. Mexico's hydrological payments program, the US's Conservation Reserve Program and Costa Rica's payments for reforestation (which inadvertently reduced water flow) have all run into limitations due to program targeting and design issues. The PRC's Conversion of Cropland to Forest and Grasslands program has also suffered from inefficiencies due to problems in the bundling of and poor differentiation between the multiple ecosystem services targeted (Bennett 2008). Targeting systems should reflect the context, since some methods are costly and require scientifically-trained individuals to implement them. More informal methods will work where there is a high degree of trust between buyers and sellers, where outcomes of land use change are readily observable by the buyers, and where the financial value of the ecosystem services is relatively low (Scherr *et al.* 2006).

## 2.2 Scaling up, regional differentiation and aggregation

Another important consideration is the balancing of the costs and benefits of scaling up, regional differentiation and aggregation of providers in public PES schemes. Whereas ecosystem services such as carbon sequestration, methane emissions reduction, carbon emissions reduction and water flow regulation, for example, generally require a low level of coordination, and so are more amenable to private sector financing, other services require higher levels of coordination for sufficient provision, thus arguing for a public sector role.

These include water quality management, erosion and sedimentation control and provision of biodiversity conservation via conservation corridors, which require moderate to high levels of coordination (FAO 2007b). These types of PES schemes also generally need to be of a sufficient scale—whole watershed or whole landscape—to ensure consistent and effective ecosystem service delivery. Ability to scale up is thus important, and will not only depend on the capacity of field programs on the ground to support farmers to implement improved land management practices at scale, and to engage effectively with farmer and other local organizations, but also the capacity of the government to manage transactions over long time periods with large numbers of people (e.g., some programs, including the PRC's Conversion of Cropland to Forest and Grassland program, have been using innovations in electronic payment schemes to reduce transactions costs associated with payment delivery). Whether 'economies of scale' in monitoring the adoption of land management practices or actual changes in ecosystem services exist is also another important consideration (FAO 2007a).

For large public PES schemes, however, scaling-up is less of an issue than regional differentiation. Too large of a scale with insufficient regional differentiation can reduce the cost effectiveness of PES due to fuzzy targeting and a high degree of bundling of ecosystem services, which does not take into account the potential tradeoffs between different services (e.g., downstream water quantity versus upstream carbon sequestration). Tradeoffs also exist regarding the degree of aggregation of service providers. The costs involved in the program administration and the targeting and monitoring of PES schemes encompassing huge numbers of individual providers and land parcels spread over large areas can be significant, and thus cost efficiencies can be achieved via aggregation of providers into, for example, community-level groups. At the same time, however, over-aggregation risks diluting the potential cost efficiencies that can be achieved from use of market mechanisms involving numerous heterogeneous service providers bidding on provision of services.

### 2.3 Measuring ecosystem services: valuation or quantification?

A key component of PES is the use of market mechanisms to determine price. In the PRC, current debate regarding PES (or more precisely, “eco-compensation”) often concerns the question of “how much are ecosystem services worth?”, or more specifically, “what should the subsidy rate be?” A sufficiently clear understanding of upstream-downstream linkages in ecosystem services flows is a prerequisite for the development of an effective PES scheme, and science plays a key role in this. However, in examining science’s role, it is important to distinguish between the *valuation* versus the *quantification* of ecosystem services flows.

Quantification of ecosystem service flows—i.e., the estimation of how many units of service provision are achieved via particular land-uses—is essential for the long-term effectiveness and viability of PES (Pagiola et al. 2002). Science clearly has a role to play in gaining a better understanding of the linkages between land use and ecosystem service provision, and in the experimentation and testing of different institutional designs. In comparison, valuation—i.e., the estimation of the economic value, or the monetization, of ecosystem service flows—is important for the initial development of a PES scheme, for example, by helping to determine whether a scheme can be cost-effective and therefore worth developing, and by helping to estimate a starting payment rate. However, over-emphasis on science to estimate the “value” of ecosystem services for the purpose of payments risks losing the benefits of a market mechanism.

In particular, market mechanisms can potentially identify the socially optimal “price” of ecosystem service provision, via the process of bargaining and bidding of numerous buyers and sellers, more effectively than traditional command-and-control measures. Use of markets to arrive at negotiated contractual arrangements helps to ensure that sellers are willing to accept, and buyers are willing to pay for, a set level of ecosystem service provision (or a particular land use or land-use change

proxy) at a given price. Furthermore, these mechanisms can also help improve targeting and cost effectiveness by helping to identify those who can provide services at the lowest price, and ensure that the welfare of participants is not adversely affected by participation. An example of these types of mechanisms is the use of reverse auctions in voluntary public payment schemes to explicitly cover the opportunity cost of alternate land uses, and through self-selection to effectively eliminate those landowners whose agricultural income exceeds their potential income from PES payments. The US Conservation Reserve Program uses this approach, whereby landholders submit bids specifying the environmental services they provide and the lowest price for these goods (often termed the “rental rate”) they will accept. The US government then ranks the bids for cost-effectiveness, paying for that land that provides the greatest environmental impact at the lowest cost (Chomitz et al. 2007). Market mechanisms can also give programs flexibility in adapting to changing relative resource scarcities, as reflected in negotiated prices.

### 2.4 PES and poverty alleviation

As with the PRC, policy makers internationally are intrigued by the potential of PES to achieve poverty alleviation co-benefits along with ecosystem service provision. Recent work has found some evidence that PES schemes could help to alleviate poverty, however only under the right conditions. Important pre-conditions for PES programs to have beneficial effects on poverty reduction is that the poor should: (i) be in the “right place;” (ii) want to participate (e.g., programs should fit into their overall household production strategy); and (iii) be able to participate (e.g., they are able to make the necessary investments, have sufficiently secure tenure, have the necessary skills, etc.) (Bulte et al. 2008; Bracer et al. 2009).<sup>56</sup> In terms of location-based eligibility, the spatial correlation between poverty and degraded and marginal lands in key upper watershed areas is often assumed to be high, yet the relatively few

<sup>56</sup> Please refer to the special edition of Environment and Development Economics on PES and poverty (Volume 13, Issue 03) for more on this.

studies that have looked at this have found a mixed picture (Pagiola et al. 2008). For example, Nelson and Chomitz (2007) find that watersheds in Guatemala and Honduras, where substantial active deforestation is occurring on steep slopes, tend to have the highest concentration of poverty, while Pagiola and Colom (2006) find very little correlation between poverty rates and the importance of an area for water service provision in Guatemala. In terms of ability of poor households to participate, this is influenced by the degree to which PES schemes involve significant changes in land uses. PES schemes targeting large land-use changes, for example, could be inappropriate for poorer households, since these likely require a level of up-front investment and of human capital (i.e., level of education, experience, and amount of household labor) that poorer households do not possess. Overall, while it is possible to link PES with poverty alleviation, policy makers need to be careful, since current evidence finds that tying the two together risks reducing the efficiency of meeting either environmental or poverty reduction objectives (Bulte et al. 2008; Bracer et al. 2009). In the PRC's Conversion of Cropland to Forest and Grassland, in fact, local officials have often over-emphasized the program's poverty alleviation goal, often using it as a way of avoiding the more difficult environmental goals (Bennett 2008).

### 3 Government as Regulator of Ecosystem Services Markets

Another important and evolving role of the government is as a regulator of ecosystem services markets. This encompasses both the "setting the rules of the game," as well as the use of legislative and regulatory mechanisms to mobilize private sector market demand for ecosystem services. Some of the earliest types of programs under this heading can be termed as "regulation-driven markets" whereby the government creates market demand via regulatory requirements to, for example, offset the impacts of development activities on important ecosystems and watersheds. In many cases, an environmental impact assessment for a project or investment may require development of biodiversity offsets to compensate for

unavoidable biodiversity damage in the project. Government-run eco-certification regimes are another, more recent, type of instrument that falls under this heading. In fact, biodiversity and certified agriculture (i.e., eco-labeling) are the most active ecosystem services markets in terms of volumes of monetary transactions (Carroll and Jenkins 2008).

#### 3.1 Regulation-driven markets

Under regulation-driven markets, the government first sets the allowable total- or enterprise-level environmental impact (e.g., a cap on total pollution emissions, restrictions regarding the maximum allowable impacts on ecosystems/wetlands as a result of land development, etc.), and then establishes a market mechanism and regulatory regime for use by economic actors to satisfy these stipulations, such as buying wetlands mitigation credits, investing in biodiversity offsets to be able to conduct land development activities, or purchasing carbon emissions credits to satisfy allowable emissions restrictions. A classic example of this is the wetlands mitigation banking system of the US. Initially developed in the early 1990s by the US Army Corps of Engineers and the Environmental Protection Agency, wetlands mitigation banking was created and adopted to ensure wetland conservation at minimum cost using market mechanisms, and, in particular, to resolve the conflict between growing economic pressure to develop coastal and wetland areas in the US and the strong laws that exist to ensure wetlands conservation. Under this system, a 'bank' of wetlands habitat is created, restored, or preserved, and then made available to developers of wetlands habitats, who must 'buy' habitat mitigation as a condition of government approval for development. Over more than a decade of development, this has progressed beyond a system of project-specific individual 'banks' of mitigation credits, to large commercial and public wetlands banks that are not tied to any particular project and that sell mitigation credits to third-party developers (Salzman and Ruhl 2004).

This mechanism has also provided a model for dealing with the impacts of land development on biodiversity conservation, either via "conservation banking" (which uses

identical mechanisms to wetlands banking for a broader range of biodiversity conservation) or “biodiversity offsets.” Biodiversity offsets are instruments for “offsetting” the unavoidable impact of projects on on-site biodiversity by creating, restoring, or preserving an “equivalent amount” of biodiversity off-site. The US, EU, Brazil, Australia and South Africa all have laws requiring biodiversity offsets in certain circumstances. The *Brazilian National System of Conservation Units*, for example, converts the damages inflicted by a development project, based on the scale of the investment, into “units” to be spent on conservation by the government anywhere within the jurisdiction concerned, with the aim of achieving optimal conservation results. The system is administered at the federal level by the Brazilian Ministry of Environment’s enforcement agency, the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA), which delegates implementation to state agencies. While most of the *Conservation Units* created through offsets to compensate for private investment fall under state jurisdiction, and so are created within a given state’s boundaries, IBAMA has the discretion to create *Conservation Units* in any of the States involved in a cross-boundary project (ten Kate *et al.* 2004).

Most offset legislation tends to include guidelines and rules for types of methodologies and metrics that are acceptable, the geographical limits for screening potential offset sites, and the types of activities that constitute an offset, a high-level goal (e.g., no net loss of biodiversity as a result of development activities), guidelines for determining when an offset may be required and when it may be inappropriate (i.e., due to the significance of the biodiversity impact), and reference to the ‘mitigation hierarchy’ principal, which requires that offsetting must constitute a last resort, only used to offset the negative effects of an indispensable plan or project for which no alternative solutions could be envisaged, and in which the project first mitigates its onsite impacts to the utmost extent possible (Business and Biodiversity Offsets Programme [BBOP] 2009).

Another important example of these types of schemes is the US framework for water quality trading. While the US regulatory structure has been quite effective at controlling

“point-source” pollution (e.g., from industries), non-point source pollution has been more difficult to control, and thus is currently the leading source of water pollution in the US today, with pollution from agriculture the leading cause (Boyd 2000; US EPA 2007). To address this, the US Environmental Protection Agency (EPA) has been promoting the development of water quality trading, or “nutrient trading”. Similar in concept to emissions trading, nutrient trading involves within-watershed trading of water pollution permits, often between point-source and non-point-source polluters, to achieve set water quality targets, embodied in *Total Maximum Daily Loads* (TMDLs) for individual watersheds under the US Clean Water Act (King 2005). The US EPA first drafted a Framework for Watershed-Based Trading in 1996 and, after funding numerous pilot studies, released a Final Water Quality Trading Policy in 2003. The Agency says it may look to nutrient trading schemes to help fight one of the most significant environmental problems it currently faces—the huge hypoxic dead zone in the Gulf of Mexico, which is primarily caused by agricultural watershed pollution, and currently provides policy support, training, and funding for the development of trading schemes (Hawn 2010; US EPA Water Quality Trading website: <http://water.epa.gov/type/watersheds/trading.cfm>). As of 2004, more than 70 schemes are in development in states across the US (up from around 25 only a few years earlier), with these involving a range of mechanisms and performance targets (Breetz *et al.* 2004).

### 3.2 Government eco-certification schemes

As mentioned in the introduction, eco-certification schemes currently comprise the largest share of ecosystem market payments internationally. Such eco-certified goods and services are certified for the ecosystem services they provide via their production process (e.g., low chemical input use, or organic, agriculture, wood certification ensuring source timber was legally obtained, and sustainably harvested). Many of these systems are run by independent certifying organizations that draw legitimacy from multistakeholder processes for



establishing certification criteria (e.g., Forest Stewardship Council, Rainforest Alliance, “bird-friendly”) or have other private or civil society labeling.

But governments play a major role as regulator in many eco-certification regimes, creating certification standards (e.g., US and EU organic food standards); developing criteria, indicators, and audit process rules governing the certification of goods and services that meet particular environmental criteria; and possibly also establishing procurement requirements for public or private buyers. In this regard, the PRC government is ahead of the curve, having already developed its own “green” and organic foods certification system, and a *China Environmental Label* certification system for non-food products, and having in 2008 put into effect a government “green” procurement law which requires all levels of government to place precedence on purchasing environmental-label products, and forbids them to purchase goods harmful to the environment or public health (Bennett 2009).

Though food safety concerns were the initial impetus for the development of low-chemical-input and organic food certification regimes—both in the PRC and internationally—an important trend in these markets is the expansion of current eco-certification regimes, and the creation of new standards, to incorporate a broader and more sophisticated bundling of ecosystem services (e.g., beyond simple low- or no-chemical-input agriculture). This includes landscape labeling initiatives—targeting scale- and location-dependent services such as biodiversity and watershed conservation—that operate like denomination of origins, so that private farmers and others within the landscape who comply with guidelines for biodiversity or watershed conservation can sell their products with that label (Ghazoul et al. 2009). Initiatives to track and certify the carbon footprint of food products are also gaining ground, such as the “food miles” labeling being considered by the UK’s Department for Environment, Food and Rural Affairs (DEFRA) (Shames and Scherr 2010; Ecoagriculture Partners 2008; DEFRA 2005). These trends indicate that the public sector will continue to have an important role to play in regulating, promoting and deepening these markets.

### 3.3 Considerations in regulating ecosystem services markets

For regulation-driven market schemes, reliable and enforceable regulations are critical. If regulatory agencies permit landowners to clear more wetlands than the law permits, then the incentive to invest in offsets will disappear, as has happened in some parts of the US during administrations with lax environmental policies. Also, a critical component of cap-and-trade and related schemes, but one which can often be politically charged, is the way in which the initial rights to credits are allocated by the government to economic actors. This can involve auctions, allocation based on an enterprise’s historical levels of pollution or relative size in the market, and the inclusion of a ‘grandfather clause’ that exempts older enterprises from some portion or all of the stipulations of the new regulatory regime, since the costs of technological upgrade implicit in meeting requirements can be prohibitive in some cases. Pending these issues being satisfactorily resolved, one of the advantages of cap-and-trade is that it creates a class of people who actually benefit from increasingly stringent environmental regulation. Thus, in the US private investors involved in developing wetland mitigation banks actively support legislation to expand conservation targets. Political support for a climate action bill in the US critically depends upon support from segments of the farm sector who eagerly anticipate receiving payments for carbon sequestration.

Another important consideration in the development of these markets is the protection of buyers and sellers. In developing countries with less secure land tenure protections, there is considerable concern that PES schemes will trigger ‘land grabs’ from economically favored groups who are informed about PES rules and opportunities. Thus some countries are considering legislation to ensure protection of sellers’ tenure rights. Other countries are putting in place protections involving processes ensuring that local communities are fully informed of and fully consent to the terms of PES payments.

A final consideration in establishing eco-certification standards is the tradeoff between rigor and scale of impacts. Producers deciding whether or not to adopt particular eco-certification standards generally weigh



the benefits of adoption (the added revenue stream due to the price premiums gained from eco-certification) with the costs (the expenses of the associated monitoring, verification, and certification regime). As the rigor of a standard increases, so does its costs. Thus, while an insufficiently rigorous eco-certification standard can result in negligible environmental impacts, even if broadly adopted due to its low cost, a very rigorous (and thus expensive to adopt) standard might also produce relatively minimal or even negligible impacts, since its added costs might significantly reduce the number and diversity of producers willing to adopt it.

#### 4 Government as Enabler of Ecosystem Services Markets

An increasingly common role taken up by governments is as an “enabler” of ecosystem services markets, by assisting private actors to buy and sell ecosystem services and by providing new legal and policy frameworks to expressly encourage and facilitate market development. This can be seen as an evolution and extension of the two roles discussed above, since an important consideration in the development of public sector schemes is that they create new private sector market opportunities. In recognition of this, many governments internationally have been making a shift from a centralized regulatory approach to environmental governance to greater emphasis on decentralized, flexible mechanisms that allow for the private sector to be a provider of public goods and services, and that allow for the development of public-private partnerships (FAO 2007a). To some extent, this is not unlike trends in the privatization of other public goods and services, such as utilities, telephone and postal services. Swallow et al. (2007b) identifies three important linkages between these “flexible” and “regulatory” approaches to environmental governance, with these having bearing on the potential entry points for the private sector into ecosystem services markets:

- (1) The institutional space created—via allowing flexibility in the approach to compliance in new environmental regulations—for public utilities, local governments, and private firms to innovate with regard to PES activities;
- (2) The incentives that exist for firms or industry groups to actively promote PES schemes as a way of demonstrating commitment to the environment so as to forestall environmental regulations; and
- (3) The incentives that exist for firms or industry groups to voluntarily establish or illustrate best practice in environmental management as a means to influence the shape of future environmental regulations.

While the public sector’s role as buyer is important for catalyzing ecosystem services market development, if too predominant it risks crowding out other potentially important economic actors in these markets. Thus, “government as key buyer” programs have been shifting in some cases to allow participation by private sector buyers. For example, the Kitengela Land Lease Program in Kenya signs leases with private landowners to allow wildlife from Nairobi National Park open access to some portion of their land. Landowners then receive three annual payments of about \$4/acre, which is approximately equivalent to what they would make from grazing livestock on the same land. The average household in the program makes a total of \$400–\$800. The program includes over one hundred households and 8,500 acres (Dunkel 2007). Mexico’s national PES scheme for forest conservation is actively seeking local private sector buyers of watershed services (Muñoz-Piña et al. 2008). Costa Rica has set up a PES scheme based on charging consumers via their utility companies (Pagiola 2008). Government watershed payment schemes, such as the Kagera River payment for watershed services scheme in Tanzania, are also actively courting potential private sector buyers to supplement this effort (FAO 2008). These considerations are also coming into play in the PRC. Concerned with the long-term financial sustainability of the Conversion of Cropland to Forest and Grassland program, for example, policy makers have been considering how to bring in greater private sector support of afforestation efforts (Bennett 2008). The State Forestry Administration’s China Green Carbon Foundation (formally the China Green Carbon Fund), for example, is one of the first public sector

instrument in the country for tapping into private sector financing of afforestation (Bennett 2009).<sup>57</sup>

Government assurances and policy frameworks are critical to facilitate greater private sector participation in both public sector and “voluntary” schemes. For example, governments can underwrite some of the risks the private sector faces in participation, or can agree to buy any credits that investors cannot sell in the case of voluntary ‘cap-and-trade’ markets (Bayon and Jenkins 2010). Other types of enabling activities include the following:

### Policy and regulatory support

- Provision of oversight and quality control over national registries of ecosystem services;
- Development of standards around what constitutes an ecosystem service credit; and
- Development of national certification systems.

### Training, technical support and other services

- Provision of offices where sellers and buyers can meet;
- Provision of training and informational services to market actors, such as business and advisory services hub for new buyers or sellers of ecosystem services;
- The mapping of ecosystem values so that private actors (or lower government levels) can easily select sites. This includes identifying priority/critical areas (e.g., mapping work underway in Africa of soil ecosystem services, by Columbia University with Gates funding), and encouraging buyers to focus on areas where institutional conditions are already in place to enable transactions;
- Partnering with private sector firms to help them design and initiate a private

PES scheme (e.g., for water bottling plant).

One example of these types of enabling activities is the US Department of Agriculture’s Office of Environmental Markets ([www.fs.fed.us/ecosystemservices/OEM/index.shtml](http://www.fs.fed.us/ecosystemservices/OEM/index.shtml)), established in 2008 to pilot, document and advise private actors in ecosystem services markets, and to coordinate the work of various government agencies on ecosystem services and on the creation and monitoring of new environmental markets. While it still faces a range of challenges—it is small with few powers, and faces an uphill struggle trying to coordinate government agencies that are notoriously poor at communicating with each other—if allowed to flourish, it would represent a great step forward, for example by helping the US Forest Service to measure the extent of ecosystem services provided by the country’s forests and consider how best to value them. Governments in Australia, Europe, Latin America, and elsewhere have begun to set up similar systems to manage natural infrastructure (Bayon and Jenkins 2010). National carbon offices are also being set up in many countries as a sort of ‘one-stop-shop’ for buyers and sellers (or intermediaries, as an information clearinghouse, a source of legal advice, etc.).

In the case of the PRC, various local governments have been setting up environmental exchange platforms in anticipation of domestic trading schemes for carbon, water pollution emissions, and energy efficiency credits, with these involving public-private partnership in several cases. This includes the Tianjin Emission Rights Exchange—which was set up in 2008 and is a collaboration between the Tianjin Property Rights Trading Center, China National Petroleum Corporation’s Resource Management Co. Ltd., and the Chicago Climate Exchange—and the Panda Standard ([www.pandastandard.org/](http://www.pandastandard.org/)), the country’s first voluntary carbon standard, which is being developed in collaboration between the China

<sup>57</sup> Since Bennett (2009), this has been upgraded from a “Fund” to a “Foundation” (*China Green Times*, 2010).

Beijing Environmental Exchange and BlueNext (Wang et al. 2008; Bennett 2009).

Overall, the public sector has the potential to play an important role in enabling and encouraging the development of these markets. It can play an important role in research on ecosystem services, including the mapping of these services, developing improved monitoring systems, understanding how ecological processes change across scales, and in training national and sub-national leaders in PES management. It would be good for governments to both direct private investments towards opportunities where institutional conditions are already in place to enable transactions (since private investment can provide public benefits) and to protect public environmental goods by not allowing PES schemes that divert public benefits to private buyers.

## 5 Looking to the Future: The Evolving Role of Government

As with international experience, the PRC's ongoing development of eco-compensation regulations and other market-based environmental policies will have much to say regarding a fundamental question underlying PES: how are ecosystem service markets created? The public sector is clearly a critical part of the answer to this, serving both to create and to catalyze ecosystem services market development. The PRC's Conversion of Cropland to Forest and Grassland and Forest Ecosystem Compensation Fund are important examples of this; despite ongoing design, implementation, and funding challenges, these programs by their sheer scale have generated significant momentum for the development of future ecosystem services markets in the country. Through the awareness-raising (regarding the offsite impacts of particular rural land-uses, and therefore their potential economic value) and hands-on experience in implementation that has been provided by these programs, rural communities throughout the PRC have been able to improve their ability to effectively participate in future PES schemes as sellers of ecosystem services. Local governments' capacities to develop and manage PES programs have as well been strengthened

via the hands-on experience in the planning, implementation, targeting, monitoring, and evaluation activities that they have gained as a result of being involved in these programs. Thus, in the PRC as elsewhere, the government has been instrumental in "getting the ball rolling."

Policy makers are now at a stage to consider next steps, and to determine the government's evolving role and level of involvement in these growing markets. Too little involvement, on the one hand, risks letting the immature fruit of ecosystem services markets shrivel on the vine. Sufficient scale is necessary in markets in order for secondary and tertiary actors—aggregators, intermediaries, insurers, market information services, etc.—to begin to arise, and thus for markets to deepen and mature. Also, sufficient regulatory oversight and legal frameworks are necessary to protect both ecosystem services providers and buyers when developing contractual agreements. Thus, governments will definitely need to strengthen their regulatory role, and will likely need to remain key ecosystem services buyers for the foreseeable future. However, at the same time, exclusive government control of ecosystem services markets risks crowding out potentially significant sources of conservation finance from non-government economic actors, dampening incentives for innovation in these payment schemes, strengthening incentives for inefficient rent-seeking behavior by the government agencies that manage these programs, and creating yet more, costly, "big government" regulatory instruments for conservation. Central to the ongoing development of these markets is the question of how to incentivize the participation in these markets by a wider range of economic actors, since it is in this way that some of the key potential benefits of PES schemes—the improved mainstreaming of ecosystem services values into economic activities, and the broadening of sources of finance for conservation activities—can be realized. This trend is already taking place internationally. While public sector buyers have historically been the largest purchasers of ecosystem services, this is changing as cap-and-trade programs for carbon and various habitat mitigation schemes are increasing the role of private sector buyers acting under

regulatory obligation. Thus, the global portfolio of PES is shifting from a preponderance of government programs financed by tax revenue, foreign aid, and loans to a greater share of true market instruments driven by private demand and facilitated by the maturation of supporting institutions (FAO 2007a; Bracer et al. 2009).

In assessing next steps, however, it should be remembered that the PRC is both ahead of and behind current international trends in environmental policy reform. While numerous frameworks for innovative, flexible environmental management mechanisms are already taking shape in the country, more fundamental improvements in basic monitoring and enforcement capacity are also needed. PES and other market-based instruments should not be considered as a low-cost alternative to basic improvements in the environmental management regime, since these tools are designed to achieve conservation and environmental restoration beyond what is required under current regulatory structures. To be viable and effective, such tools require effective monitoring, verification, and certification regimes, as well as effective enforcement of existing regulations. In the case of Tai Lake, for example, despite strong political leadership, the government still faces numerous challenges in improving water quality in the lake watershed, which has suffered various effects of development over the past 50 years, and particularly over the past decade (ADB 2008). In the absence of measures that address the underlying causes of pollution in the lake, including the lack of a strong, integrated management framework backed by a sufficiently strong legal authority, it is unlikely that PES-like eco-compensation programs or other market-based instruments, such as the emissions rights trading pilots currently being developed in the watershed, will achieve what other policies have not.

However, the government is clearly addressing these issues in its ongoing reforms of the country's environmental regulatory and enforcement regime, of which eco-compensation is a part. And it is encouraging to see that while doing so it has also been actively exploring the types of innovative approaches discussed above, such as regulation-driven market mechanisms and eco-certification schemes.

Both central and local governments, for example, have been experimenting with water and air pollution emissions-trading mechanisms since the mid-1980s, and the pace of policy and pilot developments has quickened significantly since 2000. A number of government eco-certification regimes have also been taking shape since the early 1990s. One is the PRC's environmental label certification system, recently augmented by the government "green" procurement policy, which stipulates that, as of 1 January 2007, all levels of government are to place precedence on purchasing environmental-label products, and are forbidden to purchase goods harmful to the environment or public health. The Ministry of Agriculture also has a "green" (i.e., low chemical input use) and organic food certification system, and the Ministry of Environmental Protection has its own organic food label (Bennett 2009).

As regulatory and enforcement capacity improve, these policies and programs can provide an excellent framework to be built upon and expanded to target other ecosystem services, and a wider range of economic actors. Ongoing concerns regarding the financial sustainability, design, and implementation of the PRC's current large-scale 'eco-compensation' programs suggest that these could benefit from the participation of a broader range of actors. This includes both economic actors as payees, as well as the academic and research community. Similar to Mexico's national PES scheme for forest conservation, or the Costa Rican watershed PES example, the PRC government could consider revising the funding mechanisms for these programs, in particular watersheds, to exploit the direct linkages between service providers and beneficiaries—e.g., by adding charges to water fees through utility companies. In fact, this is already taking place in some locales (Bennett 2009). These types of approaches would require clarification of land use impacts on watersheds, and a framework of ongoing payments conditional on monitored and verifiable service delivery from altered land uses. This argues for more government-academic collaboration—to pilot new PES designs and methodologies for monitoring, verification, and evaluation of ecosystem service delivery and program implementation—which would help to improve current and future programs.



Examples of this can be found in other countries, such as experiments in Germany with auction mechanisms to determine payments to farmers for changed land uses that are biodiversity friendly, with the view of incorporating these results into the EU's Common Agricultural Policy (Bertke and Marggraf 2005).

"Regulated-Market" instruments, such as biodiversity offsets and wetlands banking, also hold significant promise for the PRC as a means to cost-effectively achieve environmental targets. Though none yet exist in the PRC, in that current policies still do not involve actual offsetting activity to achieve "no net loss" in biodiversity, a number of policy frameworks are in place that could be expanded to incorporate these types of mechanisms. Examples include the Forest Vegetation Restoration Fee, and the various fee and subsidy standards and regimes governing soil and water erosion prevention and the impacts of mining activities (Bennett 2009). The PRC's various eco-certification regimes can also be expanded to include a wider range of ecosystem services, such as whole landscape scale agricultural certification to ensure biodiversity or watershed impacts. As policy makers develop a national eco-compensation policy framework, they should keep in mind the potential benefits that these types of market-based instruments could add to the environmental policy tool kit, both in terms of added flexibility and cost-effectiveness as well as for the entry points and platforms they provide for engaging and empowering a wider range of economic actors in conservation and environmental restoration.

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## Conference Paper 5: Payments for Ecological Services: An Australian Perspective

### South East Queensland Healthy Waterways as a Case Study

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#### 1 The South East Queensland Healthy Waterways

The South East Queensland (SEQ) Healthy Waterways Partnership (the partnership) framework illustrates a unique integrated approach to water quality management whereby scientific research, community participation, and policy and/or strategy development are done in parallel. This collaborative effort has resulted in a Healthy Waterways Strategy, which integrates the socioeconomic and ecological values of the waterways. It has also led to significant cost savings by providing a clear focus on initiatives towards achieving the “Healthy waterways: Healthy catchments” vision—i.e., by 2020, SEQ’s waterways and catchments will be healthy ecosystems supporting the livelihoods and lifestyles of people in SEQ, and will be managed through collaboration between community, government, and industry.

The partnership represents a whole-of-government, whole-of-community approach to understanding, planning for, and managing the use of SEQ’s waterways. The key elements of the Partnership include (i) the implementation by a range of partners of management actions ranging from upgrades in sewage treatment plants, to improved planning regimes and rehabilitation of riparian vegetation; (ii) a multidisciplinary science and research program that underpins the management action program and monitors its effectiveness; and (iii) the Healthy Waterways promotional and educational program that seeks to build on similar activities of partners and ensure that there is community awareness and support for action.

#### 1.1 *A balanced approach*

The natural checks and balances provided by the tripartite model of management, research, and monitoring (Figure 1) provide the foundation for the partnership. The interactions between management, research, and monitoring involve a two-way flow of information. Management, with input from the community, provides environmental values and resource management objectives, and identifies key environmental issues and knowledge gaps. Researchers address the key issues, gather information to narrow the knowledge gaps, and provide the scientific linkages that support and create the various indicators used by resource managers involved in monitoring. Monitoring provides feedback to researchers in the form of prioritized research based on patterns observed during the assessment of the ecosystem. The interactions between monitoring and management are somewhat similar to the management-research interactions. In both cases, management, with input from the community, provides the environmental values and resource management objectives. The major difference is that monitoring provides management with the feedback on various management actions invoked.

Achievement of the outcomes of the Partnership relies on people from various sectors of society working together. It is proposed here that the central driving force for developing an effective program or study is not the absolute amount of scientific or management activity or expertise. Rather, it is the balance between management, research, and monitoring.

**Figure 1** The Tripartite Model of Management, Research, and Monitoring



Source: Abal, et al. 2005.

### **1.2 Challenges faced by South East Queensland**

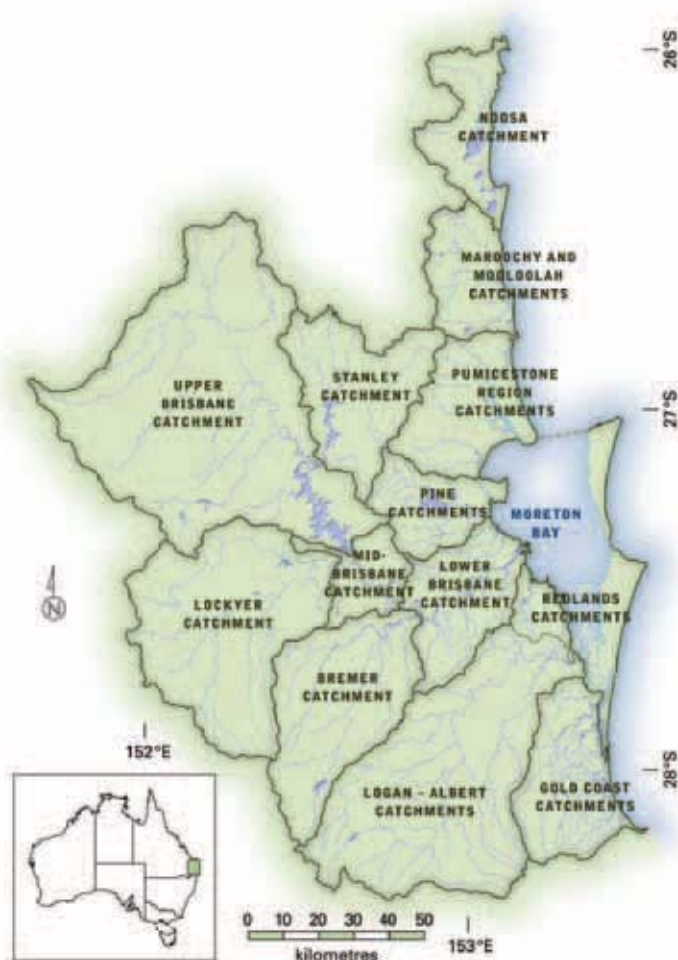
SEQ (Figure 2) has one of the fastest growing populations in Australia, with just over 2 million people. Over the next 20 years, the population of SEQ is expected to grow from 2.73 million people to over 4 million. This increase in population is expected to result in 75 square kilometers (km<sup>2</sup>) of bushland, agricultural land, and other rural land being converted annually to housing and other urban purposes. Initial scenario runs using the Partnership's decision support tools have enabled us to understand the potential impacts in 20 years' time from the predicted population growth. This rapid growth will result in increasing demands for reliable supplies of potable water, an estimated 50% increase in point-source pollution, and a 20% increase in diffuse source pollution, plus increased recreational pressures on natural areas including SEQ's waterways.

Thus, the human footprint on the catchment is currently extensive and promises to be more extensive in the future.

The riverine and estuarine environments of the SEQ catchment have been significantly altered. Land use changes and vegetation clearing have resulted in increased flows, erosion, and delivery of both nutrients and sediments from the catchments to the waterways. Only 26% of the catchment's original vegetation remains. Channel (gully and streambank) erosion is the dominant form of erosion in the SEQ catchment. Most of the sediment is generated from quite specific locations, with more than 60% of the sediment coming from less than 30% of the area. Given the episodic nature of rainfall in the catchment, protection of riparian areas, especially in the headwater (first- and second-order) streams need to be in place to prepare the catchment and waterways for extreme flow



**Figure 2 South East Queensland Region:  
Moreton Bay and the Different Catchments**



Source: Abal, et al. 2005.

events. During smaller events or dry conditions, urban areas may have a significant contribution of sediment loads to SEQ waterways.

## **2 Developing a Framework for Action: SEQ Healthy Waterways Strategy**

The Partnership developed the SEQ Healthy Waterways Strategy 2007–2012 (the Strategy), with the primary objective of halting water quality decline and, where possible, improving

the ecosystem health of Moreton Bay and the region's estuarine and freshwater assets. The Strategy provides the strategic focus and implementation priorities for the Partnership to achieve its vision. It aims to maintain and improve the health of the waterways of SEQ by

- reducing urban and non-urban diffuse source pollution;
- protecting and conserving high ecological value waterways;
- decreasing point source pollution;
- improving catchment health;

- combating coastal algal blooms;
- increasing the commitment and capacity of the general community;
- improving management via better modeling and evaluation; and
- refining the ecosystem health and event monitoring programs.

The different actions in the strategy are aimed at ensuring that the health of the SEQ waterways is maintained or improved in the face of one of the highest rates of population growth in Australia, and recognizes that the growing significance of long-term security of water supplies in SEQ highlights the importance of maintaining water quality—a key aspect of waterway health, and a key benefit of healthy aquatic ecosystems.

### 3 Developing a Business Case for the Strategy Using Payments for Ecological Services (PES) Approach

To obtain funding for the implementation of the different actions in the SEQ Healthy Waterways Strategy, a business case that outlines the costs of “business as usual” or “do nothing” scenario was developed and submitted to the Queensland government. The business case uses an approach that included the valuation of ecosystem services.

#### 3.1 What are ecosystem services?

“Ecosystem services” is the term given to the goods and services provided by natural (and semi-natural) ecosystems that benefit, sustain, and support the well-being of people. They include the production of food and medicines, the regulation of climate and disease, provision of productive soils and clean water, and landscape opportunities for recreation and spiritual benefits (Daily 1999).

Ecosystem services are derived from the complex interactions between the components and processes that occur within an ecosystem (ecosystem functions). It is the diversity of the components (i.e., biodiversity) and interactive processes within and between all ecosystems that produce the extensive range of essential services required for humans to survive. In short,

ecosystem services are the benefits people obtain from ecosystems.

The benefits, or services, that come from ecosystems, meet the full range of essential human needs, from life support to life fulfilment. The delivery of these services is declining largely due to ignorance of what the values are, an unbalanced focus on what value means to individuals rather than communities, inadequate debate about the efficiency and effectiveness of substituting technology for ecosystems, and inadequate institutions and mechanisms to encourage investment in maintenance of ecosystems (Cork et al. 2001).

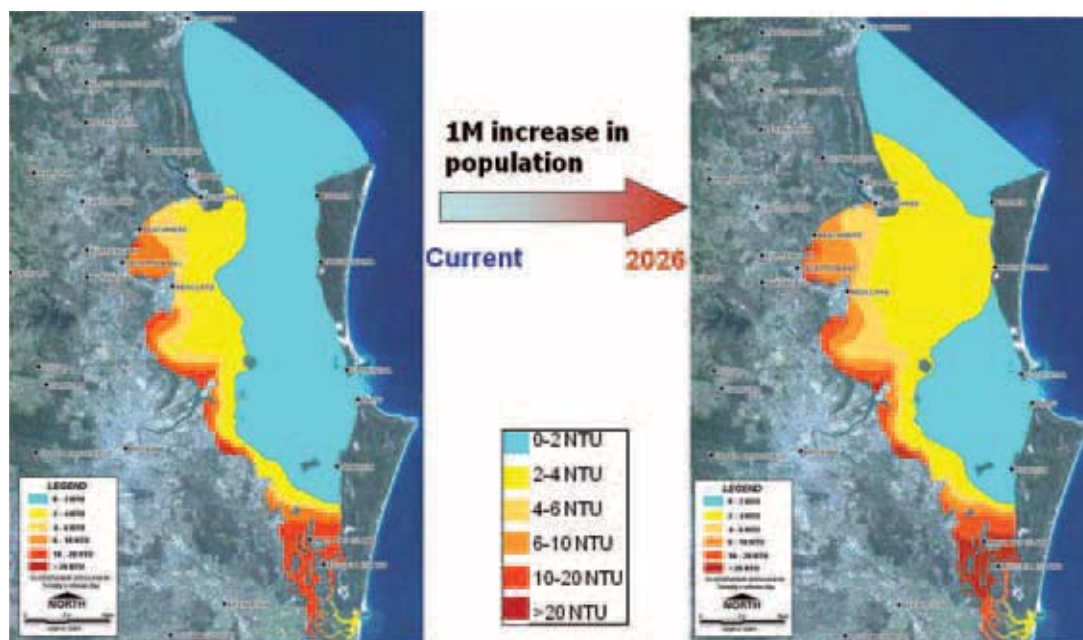
#### 3.2 Valuing the costs of not achieving the targets

Moreton Bay is a special place. It is a shallow, subtropical embayment with abundant seagrasses, mangroves, sea turtles, and dugong, adjacent to a rapidly expanding population. The significance of its biodiversity is recognized at international, national, and state levels through its listing as an international Ramsar site and creation of the Moreton Bay Marine Park. The ecosystem health of Moreton Bay is the driver for the South East Queensland Healthy Waterways Partnership.

However, like many Australian estuaries, Moreton Bay is characterized by strong lateral gradients in water quality, with hyperautotrophic and oligotrophic waters within tens of kilometers. High sediment loads, especially during high flow events, together with resuspension of fine-grained sediments in the river estuaries and western Moreton Bay lead to high turbidity, reduced light penetration, and subsequent seagrass loss. Sewage-derived nutrient enrichment, particularly nitrogen (N), has been linked to algal blooms. (Dennison and Abal 1999).

With the predicted increase in population by 2026, such threats to Moreton Bay will increase. In a “do-nothing” or “business-as-usual” scenario, the impacts will extend to Eastern Moreton Bay, which is currently home to healthy communities of seagrass and dugongs (Figure 3). To strengthen the campaign for stakeholders to commit to the healthy waterways vision, it is important to determine the costs of the “do-nothing scenario.”

**Figure 3 Turbidity Maps of Moreton Bay Depicting Predicted Population Increase in South East Queensland by 2026: A “Do-Nothing Scenario”**



NTU = nephelometric turbidity unit.

Source: Abal, et al. 2005.

Valuing the costs of the “risks” of not achieving the targets (i.e., “do-nothing” scenario) is predicated by the availability of agreed baseline environmental conditions, agreed targets, effective indicators for tracking, and the costing of use and non-use values that the community places on the waterways.

### 3.2.1 Agreed baseline environmental condition

Environmental values have been set by the community for Moreton Bay and SEQ waterways. The SEQ community values their waterways for aquatic ecosystems, wildlife habitats, human consumers, primary recreation, secondary recreation, visual amenity, cultural heritage, industrial use, aquaculture, drinking water, irrigation, stock watering, and farm supply (Table 1). These values provided the baseline environmental condition that the community has set for the waterways.

For a particular Environmental Value (EV) to be protected, it is necessary to maintain a set of aquatic ecosystem characteristics that support that EV. Water quality objectives (WQO)

are the levels of measurable indicators of those characteristics.

WQOs may be defined for a range of physical parameters (e.g., turbidity, suspended solids, and temperature); chemical parameters (e.g., phosphorus, nitrogen, biochemical oxygen demand, and toxicants); and biological parameters (e.g., algae, diatoms, macro-invertebrates, and fish), as well as other measures of catchment condition (e.g., erosion levels, riparian vegetation, and channel morphology).

Taken together, EVs and WQOs inform a range of statutory and non-statutory instruments and mechanisms for planning and natural resource management, including the assessment of development proposals. Management focused on achieving or maintaining the WQOs necessary to support agreed EVs provides the most secure approach to minimizing the social, economic, public health, and environmental risks associated with loss of quality of waterways.

The WQOs necessary to maintain most of these EVs can be defined and used as a basis for management. It is a general principle that where a water body has more than one EV, the relevant

**Table 1 Environmental Values for Waterways Set by the South East Queensland Community**

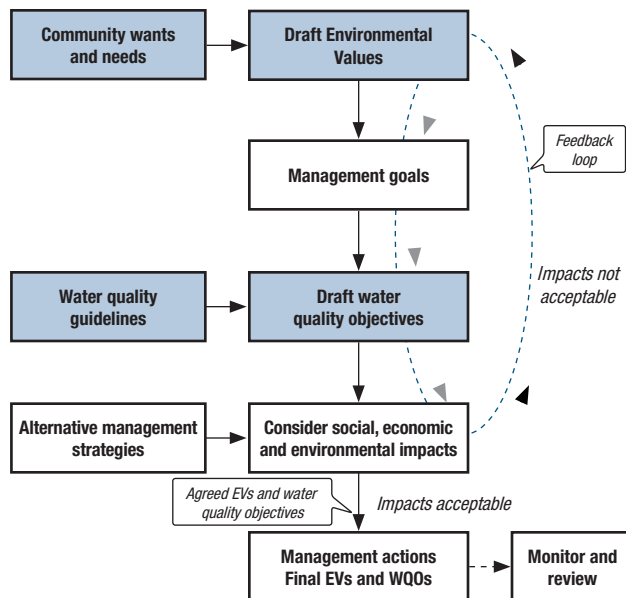
Community Value Table	
	Aquatic ecosystems e.g. Healthy seagrass which support dugong and turtles
	Wildlife Habitat e.g. Habitat for native species like the green tree frog
	Human Consumers e.g. Shellfish and fish that are safe to eat
	Primary Recreation e.g. Clean waters to swim in
	Secondary Recreation e.g. Clean water for sailing and fishing
	Visual Amenity e.g. Views of clean water and healthy coastline
	Cultural Heritage e.g. Protection of indigenous values
	Industrial Use e.g. Economic development with sustainable water use
	Aquaculture e.g. Prawn farms using best practice
	Drinking Water e.g. sufficient safe water supplies
	Irrigation e.g. sufficient water for crops
	Stock Watering e.g. sufficient water for cattle
	Farm Supply e.g. sufficient clean water for rural residents

### Environmental Values

Environmental Values (EVs) are defined as “the particular values or uses of the environment that are important for a healthy ecosystem or for public benefit, welfare, safety, or health.” EVs are what the community wants from, or values in, their environment—in this case, the waterways. Several EVs may be designated for a specific water body. Identification of community values and expectations is an essential step in defining EVs. Understanding of the factors supporting the identified EVs will indicate the characteristics of a particular waterway (including water quality levels) that need to be protected to ensure that these values are maintained.

Source: Abal, et al. 2005.

**Figure 4 Development Process of Environmental Values and Water Quality Objectives**



EV = environmental value, WQO = water quality objective.

Source: Abal, et al. 2005.

WQO for management purposes is that of the EV requiring the highest water quality. WQOs relevant to these EVs were developed based on scientific information, monitoring results, computer modeling of waterways to predict environmental impacts of pollution sources, technical feasibility of management actions to achieve WQOs, and an initial socioeconomic assessment of management actions (Figure 4). Table 2 shows the set of WQOs set for Moreton Bay.

### 3.2.2 Effective indicators for tracking

To maintain the health of SEQ's waterways, it is necessary to have an ongoing and up-to-date understanding of changes to the quality of

that environment. One of the hallmarks of the Partnership has been the development of a comprehensive and defensible ecosystem health monitoring program (EHMP) to provide an objective assessment of the health of waterways throughout SEQ. The indicators used for EHMP are those that reflect environmental values set for the waterways.

The information collected in the EHMP is used to advise councils and land managers on areas of declining health, report on the effects of different land uses, and to evaluate the effectiveness of management actions aimed at improving and protecting aquatic ecosystems.

The estuarine and marine EHMP began in 2000 and includes monthly monitoring at

**Table 2 Scheduled Water Quality Objectives for Moreton Bay, South East Queensland**

Parameter	EHMP WQOs – Bay (SEQRWQMS 2001) (annual median unless indicated otherwise)		Scheduled WQOs – Moreton Bay (March 2006) (WQOs to protect aquatic ecosystem EV)			
	Bramble Bay, Deception Bay, Waterloo Bay, Southern Bay	Central Bay, Eastern Banks, Eastern Bay	Waterloo Bay (part)	Bramble Bay, Deception Bay, Waterloo Bay (part)	Central Bay	
			<i>Level 1*</i> 20 <sup>th</sup>   50 <sup>th</sup>   80 <sup>th</sup> percentiles	<i>Level 2**</i>	<i>Level 1</i> 20 <sup>th</sup>   50 <sup>th</sup>   80 <sup>th</sup> percentiles	<i>Level 2</i>
Turbidity	–	–	1   3   6 NTU	<6 NTU	<1   1   2 NTU	<2 NTU
Chl a	<2.0 µg/L	<1.0 µg/L	0.5   1.0   1.6 µg/L	<1.6 µg/L	0.5   0.8   1.0 µg/L	<1.0 µg/L
TN	<220 µg/L		120   150   200 µg/L	<200 µg/L	110   130   160 µg/L	<160 µg/L
Oxidised N	–	–	2   2   2 µg/L	<2 µg/L	2   2   2 µg/L	<2 µg/L
Ammonia N	–	–	2   3   5 µg/L	<5 µg/L	2   3   5 µg/L	<5 µg/L
Organic N	–	–	110   150   190 µg/L	<190 µg/L	100   120   150 µg/L	<150 µg/L
TP	–	–	15   22   30 µg/L	<30 µg/L	12   15   20 µg/L	<20 µg/L
FRP	–	–	6   10   14 µg/L	<14 µg/L	3   5   8 µg/L	<8 µg/L
DO	–	–	95   100   105 %sat	95–105 %sat	95   100   105 %sat	95–105 %sat
pH	–	–	8.1   8.2   8.4	8.1–8.4	8.2   8.2   8.3	8.2–8.3
Secchi	>1.7 m		1.3   2.0   3.0 m	>1.3 m	2.7   4.5   6.0 m	>2.7 m
Lyngbya	<0% cover (annual maximum)		–	–	–	–
δ15N	<4% (reporting zone maximum)		–	–	–	–
DIN#	<20 µg/L		–	–	–	–

– = no data, µg/L = microgram per liter, Chl a = chlorophyll a, DO = dissolved oxygen, EHMP = Ecosystem Health Monitoring Program, EV = environmental value, FRP = filterable reactive phosphorus, m = meter, N = nitrogen, NTU = nephelometric turbidity unit, sat = saturation, SEQRWQMS = South East Queensland Regional Water Quality Management Strategy, TN = total nitrogen, TP = total phosphorus, WQO = water quality objective.

Note: pH is a logarithmic measure of hydrogen ion concentration which is used as a rough measure of the acidity of a solution. The “p” stands for “potenz” (this means the potential to be) and the “H” stands for Hydrogen.

Source: Abal, et al. 2005.



260 sites in coastal waterways from Noosa to the New South Wales border. The freshwater EHMP began in 2002 and now involves twice-yearly sampling at over 120 sites on all of the major streams in the region. Both programs use a broad range of biological, chemical, and physical indicators—chosen because they provide essential information about the status of valuable waterway assets. Monitoring alone, of course, is useful only for documenting declines.

A key component of the EHMP is the effective communication of monitoring activities and scientific results. One of the major outputs from the Program is the annual report card, which provides a timely reminder to local and state governments and the broader community as to how well we are tracking in terms of protecting the health of our waterways (See [www.ehmp.org](http://www.ehmp.org)).

### 3.2.3 Agreed targets: concept of sustainable loads

Improving the ecosystem health of SEQ's waterways in the face of increasing population growth in the region can be met by implementing a quantitative and defensible approach referred to as the "sustainable loads" concept. This approach underpinned the development of the SEQ Healthy Waterways Strategy.

The ecosystem health condition of SEQ's waterways is a reflection of the impacts

of different kinds of pollution offset by the assimilative capacity of the waterways, such as freshwater and tidal flushing, and internal processing. Pollution entering our waterways comes primarily from point (industrial discharges and wastewater treatment plants) and diffuse (urban stormwater plus agricultural and natural systems run-off) source emissions.

The setting of targets (or quantifiable objectives for the mass load of pollutants) as a "goal post" for management is critical in the development of water quality improvement plans and regional natural resource management plans.

"Sustainable loads" are defined as the amounts of pollutants (e.g., nutrients or sediments) that a waterway can assimilate without becoming degraded. For operational purposes, sustainable loads are the loads that a waterway can accommodate and still achieve the water quality objectives that underpin the environmental values set for the waterway (taking into consideration environmental flows and the assimilative capacity of the waterway).

Targets for the different action plans in the SEQ Healthy Waterways Strategy are shown in Table 3.

### 3.2.4 Costing use and non-use values

The value of waterways is made up of a wide range of factors, such as

**Table 3 Action Plans and Targets of the South East Queensland Healthy Waterways Strategy**

Action Plan and/or Issue Addressed	Target
Point Sources	By 2026, 100% of nutrient loads originating from point sources are prevented from entering receiving waterways and Moreton Bay.
Non-urban Diffuse Sources	By 2026, non-urban diffuse pollutant loads entering receiving waters will be reduced by 50% and in-stream ecosystem health will improve in targeted catchments.
Water Sensitive Urban Design	By 2026, all developed urban land in South East Queensland (SEQ) will meet consistent regional standards for Water Sensitive Urban Design.
Protection and Conservation	By 2026, SEQ waterways and wetlands, and vegetated areas making important contributions to waterway health, are protected and conserved.
Coastal Algal Blooms (CAB)	By 2026, in all SEQ estuarine and marine waterways, the intensity, frequency, and extent of existing CABs have been reduced, no new CABs have occurred and the impacts of CAB events have been minimized.

Source: Abal, et al. 2005.

- the values people derive from using and appreciating waterways and aquatic biodiversity;
- the full cost of restoring waterways, including aquatic ecosystems, to levels that will meet the EVs placed on waterways by the SEQ community;
- the contingent value of waterways based on the loss to society from reduced amenity, aquatic species extinction, and irreparable loss of aquatic ecosystem health and complexity;
- the farm gate or harvest-site value of products such as fish obtained from the region's waterways;
- the portion of the market value of products (including cattle and agricultural produce) obtained from managed production systems or other industries such as tourism that can be attributed to waterway attributes or services; and
- the financial loss from avoidable flood damage and declining productivity following waterway degradation (adopted from the ANZECC ANZECC and Biological Diversity Advisory Committee, 2001).

Applying economic values to this combination of factors would allow lifestyle and economic values to be grouped, using "dollar value" as the common unit. However this would be a challenging economic exercise.

Assigning economic values to indicate the magnitude of the risks that would be associated with not increasing our level of effort to maintain or improve waterway health would also not be easy. However, some idea of what would be at risk can be gained from considering the following:

- Impacts on water quality that will lead to increased water treatment costs. International studies show significant benefits as a result of treatment costs avoided where catchment and waterway management has been improved;
- Increased risks of algal blooms and other impacts, affecting SEQ's \$3.6 billion per annum tourism industry. SEQ's waterways are a major drawcard for international tourists and losses in

the quality of waterways are likely to adversely affect this vital industry, which employs approximately 136,000 people (over 7% of SEQ's workforce). It has been estimated that each year over 750,000 visitors to SEQ participate in water-based activities such as beach swimming and sailing;

- Reduced production from the commercial fisheries and aquaculture industries, collectively worth \$45.5 million per annum;
- Potential negative impacts on segments of SEQ's agricultural sector, worth about \$800 million per annum;
- Negative impacts on the recreational fishing sector, worth about \$194.2 million per annum; and
- Risks to biodiversity, which relies on maintaining and enhancing water quality and waterway health. This has been estimated to be worth about \$200 million per annum.

The above list, however, provides only a partial indication of the risks that would flow from not increasing the level of investment in maintaining aquatic ecosystem health. Preliminary work done by Partnership experts has identified a wide range of economic and amenity impacts that could be expected to flow from a decline in water quality in the region (Table 4).

What is clear is that there is a high benefit-to-cost ratio for money spent on maintenance and rehabilitation of waterways, including benefits from maintaining and improving tourism opportunities, higher property values, improved public health, higher quality of life, and reduced costs of land management and agriculture. The alternative costs, i.e., the costs resulting from not increasing efforts to protect and improve waterway health beyond those currently being taken, are likely to be both substantial and unacceptable.

## 4 Underlying Principles of PES Approach

### 4.1 Upstream vs. downstream

While massive population growth will drive significant changes in SEQ, for water, the issues will focus around adequacy of good supply

**Table 4 Economic and Social Consequences of Water Quality Decline in South East Queensland**

Environmental Values	Economic and Social Consequences of Water Quality Decline	Consequences (Social and Economic)/ Damages
Contact Reaction: <ul style="list-style-type: none"> <li>• Primary recreation</li> <li>• Secondary recreation</li> </ul>	• Health risks	<ul style="list-style-type: none"> <li>• Costs of illnesses and injuries <ul style="list-style-type: none"> <li>» Treatment</li> <li>» Lost production and/or income</li> </ul> </li> </ul>
	• Threat to tourism	<ul style="list-style-type: none"> <li>• Lost tourism expenditure plus flow-on impact <ul style="list-style-type: none"> <li>» Regional impact</li> </ul> </li> </ul>
	• Loss of recreational “amenity” use	<ul style="list-style-type: none"> <li>• Reduction in human well-being</li> </ul>
Fishing: <ul style="list-style-type: none"> <li>• Commercial</li> <li>• Recreational</li> </ul>	• Health risks	<ul style="list-style-type: none"> <li>• Costs of illnesses <ul style="list-style-type: none"> <li>» Treatment</li> <li>» Lost production and/or income</li> </ul> </li> </ul>
	• Reduced commercial fish catch	<ul style="list-style-type: none"> <li>• Loss of production plus flow-on impacts <ul style="list-style-type: none"> <li>» Regional impact</li> </ul> </li> </ul>
	• Threat to tourism	<ul style="list-style-type: none"> <li>• Lost tourism expenditure plus flow-on impact <ul style="list-style-type: none"> <li>» Regional impact</li> </ul> </li> </ul>
	• Reduced industry reputation (domestic and export markets)	<ul style="list-style-type: none"> <li>• Loss of markets</li> <li>• Remediation costs</li> </ul>
Water for: <ul style="list-style-type: none"> <li>• Potable supplies</li> <li>• Industry especially food manufacturing</li> </ul>	• Health risks	<ul style="list-style-type: none"> <li>• Costs of illnesses <ul style="list-style-type: none"> <li>» Treatment</li> <li>» Lost productivity and/or income</li> </ul> </li> </ul>
	• Increased costs of water treatment	<ul style="list-style-type: none"> <li>• Increased water treatment costs</li> <li>• Cost of bottled water as a substitute</li> </ul>
	• Reduced livability	<ul style="list-style-type: none"> <li>• Cost to economic growth in area</li> </ul>
	• Threat to tourism	<ul style="list-style-type: none"> <li>• Lost tourism expenditure plus flow-on impact <ul style="list-style-type: none"> <li>» Regional impact</li> </ul> </li> </ul>
Water for: <ul style="list-style-type: none"> <li>• Aquaculture</li> <li>• Agriculture</li> </ul>	• Reduced stock and/or crop productivity	<ul style="list-style-type: none"> <li>• Increased production costs</li> <li>• Decreased production</li> <li>• Costs of closure of fisheries and flow-on effects</li> </ul>
	• Health risks	<ul style="list-style-type: none"> <li>• Costs of illnesses and injuries <ul style="list-style-type: none"> <li>» Treatment</li> <li>» Lost production and/or income</li> </ul> </li> </ul>
Amenity use	• Reduced attractiveness of SEQ as place of residence	<ul style="list-style-type: none"> <li>• Costs associated with reduced: <ul style="list-style-type: none"> <li>» salability, e.g., property values</li> <li>» economic growth</li> </ul> </li> </ul>
	• Threat to tourism	<ul style="list-style-type: none"> <li>• Lost tourism expenditure plus flow-on impact <ul style="list-style-type: none"> <li>» Regional impact</li> </ul> </li> </ul>
Ecosystem services	• Impact on water quality	<ul style="list-style-type: none"> <li>• Increased water treatment costs</li> <li>• Cost of bottled water as a substitute</li> </ul>
Indigenous cultural heritage	• Loss of area or quality and/or integrity of cultural or traditional amenity	<ul style="list-style-type: none"> <li>• Loss of spiritual values</li> </ul>
Natural heritage <ul style="list-style-type: none"> <li>• Declared protected areas (marine park, wetlands, parks with water values)</li> <li>• Ramsar sites</li> </ul>	<ul style="list-style-type: none"> <li>• Loss of biodiversity</li> <li>• Impact on well-being</li> </ul>	<ul style="list-style-type: none"> <li>• Costs of remediation and/or replacement</li> </ul>
	• Threat to tourism	<ul style="list-style-type: none"> <li>• Lost tourism expenditure plus flow-on impact <ul style="list-style-type: none"> <li>» Regional impact</li> </ul> </li> </ul>

Source: Abal, et al. 2005.

and the significant demands urban growth will place on water allocation, water quality, and waterways quality. Water supply, water quality, waste water treatment, urban use and reuse, and healthy waterways are inextricably linked, and the strategic planning for these needs to be tightly linked. The sustainability of our rural sector and industrial growth, as well as achieving good ecosystem health in our waterways, is essential for urban growth. Hence, planning for water needs to be done in a “whole of systems” context, embracing the SEQ region overall and embodying natural resource management in the broadest sense and not just water resources in isolation. It needs to recognize the connection and dependencies between upstream and downstream communities. Waterways have no clear-cut boundaries: they flow through different townships, cities, land uses from upstream to downstream.

The application of mechanisms for payments for ecological services (PES) will only

be effective if the ecosystem services across the whole region are recognized and considered. Investments to protect the environmental values in the downstream cities need to include restoration of the river upstream.

There is already a strong focus within SEQ to deliver through a “whole-of-water cycle” philosophy that gives a strong weight to water quality planning and management (Figure 5). Key regional planning initiatives have been established in anticipation of the rapid population growth expected within SEQ over the next 20 odd years.

#### 4.2 Adaptive Management Approach

The implementation of PES mechanisms need to be underpinned by the operating philosophy of adaptive management. The adaptive management framework (Figure 6) can be described as ongoing knowledge acquisition, monitoring, and evaluation leading to continuous improvement in the identification

Figure 5 Whole-of-Water Cycle



Source: Abal, et al. 2005.

Figure 6 Adaptive Management Cycle



Source: Abal, et al. 2005.

and implementation of management. The approach recognizes that action can seldom be postponed until we have enough information to fully understand the situation. This leads to improved understanding of the means for dealing with resource management issues, as well as providing the flexibility necessary for dealing with changing socioeconomic or socioecological relationships.

#### 4.3 Future Challenges

The SEQ Healthy Waterways Partnership has built on the experiences of the past 15 years in SEQ. It focuses on water quality and the ecosystem health of our freshwater, estuarine, and marine systems through the implementation of actions by individual partners and the collective oversight of a regional work program that assists partners to prioritize their investments and address emerging issues. This regional program includes monitoring, reporting,

marketing and communication, development of decision support tools, research that is directed to problem solving, and maintaining extensive consultative and engagement arrangements.

The Partnership has produced information-based outcomes that have led to significant cost savings in the protection of water quality and ecosystem resources by its stakeholders. This has been achieved by

- providing a clear focus for management actions that has ownership of governments, industry, and community;
- targeted scientific research to address issues requiring appropriate management actions;
- management actions based on a sound understanding of the waterways and rigorous public consultation; and
- development and implementation of a strategy that incorporates commitments from all levels of stakeholders.



In the development of a business case for the SEQ Healthy Waterways Strategy, it was found that the “do-nothing” case is not an option if we were to ensure that the waterways are protected and restored to the level that the community desires. To service the environmental values set by the community, targets need to be set to further protect and improve the ecosystem health of waterways, which in turn pose follow-on effects of the social and economic well-being of the community.

There is definitely a high benefit-to-cost ratio for money spent on maintenance and rehabilitation of waterways, including benefits from maintaining and improving tourism opportunities, higher property values, improved public health, higher quality of life, and reduced costs of land management and agriculture. The alternative costs, i.e., the costs resulting from not increasing efforts to protect and improve waterway health beyond those currently being taken, are likely to be both substantial and unacceptable.

The concept of PES provides the foundation for an environmental accounting framework, a direction that the SEQ Healthy Waterways Partnership is heading toward. Such framework will depend on being able to quantify the effectiveness of management investments and the links between management investments with our ecosystem health.

The United Nations Conference on the Environment and Development in 1992 and the resulting document, Agenda 21, proposes “a program to develop national systems of integrated environmental and economic accounting in all countries.” An important aim of environmental accounting is to assess the environmental sustainability of economic activities and economic growth by quantifying any depletion and degradation of a natural resource. An environmental account provides an information system which links the economic activities and uses of a resource to changes in the natural resource base ([www.isa.org.usyd.edu.au/research/nea.shtml](http://www.isa.org.usyd.edu.au/research/nea.shtml)).

As mentioned earlier, various water planning and management initiatives have already been undertaken in SEQ. What is not clear is how each of these initiatives will knit together to ensure a strong framework for the management

of water as a potentially limiting resource, in ensuring security of supply for all sectors and the environmental outcomes we are also seeking for catchments and waterways. The opportunity that faces us is the application of the Partnership model to a wider set of regional needs in terms of water resources, not just for healthy waterways, but for water quality generally, and possibly for greater yields as well.

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## Conference Paper 6: A Policy Maker's Guide to Designing Payments for Ecological Services

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Recent years have witnessed growing interest around the world from governments, companies, communities and nongovernment organizations in payments for ecological services. This report explores in detail the design issues surrounding the creation of payment schemes, with a special focus on the People's Republic of China (PRC). The report is structured as follows: Part I describes ecosystem services: what they are; their importance to our well-being; and their treatment by law and policy. Part II focuses on using payments to encourage the provision of ecosystem services. It sets out the basic questions that must be addressed in designing a successful payment scheme. Part III considers the challenges to effective payment schemes, including property rights, supporting institutions, and perverse incentives. Part IV narrows the focus to the PRC, addressing specific experiences and political developments relevant to the creation of payments for ecological services in the country.

### 1 What are Ecosystem Services?

Healthy ecosystems provide a variety of critical goods and services. Created by the interactions of living organisms with their environment, these ecosystem services provide both the conditions and processes that sustain human life. The Millennium Ecosystem Assessment classified ecosystem services into four categories—namely: (i) provisioning services (the products obtained from ecosystems); (ii) regulating services (the benefits obtained from the regulation of ecosystem processes); (iii) cultural services (the non-material benefits that people

obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences) that directly affect people; and (iv) supporting services needed to maintain other services.

#### 1.1 Why are ecosystem services underprotected?

Despite their economic value and central role in the provision of important public benefits, ecosystem services are only rarely considered or protected by law (Salzman 1997). Nor have, in the past, significant markets arisen that capitalize on the commercial value of these services. The reason for this relative neglect is threefold: ignorance, institutions, and market failure.

**Ignorance.** Perhaps the most basic reason we do not pay more attention to the provision of ecosystem services is that we take them for granted. We are ignorant of the sources of goods and services we depend on. To design policy instruments that efficiently provide services, at a minimum, policy analysts must be able to identify services on a local ecological scale—detailing how they are generated and how they are delivered.

**Institutions.** A second obstacle to the protection of services is institutional. Political jurisdictions are rarely aligned with ecologically significant areas such as watersheds; instead, they exercise authority over areas defined by state, provincial, or municipal borders. Not surprisingly, environmental problems do not track political boundaries and it is difficult for multiple political

<sup>58</sup> Adopted from an unpublished 2010 report by Anil Markandya, Liu Jian, Zhang Lei, Jin Leshan, and James Salzman on Designing Payments for Ecosystem Services in the People's Republic of China.

actors to agree on the same course of action. More challenging, the costs and benefits of conserving ecosystem services may be separated across jurisdictions.

**Market failure.** The last reason services are difficult to protect lies in market failures. While some ecosystem services are clearly valuable to social welfare, they may have little or even *no market value* for the simple reason that no markets exist in which these services (such as renewal of soil fertility and pollination) can be bought or sold. Because these services have no market price, they appear to be free and, as a result, are taken for granted (until their importance is recognized, too late, after their loss). Indeed, many ecosystem services may be described as “*public goods*”—i.e., goods that are non-rival (consumption of the good by one does not reduce the amount left for others) and non-excludable (individuals cannot be excluded from consuming the good).

## 1.2 Why choose payments over other policy instruments?

### 1.2.1 Traditional environmental policy tools

Given the fact that ecosystem services are easy for the public to take for granted and difficult for private markets to provide, the government has an important role to play in ecosystem service provision. Because a stable supply of public goods can provide great public benefit yet little private gain, one would expect that private markets will systematically lead to the *under-provision* of ecosystem services. To correct this problem of market failure, government can step in and act on behalf of the public to ensure service provision. The government can choose from the so-called Environmental Policy Tool Kit—a tool kit of five basic strategies: prescription, penalty, persuasion, property rights, and payments (Salzman and Thompson 2007).

- (i) Through *prescription*, the government relies on command-and-control regulation, mandating certain behaviors, proscribing others, and imposing penalties for noncompliance. This is the classic approach for pollution control in industrial settings.

- (ii) With *property rights*, the government relies on privatization and allocation of access to a resource, whether a right to a particular catch in a fishery or the ability to emit a quantity of air pollution.
- (iii) Financial *penalties* and charges modify behavior through the financial signals of taxes and fees. Such an approach does not ban certain activities outright but, rather, makes them more expensive.
- (iv) *Persuasion* is a self-regulation approach, which relies on information, educating landholders of the consequences of their management practices on the landscape and informing them of alternate approaches. This is a common approach in the agricultural sector, where extension services provide counseling and technical support to farmers.
- (v) *Payment* usually takes the form of a subsidy, either as a direct payment or tax break, justified by a public goods argument.

### 1.2.2 Payments for ecological services

The concept behind payments for ecological services (PES) is no different from payments for traditional farm produce, with the level of compensation dependent on the quality and level of services provided. The environment provides critically important services. Some of these are captured by markets, but many are not. They are positive externalities that are therefore regarded by the beneficiaries as free. As a result, many ecosystem services tend to be both underconserved and undervalued. In basic economic terms, PES seeks to “get the incentives right” by capturing the positive externalities, and by providing accurate signals to both service providers and users that reflect the real social benefits that ecosystem services deliver. Government policies that recognize this basic fact, and focus on landscape management to ensure and provide services, could result in increased social welfare but would represent a departure from traditional approaches to environmental protection, land use controls and service provision strategies.

For this report, PES refers to voluntary transactions where a service provider is paid

by or on behalf of service beneficiaries for land, coastal, or marine management practices that are expected to result in continued or improved service provision. The payment may be monetary or through barter, and is intended to defray or compensate the costs of service provision. PES schemes can include many different types of parties (from farmers, communities and taxpayers to consumers and corporations); can occur over very different scales (from pollination of local farms and erosion control in a watershed to regional protection against flooding); and can span a wide range of transaction types (from one-off payments for a biodiversity offset to arms-length market transactions for carbon credits).

In choosing among policy instruments to increase service provision, it is helpful to think of PES design as a problem of asymmetric information. There is no doubt that landowners know their property better than the government. Landholders know both the opportunity cost of a specific land use change and the price they are willing to accept to implement this change. For its part, the government agency or water supplier knows how much it is willing to pay and which types of land use changes would be most valuable for service provision. The design challenge is how most efficiently to transfer both types of information—(i) willingness to pay/accept, and (ii) service provision resulting from a land use change—from one party to another in a mutually reinforcing fashion.

A key challenge in implementing a PES approach lies in creating a market where none exists—in capturing the value of the service by compensating the providers for the positive externalities they provide. This approach, notably unlike that of traditional regulatory or tax instruments, views environmental protection much as a business transaction between willing parties. When successful, PES creates positive economic incentives for land owners to conserve or even improve the function of their lands for services as varied as watershed protection, carbon sequestration, or biodiversity conservation. This can increase land owners' awareness of the true value of their properties. In the process, PES schemes may bring new resources and new incentives to conservation,

a particularly important development when funding for conservation is scarce.

### 1.2.3 Types of services receiving payments

The PES schemes operating or in pilot phases around the globe cluster around four broad types of services: watershed protection, biodiversity conservation, carbon sequestration, and landscape beauty services.

**Markets for watershed protection.** Hydrological services are among the most valuable ecological and environmental services (EES)—and, in many cases, investment in sustainable watershed management may be substantially cheaper than investing in new water supply and treatment facilities (Johnson et al. 2001). Generally speaking, in the realm of water management, PES can be most successfully implemented in maintaining water quality and water flow for drinking water and hydroelectric power generation (Verweij 2002).

**Markets for biodiversity conservation.** Biodiversity services provided under PES schemes include the protection of ecosystems of particular value, natural habitats, species and genetic resources. Contrary to the watershed protection case, PES schemes for biodiversity can be at a local, national or global scale—but, as in the case of hydrological services, biodiversity commodities are not traded directly. Instead, payments are generally made for specific land uses that are thought to protect species, ecosystems or genetic diversity rather than for specific numbers of individuals of particular species (Pagiola et al. 2002).

**Markets for carbon sequestration.** Several PES schemes focus on carbon sequestration services: active absorption of carbon through reforestation; avoided emissions through conservation of forest cover. Like biodiversity services, carbon sequestration markets may involve the local, national or global actors—although the majority of the schemes are at the global level. The markets are highly competitive and well developed (Mayrand and Paquin 2004), thus transaction costs are generally lower.



### **Markets for landscape beauty services.**

Landscape beauty services are associated with the aesthetic and cultural value of a specific site, and may involve the protection of cultural sanctuaries, natural heritage sites, or even traditional livelihoods (Mayrand and Paquin 2004). The ecotourism industry is a most important buyer of landscape beauty services, and governments are likely to be the main suppliers through the creation of protected areas or cultural heritage sites (Landell-Mills and Porras 2002).

### **1.3 Experience with PES schemes in the PRC**

The growing attention to PES schemes as instruments for environmental management is reflected in the recent strategies adopted in the PRC. The PRC government has indeed developed and implemented some of the largest public payment schemes for ecosystem services in the world. The government has been experimenting with PES schemes since the 1980s, when the Ministry of Water Resources attempted to protect fragile watersheds through paying households in sensitive areas, conditional upon appropriate management practices being adopted (Liu et al. 2008). In fact, as early as 1991, market mechanisms for watershed management were introduced in Chinese legislation (Water and Soil Conservation Act), though with limited success.

Two major PES schemes have been introduced in the PRC. The first scheme, the Sloping Land Conversion Program (SLCP), was initiated in 1999 to restore natural ecosystems and mitigate the adverse impacts of agricultural practices carried out in previously forested areas or marginal land, such as flooding, sedimentation of reservoirs, and dust storms. The government has already spent over CNY50 billion which has resulted in the enrolment of over 7 million hectares (ha) of cropland (Xu et al. 2010). But financial constraints are forcing the slowdown of SLCP implementation (Scherr and Bracer 2006). The second scheme is the Forest Ecosystem Compensation Fund (FECF), which targets the management of privately-owned standing forests, with the aim of compensating land owners for the ecosystem services their land

provides and for the land and resource use restrictions program participation entails. This scheme currently covers 26 million ha in 11 provinces, and it has cost the government about CNY2 billion annually, of which about 70% goes to farmers for an average payment of \$9/ha. Unfortunately, neither of these schemes have achieved the targeted results, and there is now growing concern over their financial sustainability (International Institute for Environment and Development [IIED] 2006, Xu et al. 2010, White and Martin 2002).

There are many other smaller scale examples of PES tools in the PRC, such as the water rights trading scheme between Yiwu and Dongyang cities in Zhejiang Province; the evolving framework of integrated watershed management and payments being developed between Beijing, Tianjin and local governments in the upper watershed of the Miyun reservoir; and the experimental emissions-trading scheme conducted jointly with the Environmental Defense Fund and taking place in four provinces and three cities (Zhou 2005). These examples of local and regional initiatives suggest that significant interest and potential exist for PES in the PRC.

## **2 Designing Payments for Ecological Services**

In designing a PES transaction, the following basic questions must be considered.

### **2.1 What is the service being provided?**

In crafting payments to ensure ecosystem service provision, the very first question one must consider is which service matters or, more to the point, whether the problem one seeks to address can effectively be addressed by land management. If landscape management either cannot provide adequate service provision or cannot do so cost-effectively, then a PES scheme may prove ineffective.

Policy makers must take care to be specific about the nature of the desired service. Within the suite of watershed services, for example, there are important differences: domestic water supply systems require a constant flow and high quality, but hydroelectric power producers with reservoirs usually prize total volume and care

little about water quality except for the absence of sedimentation (Wunder 2005). Moreover, it is important to recognize that ecosystem services may not always be the best option for service provision. In a densely-populated, urban area, for example, one can easily imagine that landscape management might prove to be more expensive than a water treatment plant, either because of high land costs or because the natural services would prove inadequate to filter the water.

Likewise, PES designers must pay careful attention to modeling and assumptions about causation. The relationship between land management and service provision is not always obvious. Local land patterns need to be considered. Also, some services are easier to model than others. For example, the relation between deforestation and erosion or biodiversity conservation is better understood than its effect on hydrology. PES designers need to be clear at the outset about trade-offs. Land management practices maximizing one type of service may result in the reduction of another service. A classic example is the relationship between afforestation and water levels—e.g., plantations of fast-growing trees, such as eucalyptus, may increase carbon sequestration, but they can equally harm biodiversity, lower water availability, and reduce streamflows because of evapotranspiration and a lower water table (Jackson et al. 2005). Equally, though, provision of some services can also increase others—e.g., maintenance of natural areas can both enhance biodiversity and pollination services.

## **2.2 Who provides the service and who benefits?**

The second question focuses on the providers and beneficiaries. A precondition for any market exchange must be willing buyers and sellers. Put simply, if a land use provides valuable ecosystem services but it is neither widely recognized nor appreciated by beneficiaries, it is unlikely that a market for services will arise in the absence of government intervention. Another precondition for functioning markets is the presence of discrete providers and beneficiaries. Unless these two groups, sellers and buyers of these services, are discrete then PES will be very difficult. Economists describe this as a

problem of collective action. Unless a relatively small number of providers and beneficiaries can get together, transaction costs become too high for contract formation. The public goods nature of many services makes this a real concern. To overcome both the challenge of collective action (the costs of organizing all the different beneficiaries) and the challenge of public goods (where there is no ready market for the service, despite its importance to social welfare), most successful service markets to date operate as monopsonies, with only one buyer paying multiple service providers.

But monopsony buyers are not limited to governments alone. One might argue that water utilities and energy companies operate in a quasi-governmental capacity, but purely private markets often act as monopsonies, as well, with single buyers and multiple sellers. In PES schemes with public buyers operating as monopsonies, the public body acts on behalf of its citizens to ensure the provision of an important service (e.g., watershed service or biodiversity). With only one buyer, service purchases can be more comprehensive and have fewer transaction costs. However, reliance on public buyers offers potential disadvantages. First, governments operate through bureaucracies, and this may actually raise transaction costs depending on the layers of administration involved. Second, public bodies are vulnerable to political influence. Finally, public bodies are generally funded annually and, depending on politics and other pressing needs, may not receive the regular stream of funding necessary to maintain PES schemes in operation.

Private purchasers, by contrast, may be able to ensure steady funding streams over longer periods of time. Competition among private buyers can drive the prices of services up, creating greater incentives for service provision. Private purchasers are also less directly vulnerable to political influence. More purchasers, however, may also increase transaction costs. In general, one sees private purchasers in cases of regulatory compliance. Larger numbers of private buyers are likely when the PES scheme resembles a commodity and there is opportunity for brokerage and arbitrage (e.g., trading of carbon credits in the carbon market).

### 2.2.1 Potential buyers

Depending on the ecosystem service, there is a wide range of potential buyers.

**Government bodies.** When services are public goods or when beneficiaries are scattered, it may be necessary for the government to step in and act on behalf of those benefiting from the services. The appropriate level of government depends on the scale of service provision. This might include government payments to landowners for the services of water quality (local government), flood control (regional government), or carbon sequestration and biodiversity conservation (national government).

**Corporations.** When services are provided to discrete beneficiaries, private PES buyers may be willing to pay providers to ensure continuous provision. Thus, ecotourism operators may pay a local community to ensure conservation of attractive biodiversity in the surrounding areas. Corporations may be motivated by indirect market concerns, as well, such as pressure from shareholders or consumers demanding improved corporate social responsibility, or regulatory requirements for offsets.

**Consumers.** A category of consumers may wish to direct its purchases toward companies and products that act in what they view as an environmentally responsible manner. Eco-labels and certification programs can provide information to guide the purchasing behavior of these “green consumers.”

**Nonprofits (environmental groups, philanthropies).** Not all buyers of services are motivated by profit. Conservation groups and land trusts may routinely pay land owners to conserve biodiversity as part of their groups’ central mission. Similarly, philanthropies may fund service providers in order to ensure continued provision of an undervalued public good.

### 2.2.2 Potential sellers

Just as the primary motivation for buyers is a perceived current or future threat to service provision, the primary motivation for sellers is marginal profit. Service providers can be

classified into two broad categories. The first category is sellers who are paid for change—i.e., payments are made to land owners willing to *change* their land use so that it provides greater services. The second category of sellers is closer to insurance. The goal here is to maintain the status quo. Whether changing current land uses or maintaining them, the key point is that PES will be most effective when the payments make land uses *marginally more profitable* than alternative land use activities. At the same time, it is important not to focus exclusively on marginal profits. A number of PES schemes have found that land owners may be willing to bear some of the costs for service provision because, for example, they take pride in their property’s biodiversity (Stoneham et al. 2003).

As with buyers, there is a range of sellers of ecosystem services, depending on the service.

**Private landowners.** In many countries, most ecosystem services are provided by private lands. While one-to-one exchanges between buyers and private landowners are possible, collective action problems are significant. Single negotiations have high transaction costs, and gathering together enough sellers to achieve a significant level of service provision may be difficult. To overcome these problems, landowners may organize into a private association so they can negotiate with a single voice, “bundle” different services together, and increase the overall level of service provision for sale.

**Public landowners.** Public bodies control large amounts of land in some countries, and may negotiate for service payments. Equally, a community group may sell services from communally held land or from land where community members have specific property rights (such as grazing or cropping).

**Mitigation providers.** In countries with offset requirements for development, private parties may create mitigation banks and sell “credits.” This happens in the United States with wetlands mitigation and in some states with endangered species habitat.

**Certification organizations.** It is worth noting that those who are directly paid may not be the provider of services. In certification systems, for example, the certifying body is often paid a licensing fee by the supplier for use of its eco-label. The certification indicates that the seller is operating in a sustainable manner and this, in turn, signals consumers that they should buy this product rather than others that are not labeled.

### 2.3 What level of service is needed?

The third question addresses the level of service that needs to be provided, and whether this can be adequately monitored. In designing a PES program, we need more precision than simply identifying potential polluters and service providers. More importantly, since PES programs do not have unlimited budgets, we need to know what we are paying for and how much we pay.

For most services, provision is heterogeneous. Certain properties provide greater service levels than others because of where they are located. Hence, landscape context matters. Determining the level of service requires identifying the biophysical pathways of service provision. Such an analysis leads to a better understanding of which landscape management practices need to be encouraged by the policy instrument (such as riparian vegetation or swales) or, conversely, those that need to be discouraged (such as land clearing). Therefore, for a PES program to succeed over the longer term, the buyers must be confident that the landscape management they pay for will, in fact, lead to either improved or continued service provision—i.e., they receive value for their money.

### 2.4 What is the most effective service payment mechanism?

The fourth question asks which type of payment mechanism is most appropriate. While one can divide the types of PES mechanisms into many different types of categories, at a broad level there are three basic types: (i) direct payment, (ii) mitigation and offset payments, and (iii) certification. Within these classes, there are many different mechanisms a PES designer should consider. Which mechanism is

most appropriate will depend on a number of factors, including the type of service, the legal setting, whether the parties are public or private, the difficulty and cost of obtaining information, the availability of funds, the supporting institutions, etc.

#### 2.4.1 Direct payment—general subsidy

The simplest form of payment is a direct subsidy. The major benefit of this approach is low information and administrative costs. Direct subsidy may allow for a period of experimentation to see which sort of land management changes provides the most benefit. It may also satisfy political pressure to provide a subsidy to a particular land-owning interest group. The PES scheme in the PRC, the Sloping Land Conversion Program, has been described as a direct payment program, whereby farmers who enroll in the scheme are paid grain seeds, seedlings and management expenses.

General subsidies, however, may prove inefficient for they cannot meaningfully distinguish between those parties who can provide high-value services and those who provide low-value services. So long as the land is located in a qualifying area and the owner commits to a particular land use practice, he is eligible for payment. Thus, this approach assumes a homogeneous landscape and value of service provision, which is untrue for most services. In fact, one would expect land owners to propose changing the management of their least productive land, regardless of whether this increases or decreases the level of service provision. This creates a problem of *additionality*—the service would have been provided whether the land holder received PES or not. As a result, the program is unlikely to ensure maximum value for money.

#### 2.4.2 Direct payment—negotiation

Another common approach involves direct negotiation with providers by either public or private parties. This approach starts with the assumption that different landholders can provide different levels of service and should be compensated accordingly. The service beneficiary sits down with the service provider and strikes a deal. While the



transaction costs can be higher than other mechanisms, it may be preferable when there are few market participants or there are significant uncertainties over service provision or willingness to accept.

Direct negotiation has the advantage of allowing individually crafted agreements but can be labor intensive if carried out with a large number of landholders. It also lacks the mechanism of farmers competing against one another to provide services and requires the purchaser to assess accurately the landholder's willingness to accept. Perhaps most important, because the negotiations will likely take place in a serial fashion, it may be hard to develop into a regional approach. In the context of water quality, for example, developing a subcatchment-wide strategy for service provision will be difficult if proceeding with farm-by-farm negotiation. This problem can be overcome in part by paying a third party, either local government or a specially-created funding body, rather than the landholders directly.

#### **2.4.3 Direct payment—scored subsidy**

Scored subsidy programs use indexes or other assessment methodologies to provide scores for various attributes, such as presence of biodiversity or proximity to a stream. The goal is to use these scores to identify the service providers who can offer the greatest level of services. While scoring systems offer advantages over general subsidies, they are more expensive to administer. Besides, they may not be accurate if the measures chosen as proxies for service provision are inadequate.

#### **2.4.4 Direct payment—reverse auction**

An increasingly popular means to disburse direct public PES is the use of "reverse auctions." This approach relies on landholders providing sealed bids to the government of how much they are willing to accept for changes in land use management. Those bids providing the greatest service provision at lowest cost are funded first, and so on until the funds run out. Reverse auctions are well suited to a situation of monopsony, when there is only one buyer and many sellers—as is often the case with water quality when a

utility company seeks to change the behavior of many landowners. If there are few sellers, though, there are potential problems of bid-rigging through collusion.

The reverse auction approach has two major benefits over general subsidies. First, communication is more efficient. Through self-selection, landowners identify their opportunity cost in producing services instead of crops. The government, for its part, decides which land use changes are most effective in meeting its overall service provision goal. Viewed through the perspective of information economics, farmers now have an incentive to "self-identify" as potentially valuable service providers, thereby considerably lowering the cost of information gathering. Second, this type of payment scheme effectively creates a market dynamic, where potential purchasers bid against one another for the payment. Given a limited funding budget, only the most cost-effective bids were funded.

#### **2.4.5 Mitigation and offset payments**

Mitigation and offset markets are based on regulations that prohibit certain behavior. For this reason, they are sometimes called "compliance markets." Regulations also create an exemption to its prohibition if the party can offset or mitigate its harm elsewhere. It should be noted, however, that in constructing smoothly functioning offset and mitigation markets, there must be a sufficient and well-defined marketplace and a community of market participants. There also must be a refined currency of trade, one that is fungible and reflects the desired environmental quality.

Mitigation and offset markets present a special concern. In a wetlands mitigation market, for example, the buyer does not care about the quality of the mitigated wetland. All the developer wants is a permit to build a development. The cheaper the developer can obtain the permit, the better. Nor does the seller (the company that created the mitigation wetlands) care about the quality of the mitigated wetland, so long as the government regulator will approve the transaction. Similarly, in carbon emission offset market, so long as credit is given by the regulator for credits from land use changes, neither the seller (the land owner) nor the buyer (the company that requires the



emission permits) cares whether the reductions are real or not. As a result, it falls on the regulator, who does not have a stake in the transaction, to ensure quality and/or legitimacy of land use changes. Thus, adequate governance and oversight are essential to effective offset and mitigation markets. For this reason, most compliance markets operate in developed countries, particularly the United States and Australia, rather than in developing countries that have weaker administrative, legal, and enforcement infrastructure.

#### 2.4.6 Certification

Growing in importance since the 1990s, certification schemes focus on the importance of consumption in degrading ecosystem services. Consumers and corporations that wish to promote environmentally responsible practices through their purchasing behavior, however, cannot do so unless they have information on the attributes of the products they wish to buy or the behavior of their suppliers. Certification and eco-labels attempt to provide this information. The premise of these programs is that an important percentage of consumers and companies will prefer to purchase goods and services that are environmentally preferable if there is a reliable means of identifying them and this, in turn, will provide these goods and services a competitive advantage in the marketplace.

### 2.5 When and in what form should payment be made?

#### 2.5.1 Payment timing

In structuring payments for ecological services, an important question concerns the timing of payments. Should they be spaced evenly, back-loaded, or front-loaded? In traditional crop contracts, payments are often back-loaded—meaning payments are made upon delivery of goods. Since services are delivered continuously, though, evenly-spaced payments seem appropriate. If there are considerable up front costs, such as building dams, swales or fences, front-loaded payments may be necessary. But, in the case of failure to perform,

front-loaded payments weaken the potential sanction of stopped payments. Payments could also be conditioned on meeting certain milestones—a certain amount at the signing of the contract, a certain amount when non-native vegetation has been cleared, a certain amount when fences have been installed, etc. This has the disadvantage of greater administrative costs but does offer the advantages of close progress monitoring and of meaningful incentives to meet the next milestone, particularly in poor areas where the milestone payments may be significant parts of a family's income.

#### 2.5.2 Payment type

In most cases, PES takes the form of monetary payments, but this need not be the case. In a PES watershed project in Los Negros, Bolivia, for example, the payments are not in cash. Rather, the participating communities are paid in-kind, with bee boxes, technical training and barbed wire (Asquith and Vargas 2007). In-kind payments provide a clear visual symbol of the potential added value that PES can provide. Payments could also be in the form of cash-value vouchers or dedicated vouchers (only valid for use in purchasing agricultural goods, for example). One potential downside to payments of infrastructure (such as building roads) or goods (such as beehives) is that these are hard to take back. Unlike periodic cash payments that can end if the provider breaches the agreement, taking back a road or even beehives is less obvious. Thus, the use of non-monetary payments can, depending on the context, weaken potential sanctions in the event of noncompliance.

## 3 Design Challenges to Effective PES Programs

After addressing the fundamental issues, PES designers need to consider the challenges in designing effective PES schemes, and in particular, whether the supporting mechanisms are adequate. These can range from the rule of law (i.e., assurance that agreements will be honored and enforced) to intermediary brokers that bring buyers and sellers together.

### 3.1 Modeling and monitoring – Can you measure what matters?

Adequate modeling and monitoring are required to assure buyers that the payments they have made will, in fact, lead to the service provision they desire. Effective modeling shows the biophysical pathway of service provision, identifying metrics that should be monitored in order to assess service provision (such as a farm's proximity to a watercourse, its slope, etc.). Effective monitoring serves two purposes. First, it creates a baseline. One cannot determine if there has been a change in service provision unless one first establishes a baseline to compare against. Second, monitoring provides the data to assess compliance and service provision once performance has begun.

Monitoring is easier in certain cases than others. Thus, PES schemes based on inputs are easier to monitor than those based on outputs. What is important is that PES schemes must be able to take into account spatial variation and landscape context, reflecting the fact that some sites are more important to a particular service provision than others, but not so expensive that transaction costs swamp the efficiency benefits of markets. PES schemes work best when rules are simple and compliance monitoring mechanisms remain inexpensive.

### 3.2 Property rights – Does the seller control the service?

Since payment is generally premised on specific land use activities, the other basic obligation of the provider is to demonstrate sufficient ownership or control of the land to ensure service provision. In broad terms, this is an issue of property rights, but there are many different types of property rights. These include, among others, the right to occupy, the right to use, the right to derive income, the right to sell, and the right to exclude. Depending on the circumstances, some of these rights will be more important for service provision than others. Supporting institutions (such as land registry, or legal authorities to adjudicate disputes and enforce judgments) are important in the context of property rights; although, they are not always present, particularly in parts of some developing countries. This does

not, however, mean that PES schemes cannot successfully operate there.

Because clear title is not always available and the cost of establishing clear title may not be justified by the size of the service payments, PES schemes must often consider both *de jure* and *de facto* legal title. *De jure* title describes the legally recognized ownership status. *De facto* describes the actual practice on the ground. Individuals or communities may effectively control land so that service provision can be ensured yet not have clear legal title. Indeed, in some cases, service payments are particularly attractive because they are seen as a way to legitimize unclear land title by giving the land manager greater credibility (International Union for Conservation of Nature [IUCN] 2009).

### 3.3 Perverse incentives

If one seeks to pay for discrete cases of ecosystem service provision, clearly some land uses are more important than others. But how should one decide who gets paid and who does not? The key point to recognize is that one is not really paying for ecosystem services but, rather, for improvements in service provision. Hence, service providers with currently low levels of service provision are most likely to be paid as they have greater potential for increased service provision. This approach, however, may pose a problem known as a "moral hazard": farmers who have already made the investments and managed their land responsibly may not receive any payments, whereas those who have been less responsible will benefit; thereby, creating a disincentive to land stewardship. Critics of the Conservation Reserve Program (CRP) have made this very point, arguing that responsible land managers can become dispirited if those who employ less responsible land management practices effectively are paid for doing so.

Concerns have likewise been raised over the problems of holdouts and free riders. These are most easily seen in the context of biodiversity conservation. The functional value of a reserve design or wildlife corridor depends critically on contiguous parcels. If successful, the benefits from the sum of connected land parcels managed for biodiversity conservation should be greater than its parts. This can be disrupted,

though, by the actions of a very small number of landholders who can hold out for prices well above market rates. Without their participation, it may be impossible to create effective habitats. Moreover, neighbors of those who dedicate their lands to biodiversity conservation may choose not to conserve biodiversity on their own land but, instead, free ride on the wildlife amenities of adjacent land. Given these two obstacles to competitive markets, one can understand the calls for coercive instruments.

### 3.4 Good governance

The term “governance” refers to the particular aspects of how decisions are carried out and implemented. At its broadest, good governance constrains government to prevent the abuse of public power and, equally, constrains private actors to prevent market abuse. Thus, good governance refers not only to governmental activity but to private actors as well. Good governance is particularly important in the context of local PES schemes, such as watershed PES, because trust is so fundamental to the long-term success of these programs.

In general, the fundamental aspects of good governance include public participation, openness, transparency, accountability, the rule of law, predictability, and timeliness. Public participation ensures not only that the relevant stakeholders are involved but feel they have meaningfully participated in decisions. Hence, stakeholders are more likely to support decisions in which they feel their concerns have been heard. Transparency and access to information are essential to good governance both because they build trust and ensure decisions will be made in an open manner. Accountability and the rule of law are important for parties entering into PES agreements to ensure that terms of the agreement will be respected and, in case they are not, that their interests will be supported. Without such reliability and predictability, parties will be less likely to enter into agreements in the first place. Remedies and dispute settlement are especially crucial when monitoring uncovers noncompliance. It is important to set out in the PES agreement either the potential consequences or the procedure to determine the appropriate consequences.

Without an adequate deterrent, noncompliance may be more likely. Determining the nature of the deterrent, though, requires careful consideration.

### 3.5 Supporting institutions

Very few transactions take place in the absence of supporting institutions. Even the simplest contracts between buyer and seller, for example, rely on institutions to adjudicate disputes when they arise and enforcement to ensure that judgments are carried out. A range of specialized institutions, both public and private, can promote PES transactions.

In many parts of the world, however, formal institutions are ineffective and parties cannot assume that laws will be complied with or enforced. In such cases, informal local institutions based on customary practices can provide the support needed for PES schemes to operate. In many rural communities in developing countries, for example, land tenure and property rights are not formally established. If a community or its members cannot document their control or ownership of the relevant landscape, structuring a transaction can prove difficult. Nonetheless, customary rules of land tenure may prove sufficient assurance for the PES scheme to work. This is an example where *de facto* rights are as important as *de jure* rights, if not more so.

### 3.6 Poverty reduction

Some reports on PES schemes have explicitly called for greater attention to the role they can play in poverty reduction. If policy makers choose to use PES schemes for dual purposes—both provision of ecosystem services and poverty reduction—they need to consider carefully the trade-offs involved.

PES schemes offer a number of clear potential benefits for local communities. The payments can provide important additional revenue for basic needs. These payments can be particularly important in communities with limited, or intermittent, revenue streams. Some schemes have also reported that payments can help ensure land-tenure security with respect to squatters by legitimizing the service provider's right to occupy the land and sell its services.

There are other less direct but perhaps no less important benefits. The conservation provided by PES schemes, for example, can promote the opportunity for income from the sale of non-forest timber products. In addition, the process of entering into and administering PES schemes can provide local training and technical assistance, thereby improving community organization and social capital (Chomitz et al. 1999).

At the same time, PES schemes may cause potential harms to local communities. PES schemes may unintentionally create barriers to entry that exclude poor communities or land owners. If poor landowners have less secure title than wealthier landowners, they may not be able to participate. Uneven land distribution would mean that large land owners may find it worthwhile to enroll in PES schemes because the transaction costs are relatively small for them. Many poor land owners with small holdings may, by contrast, find it does not make sense to go through all of the PES scheme costs given how little services their land may generate. Thus, it is important for PES designers to consider fully the equity impacts of their schemes.

## 4 PES Design Issues in the PRC

### *4.1 Economic and institutional issues for PES watershed design in the PRC*

In this section, we look at the economic and institutional issues that arise in implementing PES schemes in the PRC, with a particular focus on watersheds. PES seeks to internalize the externalities of the watershed ecosystem, both positive and negative, by paying the service providers for what they invest or for any incomes they lose. There are two main ways to pay: (i) public fiscal transfer, and (ii) market-based compensation. The public funds can be from public budgets or specific taxation or other governmental financial resources. Market-based compensation can take place between the services suppliers and the beneficiaries when the property rights are clearly defined and an operational contract is possible.

The design and development of a PES scheme involves a process of learning and there is no cure-all solution to different watersheds. Both international and the PRC experiences show that, to apply these instruments effectively

in watersheds, the following economic and institutional issues need be considered (China Council for International Cooperation on Environment and Development [CCICED] 2007, Wang and Zou 2008):

- (i) Laws, regulations and policies must be in place to provide a legal basis for PES by defining property rights;
- (ii) It is crucial to identify the stakeholders in PES schemes, and determine their respective interests, positions, strategies, and capacities regarding PES;
- (iii) Reflexive, adaptive and cooperative management is needed for governing such complex systems. This requires timely, integrated, and reliable information;
- (iv) The establishment of means for the participation and interactions of watershed stakeholders is crucial for reaching PES agreements;
- (v) Public-private partnership has proven very important for the success of PES schemes;
- (vi) A clear definition of ecological services and goods provides the basis for compensation and for determining the level of compensation. (In practice, of course, the actual amount of compensation will be the result of negotiations and subject to the local situations. As a result, the engagement of stakeholders and a watershed information system are very important to facilitate such negotiations.);
- (vii) It may be necessary, within the overall watershed PES framework, to apply different instruments for different purposes;
- (viii) Capacity building should be an indispensable part of watershed PES schemes, including raising awareness, researching consensus, obtaining commitment, building monitoring capacity, information collection and processing, organizational set-up, technical training, etc.

To summarize, the design of watershed PES scheme includes at least six elements: (i) identification of the providers and beneficiaries, (ii) choices of compensation methods,

(iii) sources of compensation funds, (iv) agreement on the basis of compensation calculation, (v) management and supervision mechanisms, and (vi) monitoring and evaluation systems.

#### 4.2 PES political developments in the PRC

After years of difficulties with its PES schemes, the authorities from the PRC are acting to reform institutions along the lines laid out above. During the recently concluded 11th National People's Congress, many representatives emphasized again the importance and urgency of establishing eco-compensation mechanisms. At the national level, the "State Council Decision on Strengthening Environmental Protection Aiming at the Implementation of Scientific Development Outlook" urged the relevant ministries to establish eco-compensation mechanism as soon as possible and to take this into account in national and local fiscal transfers. Eco-compensation was also listed as one of the priorities by the State Council for achieving energy saving and pollution reduction targets (State Council Policy Paper 2007 [8] and [15]). The General Affairs Department of the National Development and Reform Commission (NDRC) assigned the tasks of establishment of eco-compensation mechanisms to relevant ministries and departments (NDRC Announcement 2007 [914]). In response to this call, the following was undertaken by the different ministries:

- (i) The State Environmental Protection Administration (SEPA) (known as the Ministry of Environment since 2008) issued "Guidance on the Implementation of Eco-compensation Pilot Projects" (SEPA Policy Paper 2007 (130)) to carry out experiments on eco-compensation in natural reserves, key ecological functional zones, mineral resources exploration, and water environment protection in watersheds.
- (ii) The Ministry of Water Resources organized to conduct research projects on water-related eco-compensations mechanisms from early 2009. These projects focus on the valuation of water ecological systems and how social economic activities affect the systems.

- (iii) Since 2001, the Ministry of Finance and the National Forestry Administration have supported eco-compensation pilot projects in 685 counties and 24 national natural reserves in 11 provinces, involving a total investment of CNY1 billion.
- (iv) The Ministry of Finance is also adjusting its policies to support a shift to circular economy, pollution control, eco-compensations, etc.
- (v) The targets of eco-compensations are often less developed regions and rural populations. Water is critical for crop and animal farming activities, and activities like application of pesticide and fertilizer, animal wastes, soil erosion, etc. affect the quantity and quality of water. Recent years have seen increasing discussions on eco-compensations from the farmers' perspective (Liu et al. 2008).
- (vi) While all these efforts and appropriate experiments are encouraging, challenges remain over the appropriate level of compensations/subsidies, lack of stable funding sources, absence of nongovernment actors in decision making and overall coordination mechanisms.

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# Toward a More Effective Eco-Compensation Policy Framework

The growth of the People's Republic of China's (PRC) eco-compensation policies is encouraging for a number of reasons.

First, it is indicative of the government's commitment to increasing investment in environmental protection and management. Environmental spending within the 11th Five-Year Plan period is projected to top CNY1.530 trillion—a 70% increase from the 10th Five-Year Plan, although still short. In the future, outcomes will improve if funding amounts correlate with the scale responsibilities assigned to the various central and local actors involved in environmental management (ADB 2007).

Second, developing and refining both central and provincial government eco-compensation programs and policies is improving the basic implementation of core components to effective environmental management. These include clarifying rights and responsibilities over ecosystem services and natural resources, resolving equity issues, improving strategic environmental planning, clarifying and prioritizing goals and targets, and strengthening monitoring and enforcement capacity.

Finally, eco-compensation policy is also stimulating innovation in environmental policy, including the development of more incentive-based management regimes, and greater adoption of and innovation in market-based instruments such as payments for ecological services (PES). Such innovations stand a good chance of improving the environment and the sustainability of funding for conservation. This brings together a wider range of economic actors and stakeholders and better internalizes environmental management costs as well as the benefits of ecosystem services into economic activities.

As the government continues to develop a national eco-compensation policy framework, it should keep in mind the following recommendations.

## 1 Legal and Regulatory Grounds for Eco-compensation

The general legal framework for eco-compensation should address two fundamental issues: property rights over ecosystem services and coordination between jurisdictions and institutions.

### *1.1 User rights would protect ecosystem services and intended beneficiaries*

The government should continue to clarify and strengthen laws about rights and responsibilities over natural resources, which would point to who are responsible for ensuring the related ecosystem services. Rights determine the key actors and stakeholders of ecosystem services markets and will provide the foundation for successful eco-compensation programs. For example, the state owns water resources and is responsible for allocating resources through government orders and water quotas. But the state has not defined who has rights to use that water. The state also tends to maintain artificially low water prices—prices that do not reflect the real cost of protecting, treating, distributing, managing, or maintaining water systems. As a result, an open access system has developed—one that is characterized by conflict and inefficient distribution of resources (National People's Congress 2002; Zhang et al. 2009).

In the case of land resources, unclear property rights can have unforeseen

consequences and produce counterproductive outcomes, such as “elite capture,” whereby powerful local individuals or groups take control over valuable resources that have ambiguous property rights. As a result, the intended beneficiaries—farmers, who are the original providers of the program’s targeted ecosystem services—not only miss out on the payments but also lose access to their land and income. The implications of this scenario become even more important in eco-compensation programs that target poverty alleviation.

### ***1.2 Policy, regulation, and incentives would trigger coordination between jurisdictions***

Because ecosystem services (such as water resources) often cross administrative boundaries, the management of these services requires the coordinated involvement of different sectors, agencies, and provincial governments. Various initiatives are being developed *within* provinces to create frameworks for cross-district programs. However, given the range of central and provincial government ministries and departments with different and sometimes overlapping responsibilities for natural resource management, the central government must develop the legal and regulatory frameworks for cross-provincial coordination and cooperation (Wang et al. 2009). While assigning the National Development and Reform Commission as the leading agency in the development of eco-compensation policy is a good first step, mechanisms for coordination and cooperation between other key ministries will also need to be developed.

Incentives could encourage cross-boundary cooperation for PES schemes within the PRC. For example, the government could financially reward those ministries that partner together and, as a result, demonstrate the kind of interagency cooperation that enables cross-boundary eco-compensation programs.

## **2 Keys to Making Eco-Compensation More Effective**

If eco-compensation is going to achieve its potential on the PRC’s agenda for environmental

management, the very term “eco-compensation” needs to be better understood, as does its role in the overall environmental policy framework. Beyond these basics, focus should shift toward market development and in two ways: firstly, allow basic market-based, economic processes determine the rates of environmental service payments; and secondly, legislate and regulate to attract private sector participation.

### ***2.1 A policy framework requires a clear definition of eco-compensation***

Clarifying the meaning of eco-compensation is important for creating an effective national eco-compensation policy framework. While the creation of the term and the outgoing discourse regarding its function and meaning have stimulated a valuable debate about the PRC’s environment policy in general, provincial governments have expressed the need for a clearer definition. The provincial case studies presented at the conference, however, highlight the challenges that the central government will face in doing this—the country has a wide range of socioeconomic conditions and environmental challenges and varying priorities. A clearer definition of eco-compensation will consolidate understanding and allow priorities and targets to emerge more clearly in the process of developing the policy framework. The provincial case studies provide guidance on how to approach this, since they reveal the range of concerns and issues faced by the key regional stakeholders and actors in environmental management, which will need to be taken into account in developing the national policy.

### ***2.2 Incentives can improve fiscal efficiency and environmental effectiveness***

National policy should encourage, even emphasize, the development and use of incentive-based eco-compensation programs. Because eco-compensation programs are systems of fiscal transfers from central to provincial governments, the development and inclusion of incentives in PES programs (such as outcome-based, performance-based eco-compensation contracts) should improve both the environment and financial efficiency.

Numerous provincial programs have already begun to experiment with such mechanisms. The widely-applied general subsidy approach in the PRC, though the simplest payment mechanism, does not account for the various types and values of land use and potential eco-services. Instead, all land within a program area is given the same value and amount of payments, which is neither fiscally efficient nor environmentally effective. More sophisticated designs, such as scored subsidy and reverse auction, should be experimented with at the local level and their experiences shared.

### ***2.3 Rely on market-oriented tools for setting compensation rates***

Subsidy rates should be negotiated by ongoing contractual arrangements between beneficiaries (or the government on behalf of beneficiaries) and providers of ecosystem services, rather than based on over-studied methodologies and formulas. This will help ensure that the PRC's eco-compensation schemes can improve incentives, lower costs, and provide the economy with greater flexibility in adapting to changing environmental challenges.

To date, though, as indicated in the case studies provided at the conference and in numerous academic papers in the PRC, research to inform the development of eco-compensation mechanisms focuses too heavily on methods to calculate subsidy levels. Calculating a starting price, value, or willingness-to-pay for the provision of ecosystem services is often a necessary first step for launching a PES mechanism. However, the emphasis on the methodology risks missing the point of market-based programs. Economic theory states that those best able to calculate the opportunity cost of ecosystem service provision are the providers themselves. As such, gains in program efficiency and cost are achieved by allowing for subsidies to be negotiated by the various potential participants and stakeholders, since this means that those who provide services at lower opportunity costs (and therefore lower price) will more often be the participants in PES. If providers and buyers of ecosystem services cannot agree on an acceptable price, then PES is probably not the appropriate policy instrument to address the problem in question.

In general, markets also provide a number of important benefits for the provision of goods and services, and these should carry over into ecosystem services markets. One benefit already mentioned is price discovery, wherein the socially optimal value of goods or services is revealed via the competitive bidding of numerous buyers and sellers. Another is the effective signaling, via the relative resource values represented in market prices, of where technological innovation will be most profitable (i.e., which resource bottlenecks are most critical). A third is the ability of markets to flexibly induce changes in the economy's structure of production and resource use that are more appropriate for relative and changing resource scarcities, as signaled through market prices.

### ***2.4 Legislate and regulate to develop environmental service markets that attract the private sector***

Gains made by the large-scale provincial eco-compensation programs will be unable to mature without the central government's further development of legal and regulatory frameworks that target the private sector. The large-scale central government payment programs for forest area management and land conversion have provided powerful boosts to provincial experimentation and innovation in market-based environmental policy instruments in recent years. At the same time, an overly large public sector presence as buyer risks crowding out the private sector. This is an important concern, given that one of the promising attributes of PES schemes is their ability to tap private sector funding for conservation.

In developing a national eco-compensation policy framework, the government needs to think carefully about how its role can evolve from being the main buyer of ecosystem services to more of an "enabler." It can make this transition by providing a range of new PES-support programs, such as information services that link private buyers and sellers, research services for program development, legal and regulatory frameworks to ensure that contracts are enforced and to encourage private sector participation, and regulatory requirements

that can create markets (such as having to offset the impacts of projects on biodiversity or watershed services).

### 3 Leveraging Existing Sector Policies and Measures

The conference also discussed the PRC's environmental policy tool kit. It has done so to emphasize the many parts that make up a whole. A healthy and sustainable environment requires the attention of many sectors and tools. Some of the required laws, policies, regulations, programs, and incentives to address rebuilding the environment and natural resource base already exist in other sectors. These can be used, improved upon, or replaced with more relevant, advanced ideas. Eco-compensation—and more specifically, PES schemes—is only one tool in the tool kit and should be explored and used alongside other complimentary tools.

#### *3.1 Eco-compensation is not a substitute for institutional, and administrative measures*

PES is not a substitute for better monitoring and enforcement capacity and, in fact, will fail without these qualities of good governance. Although PES is one solution for conservation and environmental restoration beyond what is required under current regulatory structures, it should not be seen as a low-cost alternative to basic improvements in the environmental management regime. It is actually only one of many tools in a policy tool kit. Tai Lake is a good example of this.<sup>59</sup> Despite strong political leadership, the government still faces numerous challenges to improving water quality in the lake watershed, which has suffered various effects of development over the past 50 years, particularly over the past decade (ADB 2008). Without measures to correct pollution in the lake, including the lack of a strong, integrated management framework backed by a sufficiently strong legal authority, PES-like eco-

compensation programs or other market-based instruments, such as the emissions rights trading currently being piloted in the watershed, will not achieve what other policies have tried and failed.

#### *3.2 Adjusting other sector policies may be more effective*

A national eco-compensation policy framework will need to take account of the range of policies across all sectors that already support, as well as those that undermine, good resource use and environmental protection. Otherwise, sector-specific piecemeal environmental policies risk creating countervailing incentives, or simply being made irrelevant by policies affecting other sectors. For example, farmers are offered only CNY5 per mu by programs to protect the Sanjiang Plains wetland, compared to earning CNY320 per mu from agricultural revenue, of which CNY130 per mu comes from direct agricultural subsidies (Ma 2009).<sup>60</sup>

Adjusting policies in other sectors might be more effective in achieving targeted environmental outcomes than through separate eco-compensation programs. Existing policies that could be modified to improve environmental outcomes include those that (i) encourage rural–urban migration; (ii) discriminate against rural development; or (iii) increase investment in public services, access to credit, information, health services, and education (Crooks 2009).

#### *3.3 Eco-compensation to reduce poverty requires high strategic thinking*

Using PES schemes to reduce poverty is difficult to achieve, and designers should be especially strategic about incorporating such goals into a program. PRC policymakers, along with their international peers, are clearly energized by the prospects of using PES and eco-compensation policy to achieve the win–win outcome of poverty reduction and environmental improvements. Related goals should also be approached with caution. Research on PES often finds that poverty does not always closely correlate to

<sup>59</sup> Tai Lake is the third largest freshwater lake in PRC, and its catchment is located in three provinces (Jiangsu, Zhejiang and Anhui) and a provincial level municipality (Shanghai).

<sup>60</sup> A mu is a traditional Chinese unit of land measurement (1 mu = 1/15 hectare).



the quality of the local environment or the value of ecosystem services. Poor households may also lack the skills and education to effectively participate in PES schemes in terms of learning and implementing new land use practices and negotiating contracts.

Giving programs multiple goals, such as poverty reduction, also risks their effectiveness. For example, research on the Conversion of Cropland to Forest and Grassland Program found that the program's poverty reduction goal has often been used as an "exit option"—if the environmental targets prove too difficult to achieve, local officials shift to the poverty reduction goal, resulting in poor environmental outcomes.

Policy makers should strategically build poverty reduction goals into eco-compensation programs, perhaps by legislating guarantees that protect rural households that participate in these programs. In some cases, however, separate but complementary policies specifically targeting poverty reduction might be more effective.

## 4 Conclusion

The International Conference on Payments for Ecological Services held on 6–7 September 2009 in Ningxia Hui Autonomous Region concluded that the development of an eco-compensation policy framework in the PRC can be improved by incorporating more ideas from other countries' experience with PES programs and market-based environmental policy instruments. The conference also acknowledged the PRC's own wealth of experience with eco-compensation that should be shared with other countries.

The majority of provincial case studies presented at the conference focused on compensation for watershed services. This not only suggests the significant potential for payment of watershed services in the PRC, but also the need to clarify and strengthen the PRC's laws governing rights and responsibilities over watershed services in the context of integrated river basin management. The sheer scale of the Conversion of Cropland to Forest and Grassland Program—which now extends to all

corners of the PRC—suggests a wide variety of local de facto implementation regimes which, if better documented, could provide valuable lessons and innovative examples. Thus, the PRC government has a real opportunity to provide leading examples of public sector PES programs and policies that catalyze the development of ecosystem services markets. Such opportunities will only be realized, however, with better documentation, research, and evaluation of the PRC's ongoing eco-compensation programs.

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## International Conference on Payments for Ecological Services

Shizuishan, Ningxia Hui Autonomous Region (NHAR), People's Republic of China (PRC)

6–7 September 2009

Co-sponsored by the National Development and Reform Commission (NDRC),  
the Ministry of Environmental Protection (MEP), the NHAR Government, and  
the Asian Development Bank (ADB)

### Conference Agenda

Time	Activities
<b>6 September 2009 (Day 1)</b>	
<b>Session 1: Opening Speech</b> Chair: Qin Yucai , Director General, NDRC Western Regions Development Department	
9:00–10:00	Zhao Xiaoping, Vice Governor, NHAR Du Ying, Vice Chairman, NDRC Zhuang Guotai, Director General of Department of Nature and Ecological Protection, MEP Klaus Gerhaeusser, Director General, ADB Li Wenzhang, Secretary of Shizuishan Municipal Committee of the Chinese Communist Party
10:00–10:10	Coffee/Tea Break, Group Photo
<b>Session 2: International Experiences and ADB Perspectives</b> Chair: K. Kannan, Director, Agriculture, Environment, and Natural Resources Division, ADB	
10:10–10:30	<i>Payments for Ecological Services: ADB Operations in the PRC and Future Prospects</i> Qingfeng Zhang and Frank Radstake, ADB
10:30–10:50	<i>Payments for Ecological Services: International Experiences and Implications for the PRC</i> Michael T. Bennett, Forest Trends
10:50–11:10	<i>Promoting the PES Approach in the PRC: Some Practical Issues that Will Need to be Addressed</i> Robert Crooks, International Environmental Specialist
11:10–11:30	<i>Valuation and Payments for Ecological Services: Some Discussions</i> Tun Lin, ADB
11:30–11:50	<i>Payments for Ecological Services in the Greater Mekong Region: The Case for PES in the Biodiversity Corridor in Xishuangbanna, PRC</i> Hasan Moinuddin and Jiao Xi, GMS Environment Operations Center
11:50–12:00	Photo (Xinghai Square of Shizuishan)
14:30–14:50	<i>Payments for Ecosystem Carbon Sequestration and Sink Services: Emerging Opportunities from REDD and Reforestation</i> David McCauley, ADB
14:50–15:10	<i>Payments for Ecological Services in Water Sector</i> John Coulter, Senior Water Economist, Ministry of Water Resources
15:10–15:30	<i>Payments for Ecological Services in Australia and AusAid Program</i> Eva Abal, Associate Professor, Queensland University
15:30–15:40	Coffee/tea break
<b>Session 3: Eco-Compensation—Issues and Options in the PRC</b> Chair: Zhuang Guotai, Director General, MEP	
15:40–16:00	<i>Eco-Compensation in the PRC: Some Reflections</i> Li Wenhua and Liu Moucheng, Chinese Academy of Sciences
16:00–16:20	<i>Watershed Eco-Compensation in the PRC: Policy Framework</i> Wang Jinnan, Chinese Academy of Engineering Physics (CAEP)
16:20–16:40	<i>Research on the Legislate of China Eco-Compensation</i> Shao Yingchun, Beijing University

*continued on next page*

Conference Agenda *continued*

Time	Activities
16:40–17:00	<i>Watershed Eco-Compensation Rate Estimation</i> Zhang Huiyuan, CAEP
17:00–17:20	<i>Public Transfer for Eco-Compensation in the PRC</i> Kong Zhifeng, Ministry of Finance Institute
17:20–17:40	<i>Eco-Compensation in the PRC: Legal Framework</i> Du Qun, Wuhan University
17:40–18:00	<i>Eco-Compensation and Eco-Security</i> Ma Zhong, Renmin University of China
18:00–18:20	<i>Eco-Compensation as One Instrument in Policy Tool Kits</i> Jin Leshan, China Agricultural University
18:20–18:40	<i>The Quantitative Simulation and Analysis and the Framework Research on the Economic Impact Brought by Eco-Compensation</i> Zhang Yaxiong, State Information Center
7 September 2009 (Day 2)	
<b>Session 4. Local Cases of PRC Eco-Compensation</b> Chair: Ruan Jiaoyu, Standing Member of Shizuishan Municipal Committee and Standing Deputy Mayor of the Municipal Government	
8:30–8:45	<i>Establish an Effective Ecological Compensation Mechanism, Infuse the Motive Force of Sustainable Development into the Construction of Ecological Barriers</i> Guo Bingchen, Vice Director, Ningxia Development and Reform Commission (DRC)
8:45–9:00	<i>Implement the Pilot Policy for Sustainable Development of the Coal Industry, Build Comprehensive Eco-Compensation Mechanism for Coal Mining</i> Li Haisheng, Director, Shanxi DRC
9:00–9:15	<i>Combine the Theory and Practice, Explore and Establish a New Mechanism for Ecological Compensation</i> Dong Chengyu, Deputy Inspector, Liaoning DRC
9:15–9:30	<i>The Condition of Carrying Out Pilot Ecological Environmental Compensation Works in Jiangsu Province</i> Lu Jiankang, Director General, Jiangsu DRC
9:30–9:45	<i>The Condition of Establishing a Comprehensive Eco-Compensation Mechanism in Zhejiang Province</i> Li Kechuan, Consultant of Environmental-and-Resources-Protected-Area Office, Zhejiang DRC
9:45–10:00	<i>The Condition of Carrying Out Eco-Compensation Mechanism in Anhui Province</i> Xu Hesheng, Director, Anhui DRC
10:00–10:15	<i>The Practice and Plan Designing of Improving the Eco-Compensation Mechanism in the Drainage Basin of Fujian Province</i> Cong Lan, Deputy Director, Ministry of Environmental Protection of Fujian Province
10:15–10:30	Tea Break
10:30–10:45	<i>The Condition of Carrying Out Eco-Compensation Works in Jiangxi Province</i> Ye Baiqing, Deputy Director, Jiangxi DRC
10:45–11:00	<i>The Works to Establish the Mechanism for Ecological Compensation in Guangdong Province</i> Zhang Lijun, Deputy Inspector, Guangdong DRC

*continued on next page*

Conference Agenda continued

Time	Activities
11:00–11:15	<i>Practices and Explorations of Ecological Compensation in Hainan Province</i> Feng Yan, Director, Regional Economic Service, Hainan DRC
11:15–11:30	<i>The Condition of the Pilot Project of Eco-Environment Compensation in Chongqing Municipality</i> Dong Xiaochuan, Director, Environmental Protection Division, Chongqing Municipal DRC
11:30–11:45	<i>The Report of Ecological Construction Conditions in Gansu Province</i> Sun Xiaowen, Deputy Director, Gansu DRC
11:45–12:00	<i>Consideration and Suggestions on the Related Policies of Establishing Comprehensive Eco-Compensation Mechanism in Qinghai Province</i> Hu Jun, Vice Director, Qinghai DRC
12:00–12:30	<i>Summary Speeches</i> (1) Qin Yucai, Director General of the Department of Western Regions Development, NDRC (2) Zhuang Guotai, Director General of Nature and Ecological Protection Department, Ministry of Environmental Protection (3) Klaus Gerhaeusser, Director General of East Asia Department, ADB
14:30–18:30	<i>Field Visit</i> Coal Mining Subsidence Area of Huinong District Xinghai Lake Wetland Ecological Reserve China Strange Stone Mountain (Qishi Mountain) Nansha Seascape Area, Sheyu Park North Wudang Ecological Scenic Area



## **Payments for Ecological Services and Eco-Compensation: Practices and Innovations in the People's Republic of China**

Policy makers in the People's Republic of China have been experimenting with new approaches to environmental management, resulting in a wide array of policy and program innovations under the broad heading of eco-compensation. Many of these are market-based instruments, particularly payments for ecological services—currently an emerging policy debate regarding the extent to which beneficiaries should pay, and the providers should be compensated—for the provision of natural resources and environmental services to promote sustainable, balanced growth. These proceedings are a collection of papers presented at the International Conference on Payments for Ecological Services convened in Ningxia Hui Autonomous Region in September 2009 to support eco-compensation programs in the country.

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