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Promoting Market-oriented Ecological Compensation Mechanisms:

Payment for Ecosystem Services in China

The World Bank

This policy note is one of the policy reports of the World Bank's Analytical and Advisory Assistance (AAA) Program "China: Addressing Water Scarcity – From Analysis to Action". It was prepared by the Rural Development, Natural Resources and Environment Unit (EASRE) of the East Asia and Pacific Region of the World Bank.

Environmental and natural resources management issues are an integral part of the development challenge in the East Asia and Pacific (EAP) Region. The Environment Strategy for the World Bank in the East Asia and Pacific Region has provided the conceptual framework for setting priorities, strengthening the policy and institutional frameworks for sustainable development, and addressing key environmental and social development challenges through projects, programs, policy dialogue, non-lending services, and partnerships. This study provides a forum for discussion on good practices and policy issues within the development community and with client countries.

For more information on and the reports of the AAA Program, please visit the website of the China water AAA program at http://www.worldbank.org/eapenvironment/ChinaWaterAAA.

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TABLE OF CONTENTS

List of Tables

List of Figures

Abstract

Natural environments like forests, wetlands, and watersheds provide a wide variety of goods and services to a country's population. Many of these goods and services are provided indirectly – that is, there is no direct link between the service provider and the consumer of the service. This is usually due to the spatial separation between the environmental services providers (often land owners or resource managers in the upper watershed) and the users of the same environmental service (beneficiaries such as consumers of potable water, or industries or agriculture located downstream). As a result, the market for these services is often non-existent or poorly developed. Ecosystem managers have little economic incentive to improve environmental management.

Consequently, in most places environmental services are "underprovided" -- fewer services, or poorer quality environmental services, are made available than is desirable. The new concept of Payment for Ecosystem Services (PES) is designed to correct this problem. In a PES system a market for environmental services is created when money is collected or re-allocated from the beneficiaries who use environmental services (e.g. water consumers) and payments are made directly to those who provide these services (e.g. watershed land managers). Market force helps encourage more efficient and more sustainable delivery of environmental services, in this case improved management of watershed lands. PES programs are easiest to introduce where there are direct links between service providers and service users; many of the earliest examples deal with watershed management and water supply.

In China, the traditional approach to the provision of environmental services has been through ecological compensation payments made directly from the Government to providers of environmental services (such as the very large "Grain for Green" program). This "supply side" approach can be augmented by and improved upon by learning from more market-oriented systems. This Policy Note explores the market-oriented PES approach and discusses its application in China, using a case study from Lijiang old town and the Lashihai Nature Reserve. The case study illustrates how the economic values associated with improved water management can be estimated and then translated into a PES system. Other international examples are also presented. Although PES is not a panacea for all natural resource management issues (and guidance is given where PES is more likely to be successful) it is one of the most exciting new environmental policy tools being developed today. Due to faulty information and imperfect markets, many environmental services are being degraded or lost even though there are people who are willing and able to pay for these services. Market-oriented PES systems are designed to help address this problem.

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1. Water, River Basins and Payment for Ecosystem Services: An Introduction

In many countries the availability of water may be the largest constraint to sustainable economic growth in the 21st century. Rapid urbanization and economic growth have placed severe demands on available water supplies – both surface water and groundwater. Agriculture, industry and municipal users all compete for increasingly scarce, and often polluted, water supplies. Consequently countries are looking for ways to better manage existing water supplies (and the watersheds that produce them). No longer can water be treated as an infinitely available "gift of nature" that will always be there to meet human (and ecological) needs.

Increasing scarcity for any commodity is usually reflected in an increased "price" of the commodity – either actual or perceived. As water has been changing from a resource available for the price of collection and distribution, to an economic "commodity" that is managed and sold, water resource managers are beginning to realize that there are interesting lessons that can be learned from other functioning resource markets (such as for energy, timber, or food): those who provide the resource (the providers) are paid to provide this service, and the payment usually comes from those who benefit from and use the resource (the beneficiaries). This simple link between service provider and service beneficiary is the basis of any market economy. For environmental services, however, because they are traditionally thought of as being provided "free" by nature, this is something of new idea. Water is just one of the environmental services where these links between service providers and service beneficiaries are being set up and formalized. Other examples of emerging markets for environmental services include conservation of biodiversity, carbon sequestration, and protection of scenic landscapes.

This note explores these issues in the context of China and the development of Payment of Ecosystem Services when water is the service being bought and sold[1]. These PES systems are often introduced at the level of a specific watershed or even a larger river basin – both of which can be thought of as "water machines" that can be managed well or poorly, equitably and efficiently or not. PES systems help complete the link between those who provide an environmental service and those who use the same service. In the case of water and watersheds the environmental service can take many forms: potable water for drinking, irrigation water, flood control benefits, water for transportation, and water to produce scenic or aesthetic benefits.

[1] Note that one sees three different terms used for the "E" in PES – environmental, ecological, or ecosystem – but the idea is the same. In the current literature the term environmental is most commonly used. In this note we often use the three terms interchangeably.

2. The Concepts of Payment for Ecosystem Services and (PES) and Ecological Compensation Mechanism (ECM)

Countries are constantly searching for ways to increase the resources available for the conservation of protection of the environment. In China, the widely used Ecological Compensation Mechanisms (ECM) approach relies on available government funds and directs them to conservation activities, as in the Grain for Green program that reaches some 30 million farm households and distributes some US$8 billion per year (see Uchida, Rozelle and Xu, 2007). Note that the ECM does not create new financing; it merely targets existing funds to conservation. In contrast, the Payment for Ecosystem Services approach (PES) is designed to create a new market to increase funding and target those funds to conservation activities. In some cases the revenues can come from existing sources of revenue (e.g. water bills), in other cases, special "earmarked" fees are introduced to fund the PES payments.

The payments or compensations are required to recognize the importance of specific environmental services indirectly provided by the ecosystem, and to give a direct monetary reward to those individuals who help provide them either by changing their behavior/ activities, or by "doing nothing" and allowing an intact ecosystem to continue to provide services. In both cases the PES payment is directed at individuals to change or re-enforce their behavior. In the absence of payments, the desired environmental services will tend to be "under provided" by the market -- fewer services will be provided than are actually demanded by society. PES systems therefore can help to both ensure provision of environmental services and increase overall social welfare which is an economic measure of the well-being of society. If social welfare increases, it means that the sum of the benefits of the change exceeds the sum of the costs, and overall society which includes all individuals is "better off".

Ecological Compensation Mechanisms (ECM) are fairly common in China and are a modern variant of traditional government payments to providers of services. The Government uses money from many different sources (e.g. individual tax payers, excise taxes, industrial taxes, and pollution fines) and makes payments (transfers) to land use managers for specific actions. This approach of making Government transfers for environmental protection is a well-established tradition around the world, whether payments are for soil-conservation measures, improvements in watershed management, or coastal zone protection measures. Some authors call this approach "supply-side PES" since Government decides what environmental services to support and uses general tax revenues to do so. There is no direct input from service users on what they want (or how much they are willing to pay for it). Since there is no explicit linking of service providers and service users, the Government decides what environmental services to support, and how much to pay for them. It may choose to address the wrong problem, or make inefficient investments. This potential weakness of the ECM approach can be addressed by creating better "market signals" as to what environmental services people want / demand and what other people are willing to accept to provide these services.

The **Payment for Ecosystem Services** (PES) approach is designed to meet this need and

does so by mimicking a market transaction. The PES approach simulates the creation of a new market whereby revenues are collected and an explicit link is made between those who benefit from an environmental service and those who provide the same environmental services. In the past those who benefited from environmental services (the **beneficiaries**) usually had no connection with and made no direct payments for their provision (other than through general taxation which governments then re-distributed to many uses). At the same time, those who provided the services (the **service providers**) received no direct financial payments for providing this service. The PES approach is designed to compensate those who provide environmental services from revenues collected from those who receive the services. Hence although both the ECM and PES concepts share similar objectives (improved provision of environmental services), the PES concept recognizes the direct link between service provider and service user and is designed to create a new market where previously a market did not exist.

Determining the appropriate payment for an environmental service obviously depends on many factors including how much the service beneficiaries value the service (and their ability to pay) as well as the cost to service providers of maintaining the service. Any effective PES system will have to balance the amount of payments that are possible with the financial requirements of service providers. In a number of watershed-based PES systems, fairly modest fees per water user have been sufficient to collect sufficient finances to make effective PES payments. The actual level of PES payments has to be determined in each case, and must balance the ability to pay by those who benefit from the service, and the demands from service providers for compensation.

Much has been written on the PES approach, and recent work includes the writings of Pagiola and Platais (2002, 2007), Pagiola et al. (2002) and Landell-Mills and Porras (2002). Recent works focusing specifically on China include two reports prepared by FEEM (2006, 2007), Scherr et al. (2006), and Zheng and Zhang (2006). Of all of these references the most complete and useful discussion of the PES approach is found in Pagiola and Platais (2007), a report still being finalized as of the end of 2007. This Policy Note builds on these publications and reports and explores the concept of PES systems and their potential application in China.

3. Types of Ecological Services Commonly Involved in PES Schemes

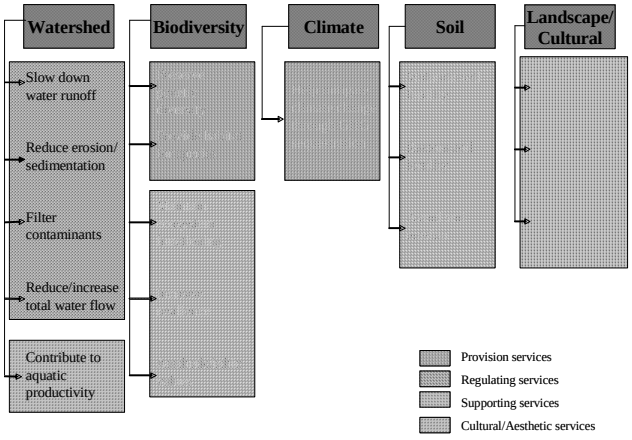
In theory a PES system can be developed wherever a market for an ecosystem service did not previously exist. In practice many of the early PES systems have developed around ecosystem services where the cause and effect link between the provider of the service and the beneficiary is close: e.g. watershed protection and consumers of the water produced by the watershed; or, recreational users of coral reefs and the protection and/or conservation of the coral reefs.

Figure 1 from the FEEM study (2006) lists a wide variety of ecosystem services that are potentially amenable to PES schemes. This typology divides ecological/ environmental services (EES) into several main categories: Watersheds, Biodiversity, Climate (and climate change), Soil, and Landscape/ Cultural. This is a useful division and illustrates that EESs can be found in many different parts of a country's landscape.

Each of these EESs potentially provides a benefit to someone other than the owner/ manager of the ecosystem itself, and therefore an opportunity exists for the creation of a PES system.

The economic logic behind establishing a PES system is seen in Figure 2. In this example the focus is on how a land owner manages a forested area in a watershed. The owner/ manager can convert the forest to pasture and earn the expected return as shown in the bar on the left side of Figure 2

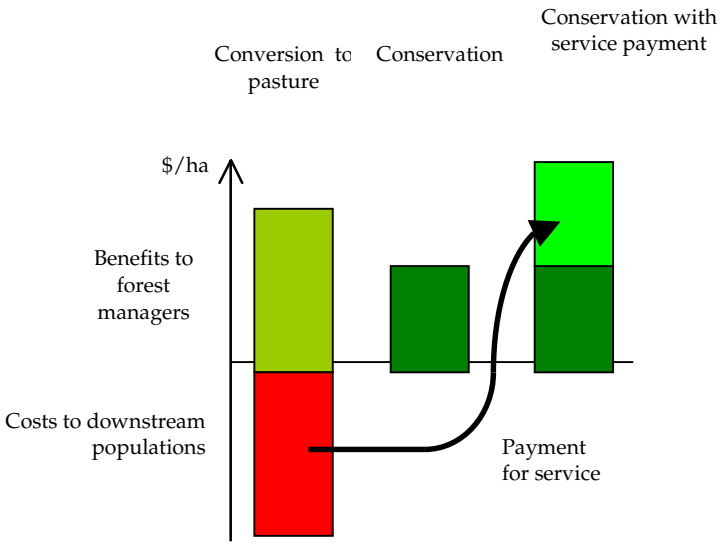
Figure 1 Main Ecological and Environmental Services by Type of Service



Source: FEEM (2006).

or the owner can leave the forested area under conservation and earn the expected return shown in the middle bar in Figure 2. The first option, conversion to pasture, earns more income for the landowner. The conversion of forest to pasture, however, reduces the environmental services of the land in terms of providing water to downstream users. This is shown as the "cost to downstream users" area below the axis in the left hand bar in Figure 2. Herein lies the quandary: from a social perspective the net benefit to society from conversion of forest to pasture is quite small or even negative (the benefit to the forest manger minus the cost to downstream users from the first bar) but the forest manager does not see it the same way. He or she compares the two areas above the axis in the first two bars and makes the reasonable decision to convert from forest to pasture since the net benefit to the forest manager is larger.

Figure 2 The Simple Economics of Payments for Environmental Services

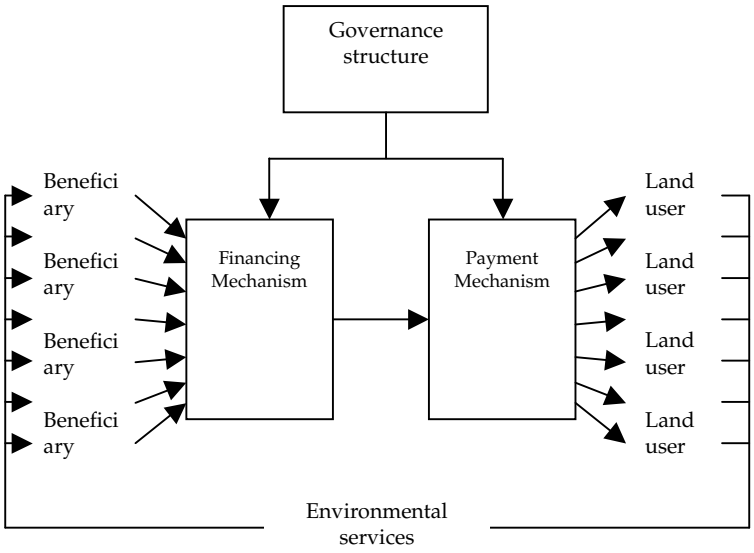


Source: Pagiola and Platais (2002)

With a PES system, however, a payment is made to the forest manager that produces the result shown in the right hand bar in Figure 2 – the forest manager has a larger net benefit (revenues from conservation plus the PES payment), and the downstream beneficiaries are also ahead since the cost of the PES payment is less than their loss would be if the forest land was converted to pasture. The PES system allows the transfer from downstream beneficiaries to upstream forest land managers to take place, something that would not happen without the PES system. With the PES system, overall social welfare (or economic well-being) is increased (as measured by the total welfare for upstream and downstream users combined). Of course, any efficient PES system depends on the magnitudes of upstream and downstream benefits and costs being such that the downstream users can make the needed payments, thereby avoiding a damage or loss, and still be better off economically. Similarly, the upstream land manager must be at least as well off after the PES payment has been made as he/she would have been after converting the land to a different use.

The actual mechanics of a PES system are seen in Figure 3 (Pagiola and Platais, 2002). The PES system has a governance structure (institutions) that allow payments to be collected from beneficiaries of the ecosystem service (on the left hand side of Figure 3), the payments then go into some sort of financing mechanism (often a special fund) and are distributed via a payment mechanism to the various service providers (or land users in the example in Figure 3). This payment helps assure the continuing provision of the environmental services that in turn benefit the service beneficiaries. The "loop" is thus closed, and there are incentives provided to the service providers to continue to produce ecological and/or environmental services.

Figure 3. The Flow of Compensation from Beneficiaries to Land Users in a PES System



Source: Pagiola and Platais (2002)

Almost all PES systems follow a similar pattern – the main differences lie in the details of how service beneficiaries make payments (the taxes) and the form of the financing and payment mechanisms. The institutional arrangements for facilitating the transfer of funds are of fundamental importance to the success of any PES system. Pagiola et al. discuss these issues in some detail in their book on selling forest environmental services (2002), and Pagiola and Platais explores these issues at length in their 2007 report.

A key determinant in establishing a successful PES system is the economic value of the ecosystem service itself. The perception by the public, or the direct beneficiaries, that the service is of economic value and hence worth paying for will make it easier to establish a PES system. If the ecosystem service is seen as having no direct benefits to another group, there is no incentive or willingness to be taxed and help pay for this benefit. This becomes a major concern with ecosystem services that produce global benefits (e.g. reductions of green house gases or ozone depleting substances; some forms of biodiversity or genetic material conservation), since it is harder to establish realistic and acceptable payment mechanisms. In the case of many global benefits, PES systems will usually require some form of global payment mechanism. The recent developments in the climate change field illustrate some of these points.

In the case when there are either local/ national benefits or global benefits, recent work in China and around the world has increasingly shown that many people recognize that ecosystem services are "of value" and worth protecting and paying for, even if no market or market price previously existed. The whole area of economic valuation of environmental goods and services (putting "prices" on different parts of the environment) is a rapidly developing field and many excellent studies have been done in countries around the world to determine monetary values for ecosystem goods and services. The PES approach builds on this foundation.

4. Factors Determining the Ease or Difficulty in Establishing a PES System

It is important to stress again that PES does not just mean government payments to providers of ecosystem services. These so-called "supply side" PES payments are a common function of government whereby general tax revenues are used for any of a number of purposes: health, education, defense, the environment, etc. The defining characteristic of a PES system is the establishment of a financial link between those who use an environmental service and those who provide it. The payments may come from new/ additional sources of revenue or may come from current revenues.

Since a PES system is basically creating a new market where one did not exist before, any resource manager in China who is considering establishing a PES mechanism must consider a number of factors that influence the ease with which a PES mechanism can be implemented (a useful discussion of these factors is also found in the FEEM case study paper (2007) and Pagiola and Platais (2007). The main factors to consider are the following:

The "distance" between cause and effect. The link between ecosystem service providers and service users or beneficiaries varies from very direct and immediate (e.g. local watersheds and drinking or irrigation water supply) to very distant (e.g. carbon sequestration and impacts on global warming). In practice, the "distance" between the provider of the service and those who enjoy the benefits is an important variable in deciding how easy or difficult it is to set up a PES scheme. It is normally easier to set up a PES system when the "distance" is small, and harder to do so when the "distance" is large.

For example, some of the earliest examples of PES systems are found in watersheds where water users in a lower watershed (the beneficiaries) provide the funds and payments are made to watershed managers in the upper watershed (the service providers). In Heredia, Costa Rica, in one of the first examples of an operating watershed-based PES system, the distances involved were measured in the tens of kilometers. In a much larger example, that of New York City and the payments for protection of the municipal water supply source in the upper watershed, the distance was larger (hundreds of kilometers) but the concept was very similar and the cause and effect links were equally clear. These examples are discussed later. Similarly, for biodiversity conservation it is often easier to collect payments from those beneficiaries that directly use or view the resource, often for recreational purposes. Many marine parks around the world have introduced special fees on park users to help protect the broader marine resource. This is another example of a type of PES system.

The numbers of service providers and service beneficiaries. Although institutional issues play an important role, in general the ease or difficulty of setting up a PES system depends on the numbers of people (or institutions or organizations) involved on both sides. Since the providers of the ecological service have to receive payments it is important that their number is manageable and that an institutional mechanism exists to reach them (and make the payments). In Costa Rica, for example, in the Heredia watershed there are a total of several hundred farmers who take part in the system and receive payments. In other locations the number of "service providers"

may number in the 10s of individuals. These cases are obviously much easier to handle than in case where there are hundreds of thousands (or more) service providers – e.g. the farmers or foresters in a major watershed in India.

Similarly, the number of service beneficiaries matter but may not always be as much of a problem. In many watershed-based PES schemes, the beneficiaries (individual users) are already paying for the water (or electricity) provided and therefore the additional PES payment can be added to existing billing and collection systems. The water utility in effect is the user group and one utility may represent hundreds, thousands, or even millions of people. If, however, there is no payment system in place for beneficiaries, setting one up and collecting fees can be a major, and expensive, challenge. For example, an important service provided by some ecosystems is biodiversity and its conservation and management. But there is usually no organized payment system for this service. Even though people value the biodiversity they are not used to paying for it and in fact make no regular payments. Therefore setting up a fair, transparent, and manageable payment system would be very difficult and expensive to implement. The one exception is if everyone was made to pay a "biodiversity supplement" to some other tax or payment that is regularly paid, such as a property tax, an income tax, or some other user fee.

Collecting beneficiary payments and making transfers payments to service providers. It costs money to collect money and it costs money to distribute money. Therefore, to implement a PES system one also has to face the administrative and institutional issue of how one collects the payments from the beneficiaries and actually makes the transfers to those who are providing the services. Many of the early PES systems established special "funds" where the payments collected could be placed until they were paid out to the service providers. Any new system takes time, effort and money to establish. Obviously as the number of individuals or groups involved increases on either side – beneficiaries or service providers – the administrative and institutional costs of the collection of payments and making necessary transfers will also increase.

The example of Costa Rica and a number of other watershed-based PES systems is instructive. Figure 3 stressed the needs for an overall governance structure as well as separate financing mechanisms (how the money is collected) and payment mechanisms (how the money is paid to service providers). Sustainability of a PES system requires that the costs of administering the system be kept low – a number of successful PES systems have overall "costs" of 20% or less (meaning that 80% or more of the collected money is actually used to make payments to the service providers). If these figures were reversed, and 80% of the money collected went to administrative costs, then the PES system would be a very inefficient way to collect and transfer money. In some cases (e.g. the Costa Rican national programs) NGOs have played a valuable (and cost-effective) role in implementing PES systems. For example, FONOFIFO, the Costa Rican implementing agency for the national program, has its costs capped by law at 7%, resulting in 93% of collected funds being distributed to beneficiaries.

The legal and institutional framework. Without doubt the biggest potential handicap to establishing a PES system is the creation and/or functioning of an appropriate legal and institutional framework. Since financing is often being

newly collected and payments are being made to those who were not previously receiving payments, the requirements for appropriate legal and institutional mechanisms are paramount. Whether new laws or institutions are required depends on the situation in each country, and tend to be very location-specific. This Policy Note cannot go into the details here. Useful guidance and examples are provided in the Pagiola and Platais manuscript (2007).

5. A Growing International Experience with PES Systems

The earliest examples of PES systems were often associated with watershed management and potable water supply. This is not surprising since the physical link between watershed management and downstream water supply and quality is often recognized (even if imperfectly understood) and the institutional side of the water users is well developed. Service users (water customers) demand and are willing to pay for potable water, and a mechanism usually exists (the water bill) that can be used to collect the PES payments. Still, the institutional mechanism for making the payments to environmental service providers usually has to be developed.

Two of the best known examples of this form of PES systems are found in the cases of New York City and Heredia in Costa Rica. Although these two cities are polar opposites with respect to size, the PES approach used in each is actually quite similar (albeit at quite different scales!). In both cases the managers of the urban water supply became concerned about changes in the water coming out of the watershed and decided to protect the water quality (and quantity) at the source in the watershed, rather than treat water quality problems once the water reached the urban area.

New York City example (abstracted from Pagiola and Platais [2007]). New York, one of the largest and richest cities in the world, obtains its water supply from watersheds in the Catskill Mountains north of the city. Water quality was naturally good and little or no treatment or filtration was required to make the water potable. New York City consumed between 4 to 5 billion liters of water per day. However, by the end of the 1980s changing agricultural practices and other developments in the Catskills (e.g. non-point source pollution, sewage contamination, and soil erosion) threatened water quality.

New York water planners considered two options: constructing a water treatment system at a capital cost of $4 to $6 billion with an additional annual operating cost of about $250 million (for a total present value cost of some $8 to 10 billion), or, implementing a plan to work with the upstream land owners/managers in the Catskill watershed to eliminate potential problems and maintain a high quality water source. The second option was chosen. It is a classic PES approach that included a number of different measures and actions (including payments for both on-farm capital costs and pollution reducing agricultural measures). The plan was implemented for a cost to New York City of about $1.5 billion, or less than 20 percent of the cost of the alternative option of a water treatment system.

Note that in either case the water users in New York City would have had to pay the costs through their water bills and other bond/debt instruments. However, by exploring and implementing a PES approach to the problem (rather than paying to correct a problem after water quality had deteriorated) the citizens of New York City benefit from continued good quality drinking water and avoid very large and on-going treatment costs. In addition the PES approach helps to protect the watershed and the other services that the watershed provides (recreation, biodiversity conservation, and other environmental services). The payments to the service providers in the watershed come

out of the revenues collected from water users (who have to pay the charge as part of their water bill). Note that the "market" in this example exists between the water utility in New York City and the watershed managers, and not between the millions of individual water consumers in New York City and the watershed managers.

Heredia, Costa Rica example (based on Castro, [2002], and Barrantes and Gamez [2007]). Heredia is a small university town in Costa Rica, not far from the capital of San Jose. Faced with similar issues as New York City – changes in the watershed were having an impact on the potable water supply – Heredia set out to set up a PES system that would tax the water users (about 50,000 connections) in order to pay farmers in the watershed to undertake improved conservation measures. Heredia consumes about 3 million liters per day, one tenth of one percent of New York City's consumption.

In the late 1990s analysts (see Castro, 2000) considered a variety of environmental services produced by a forested watershed – water supplies, biodiversity, carbon sequestration, recreation, and flood mitigation. If land was converted, extensive dairy operations were the most attractive alternative use with an estimated gross income of about 53,000 colones per hectare per year – a bit over US$175 per ha per year. Further analysis showed that farmers were willing to "sell" their conversion rights and maintain the forest under conservation for a payment of roughly 23,000 colones per hectare per year (about US$75). This money will compensate farmers for foregone income and to allow them to undertake additional conservation measures.

Further analysis estimated that a PES payment of 2.70 colones per cubic meter of water (less than one US cent) would be sufficient to collect enough funds from water consumers to pay compensation of 23,000 colones per hectare per year for conservation in the watershed and administer the program. The PES charge is equivalent to an increase in the water tariff of between 1 and 3 percent (water rates vary by type of water use). This system is now being implemented, and the charge per cubic meter has doubled from the initial charge of 1.90 colones per cubic meter in the year 2000 to the present charge of 3.80 colones per cubic meter. Still, the PES charge is less than 2.5% of the total water bill. Note that the Heredia case illustrates an application of a targeted "earmarked" fee to increase revenues for the water utility and make payments to help avoid future problems and future expenditures on water supply. In contrast, in New York City the PES system relied on current revenues and was set up to address an immediate problem. The PES approach was found to be the most cost-effective response to the emerging problems in the watershed.

Other Latin America/ Central America examples of PES systems (largely drawn from Pagiola and Platais, 2007) include the following:

- Quito, Ecuador: Ecuador is trying various PES approaches in different parts of the country. In Quito, the capital, water utility and electric utility are re-allocating part of current revenues to make payments to private landowners and protected areas in the watersheds serving the town. These PES payments pay for various conservation activities in the watershed to help protect Quito's water supply.

- Yamabal, El Salvador: In an example of a PES system where there are direct transactions between the local municipality that is concerned with the

re-charge of the aquifer that supports local water supplies, and upstream land users. PES payments are made to private landowners located in the recharge area of the aquifer and support land uses that promote enhanced infiltration of water into the aquifer.

- Mexico: An example of a supply-side PES system is the national program called *Pagos for Servicios Ambientales Hidrologicos* (PSAH), or Payment for Hydrological Environmental Services. The PSAH pays members of upstream *ejidos*, traditional community owned lands, to avoid deforestation to help protect the watershed. The payments come from downstream water users, by re-allocating funds collected for water use, but the actual allocations of payments are decided by the government and often reflect political considerations (e.g. "spread the money around") rather than efficiency considerations.

Other international examples include the following:

- South Africa: A supply side PES program uses government resources to fund the removal of invasive alien plant species that are more water using than traditional native species. The Water for Work (WfW) is largely funded by poverty elimination/ job creation funds, although some actual PES systems are developing in select localities (e.g. the municipalities of Hermanus and George).

- France: To help ensure the quality of its water sources, the private water bottler Perrier-Vittel pays farmers to reduce or eliminate agrochemicals and use changed farm management practice, both steps designed to reduce contamination of groundwater resources. Started in the late 1980s, initial contracts with farmers ran from 18 to 30 years with PES payments of around US$230 per ha per year, largely made in the first 7 years of the program when most expenses occur. Perrier-Vittel targets farmers whose activities are most likely to affect their water sources.

It is sometimes surprising to note that even with so much interest in PES systems (often seen as a potentially self-financing answer to improved environmental conservation), the actual examples of successfully implemented systems is still quite small. Many of the same examples are cited in almost all reports (including this Policy Note) and often include watershed-management related cases. PES systems usually focus on indirect uses of environmental resources (e.g. watersheds and water supplies; reef conservation and fisheries); but when there is direct use (as in the case of reef conservation and divers for example) raising admission fees for recreational uses is a fairly common example since the distance between the service provider and the user is effectively "zero". There are many examples of direct-payments for environmental service use. When the distance is greater, the services are provided indirectly, then the number of examples decreases rapidly.

When environmental services are provided at the national or global level successful examples of PES systems are even fewer in number. For global environmental services such as biodiversity conservation or reduction in green house gases, for example, most PES schemes are dependent on global transfers from either the GEF or other funders. These are therefore examples of supply-side PES systems at a global level. This example points out that PES systems are not a universal panacea, and that many countries are struggling to implement the PES approach. China is no exception in this regard.

6. PES in China – Opportunities and Challenges

China, as a large and densely populated country, faces major challenges to properly conserve and manage its river basins. 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 water pollution, the Government of China has also made massive direct investments and incentive payments to promote soil and water conservation. Both the broader use of Ecological Compensation Mechanism approaches and the targeted Green for Grain program are being used to provide incentives for improved land use. This Policy Notes explores a new approach – the use of targeted payments to the providers of ecological services, where the payments come from those who directly benefit from those services. Thus the Payment for Ecosystem Services (PES) approach is another way to address pressing environmental management problems and relies on "mimicking" a market to link service providers and service beneficiaries. PES systems are an attempt to help "close the loop" between those who benefit from existing environmental/ ecological services and those who provide these services. Since PES systems usually create new sources of funding from the service beneficiaries, this approach also helps relieve Government fiscal constraints.

PES as an extension of existing practices. Although PES is considered as relatively "new" in China, there is historic precedent of the Government making payments to individuals to encourage them to take ecologically-friendly land use decisions or other investments (e.g. the ECM approach and the Grain for Green program). Whether these include funds for improved terracing of erosion-prone uplands and loess areas, or grants to discourage deforestation in wooded areas, these are basically supply-side PES systems, but ones that are funded by revenues (taxes) collected by the Government. What was missing in the past was the explicit link between payments from the beneficiaries of improved ecosystem services, and transfers/ payments to those who provide these services. This is what makes the PES approach different.

The need to link cause and effect in theory and practice (causality). As mentioned earlier a critical first step is the identification of the cause and effect link between ecosystem conservation and management and the provision of ecosystem services to beneficiaries. Once this is established the payment system can either reflect a payment for some desirable ecosystem good or service, or a payment to prevent something bad from happening.

Note that the traditional "polluter pays" approach championed by the OECD in the early 1960s and now commonly used in China today is a variant of the PES approach, but one where the creator of pollution is charged an amount that is in theory linked to the magnitude of damage done to others. It is not a PES system per se, since the polluter is charged for damage created, and the beneficiaries of the unpolluted service are not asked to help pay for the service. In a PES system the "beneficiary pays" approach is used and although both "polluter pays" and "beneficiary pays" approaches are different, they can often work together as part of a package for improved environmental management.

PES and "low hanging fruit". Economists like the idea of "low hanging fruit" – easy

victories that can be obtained with minimum effort. Hence the analogy to collecting those fruits on a tree closest to the ground and can be easily and quickly gathered. In the development of PES systems we also look for "low hanging fruit" – examples where a system can be easily and quickly implemented. Such a situation would exist when the following conditions are met:

- The cause and effect link between providers of ecosystem services and the beneficiaries is clear and relatively close,
- The beneficiaries realize the importance and value of the ecosystem services
- Mechanisms exist (both institutional and legal) to efficiently collect payments for the ecosystem service from the beneficiaries and make transfer (payments) to the service providers,
- The institutional structure to collect payments and make transfers is in place,
- The numbers of service providers is manageable and the number of beneficiaries is clearly defined and not too large (or at least clearly defined as in the case of municipal water consumers),
- There is public and private support (e.g. on the part of both Government and individuals) for establishing a PES system.

The Political Economy of Implementing a PES Scheme. Even when a PES scheme makes perfect sense, there is the very real question of the political economy of introducing something new, especially when it involves collecting funds and then making transfers to another group and the implication of fundraising and transfers to the rest of the society. For instance, if one group of service providers starts to receive payments when none were given in the past, other service providers in other areas may well demand payments also. This is a legitimate concern and deserves a lot of attention in implementation arrangements. One answer is that in theory those who provide valuable ecosystem services should receive payments; the question is the institutional ability of any society to do so. Rather than use this as a reason for not attempting to implement a PES system, resource managers should recognize that new demands for PES systems may arise, and that this is actually a good development in the long run as ecosystem service providers and ecosystem service beneficiaries develop a deeper understanding of and appreciation for the value of environmental resources. In addition to public support and participation, political will also plays a crucial role in introducing and implementing a PES scheme.

Establishing PES systems and their feasibility in China. Taking into account the various conditions discussed above it may be possible to establish a PES system in China. As the discussion has shown there are different forms of PES possible in China depending on who receives the benefit of the ecological/ environmental service (EES). The main potential service users/ beneficiaries are the following:

- Direct resource users (e.g. recreation; direct extraction of resources such as fish or birds).
- Indirect users of the resource (e.g. water quantity and quality for agriculture, domestic, urban, aesthetic uses).
- Beneficiaries of broader ecosystem services (e.g. species and habitat preservation) and their use.
- Beneficiaries of reductions in Greenhouse Gas Emissions.

Clearly the first few groups of beneficiaries (direct and indirect users of the resource) will be easier to identify and tax if a PES system is to be set up. The case study in

Lijiang focuses on these groups. The third group of beneficiaries (of broader ecosystem services) is harder to identify and tax. One possibility is a general "environmental tax" on all citizens in the country (or a province or region) to collect funds to help provide broad ecosystem services. Such broad taxes are never popular and the taxpayers rightly feel that their money is not necessarily producing any real benefits for them. This is an example of the "cause and effect" and the "distance" issues discussed earlier.

The final category of beneficiary, those who benefit from reduced Green House Gas (GHG) emissions and climate change – is even more problematic. In this case the potential beneficiaries include most people in the world (although certain groups more than others: e.g. residents of low lying areas subject to flooding). PES systems to address climate change have been established, but while the service providers are local groups (often managers/ owners of forested areas) the beneficiaries who make the payments tend to be located in other countries and are usually looking for low-cost ways to meet their carbon reduction requirements.

There are many types of PES schemes being tried around the world. Table 1 (FEEM, 2006) presents one typology of PES schemes divided into those that are Voluntary Contractual Agreements, Public Payment Schemes, and Trading Schemes. Many of the PES schemes being proposed for China fall in the second category (Public Payment Schemes, of which the ECM is one example) with the Government collecting the payments (either directly from service beneficiaries or from general taxation) and then making the transfer payments to the service providers. The reader is referred to the original paper for more details on each of these approaches.

Table 1. Main Types of PES Schemes as identified in the FEEM Study

Type of PES	Participants	Type of EES	Requirements
Voluntary contractual agreements VCS	- Private to private. Role of government limited to enforcement of property rights.	- High-value EES, related to private good. - Low cost of provision of EES. - Small scale.	- Clear and enforceable property rights. - Negotiable contracts. - Limited number of providers and beneficiaries.
Public payment schemes PS	- Government to private, government to government, or government to other organizations (e.g. NGOs, CBOs)	- Public good, significant externalities involved. - High value of EES, but high cost of provision.	- Generation of funds for government (e.g. taxes, user fees,…) - Transparent institutions. - Public participation.
Trading schemes TS	- Private to private, with government setting initial standards and allocation of rights.	- High value of EES, variable costs of provision. - EES related to private good. - Services provided by different providers must be perfectly substitutable.	- Strong institutional setting. - Strong monitoring and compliance mechanisms. - Initial allocation of rights.

Source: FEEM (2006)

7. The Lashihai Nature Reserve, Yunnan Case Study

The Lashihai (Lashi Lake) Nature Reserve was established in 1998 in Lijiang City, Yunnan Province, China. The main purpose of the Reserve is the protection of the Lashihai wetland (including its important freshwater lake), a Ramsar listed wetland important to migratory birds. Major protection measures focus on fishing, poaching, and hunting within the wetland and threats from increased tourism to the wetlands and agricultural activities in the surrounding areas.

In a recent study carried out by FEEM of Milan Italy and Conservation International in conjunction with Chinese researchers (see FEEM (2007) and Conservation International etc (2007)), a number of major environmental issues were identified including the following:

- Ecological services provided by the Lashihai watershed including biodiversity protection (especially birdlife) and landscape/ water supply benefits in terms of improved water quality in the nearby tourist town of Lijiang,
- Economic damages to farmers whose crops are eaten by protected bird species, and
- Economic costs associated with changes in agricultural practices to reduce fertilizer and pesticide inputs into the water system that serves both the wetlands and Lijiang town.

The study estimated economic values associated with these different impacts in order to identify the magnitudes involved and assess the feasibility of establishing a PES system to help better manage the areas. This case study illustrates the types of ecological and environmental impacts that have to be taken into account and both the opportunities for PES, and the limitations on introducing a PES system. Table 2 summarizes the main ecological/ environmental services, service providers, and service beneficiaries. The map in Figure 4 locates the Lashihai Nature Reserve and Lijiang old town.

Table 2. Summary of EES, Service Providers, and Service Beneficiaries in the Lashihai Case Study, China

EES Service	**Service providers**	**Service Beneficiaries**
Improved water quality for landscape services	Farmers around the Lashihai lake	Citizens of Lijiang Tourism industry – Lijiang old town / Visitors to the old town
Maintenance of birds' biodiversity	Farmers around the Lashihai lake	Tourism industry – Lashihai Nature Reserve Visitors to the nature reserve Global benefits – biodiversity preservation*

*Global benefits are traditionally not included in local PES schemes.
Source: FEEM (2007)

There are a number of ecological/ economic interactions in this case, only some of which are suitable candidates for a PES system. The most obvious candidate for a PES system is that between the wetlands, agriculture, and the tourist town of Lijiang. The Lashihai wetland is an important source of supplemental water flow to Lijiang (and its system of canals). Lijiang is a major tourism destination (estimated at some 2,300,000 domestic visitors and 110,000 international visitors per year) and both tourists and merchants in the town value the amenity benefit of good quality water for consumption and for landscape uses as it flows through the town. Parts of

the case study focused on estimating willingness to pay by tourists for water quality and water quantity services, and the costs of improving agricultural practices to help maintain or improve water quality.

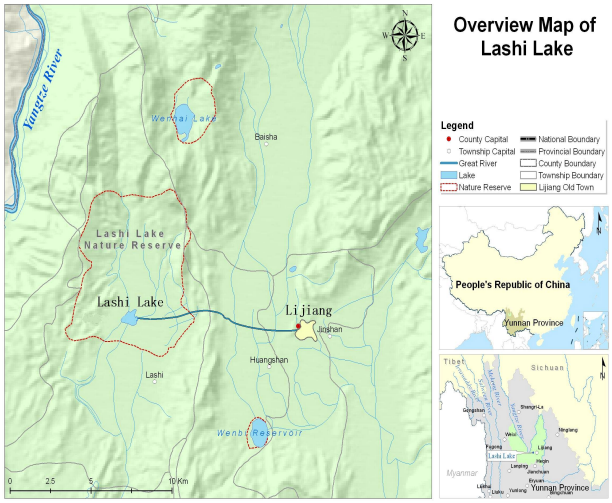


Figure 4. Overview Map of Lashihai Project

The link between the wetlands and surrounding agricultural areas is two-fold: first, agricultural activities affect the quality of water entering the wetland, and second, the protected birds in the wetland forage outside of the wetland for food, and eat part of the crops in nearby fields. In addition there is a growing visitor industry in the wetlands, largely focused on bird watching. It is not clear who should pay who in this case – farmers want to be compensated for bird damage to their crops, and the wetland wants farmers to reduce fertilizer and chemical use and thereby improve water quality in the wetland (and also make it a better habitat for birds, which eat crops grown by the farmers!). The problem with the wetland-farmer link is that there are benefits and costs on both sides, and the number of yearly visitors to the wetlands is still fairly small.

These two sets of interactions: wetlands - agriculture-Lijiang town, and wetland-tourism-agricultural activities, are examined in turn:

The Wetlands – Agriculture -- Lijiang link. Lijiang is a major tourist destination in China and attracts close to 2.5 million visitors a year to see its historic town and system of canals. Sometimes called "the Venice of China", water quantity and quality are important to the visitor experience. The case study focused on the links between water quality and quantity and agricultural practices of surrounding farmers. In this case the farmers are the potential providers of the improved EES – better quality water – and the visitors are the beneficiaries. The study carried out a contingent valuation method survey (CVM) of the willingness-to-pay (WTP) of visitors to Lijiang for improved water quality. A CVM survey is an analytical technique that relies on people's responses to a hypothetical question to estimate economic values. In the Lijiang study the CVM survey determined that there was a median WTP of RMB 8 for "landscape" water quality, with an average or mean WTP of 10.3 RMB.[2]

In contrast, a separate CV survey of the willingness-to-pay (WTP) of visitors to the nature reserve for maintenance of bird biodiversity in the nature reserve found the same median WTP -- 8 RMB -- but a much higher average or mean value of 33.4 RMB (due in part to the very high maximum WTP results for biodiversity viewing as reported in Table 3). This means that on average wetland visitors were often willing

[2] A median value is the point where half of the respondents were willing to pay at least this amount, while the mean or average amount is the total WTP of all visitors divided by the number of visitors.

to pay more per person for bird biodiversity conservation than visitors to Lijiang town were willing to pay for better "landscape" water quality. Of course, the number of visitors to Lijiang town far outnumbered the number of visitors to the nature reserve. Table 3 presents the results for the contingent valuation survey of willingness-to-pay for both landscape water quality in Lijiang old town and biodiversity conservation in the nature reserve. The substantial number of "zero" bids means that these survey results have to be used with caution, but there clearly is a willingness to pay by visitors for both better urban water quality and enhanced biodiversity conservation.

Table 3. Willingness-to-Pay Results from Landscape Water and Biodiversity Conservation Contingent Valuation Surveys.

	Mean WTP	**Median WTP**	**Min**	**Max**	**Sample size**
WTP for landscape water quality	10.3	8	0	157	254 (138 non-zero)
WTP for biodiversity in Lashihai Nature Reserve	33.4	8	0	2500	254 (116 non-zero)

Source: FEEM (2007)

Looking at both service providers (largely framers around the Lashi Lake) and service beneficiaries, and the estimated economic values associated with both damage (real or potential) and willingness-to-pay for benefits, it is seen that the two main ecological services – water quality and biodiversity (largely birds) conservation – have quite different stories. The landscape service and quality of water in Lijiang Old Town appears much easier to fund in a PES system than biodiversity conservation and farmer compensation for bird damage. Table 4 presents a summary of the key factors.

Table 4. Environmental/Ecological Services – Providers and Beneficiaries – Key Factors

	Biodiversity service: birds' population	Landscape service: quality of water
Service providers	Farmers around the Lashihai Lake	Farmers around the Lashihai Lake
Cost of provision to the service provider	Average yearly damage (2000-2005): RMB 1,845,613 (damages inflicted to crops) US$ approximately 233,470	Not yet assessed. It is however expected that the cost of provision to the farmers will not be high, as they are unlikely to be on the production possibility frontiers – reducing inputs of fertilisers and pesticides is likely not to lead to lower yields
Service beneficiaries	Tourists visiting the Lashihai Nature Reserve for bird watching (national and international)	Tourists visiting Lijiang old town (national and international)
Value of the service to the beneficiary	WTP survey – 520,000-2,171,000 RMB per year	WTP survey – 32,338,400-42,635,690 RMB per year

Source: FEEM (2007)

Funding a PES Scheme. The study concluded that a small increase in the visitor fee presently charged visitors to Lijiang would be sufficient to raise enough money to pay for need agricultural extension services and other measures (including promoting organic agriculture) to help the agricultural sector provide the desired ecological services (improved water quality and quantity). Thus a PES system seemed quite feasible given the direct link between agricultural practices and the ecological service of improved water

quality, and the very large number of visitors (service beneficiaries) who come to Lijiang. It is important to note, of course, that water quality in Lijiang old town is also affected by the town itself. Therefore to address water quality more broadly in Lijiang will require measures to both improve the quality of water coming from agricultural areas as well as managing municipal sources of pollution (e.g. sewage and waste water).

Since the visitors already pay a visitor fee, it would be fairly easy (and low cost) to impose the extra ecological service charge. In fact, the study calculated that if the average visitor fee of RMB 40 was increased by 1 percent for Chinese visitors (to 40.4 RMB) and 5 percent for foreign visitors (to 42 RMB) this would produce enough revenue to implement the PES scheme and pay the required transfers to service providers (see Table 5). Experience in other parts of the world suggests that the proposed increase is very modest and should have no impact on visitors' numbers. In fact, a substantially larger "environmental surcharge) could probably be added to the visitor fee and still have no negative impact on demand.

The Wetlands -- Agriculture link. The focus of the economic analysis of the agriculture-wetland link was on the damage created by birds eating grain from farmers' fields. These costs were estimated to be as high as RMB 1.8 million per year (about $233,000 per year). Since the average number of visitors to the reserve is still fairly small (estimated at 50,000 Chinese and 15,000 international visitors per year), a substantial fee would have to be collected per person in order to implement a PES system. This fee, which would have to average about 28 RMB per visitor, considerably exceeds the average stated

Table 5. Suggested Increase in Lijiang Old Town Visitors' Fee to Fund PES Scheme

	Domestic	International	
Increase	1%	5%	
RMB per person	0.4	2	
Number of paying visitors	2,315,700	109,680	
Funds generated (RMB/year)	926,280	219,360	1,145,640
Funds generated (US$/year)	117,174	27,749	144,923

Source: FEEM (2007)

WTP as determined by the CV survey mentioned earlier (a median value of RMB 8).

The authors of the study concluded that even with a two-tiered pricing system for wetland visitors (a higher charge for international visitors than for national visitors) a PES system for the agricultural-wetlands link would only be partially sustainable, and that additional funds would be required from other sources. If domestic visitors were charges 8 RMB and international visitors were charged 40 RMB this would raise about 1 million RMB per year, about half of what is needed to compensate farmers for bird-damage to their crops (see Table 6). The full report of the case study (FEEM, 2007) has much more detail on the study and the estimated values.

The Lashihai case study pointed out a number of useful lessons: establishing a PES system is easier when the cause-effect link is clear (true in both examples presented here), where the numbers of service providers is manageable, and where existing institutional structures exist to implement a new payment system (e.g, the

already existing visitor fee at Lijiang old town). When the number of service beneficiaries is small, and a payment system is not in place (both of which are true for the Lashihai Nature Reserve) then introducing a PES system is much more difficult.

Table 6. Suggested Entrance Fees to Lashihai Nature Reserve to Fund PES Scheme

		Entrance fee RMB	Entrance fee US$
Number of domestic tourists	50,000.00	8	1
Number of international tourists	15,000.00	40	5
Total Revenue		1,000,000	126,500

Source: FEEM (2007)

The case study further discusses the institutional arrangements in Lijiang old town and in the Lashihai Nature Reserve, and how existing institutional systems will affect the implementation of any PES system. As the study points out, collecting the payments from service beneficiaries may be the easiest part of the scheme. Actually managing the money and making the needed transfers may prove more difficult. There are other political economy concerns over the impact of introducing a new financing mechanism on the rest of the society beyond the direct service providers and beneficiaries in Lashihai watershed; for instance, the communities outside Lashihai area who provide drinking water or other environmental services to Lijiang old town. These concerns have to be addressed appropriately in order to build up enough political momentum for launching a PES system and facilitating its smooth implementation. For more details see the full case study report (FEEM, 2007) and supporting institutional analysis and implementation guidelines (Conservation International, 2007).

8. Broader Lessons of the Use of PES in China and Concluding Remarks

The PES approach has much appeal in China. PES is seen as a way to increase funding to help pay the costs of maintaining or enhancing the provision of important ecological and environmental services. As this note has pointed out, even though the number of fully implemented PES systems is still small, this is an area where much work is being done in many parts of the world on developing new PES systems and various approaches are being tried. China should actively promote the use of PES.

The Lashihai Nature Reserve case study illustrates some of the analytical techniques that can be used to identify the various economic values associated with any proposed PES scheme, as well as some of the factors that need to be considered in implementing a PES scheme. Some promising actions are suggested by the case study and should definitely be tried.

Still, one has to be cautious. PES schemes are not a universal panacea nor always easy to introduce. Certain conditions have to be met and some types of use (usually the more direct and interactive uses, often based on direct use of the service, e.g. water supply, or tourism/ recreation) are more amenable to PES schemes than other situations (e.g. where there is a long "distance" between the service provider and the service beneficiary, or where the benefits are global, not local benefits as in the case of greenhouse gas emission reductions).

Guidelines for China. In sum, the following guidelines can be offered to help identify possible PES schemes and their relative ease or difficulty of implementation in China:

The closer are the close physical/ interactive links between the beneficiary and the provider of an environmental or ecological service, the easier it will be to establish a PES scheme (e.g. watersheds and local water supply; or water quality and recreational use).

Economics does matter – if the economic activities of those affecting the sources of environmental services are highly profitable (e.g. horticulture or vegetable growing), it will be harder to use PES schemes to make them change their behavior.

The more direct the use of and demand for the environmental or ecological service, the easier it will be to establish a PES scheme (e.g. recreation and tourism; soil erosion and dam sedimentation). Spatial analysis can help identify areas that produce multiple benefits (e.g. watershed protection and biodiversity conservation) and can lead to more effective and targeted PES systems.

The more indirect are the uses of environmental or ecological services, the harder it will be to establish a PES scheme (e.g. water use in a large watershed; protection of migratory bird species that are viewed elsewhere; protection of coastal habitats for fish that are caught elsewhere).

PES systems can be based on new revenues collected from environmental service users, and can also be funded from current revenues if service users are already making direct payments (e.g. water users).

PES systems should be considered as one way to avoid future costs by better

managing environmental resources now (and avoiding environmental damages).
Global environmental services or ecological benefits are usually very hard to fund via national PES schemes. Global financial transfers are often needed to make this sort of PES schemes work.

Finally, political will, governance mechanisms and institutional arrangements are crucial in introducing and implementing any PES scheme. Building on existing institutional and social systems is often essential to making a PES scheme work and be cost-effective. Establishing a new revenue collection and payment distribution system is costly and time consuming. A simple benefit-cost analysis will show if the institutional costs are justified by the expected increase in NET revenues (revenues less collection/ administrative costs) that can be transferred via a PES system. The broader political economy implication of a new PES scheme to the rest of the society should also be addressed.

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