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Payments For Environmental Services In Vietnam: Assessing An Economic Approach To Sustainable Forest Management

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This study looks at whether Vietnam could adopt the Payment for Environmental Services (PES) approach as part of its national conservation strategy. Using a pilot study in the country's uplands, it investigates how such a scheme might run and assesses its impact on the environment and on the local people's livelihoods. Through a review of current Vietnamese conservation practice, it assesses the barriers to the adoption of such schemes and the factors that might encourage their implementation.

Results are promising. Interest and involvement in the pilot scheme was quite high despite the experiment's limited duration. The PES trial also had positive environmental impacts, including a reduction in soil erosion and the extraction of natural forest products. Because of a number of barriers to PES implementation, the study recommends that further PES trials be run to gain more experience and knowledge, before large-scale implementation is tried in Vietnam.

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ACRONYMS

5MHRP	5 Million Hectare Reforestation Program
CDM	Clean Development Mechanism
CIFOR	Center for International Forestry Research
CPC	Commune People's Committee
DPC	District People's Committees
ES	Environmental Service
FIS	Forest Inspection Station
MARD	Ministry of Agriculture and Rural Development
PAM	United Nations' Food Program
PES	Payments for Environmental Services
PPC	Provincial People's Committee
SFEs	State Forest Enterprises
TC	Transaction costs
VND	Vietnamese Dong

ABSTRACT

This study assessed the potential for the PES conservation approach in Vietnam. This was done through a review of the country's legal framework and by conducting an experimental PES scheme involving sustainable forest management. The work was constrained by the fact that all land in Vietnam is state-owned and that there has been limited ES market development in the country. However, the results of the PES experiment (in forest areas where the fundamental conditions for PES were met) were quite promising. Participation in the trial scheme was good, despite the fact that it was an experiment of limited duration. Moreover, institutional support for this kind of PES initiative was found to be already available and effective. Expected environmental impacts were also observed: The sustainable forest management regime that was tied to the PES scheme resulted in a reduction in both soil erosion and in destructive natural forest extraction activities. In light of these findings, it is suggested that more practical policy/program trials should be implemented. These will allow Vietnamese policy makers to gain more experience and knowledge before the large-scale implementation of PES is tried in the country.

1.0 INTRODUCTION

1.1 The Research Problem

The majority of the poor in Vietnam live in the country's uplands, namely its hilly and mountainous areas. Many upland farmers provide significant environmental services that benefit the wider community. They do this through the environmentally friendly ways in which they implement forestry and other tree-based land use activities. These services include watershed protection, biodiversity conservation, carbon storage and the preservation of landscape beauty. These environmental services are very important because they support ecological balance, serve as the base for economic activities and provide a wide range of amenities for society (Francisco 2002).

Healthy forests provide important environmental services to society. This is recognised by the Vietnamese government and by international agencies and NGOs based in Vietnam. They provide incentives and rewards to some upland farmers to encourage them to afforest and reforest bare hills and mountains and other areas. In Vietnam, upland reforestation and afforestation work started extensively in the early 1990s, under the support of PAM (the United Nations' Food Program), and through Program 327 (a nation-wide reforestation program) and other reforestation programs. In 1998 the Vietnamese government launched the Five Million Hectares Reforestation Program (5MHRP), as a continuation of Program 327, in order to increase the existing forest cover of about 28% to 43% by the year 2010. The majority of upland farming households undertake reforestation work and they are now the primary owners of planted forests.

The main problem facing the country's uplands is that a significant number of upland farmers still do not manage their land in sustainable ways and often clear cut the forest, which is very destructive to the environment. Moreover, the majority of upland farmers are not paid for those environmental services they do provide. This problem is compounded by the fact that many of the planted forests managed by upland farmers are in ecologically sensitive/fragile areas.

The Payments for Environmental Services (PES) approach has emerged in recent years as a promising ecosystem conservation concept and tool. It also has the potential to improve the livelihoods of environmental service providers. In developed countries, there are already a variety of PES programs that pay individuals or groups for supplying ecologically valuable goods and services (Ferraro 2001). However, PES is much less popular in developing countries.

Given this situation, it is clear that it is vital to explore the potential for PES in Vietnam. This research study aimed to do just this using an experimental approach. The research was based on the hypothesis that forests would be better maintained or managed if forest owners were compensated for all the environmental services they provide. In this experiment, payments were made to farmers who managed reforested/afforested plots in a sustainable way through, for example, selective cutting and complementary planting.

1.2 Research Objectives and Research Questions

1.2.1 Research Objectives

The general objective of this research was to assess the potential of the PES approach in Vietnam and to highlight any constraints that would limit its applicability. Specific objectives included:

- To introduce the PES approach to the relevant authorities;
- To understand farmers' responses to PES payments and to assess the possible impact of these payment on farmers' livelihoods and on the environment;
- To explore the reaction of potential donors to PES schemes in Vietnam;
- To provide recommendations for the development of PES schemes in the Vietnamese context.

1.2.2 Research Questions

This research attempted to answer several questions related to the potential for PES in Vietnam. These were as follows:

- What factors determined a person's decision to join the study's PES scheme?
- What changes would take place in the allocation of household labor resources as a result of the adoption of the study's PES scheme?
- The cost of a PES program includes not only the amount paid to the households but also the transaction costs (TC) associated with establishing and monitoring the scheme. How much would the TC of the project be?

2.0 LITERATURE REVIEW

2.1 Payments for Environmental Services

Payments for environmental services (PES) can be broadly understood as economic incentives that are provided in return for environmental services. These services can be provided by environmentally beneficial activities such as reforestation, watershed protection and soil conservation. PES are designed and implemented to make it more worthwhile, in both financial and livelihood terms, for individuals and/or communities to maintain, rather than to degrade, natural resources.

"PES presents a new approach that focuses directly on creating a conditional benefit transfer between providers and beneficiaries of an environmental service. As such, they do not implicitly assume that natural "win-win" solutions with simultaneous gains in both conservation and development exist. On the contrary, the payment option is being pursued in recognition of existing "hard trade-offs" between conservation and development, which cannot be addressed by indirect changes in the productive logic of households, but which a direct compensating PES can help to bridge." (Wunder, The and Ibarra 2005).

The PES definition used by CIFOR includes five simple criteria (Wunder 2005). PES are (1) a *voluntary* transaction where (2) a *well-defined* environmental service (or a land-use likely to secure that service) (3) is being "bought" by a (minimum one) ES *buyer* (4) from a (minimum one) ES *provider* and (5) the ES buyer does so if and only if the service provider continuously over time secures the provision of that service (*conditionality*).

The definition of the environmental service being paid for is a vital prerequisite of any PES scheme. In some cases, it could be the environmental service itself. In other cases, it could be the adoption of a certain land use approach that is likely to generate the desired services. This latter approach is often taken. This is because environmental services can be hard to measure and monitor. Moreover, the linkage between resource use practices and the availability of ESs is often complex.

With respect to the relationship of buyers and sellers, the principle here is that the two parties involved can negotiate a bilateral agreement that makes both better off. The *conditionality* of PES implies that payments are made only if the agreed service is provided. In other words, decisions on whether to make payments or not are based on monitoring compliance with contractual obligations. This also means that payments will typically be made periodically, rather than up front. This provides a clear incentive for service providers to continue to adhere to a PES scheme's contractual obligations. It also provides an opportunity for the service buyer to exit the scheme in the case of provider non-compliance (Wunder, The, and Ibarra 2005).

Pagiola and Platais (2002) point to several advantages of PES. These include more efficient, sustainable and mutually beneficial arrangements between environmental service providers and users. Similarly, Landell-Mills and Porras (2001) show, through a global case study analysis, that PES systems can result in both improved ecological conservation and

improved livelihoods for poor people. Rosa *et al.* (2003) emphasize the potentially positive social outcomes that, monetary benefits aside, can be achieved through increased cooperation among participants in a PES system.

2.2 Environmental Services

What are the environmental services that are typically being bought under current PES schemes, and from what ecosystems do they originate? Most attention has been focused on forests. This is primarily because forests provide very valuable environmental services to humans. Secondly, high deforestation rates in recent decades have increased the need to try out innovative tools for forest ecosystem preservation. The broad categories of forest environmental services that are currently being commercialized through PES schemes on a significant scale are watershed protection, carbon sequestration, biodiversity conservation and landscape beauty.

Watershed protection includes soil protection and the regulation of water flow. The maintenance of forest and other dense vegetation cover in the upper part of a watershed is needed to avoid erosion, to store rainwater and to regulate water flow downstream, thereby limiting the incidence of extreme droughts and floods. The availability of these services very much depends on the land use practices employed by those people, especially farmers, who are based in the uplands. Negative effects occur when erosive land use systems are implemented. Positive effects are linked to the maintenance of a dense vegetation cover in the form of forest, tree crops and agroforestry plantations. The external beneficiaries of watershed services include the human and animal populations which live downstream, and use water in a river's basin (Francisco 2002; Gouyon 2002; Aylward 1998).

The benefits provided by protected forests in watershed areas include the regulation of both the quality and quantity of water runoff. Such benefits are considered especially significant in hilly tropical areas that are subject to intense and heavy rainfall.

Carbon sequestration refers to the removal of carbon from the atmosphere to counterbalance the effects of fossil fuel emissions on global warming (Gouyon 2002). Upland farmers can contribute to carbon sequestration in a number of ways. These include the conservation of the existing carbon storage mechanisms (forest conservation areas), the implementation of land use regimes that have a high carbon storage capacity (eg. reforestation) and by introducing changes in current land use management that help to increase the amount of carbon that is sequestered.

Markets for carbon sequestration are currently opening up under the Clean Development Mechanism (CDM) of the Kyoto Protocol. These reward the planting of trees that compensate for greenhouse gas emissions. The storage of CO_2 in trees that would otherwise have been felled or cleared – "avoided deforestation" – has until now not been eligible under the CDM, but experimental extra-Kyoto markets exist that reward active measures to conserve forests that would otherwise be lost.

Biodiversity conservation is another environmental service provided by upland farmers. It occurs when they manage their forest land in such a way that they maintain biodiversity. The diversity of fauna and flora - biodiversity - differs across different agro-ecosystems and depends significantly on the choice of cultivation system a farmer makes.

Upland farming systems, especially in poor areas, tend to be more diverse and less specialized than those in lowland areas which have good road access and are easier to mechanize. Land clearing, tilling and fertilizing practices have a particularly important effect on biodiversity, both below and above the ground surface. The rural upland poor are likely to use fewer chemical inputs. This results in a relatively high degree of species diversity.

The direct beneficiaries of high species diversity include biotechnology companies and laboratories (which can exploit it commercially), the local tourism industry and future generations. Indirect beneficiaries include consumers, producers and industries. All can benefit from the better crops, medicines and other products that can be derived from genetic resource experimentation (Babcock et al. 2001; Gouyon 2002). Some pharmaceutical companies have already paid to investigate the biodiversity contained in certain spatially defined areas (bioprospecting), though these payments have been low and the number of schemes has been very limited. Global wildlife enthusiasts may also be willing to pay for the existence value of biodiversity – the knowledge that a certain species survives. Donations to large international conservation organizations are one way in which this willingness to pay manifests itself.

Landscape beauty: Forests also provide landscape beauty in recreational areas which people enjoy and value. “Beauty” can here refer to both a scenic view, or to the likely sight of a rare and charismatic animal in the wild. Both domestic and international tourists are willing to pay for landscape beauty, and this has proved to have been the most important economic value possessed by many forests in developing countries. Tourists often reveal the value they place on this beauty by paying elevated travel costs to get to an attractive site and, in some cases, by paying additional entrance fees, higher-than-normal accommodation costs and other surplus charges. Conversely, local people can be rewarded for the preservation or restoration of landscape beauty in a number of ways: either through a share in entrance fees paid by tourists; through site-operation fees and fringe benefits paid by tourism companies; or through tourism-derived employment and petty trade (food, handicrafts, etc.). Such employment is often better remunerated than locally available alternatives.

It should be noted that the services provided by forests - watershed services, biodiversity maintenance, carbon sequestration and landscape beauty - are joint products and that minimal tradeoff between them can be expected (Francisco 2002). It is very rare that these services can be separated in practices (Gouyon 2002). Clear air, clean water, wildlife habitat, the preservation of biodiversity and other natural resource values are in most cases achieved jointly. For example, afforestation to enhance watershed services usually results in higher biodiversity and greater carbon storage. This is important, because if environmental goods are produced jointly, the anticipated benefit from the provision of a single good will underestimate the total social benefit that is obtained (Babcock 2001).

2.3 Challenges and Issues in the Design and Implementation of PES

The success of a conservation payment program depends critically on its design and implementation. There are a number of specific issues to which particular attention should be paid (Babcock 2001). It is important to establish a baseline, which determines “how new” certain activities must be to be eligible for payments. Choosing a baseline will

involve trading off a program's efficiency against equity. From a static efficiency perspective, payments should induce "new" activities and not reward environmentally friendly activities that have already been implemented. However, this may be perceived as unfair to good stewards. An efficiency problem also arises in that farmers who have already adopted good environmental practices may temporarily suspend this work so that they can become eligible for payments. The payment should therefore be designed to discourage such behavior (Babcock 2001). However, in one study, which focused on carbon sequestration, it was found that paying all farmers for carbon gains would require a budget three times larger than that needed if only new adopters were paid (Pautsch *et al.* 2001).

A critical feature of any PES program is the way in which payments are made. Performance-based instruments determine payments according to the flow of environmental services. This approach therefore targets service delivery directly. However, it also requires the direct monitoring of the flow of services, which is very expensive. In contrast, practice-based instruments base payment schedules on the known relationship between particular land-use practices and the environmental services they deliver. The efficiency of this approach therefore depends to a large extent on the accuracy of this relationship.

Kiss (2002) discusses the reasons why the implementation of direct PES is challenging in developing countries. The reasons lie in the nature of developing countries' economies and legal and social systems. Direct payment approaches are easier to use when land is privately owned than when it is held communally and/or without a legal title. In communal situations there must first be a reasonably effective, legally-recognized organizational structure that allows contractual arrangements to be negotiated and implemented. For this reason, conservation schemes involving communally-held land have often been difficult to put in place.

Another significant challenge relates to the fact that rural populations in developing countries mostly earn their livings directly from subsistence agriculture or from the extraction of natural resources. When land is dedicated to conservation through direct payments, people may become dispossessed if their land rights are not secured. Even if local people do become the direct beneficiaries of conservation-related payments, large numbers may therefore become unemployed as a result of the conservation initiative. This is likely to lead to social disruption and many of the people are likely to continue their previous destructive activities (Kiss 2002).

In developed countries, the financial incentives provided to landowners for environmental services are often provided in the form of property tax breaks. This is not applicable in countries where property taxes do not exist or routinely go unpaid. Financial incentives must therefore be provided as direct cash transfers. These are usually more difficult to obtain than tax relief.

Other issues that must be considered include the enforcement and timing of payments. The weak judicial systems typical of many developing countries can make it difficult to implement and enforce long-term legal commitments. Long-term payment structures can themselves bring problems, as the short-term opportunity costs of poor landholders involved in PES schemes can be high. A balance must therefore be struck between effective short-term incentives and sustainable long-term incentives.

Poor farmers who manage land in upper watersheds are important potential supplier of environmental services. Payments for these environmental services could be an important addition to their income. It is therefore vital to ensure that the poor have access to any new opportunities created by an environmental services payment program. However, it should also be noted that working with small, dispersed farmers imposes high transaction costs. Organizing farmers into groups through which they can join a PES program is one possible way to reduce these transaction costs (Pagiola and Platais 2002).

2.4 World Wide PES Experience

A variety of programs are already in existence that pay individuals or groups for supplying goods and services of ecological value (Ferraro 2001). The best-known conservation payment initiatives are the agricultural land diversion programs found in high-income nations. In the United States, the Conservation Reserve Program (CRP) spends about $1.5 billion annually to contract for 12 - 15 million hectares. In Europe, 14 nations spent an estimated $11 billion between 1993 and 1997 to divert over 20 million hectares into long-term set-aside and forestry contracts (Ferraro et al. 2000).

Environmental services payments are much less popular in developing countries. However, there are a few examples of projects that are up and running. In Guatemala, the Forestry Incentives Program (PINFOR) makes direct payments to forest stewards who manage forests for conservation goals (World Bank 2000). The PES Program in Costa Rica has created institutional mechanisms through which local, national and international beneficiaries of ecosystem services compensate those who protect ecosystems. Similar programs are underway in El Salvador, Colombia, Honduras and Panama.

Costa Rica has been a pioneer in developing systems of payments for environmental services. Land users can receive payments for specified land uses, including new plantations, sustainable logging and the conservation of natural forests. Payments are made over five years, but land users are obligated to maintain the specified land use for a further 10-15 years. This program has apparently been very popular and requests to participate have far outstriped available finance (Pagiola and Platais 2002).

The PES program in Costa Rica is financed in a variety of ways, including revenues from a fossil fuel sales tax, sales of certifiable tradable offsets (CTOs) to countries under the Joint Implementation program and payments from private hydrological electricity power generators. Costa Rica has also financed biodiversity conservation activities through agreements on bioprospecting and debt-for-nature swaps (Castro et al. 1997).

There are other PES experiences in developing countries. In Ecuador, the capital city of Quito has used water-use fees to create a Watershed Fund which finances the protection of a forest reserve crucial for watershed protection. Attempts to protect biodiversity are manifested in various other schemes. Conservation concessions are schemes in which environmental service providers receive a direct payment for setting aside private lands as natural habitats that would otherwise have been put to alternative uses. For example, in El Salvador environmentally conscious consumers pay a price premium for bird-friendly coffee. This price premium flows back to producers and helps finance the extra costs of producing coffee in an environmentally friendly manner (Wunder, The, and Ibarra 2005).

3.0 PES CONTEXT IN VIETNAM

This section provides a brief overview of Vietnam's forest resources and the legal framework for PES in the country.

3.1 Forest Resources

In Vietnam, forests are classified into three categories: special use forest (national park, natural reserves, historical area, etc.), protection forest (watersheds, sandy, sea-wave, etc.), and production forest. The protection forest is further divided into three sub-categories: highly critical, critical and less critical. The protection forest classification allows for some degree of timber exploitation, and there are cases where forests have been reclassified from production to protection forest, and vice versa. There is therefore some flexibility built into the system which allows it to respond to society's changing demands on the national forest resource.

The country now appears to be on the rising part of a forest transition curve: In 1943 forest cover stood at 43%, this fell rapidly to 29% in 1991; however by the end of 1999 it stood at 33.2%, and by 2005 it was 39.7%. Between 1990 and 2000, the average annual reforestation rate in Vietnam was 2.52%. This rate decreased to 2.06% for the period 2000 - 2005. At present, the country's forest area is 12,931,000 hectares. Of this, 0.7% is classified as primary forest, the most biodiverse form of forest (Statistics: Vietnam @ http://rainforests.mongabay.com).

Reforestation policies in Vietnam have been motivated by both environmental and commercial factors. The country's demand for construction timber, paper, furniture, etc. is rapidly growing. Producer prices for wood have also risen. These factors provide motives for the government to give priority to reforestation efforts using fast-growing native and exotic species. They also give good incentives to rural households to grow trees. The need to safeguard and improve forest services, in particular watershed protection, has also been an important motive behind the country's massive reforestation drive.

3.2 Legal Framework

Since 1990, the National Assembly of Vietnam has issued a number of laws that have established a legal framework for the management of environment and natural resources, including forests. Major laws include the Land Law and its multiple revisions (1993, 1998, 2000, 2001), the Law on Forest Protection and Development (1991) and its revision draft and the Law on Environmental Protection (1991). Important core legislation relating to the management of the forest resources and PES initiatives consists of:

- Government Resolution 01/CP 1995 on the allocation and contracting of land to state enterprises for agriculture, forestry and aquaculture production;

- Prime Minister Decision 661/QD-TTg (1998) on the objectives, tasks, policies and organizations for the establishment of five million hectares of new forest;

- Government Decree No. 163/1999/ND-CP concerning the allocation and lease of forest land to organizations, households and individuals for long-term forestry purposes;

- Ministry of Agriculture and Rural Development Circular No. 56/1999/TT/BNN-KL (1999) guiding the development of regulations on forest protection and development to village/hamlets and communities;

- Prime Minister Decision No. 08/2001/QD-TTg (2001) concerning management rules for special-use forest, protection forest and production forest;

- Prime Minister Decision No. 178/2001/QD-TTg (2001) on the rights and obligations of households/individuals who have been allocated forest land for benefit sharing.

The Ordinances, Resolutions, Orders, Decrees, Decisions, Directives and Circulars mentioned above define, among other things: (1) the ownership of forest and forest land; (2) forest and forest land contracts and allocation; and (3) benefit sharing policy.

3.2.1 Ownership

In Vietnam land belongs to the state. However, households, individuals and organizations are allocated land for long-term agricultural, forestry and aquaculture development purposes. They have the right to exchange, transfer, rent, inherit or mortgage the right to use the land they have been allocated. Landowners are also allowed to contribute their land as capital for joint ventures with domestic and foreign organizations and individuals.

With regard to the ownership of forest resources, special use forests and protection forests are under the unified management of the state. The following management mechanisms are used for the different forest classifications:

Special use forests: A management board is established for special use forests that have an area of concentrated forest cover of over 1000 ha. Special use forests of less than 1000 ha are allocated to organizations, households and individuals for management and protection.

Protection forests: A management board is also established for protection forests of 5,000 ha and above. If the protection forest area is more than 20,000 ha in area, a Forest Protection Unit will be set up under the Protection Forest Management Board. Protection forests of less than 5,000 ha in area are allocated to organizations, households and individuals for management, and protection.

Productions forests: Production forests are allocated or leased to organizations, households and individuals. Natural production forests are allocated and leased by the state through State Forest Enterprises (SFEs) to groups such as households, individuals, cooperatives, companies and factories.

In short, there are a wide variety of forest owners. These include: state forest enterprises, the management boards of special-use and protection forests, Provincial People's Committees (PPC), District People's Committees (DPC), Commune People's Committees (CPC) and other organizations such as schools, cooperatives, army institutions, village communities and households and individuals. However, it should be noted that the purposes for which each forest and forest land category can be used are pre-determined by the government. In other words, forest owners have restricted use rights to the forest and forest land they manage.

The role of households and individuals as forest owners is clearly set out by the Land Law, the Law on Forest Protection and Development and in related resolutions by the government. One recent change in forestry policy is associated with the forest categories that can be allocated to households and individuals. In the past only barren land and plantations could be allocated to households and individuals. Now, special use forest (less than 1000 ha), protection forest (less than 5000 ha, or scattered plots) and natural production forest can be allocated or contracted to households and individuals for management and protection. This means that households and individuals can be owners of these forest categories, albeit with restricted forest use rights.

3.2.2 Forest and Forest land Contracts and Allocation

State forest enterprises, and the management boards of special use and protection forests, sign afforestation and forest protection contracts with households and individuals (who are legally residing in the relevant localities) for the long-term protection and development of forests. The State itself allocates forest land to organizations, households and individuals for long-term use with no attached land use charges. No more than 30 ha are allocated per household in this way. The term of this type of forest land allocation is 50 years. Upon expiry of this term, the State is obliged to let land users continue to manage their land, if it has been used properly and if the land user wants to remain involved. The State also contracts forestland to organizations, households and individuals. The duration of these contracts depends on the type of forest (for protection forests and special use forest it is 50 years; for production forests it depends on the business rotation schedule). There is no restriction on the scale of forestland leased to households and individuals in this way.

Recently, attention has been paid to community forest management. MARD issued Circular 56/1999/TT/BNNKL, which guides the development of rules and regulations for the protection and development of forests by village communities. These rules govern the mobilization of local resources to tend, maintain and develop forests allocated or contracted to village/hamlet communities. They are proposed, discussed and finalized/agreed through community meetings which involve the participation of all villagers or representative households. According to the Forest Protection Department within MARD, by June 2001 1023 communes in 146 districts of 24 provinces and cities had established community forest management plans. These encompassed a total forest area of 2.35 million hectares (Do Dinh Sam and Le Quang Trung 2001).

3.2.3 Benefit Policy

Under the 5MHRP program, the government reserves a budget to invest in the protection and development of special use forests and protection forests; loans are provided

to production forests. The annual payment made for the protection of special use forests and protection forests is VND 50 thousand (equivalent to USD 3.5) per ha. The Government also allocates VND 2.5 million for the planting and tending of each hectare of protection forest for an initial three year period. For production forests that contain rare, precious species with a high economic value, VND 1 million is allocated for natural regeneration combined with additional planting, and a further VND 2 million is allocated for planting and tending production forests. This allocation is made over a 30-year cycle and is only supplementary funding. The financial support by the government covers only a portion of the total amount of money needed to establish one ha of forest. Individuals and organizations that invest in reforestation and forest regeneration (linked with additional planting) enjoy preferential regulations as stipulated in the Domestic Investment Promotion Law.

Decisions No. 08/2001/QD-TTg and 178/2001/QD-TTg detail benefit sharing regulations and specify the obligations of the households and individuals that are allocated with or contracted to manage forest and forest land. The benefit-sharing policies cover the three main types of forest and forest land. Brief details of these regulations and obligations are as follows:

Special use forest: Households and individuals to who special use forest has been allocated by the state for management and protection are funded by the state. Alongside this forest management work, they are also allowed to conduct scientific, cultural and social research work and eco-tourism. Households and individuals who have been granted contracts to protect and regenerate special use forests are entitled to payment for the plantation, protection and regeneration work they undertake. They are also allowed to participate in tourist or service activities.

Protection forest: Households and individuals who are allocated protection forest areas to plant, manage and protect are entitled to payment for the work they do. They are allowed to harvest non-timber forest products and dry, dead and diseased trees. They are also allowed to harvest bamboo (with a maximum cutting intensity of 30%) when the forest cover reaches 80%. At certain times, they are also permitted to harvest timber by selective cutting (with a maximum cutting intensity of 20%). They can enjoy 85-90% of the products of harvest (after tax).

Households and individuals who have been allocated non-forest land that is scheduled for conversion to protection forest status, are entitled to financial support from the state for planting and tending forest trees. They can benefit from all the products that result from their work including supplementary trees, additionally planted trees and thinned trees (provided that the vegetation cover remains at over 60% after thinning). They are allowed to harvest timber by selective cutting, with a cutting intensity of not more than 20%. In addition, they are allowed to use a maximum of 20% of their non-forest area for agricultural and aquatic production. If a households or individual invests their own funds, then they are entitled to benefit from 100% of the products they obtain from their forest area when it reaches harvesting age.

Households and individuals that have been contracted to plant, protect and manage protection forests are paid for this work. They are allowed to collect non-timber forest products and dry, dead and diseased trees. They are also allowed to harvest bamboo, with a

maximum cutting intensity of 30%, and to harvest timber by selective cutting with an intensity of 20%.

Production forest: Households and individuals who have been allocated natural production forest to manage are allowed to grow plants, herbs and to graze animals, etc. They have the right to collect dead trees. They are also allowed to collect trees damaged by fire or other natural calamities or by the application of silviculture technologies. They can also harvest forest products to meet their own family consumption needs. Subject to approval, newly established families are also allowed to construct a house using harvested wood (wood use cannot exceed 10 cubic meters per family). They can harvest the forest when allowed. They are also entitled to 100 % of the products from poor regeneration forest, 70 to 80 % of the products from regenerated forest (after shifting cultivation), and 2 % of the annual products from forests that have an annual growth rate of 100 cubic meters per hectare. In the case of bamboo forest, they are entitled to 95 % of forest products. When natural production forests are contracted (not allocated) to households for protection, the households are allowed to use forest products during silviculture. They are also allowed to interplant and to graze cattle. When the forest reaches the harvesting stage, they can enjoy 1.5 – 2 % of the harvest each year (after paying tax).

Households and individuals who are allocated with plantations established by state funds are entitled to 75 to 80 % of all forest products. They can also benefit from inter-planting and herb collection. If households are allocated with forest land to develop production forests, they are financially supported by the state to undertake planting. When households use their own funds to establish plantations, they have the right to decide the tree species and planting techniques they will use. They can also harvest and use forest products and can market the harvested products. When land for production forests is contracted (not allocated) to households for forest development, the households are funded to plant, tend and protect the forest. This means that the households have little leverage on land use. They are allowed to carry out inter-planting and agroforestry and they are entitled to enjoy 2 – 2.5 % of the harvest each year.

From this review of the legal framework for PES in Vietnam, it is clear that the fundamental conditions for PES are met only in the case of production forests. This explains partly why this study's experimental PES scheme deals with this category of forest.

4.0 THE EXPERIMENT

4.1 Proposed Forest Management Practice and Stakeholders

To attain the research objectives, an experiment was designed in which cash compensation was provided to forest owners who adopted a sustainable forest management program. The experiment lasted for 26 months, starting in September 2003. The experiment was carried out in a cluster of three selected upland communes (Khe Tre, Huong Phu and Xuan Loc) in Thua Thien Hue province, Central Vietnam. In the three selected communes farmers engage in agricultural production and forest exploitation (hunting, logging, non-timber forest product collection). These activities represent the main income sources in the region. This is the general situation in the rest of the province's uplands. The incidence of poverty in the area is quite high; in the year 2001, about 35% of the households in the area were classified as poor.

Farmers undetake a number of environmentally degrading activities in the commune areas. These include destructive timber harvesting in natural and protection forests. Farmers typically clear-cut. When this happens forest plantations are totally felled, often in the dry season from April to August. Once the litter and cut branches left on the ground have dried, plots are burned to make them easier to replant. Plots are then left without vegetation cover, often for several months. This practice results in severe soil erosion, the loss of ground biodiversity and an increase in carbon emissions.

The sustainable land management approach promoted in this study's experiment was a type of selective cutting that was designed by local forestry experts. Under this approach, timber harvesting in a plantation takes place in three consecutive years. The cutting intensities allowed in year 1, year 2 and year 3 are 40%, 30% and 30% respectively. Additional planting is done each year. This harvesting practice is more environmentally friendly than the clear cutting approach described above as it allows adequate vegetation cover to remain. This prevents soil erosion. Furthermore, it allows farmers to have a more regular income flow and a stable supply of firewood.

Stakeholders in the experiment included the local Forest Inspection Station (FIS), the Commune People's Committee (CPC) of the communes and households who volunteered to adopt the proposed forest management practice. In addition, collaborators in the implementation of the experiment included experts from the District Agricultural Office, the Hue College of Economics and the Hue College of Agriculture and Forestry. Each of the different stakeholders was assigned different responsibilities.

The FIS is an executive agency that is involved in the protection and management of forests and forest products. It is under the administration of the respective provincial Forest Inspection Division, which is attached to the Provincial Peoples' Committee. The FIS's tasks include: (1) propagating, popularizing and monitoring the implementation of laws on forest management and development in the region; and (2) issuing licenses to households to exploit production forests. In this experiment, the FIS and its substation monitored the adoption of the sustainable forest management strategy by participating households. It also undertook enforcement work when necessary.

The CPC guides villages in the design and implementation of forest management and protection plans. It also monitors this work, checks any violations and works to resolve disputes as per the law. In this experiment, the Commune People's Committee cooperated with the FIS and its substation to monitor how households adopted the proposed sustainable forest management strategy. It also undertook any necessary enforcement work. The households who joined the experiment adopted the proposed sustainable forest management strategy. At the same time they managed their forest land and forest plantations in accordance with relevant regulations. (Most farmers in the study area were in compliance with these laws).

4.2 Project Implementation and Monitoring

The implementation and monitoring of this project, and the problems that were met along the way, are briefly discussed below.

4.2.1 Institutional Arrangement

For a project of this kind, institutional and social arrangements must be implemented first. A workshop was therefore held for all the project stakeholders. At this workshop a number of issues were addressed. The workshop participants confirmed that the experiment's objectives were justified, that the proposed forest management practice was relevant and that it conformed to prevailing forest management regulations. An action plan was prepared and a monitoring system set up. The roles and responsibilities of the various stakeholders were determined. To have these formally recognized, a "Memorandum of Understanding" was prepared and signed by all the stakeholders.

The workshop participants discussed a number of challenges that faced the project. One key challenge was that the educational attainment level of farmers in the area was quite low, especially among ethnic minorities. This presented a problem because, if farmers were to enter into new contractual arrangements and adopt the proposed forest management regime, they would need certain administrative skills and would have to acquire new knowledge. To overcome this constraint it was suggested that training on sustainable forest management should be done in a participatory way. This meant that, aside from group discussions, it would be necessary to have relevant demonstrations. To increase the probability of success it was suggested that the experiment should not be done in remote communes with very high illiteracy rates. A second problem was that forest land allocation in the study area had been implemented slowly and many farmers had still not received their land use certificates. It was decided that production forest without secure property rights should be excluded from the experiment. It was also decided that land use certificates should be presented when contracts were signed and that the commune people's committee should make any necessary verifications. Moreover, to ensure that participation in the experiment was a joint decision by a household, it was decided that both the husband and wife should sign the contract. It was hoped that this would avoid contracts being broken as a result of family disputes.

4.2.2 Eligible Farmers, the Control Group and WTA Prices

It was decided that households would be eligible for the experimental PES scheme if they had at least 0.5 ha of forest ready for exploitation. These households were identified using forest inventory data from the FSI and the CPC. A household survey was carried out to collect data on the socio-economic characteristics of the eligible households. Details were also gathered on their forest plantation holdings. Data from the survey allowed the eligibility of the households to be validated.

Training workshops on the proposed sustainable forest management approach were held for eligible farmers. The project organized two training courses for two batches of farmers. The first course was organized in September 2003, for 91 farmers. The second course was held in September 2004, for 89 farmers.

The training involved a participatory learning approach (PLA). This was application-oriented and interactive and emphasised group discussions. The proposed sustainable forest management approach was introduced and compared with the farmers' current practices. Participants were asked to identify possible technical problems that might stand in the way of PES adoption. They also discussed how to solve such problems. Along with technical issues, the economic benefits and costs associated with the proposed practices were identified and discussed. They were asked to make an economic comparison between the proposed approach and their current farming practices. Farmers found it difficult to estimate some costs and benefits, as they had had no experience with the proposed forest management approach. Furthermore, it was clear that the costs and benefits would vary between plantations, and that they would be dependent on plantation characteristics such as slope, accessibility and potential growth.

After the training, the payment that farmers would require to adopt the proposed approach was explored using secret ballot. This gave an assessment of the so-called WTA price. Each participant was asked to write on a piece of paper the payment rate (per ha per year) that (s)he would accept. They were also asked to write down the area for which they would adopt the proposed approach. It was explained in advance that the price and area they gave would be used to help select participants for the experiment. It was explained that those who gave a lower price would have a greater probability of being part of the experiment.

The WTA payments required by the first batch of 91 farmers ranged from VND 80,000 – 320,000 per ha per year, with an average of about VND147,000. A 'cut-off' payment rate of VND 140,000 was chosen. This resulted in 45 farmers being eligible to participate. As a result the participation amongst the first batch of farmers was about 50%[1].

The WTA price of the second batch of 89 farmers ranged from VND 90,000 – 400,000 per ha per year, with an average of VND 156,000. There were 41 farmers who gave WTA prices equal or lower than the 'cut-off' payment rate of VND 140,000. Consequently, the participation rate amongst the second batch of farmers was 46%.

1 The range in proposed payments from VND 80,000 - 320,000 reflects the heterogeneity of the plots. The 'cut-off' payment amount of VND 140,000 was chosen to get 50% of the respondents to participate in the experiment. A more complex payment scheme (e.g., differential prices based on land quality and other characteristics) would probably generate a higher participation level.

A control group was also selected to evaluate the impact of the adoption of the proposed forest management approach. This was made up of 50 households in another upland commune. The control group was constituted so that it had the same characteristics as the 'main' adopter group. A separate training course was also organized for the farmers of the control group.

4.2.3 Contracts and Payments

In 2003, a total of 45 contracts were signed with the first batch of adopters. The total forest area covered by project was 72 ha - about 1.6 ha per contract. In 2004, the total forest area covered by the project was 134 ha. This included 63 ha that were managed under 41 contracts signed with the second batch of adopters. It also included 72 ha managed under 44 contracts that had been renewed by the first batch of adopters.

The first batch of farmers was asked why they had decided to renew their PES contracts. It was clear that after one year's experience, they had a better idea about the costs and benefits associated with joining the PES experiment. They considered that the payments they received were low but acceptable. They also wanted to continue exploring the economic viability of the more sustainable forest management approach. Only one farmer did not renew his contract. His explanation was that his plantation had a very low growth rate and that selective cutting was difficult given its steep slope and distance from a road.

Participating farmers were paid in three installments: (1) a first payment of 50% of the total value of a contract was made when it was signed; (2) a second payment of 30% was made after six months; and (3) a third payment of 20% was made after 12 months. The following conditions were applied to these payments: Any farmer who broke his or her contractural commitments was obliged to pay back this money plus a fine. His or her contract would then be cancelled. Other punishments would be applied to those who violated their contracts. Moreover, the Forest Inspection Station would not issue logging permits to any violating farmers unless they paid back the money they had been given along with any outstanding fine.

4.2.4 Monitoring

All contracted households were monitored to ensure that they adopted the proposed forest management approach properly. The project stakeholders jointly monitored the project activities. The key players who did monthly monitoring visits were the local collaborators (one from each commune). These were assigned by the CPC of the three communes and by staff from the FIS of the area. In addition to this monthly supervision, quarterly inspections were jointly undertaken by researchers from Hue University and by the local monitoring collaborators.

To get permission to harvest forest timber a forest owner had to send a request to the CPC. After making the necessary verifications, the CPC noted and sent the request to the FIS for a final approval. This meant that the FIS staff and the commune collaborators knew exactly when and where the participating households harvested timber. Monitoring collaborators went to the sites to check that the forest harvesting that took place complied with the study's sustainable forest management approach. This meant that contract

compliance monitoring was very effective, although it got more difficult as the number of participants increased. Overall, the monitoring results showed that participating farmers did adopt the proposed approach properly.

4.2.5 Interviewing Relevant Governmental and Non-governmental Officials

A number of interviews were made to explore the reaction of relevant governmental and non-governmental groups to the PES scheme. Interviewees included government officials from ministries, environmental and forest-sector institutions and representatives of donors and international organisations. The researchers visited the Department of Environment and the Ministry of Natural Resources and Environment in Hanoi. The opinions of WWF and IUCN officials in Hanoi were also explored. The researchers interviewed officials from the Department of Natural Resources and Environment, the Department of Agricultural and Rural Development and the Department of Science and Technology of Thua Thien Hue province. In addition, field interviews were carried out with forestry agency officials, state forest enterprises and forest management boards, amongst others. All interviews were carried out using a semi-structured interview technique. The concept of PES and the findings from this study's experiment were introduced to interviewees and their reactions were explored. The findings from these interviews are discussed in the section on PES constraints and potential later in this report.

4.3 Selected Characteristics of the Households Involved

Table 4.1 presents selected demographic and socio-economic characteristics of adopter, non-adopter and control households involved in the experiment. For the sample as a whole, family size ranged from three to 11 people (with an average of 6.1 people) and each household could provide the equivalent of about 3 laborers. Across household groups, the average family size was not significantly different. However, there was a significant difference in the availability of family labor between adopter and non-adopter groups. On average, an adopter household had 3.1 laborers and a non-adopter household had only 2.5 laborers. The same observation was also true for a similar comparison between the control and non-adopter groups.

For the whole sample, the mean age of farmers was about 46 years. This was not significantly different across the groups. Most of these farmers had attained primary education. In comparison with the non-adopter group, the adopter and control groups had a higher level of educational attainment. Differences existed in the number of years farmers had attended school. Adopters of the sustainable management approach were shown to have, on average, more than 1.5 times as many years of schooling as the non-adopters.

Table 4.1 shows that the annual income level of the households was rather low. It was about VND 10 million (equivalent to 640 USD). Household income was defined as the sum of: 1) cash income from livestock, timber, fruit and forest product sales; 2) income from non-farm activities; and 3) the value of crop production. A significant difference in economic situations was observed. In comparison to the adopter and control households, the non-adopter households had lower income levels and higher levels of outstanding loans. Control and adopter households had considerably higher incomes.

The major income sources of the households (non-adopter, adopter and control households) involved in the experiment included crop production, animal husbandry and NTFP collection (see Appendix Table 1). It should be noted that forestry income (including both plantation harvests and NTFP collection) accounted for about 20% of household income. For non-adopter households, a significant portion of income was from NTFP harvesting. As commonly observed in the uplands, the poor are more forest-dependent than the well off.

Table 4.1: Characteristics of households involved (before any payments made)

	HH members	Labor (person)	Age of HH head (year)	Education (years of schooling)	Planted forest (ha)	HH income (Mill. VND)
All (230)	**6.1**	**2.9**	**45.9**	**5.4**	**2.0**	**10.3**
Non-adopter (94)	5.8	2.5[b,c]	47.1	3.9[b,c]	1.1[b,c]	7.6[b,c]
Batch 1 (46)	*5.8*	*2.5[b,c]*	*46.9*	*3.9[b,c]*	*1.1[b,c]*	*7.9[b,c]*
Batch 2 (48)	*5.9*	*2.6[b,c]*	*47.2*	*4.0[b,c]*	*1.1[b,c]*	*7.4[b,c]*
Adopter (86)	**6.2**	**3.1[a]**	**44.1**	**6.5[a]**	**2.6[a]**	**11.5[a]**
Batch 1(45)	*6.3*	*3.2[a]*	*45.4*	*6.2[a]*	*2.5[a]*	*11.6[a]*
Batch2 (41)	*6.0*	*3.0[a]*	*42.8*	*6.9[a]*	*2.8[a]*	*11.4[a]*
Control (50)	**6.4**	**3.2[a]**	**46.7**	**6.1[a]**	**2.7[a]**	**13.4[a]**

Source: Field survey
Note: [a] = significantly different from respective mean of non-adopter households at 0.1 level or better.
[b] = significantly different from respective mean of adopter households at 0.1 level or better.
[c] = significantly different from respective mean of control households at 0.1 level or better.
Number in the brackets is the number of observations.

As shown in Table 4.1 the average forest area managed by adopter and control households was 2.6 ha and 2.7 ha respectively. This was more than double that of non-adopter households. Detailed information of the participating households' land use is given in Appendix Table 2. Although the region's uplands have a low population density, the cultivated land area per household in the study was only 2.7 ha or 0.45 ha per capita. On average each household had about four to five land parcels. Adopters were shown to have considerably larger farms than non-adopter. Participants in the sustainable management experiment tended to have the highest share of forest as a percentage of their total farm systems. All participants in this trial were in possession of land titles. This was consistent with the requirements for participation.

Significant differences between participants and non-participants were found in a number of farm systems and across a number of socio-economic variables. Adopter and control households were considerably different from non-adopters. The control group was deliberately chosen to be as similar as possible to the adopter group. It was not possible to

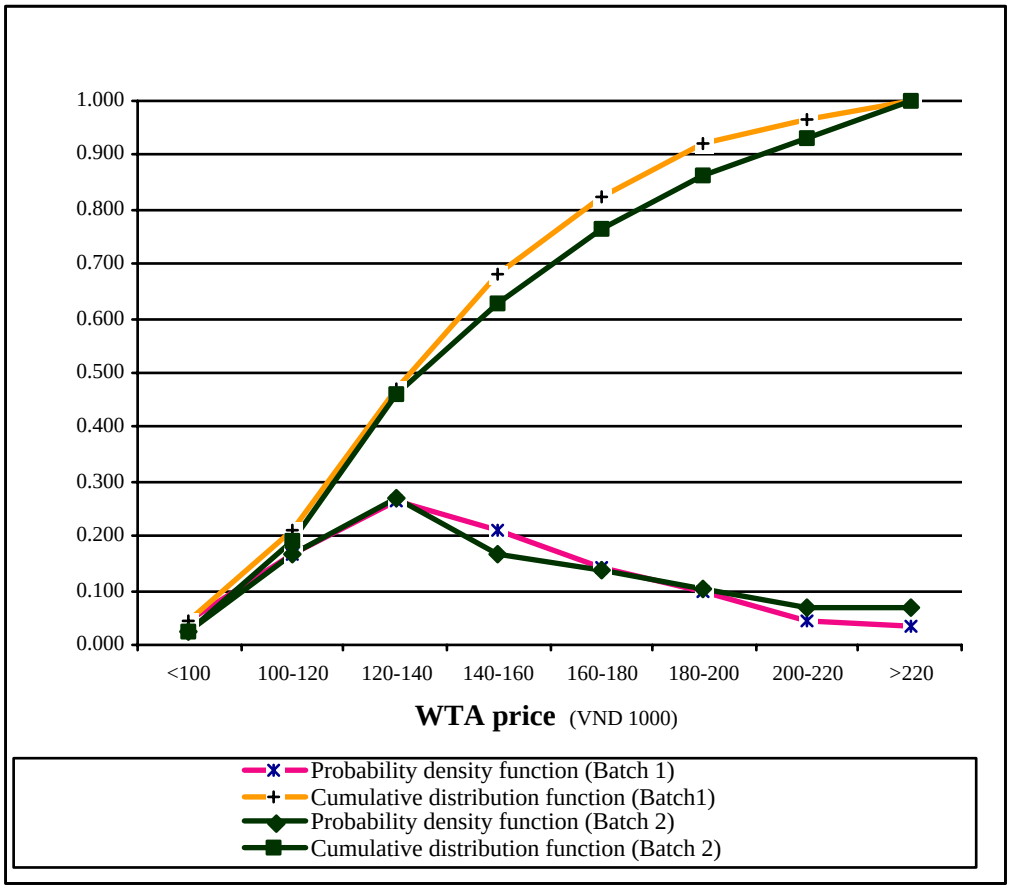
make it identical in all respects, but any differences between these two groups were statistically insignificant.

5.0 WTA PRICE AND DETERMINANTS OF ADOPTION

5.1 Distribution of the WTA Price

Given the differences between the eligible households that took part in the two training sessions, it is not surprising that the WTA prices they gave varied significantly. Figure 5.1 presents the distribution of the WTA prices of the two batches of farmers. For the first batch, the WTA price ranged from VND 80,000 to VND 320,000 per ha per year, with an average of about VND147,000. The WTA price of the 89 farmers from the second batch ranged from VND 90,000 - 400,000 per ha per year, with an average of VND 156,000. The dispersion of the bid values was quite remarkable and reflected the heterogeneity of the eligible households. About 46% of the household gave WTA prices that were equal to or lower than the experiment's actual payment rate of VND 140,000. There would have been a participation rate of about 80% if the payment rate had been set at VND 180,000 per ha per year.

Figure 5.1: WTA price distribution



It should be noted that the distribution of the WTA price would vary across localities and over time. Changes in market conditions and government policy could affect the opportunity cost of adopting the proposed forest management approach. For example, at the time of this experiment, there was an on-going project to encourage farmers to establish

rubber plantations in the study area. This rubber project provided incentives to participating farmers and therefore made this particular land use option quite attractive. In turn this meant that the opportunity cost for local farmers of joining the PES scheme was higher than it would otherwise have been. Therefore, it is likely that some farmers might not adopt the PES scheme initially, but might subsequently join the program once they had established rubber plantations.

5.2 Factors Influencing Adoption

The literature on forestry and agroforestry, program participation and agricultural technology adoption shows that there is a wide array of factors that interact to shape the decisions of upland farmers concerning which forest management practices they choose to adopt. These range from field-level variables to industrial and macro policies. Many economic, household and farm-related variables have been identified. Farm size, for example, is thought by many studies to be positively associated with program participation (Chambers and Foster 1983; Caveness and Kurtz 1993; Thacher, Lee, and Schelhas 1997; Ayuk 1997). It is felt that farmers who have large landholdings typically have greater flexibility to engage in new activities including innovative government programs (Nowak 1987).

The adoption of new technologies and practices is constrained by, among other things, a farm's labor and financial resources. Family labor availability and allocation are often found to be central in determining adoption and participation decisions. De Graaff (1993), for example, states that a household optimizes its consumption and saving opportunities in part through the allocation of family labor. This is key because sustainable forest management is often labor intensive. A number of other studies have confirmed the significant influence of labor allocation in determining technology adoption (Scherr 1992; Ayuk 1997; Neupane, Sharma and Thapa 2002). Some studies have also confirmed the influence of income and debt on a particular adoption or participation outcome (Sureshwaran, Londhe and Frazier 1996; Thacher, Lee and Schelhas 1997). It is clear that when farmers are poor and unable to finance expensive economic activity (and when they do not have access to credit lines) they should adopt a forest management practice that requires low capital. Incentive payments may be a way to reduce financial constraints and thus influence participation decisions. However, this will only be the case if the incentives are large enough to mitigate any debt pressure.

The influence of factors such as the age and educational status of household decision-makers has been assessed by many participation and adoption studies (Chambers and Foster 1983; Rahm and Hufmann 1984; Nagubadi et al.1996; Ayuk 1997). Experienced and educated farmers often strategize their land-use planning over relatively long time scales. They can therefore more easily take into account any trade-offs between current and future benefits and costs. It is likely that a farmer's education, experience and living conditions are important factors that influence decision making. Educational attainment is expected to be positively associated with the adoption of sustainable forest management.

The role of age in adoption decisions is ambiguous. The age of a household head can indicate experience, however this may be offset by his or her greater reluctance to try new things, including new technologies or government-sponsored programs. An older farmer is considered more risk averse, and is thus less likely to be involved in new and

possibly risky contractual arrangements. However, this observation may change over time as the current younger generation (which is more knowledgeable about policy and has more education) ages.

The costs and benefits associated with the adoption of a resource management program depend on forest plantation characteristics such as acreage, slope, soil fertility, potential growth and distance to a road. Therefore plantation characteristics are important explanatory variables when it comes to farmer participation in such programs.

Secure land tenure plays an important role in the encouragement of both long-term investments and the adoption of sustainable forest management systems (Godoy 1992; Schuck, Nganje and Yantio 2002). Limited tenure rights are often a significant constraint to the expansion of such forest activities in the developing world (Godoy 1992). Since possession of a legal land title was a pre-condition for joining this study's trial, this variable is not relevant here. However, it needs to be re-emphasized that secure land tenure is a necessary condition of any PES policy.

5.3 Analytical Procedure

Farmers' decisions to participate in this study's sustainable forest management promotion program were analyzed with a choice model. The explanatory variables of the empirical logit model used are presented in Table 5.1. They were based on the hypothesized determinants for participation as discussed above.

Table 5.1: Definition of variables[2] used in the binomial logit model

Variable name	Description
ADOPTION	1 if adopting sustainable forest management, 0 if otherwise
FLABOR	Availability of family labor (no. of workers)
AGE	Age of head of the household (year)
EDUC	Education of household head; number of years in school (year)
FOREST	Forest plantation area of household (ha)
INCOME	Annual household income (million VND)
LOAN	Amount of outstanding loan (million VND)
ACCESS	1 if plantation highly accessible (near to road, not very steep slope) 0 if plantation less accessible (far from road, high slope)
GROW	1 high potential growth plantation; 0 for low potential growth plantation

2 Farm size is excluded because it is strongly correlated with FOREST variable

The empirical logistic model used to examine the adoption of the proposed sustainable forest management practice by upland farmers was as follows:

$$ADOPTION = \beta 0 + \beta_1 FLABOR + \beta_2 AGE + \beta_3 EDUC + \beta_4 FOREST + \beta_5 INCOME + \beta_6 LOAN + \beta_7 ACCESS + \beta_8 GROW$$

5.4 Regression Estimation Results

The logistic regression model was estimated based on the survey data. The LIMDEP software package was used. The Maximum Likelihood Estimation method was used to estimate the coefficients, which along with the appropriate test statistics, are summarized in Table 5.2.

The coefficients of six of the eight explanatory variables included in the model were found to be significant at the 5% level or better. The chi-square test statistic for the estimated model is 159 with 8 degrees of freedom. This means that the null hypothesis that the non-intercept coefficients are jointly zero is rejected at the 0.01 level. The empirical logit model is highly significant in explaining the adoption of sustainable forest management by upland farmers. The likelihood ratio index of 0.64 indicates that 64% of the total variation in the probability of adopting sustainable forest management is explained by the independent variables included in the model. The predictive power of the model is good, providing correct predictions in 91.11% of the sample. The marginal effect of the independent variables on the probability that the sustainable forest management approach was adopted was estimated at the sample means.

The availability of family farm labor (FLABOR) was found to be positively associated with adoption. This finding is consistent with expectations. Families with sufficient labor resources typically choose to engage in labor-intensive forest activities, which are more profitable. Additional labor could increase the probability of adoption of the proposed forest management approach by 0.296. With respect to educational attainment, the number of years of education (EDU) was found to significantly influence adoption. Entering a new contractual arrangement and implementing the sustainable forest management approach requires administrative skills and involves the acquisition of new knowledge, both of which can be enhanced by education. This means that if the educational attainment of a farmer increased from the sample average of grade five to grade six, the probability of him or her adopting the proposed approach could increase by 0.105.

Forest plantation area (FOREST) was positively associated with adoption. This reflects the greater flexibility in resource management that can take place on a large farm. Another possible explanation is the higher cost-efficiency associated with large-scale adoption. Outstanding loans (LOAN) were estimated to have a significant influence on the adoption of sustainable forest management. The coefficient of this variable is negatively signed and significant at a 0.05 level. An increase of one million VND in outstanding loans would result in a decrease of 0.041 in adoption probability. It is likely that debt pressure may force some farmers to harvest their plantations as soon as possible and that any income from environmental payments would not be sufficient to mitigate this problem.

Table 5.2: Logit estimates for the adoption of sustainable forest management

	Coefficient and P-value		Marginal effect and P-value	
Constant	-8.078 *(2.156)*	0.000		
LABOR	1.275 *(0.330)*	0.000	0.296 *(0.080)*	0.000
AGE	-0.031 *(0.0341)*	0.356	-0.007 *(0.008)*	0.360
EDUC	0.453 *(0.118)*	0.000	0.105 *(0.028)*	0.000
FOREST	2.550 *(0.518)*	0.000	0.593 (0.099)	0.000
INCOME	-0.026 *(0.047)*	0.581	-0.006 *(0.011)*	0.579
LOAN	-0.178 *(0.081)*	0.027	-0.041 *(0.019)*	0.029
ACCESS	1.785 *(0.639)*	0.005	0.408 *(0.138)*	0.003
GROW	1.23 *(0.571)*	0.032	0.274 *(0.125)*	0.028
Number of observations	180			
Likelihood ratio test statistic	159.003			
Likelihood Ratio Index	0.642			
Correct predictions (%)	91.111			
Adoption (%)	94.874			
Non-adoption (%)	88.235			

Source: Field survey
Note: Numbers in brackets are standard errors

The costs associated with the adoption of the proposed forest management approach depend on plantation characteristic such as acreage, slope, soil fertility, potential growth and distance from a road. Low potential growth, low slope and greater accessibility imply low adoption costs. The two variables associated with plantation characteristics (ACCESS and GROW) are signed as expected. In other words, plantations that are accessible and have a high growth potential are more likely to adopt the proposed approach.

A number of non-adopter farmers reported that they preferred to clear-cut because *acacia auriculiformis*, the main tree species in their forest plantations, was not growing well. They wanted to plant another species, *acacia mangium.* This species grows very fast in the study area. If such farmers had adopted the sustainable forest management approach they would have gained very little increase in timber volumes. This meant that the opportunity cost of adopting sustainable forest management in their plots was high. However, if these farmers had been already working with the 'better' tree species then they would have been adopters. This means that, over time, they might become adopters, once their new tree species are established. Their reported stance was therefore just a timing issue.

The variable AGE did not appear to be an influential factor on adoption. The age of a household head is a proxy for his experience. The insignificance of the coefficient of this variable is understandable because the mean age of the two groups, adopter and non-adopter, was not significantly different. The coefficient of the variable INCOME was also not significant.

The adoption analysis reveals that there are several factors that significantly influence the decision of a farmer to adopt the sustainable forest management approach. The adopters have, on average, larger forests, more labor and higher educational attainments compared to non-adopters. Age and household income did not appear to be influential.

In drawing general conclusions from both the descriptive statistics and the regression analysis, it is clear that three key influences appear to determine adoption: forest area, human capital and household economic factors. Each of these deserves further elaboration. As shown in the descriptive statistics, adopters own considerably larger forest areas than non-adopters. This suggests that adoption may be more attractive to households with larger forest areas and correspondingly larger plots. Human capital and household economic variables associated with factors such as family labor availability and years of schooling are also shown to be significant determinants of adoption. Less educated farmers appear, on average, to be less likely to possess the skills needed to take full advantage of the forest incentive program under scrutiny.

6.0 SOCIO-ECONOMIC AND ENVIRONMENTAL IMPACT

It was hypothesized that the PES experimental scheme would have effects on the environment and on stakeholders, especially the adopter households. Its socio-economic and environmental impacts were therefore assessed. Given the limited scale and the short time frame of the project, it was difficult to gauge all of its possible impacts. This should be kept in mind when reviewing what was observed.

6.1 Socio-economic Impact

The cash payments made to farmers under the scheme was one of the most important reasons for participation in the scheme. The average payment that a participating household received was approximately VND 230,000 per year. On average, this was equivalent to 2% of household income. However it represented 4% of the household income of the poorer non-adopter households. Most landowners obtained the majority of their income from livestock, agriculture and NTPFs. This implies that the economic/income effect of scheme payments on household income was quite limited. To verify this, an "after" income mean comparison between adopter and control groups was made. The test results showed an insignificant difference in income between adopter households and control households.

However, it is important to realise that the participating households had limited leverage on how they used their land prior to, and after the termination of, the experimental scheme. In most cases households were not allowed to convert their forest land to other uses such as monoculture. This was because the government had pre-ordained the use purpose of their lands. This indicates that the opportunity cost of their land was associated mainly with alternative forest management practices, since other land use options were not permitted. Therefore, the major opportunity cost of adopting the proposed approach was linked to labor time and to benefits that were foregone because farmers had managed their forest areas rather than cutting them down. Given the seasonality and under employment situation in the study area, the labor opportunity costs were low. This could explain why households participated in the study, despite the low economic benefits they received.

The experiment did have an impact on the human assets of the stakeholders, particularly the adopter households. The participants considered the technical assistance and the training they received during the experiment to be important benefits. This project provided training and advice on harvesting, on the planting process and on the tending of forest plantations. The knowledge and skills that were gained from the training were found to be really useful. The training also enhanced the environmental awareness of the participants. This was much appreciated by the local authorities.

Participants also found that taking part in the bid process and entering into a contract agreement with the project was a really worthwhile experience. They benefitted especially from the budgeting and cost-benefit analysis exercises they took part in. Group discussions and the exchange of information with economic and forestry experts during the training also provided useful information and knowledge. Overall, this process made a positive contribution toward increasing participants' budgeting skills and their ability to make proper decisions.

The local governmental organizations that took part in the project's training and workshops also benefitted. These organizations included the district agricultural office and FIS. This was the first time that staff from these groups had learnt about the PES concept as a way to deal with market failures. Knowledge gained from the project helped them to better understand the advantages and disadvantages of the command and control approach they had been using. The implementation of this experiment also promoted inter-organizational co-ordination among these groups.

6.2 Environmental Impact

The creation of a market for environmental services can potentially generate a number of potential benefits and risks for natural assets. Possible benefits include increasing the value of forests, due to improved management and new market opportunities. Benefits can also include increasing the value of land, improving soil fertility and biodiversity conservation, improving water resources and creating better air quality. Potential risks include a loss of access and use rights, due to increased competition for resources. Risks can also include a reduction in timber values and possible negative spin-offs in biodiversity and water conservation (Landell-Mills and Porras 2002). The impact of a PES program on natural assets depends on its design, implementation and operational context. For this experimental scheme, given its small scale and short time span, it is difficult to fully assess the impacts it would have on the natural environment. However, there are relevant indicators that do indicate likely trends.

The impact of study's sustainable forest management approach on levels of soil erosion was assessed. This was done using the erosion model, Soil Changes Under Agriculture, Agroforestry and Forestry (SCUAF) version 4.0 (Young et al. 1998). The average annual soil loss due to erosion was assessed for both the study's sustainable management approach (with program) and for the farmers' 'normal' way of working (without program). This was done for the first four years after harvesting for the both systems. 'With program' the annual soil loss was 34 ton ha^{-1} $year^{-1}$. The result for the 'without program' calculations was 43 ton ha^{-1} $year^{-1}$. Since the program's adoption scale was small, it was impossible to link the reduction in erosion it produced to any changes in the water quality of the rivers in the area. However, it is clear that if the adoption scale were large enough, improvement in water quality and flow would be observed. Reduced soil loss due to erosion also implies improved soil fertility. This could result in a future increase in land values and could open up the opportunity to convert the area for agricultural or agroforestry use.

As mentioned earlier, the proposed forest management approach was more labor intensive than the farmers' normal management approach. It also allowed adopter farmers to have a more regular flow of income and a more stable supply of firewood. It was expected that farmers involved in the experiment would be able to allocate less labor resources to the extraction of natural forest products. To see if this happened a mean comparison was undertaken to see how many person-days households spent extracting NTFPs from natural forest in a year. The results are presented in Table 6.1.

This "before-and-after" comparison showed that there was a significant decrease in the number of person-days that adopter households (of both batches) spent extracting NTFPs from natural forests. The comparison for Batch 1 adopters was significant at a 0.15

level by one-tail test. The same result held for Batch 2. To verify this finding an "after" mean comparison between the adopter and control groups was made. The test results show a significant difference in the number of days that adopter households (Batch 1 and 2) and control households spent extracting NTFPs. The "after" mean of A1 and A2 is significantly smaller than that of A3 at 0.1 level by one-tail test. This implies that the adoption of the sustainable forest management approach significantly reduced the number of NTFP extraction days that adopter households had to undertake.

Table 6.1: Natural forest extraction of the adopter and control households

	Natural forest extraction (person-day)
BEFORE	
Batch 1 adopter (B1)	72.0[a1]
Batch 2 adopter (B2)	71.1[a2]
Control (B3)	69.8
AFTER	
Batch 1 adopter (A1)	66.7[a3]
Batch 2 adopter (A2)	66.3[a3]
Control (A3)	72.7[a1, a2]

Source: Field survey

Note: a1 = significantly different from respective mean of A1 at 0.15 level or better by one tail test
a2 = significantly different from respective mean of A2 at 0.15 level or better by one tail test
a3 = significantly different from respective mean of A3 at 0.15 level or better by one tail test

It is important to note that this inference is only valid if the control group is well controlled. During the last two years of the experiment, the situation in the experimental site was stable and the local socio-economic and political environment were similar to the situation at the start of the experiment. No additional interventions or interferences were observed that could have significantly affected the local communities. Information was gained from farmer interviews and from group discussion with key informants at the commune. These indicated that there had been no recognizable land use changes. They also showed that there had been no changes in the income generating activities undertaken by the control households. These findings imply that the observed differences in the number of NTFP extraction person-days between the adopter and control groups could be attributed mostly to the payments the adopter households received.

A regression analysis was also done to assess the impact of adoption on the extraction of NTFPs by the adopter households. The estimate results are presented in Table 6.2. The dependent variable of the regression model was the number of person-days extracting NTFPs of adopter and control households after the payment. Independent variables of the model included family labor (FLABOR) and two dummy variables (BATCH1 and BATCH2) that took a value of one (1) for adopter households and a value of zero for control households.

Table 6.2: Impact of adoption on forest extraction activities

	Coefficients	P-value
Intercept	71.15 *(5.442)*	0.000
FLABOR	0.489 *(1.517)*	0.747
BATCH1	-5.953 *(3.906)*	0.130
BATCH2	-6.250 *(4.014)*	0.122

Note: Number of observations are 136.

The estimates indicate that the adoption of the proposed forest management approach would reduce the number of person-days that adopter households spent extracting NTFPs by six days on average, about one tenth of the mean. This is consistent with the finding from the mean-test analysis above. However, the effect coefficients of the adoption were significant at a 0.13 level. The effect of FLABOR variable was not significant. This supports the observations discussed above that the family labor characteristics of adopter and control households after the payment were unlikely to be different from each other.

Before the experiment, the collection of NTFPs in the area was not sustainable and the risk of over exploitation was increasing. Several species that were still used as NTFPs appeared on the IUCN red list of threatened species (Wetterwald 2004). Given this situation, it is therefore likely that the payment scheme reduced pressure on the area's natural forest.

7.0 TRANSACTION COST

7.1 Some Practical Considerations

The transaction costs (TC) involved in setting up and managing PES schemes are central to their cost-efficiency. Transaction costs (as a concept) have been defined in several ways. Some authors define TC broadly while others give specific definitions depending on how the concept is applied. TC include cash costs and the value of time spent in planning, monitoring, coordinating and motivating people and in follow-up enforcement activities.

The value of time spent in the planning, following-up and monitoring activities was estimated for both adopter and non-adopter farmers. This was based on the expected net income that they could have gained from alternative employment. The identification of an appropriate labor opportunity cost depends on the nature of the activity to be performed, the characteristics of the workers and the availability of alternative employment. The employment market in the study area was undeveloped. Wages ranged from VND 20,000 - 30,000 (USD 0.8 to 1.4). Farmers could earn the same amount by collecting firewood and other NTFPs from natural forest. Farmers in the locality were willing to work as paid laborers at a rate of VND 20,000 per man-day. Given this situation, the opportunity cost used to estimate the time costs of participant farmers was VND 20,000 per day.

For local governmental officials involved in the project activities, the opportunity cost of time was based on their average daily salaries. Given the salaries of those concerned, the opportunity cost of time for local governmental staff was estimated at a rate of VND 30,000 per man-day.

7.2 Estimated Transaction Costs

Table 7.1 presents the estimate TC of the experiment. It is clear that the TC are rather high; TC per ha per year is higher than the experimental payment rate of VND 140,000 per ha per year. TC of year 1 are much higher than those of year 2 because most institutional arrangement costs occurred in the first year when the number of contracts was limited. For year 2, TC per contract and per enrolled ha were substantially reduced due to the increased number of contracts and the lower institutional arrangement costs.

Table: 7.1 Estimated transaction cost of the experiment

	Total TC (VND 000')	TC per contract (VND 000')	TC per ha enrolled (VND 000')
Year 1	46592	1035	621
Year 2	28395	330	194
Average	**37494**	572	339

There are several reasons for the high transaction costs. Firstly, this project was a research project and was on a small scale. Some of the transaction costs, especially those associated with institutional arrangements and monitoring, might remain the same even if the scale of the project was larger (although below a threshold limit). Secondly, the two-year time frame of the project was relatively short. Therefore, the start-up costs per year were high. Thirdly, the enrolled forest area per contract was small and scattered in a complicated topography. This made monitoring difficult.

It is likely that TC per contract and per ha enrolled might reduce if the scheme lasted longer. The large set up costs would then be distributed over a longer time period. The operating and monitoring costs would also increase at a lower rate than the overall expansion rate of the scheme. This might lead to average costs decreasing over time.

8.0 CONSTRAINTS AND POTENTIAL FOR PES IN VIETNAM

8.1 Constraints

Ownership: In Vietnam land is owned by the state. By constitution, all lands, including forest land, belong to the Government. However, forest and forest land can be contracted or allocated to farmer households and village communities. The purposes to which such land can be put to use are pre-determined by the government. In the case of production forests that have been established by landowners, the forest owners have the right to decide which tree species to grow and also the timing of harvests and the harvesting methods used. However, in the case of protection and special use forest households and village communities have no leverage on land use. Given this context, the PES concept would be most applicable to the production forest category where forest owners have some leverage on land use.

It is difficult to think about PES in the case of protection and special use forest where the state owns the forest resources. It can be argued that, in the Vietnamese context where land is owned by the state, the government is the most important provider of ES. SFEs, national park authorities and the management boards of special use and protective forests are therefore key players in the provision of ES on behalf of the government. Given the current policy trend towards social forestry, rural villages and rural households are also playing an increasingly important role in the provision of ES to society.

Limited ES market developments: The study's interviews indicate that watershed services are the most important ES provided by forest protection and rehabilitation programs in Vietnam. Priority has been given to the protection and rehabilitation of natural forests classed as special-use forests and as 'very critical' and 'critical' protection forests. The environmental services provided by production forests seem to be of limited concern to policy makers and have largely been ignored. This is also reflected in the relatively low levels of interest that PES receives in Vietnam and a general lack of knowledge about the approach. Current interest in PES is basically concentrated among a few donor representatives.

Fragmentation: Production forest in Vietnam is mostly owned by individual households and SFEs. As seen in the experiment, on average each household has only two ha of plantation and this is often fragmented into several plots. It is very difficult to monitor the compliance of a large number of contractors working in forests scattered in many different places. This implies that the management of PES schemes will incur high transaction costs. Furthermore, there is only incipient concern about environmental services outside protected areas (in special use and protection forest).

Effectiveness of the prevailing tools: The PES approach is most needed when current nature conservation tools or approaches do not work well and PES offers an alternative way to address pressing problems. In Vietnam, the current command and control system works relatively well. It is therefore unlikely that the State would deliberately allocate more protection forest lands to households. Vietnam is a country with a substantial planning tradition and only an incipient market orientation; compared to PES, the established command-and-control measures therefore provide a more reliable nature

conservation and land use control mechanism. In addition, the implementation of PES would increase the budget burden of the government.

8.2 Potential

Given Vietnam's current land ownership regime and the relative effectiveness of the country's command-and-control tools, the potential for PES in Vietnam is hard to predict. However, there exists a number of enabling factors for PES in Vietnam.

Official recognition of forest environmental services: The need for PES could arise when the needs for ES (watershed protection, carbon sequestration, tourism and biodiversity protection outside of protected areas) develop and receive greater official recognition. In Vietnam, forest environmental services are now formally recognized. The revised Law on Forest Protection and Development 2004 specifies that the valuation of forest goods and environmental services needs to be carried out. Currently the Government is preparing a legal decree on the methodologies for this valuation.

Increasing needs for forest environmental services: During the last decade floods and droughts have occurred more frequently in Vietnam. Most mountainous regions have suffered from a lack of fresh water. During the dry season, residents in many upland communities have to travel five to 10 km to fetch water. Several hamlets have had to move to other places because of water shortages (Vo Quy 2002). The operation of the two biggest hydropower plants, Da Nhim and Tri An, in the Central Highland has been interrupted in the dry season due to severe water shortages. In the last few years, thousands of hectares of rice and coffee in the uplands have died due to long severe droughts. These facts illustrate the country's increasing need for more forest environmental services.

Existence of PES-related experience: There exists a number of PES-related programs in Vietnam. The most striking examples are the two national reforestation programs: program 327 and the 5MHRP program. In these two programs, direct payments were made for reforestation and forest protection. Rural people were offered cash incentives through forest contracts to replant trees and/or to protect existing forests. SFEs, the management boards of special use and protection forests, and FISs have been involved. These bodies have signed forest rehabilitation and protection contracts with different organizations and individuals such as village communities, groups of households and individual households (Bui Dung The *et al.* 2004; Wunder, The and Ibarra 2005). The PES-related experience gained through these programs could be used to start PES or PES-hybrid initiatives when further enabling factors for PES appear.

Potentially high participation rates: As shown in this study's trial, potential PES participation rates are high. This is the case, even though this experiment was run for only two years and incentive payments were small in relative and absolute terms.

International carbon trading and CDM: International carbon trading and CDM could facilitate the emergence of PES in Vietnam. The current CDM's carbon credit rules for forests focus entirely on reforestation and afforestation. This means that a country like Vietnam, that aims to increase its forest cover, stands to gain a lot from participating in the emerging international carbon market. Carbon forestry therefore offers a good potential mechanism for the finance of reforestation and PES initiatives in Vietnam.

9.0 CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusions

This study assessed the potential for PES in Vietnam and the constraints facing the introduction of this approach through a review of the legal framework in the country and by conducting an experimental PES scheme. In this scheme, an annual payment of VND 140,000 per ha was paid to farmers who adopted a sustainable forest management approach. This approach was designed to help protect the upland watershed and so help safeguard the services provided by this environmental feature. The WTA price that farmers would be prepared to accept to adopt the proposed approach was explored. Factors affecting farmers' decision to join the scheme and the preliminary socio-economic and environmental impacts of this initiative were also assessed. The TC of the scheme was also estimated.

It was found that the WTA price ranged from VND 90,000 to VND 400,000 ha^{-1} $year^{-1}$ with an average of about VND 155,000 (about USD 10). Empirical results from a logistic analysis showed farmers' decisions to join the scheme were significantly influenced by: household characteristics such as the education and age of the household head; family labor; the forest area managed; and levels of outstanding loans. Forest plantation characteristics such as the growth potential of a plot and its accessibility (slope, distance to road) also affected farmers' decision making. The WTA price was affected by the fact that farmers knew that the PES scheme was an experiment of limited duration. This fact also affected their decisions to join. If the scheme had lasted longer, participation rates might have been higher.

The impact of a PES scheme depends very much on its design. This in turn depends on the causes of the environmental problems that are being addressed and the environmental services that are under scrutiny. The impact and design of such a scheme also depend on the socio-economic and institutional context in its locality. Given the design of this study's experiment, the PES payment had limited income effects. Income from the payment was only about 2% of the adopting households' incomes. This implies that this PES scheme is unlikely to have a significant poverty reduction impact. One of the reasons for this was that the participating farmers were resource-poor; on average each household could submit only 1.5 ha to the scheme.

Given the scheme's proposed forest management approach, the PES scheme was likely to have some positive environmental impacts. The proposed approach resulted in lower levels of soil erosion than those caused by the 'normal' land use approach in the study area. In addition the adoption of the proposed approach resulted in a reduction in the number of person-days that households spent extracting NTFPs. This, consequently, reduced pressure on natural resources. However, this reduction was only six person-days per household per year.

The TC of this experimental scheme was rather high. The annual total TC per contract and per ha of forest enrolled in the scheme were VND 572,000 and VND 339,000 respectively. The later figure was more than twice the annual payment rate per ha. There were several reasons for the high TC. Firstly, this was a small-scale research project. Some

of the transaction costs, especially those associated with institutional arrangements and monitoring, might remain the same even if the scale of the project was larger (although below a threshold limit). Secondly, the two-year time frame of the project was relatively short. Therefore, the start-up costs per year were high. Thirdly, the enrolled forest area per contract was small and scattered in a complicated topography. This made monitoring difficult.

The findings of the study's experiment, of the review of the legal framework for PES in Vietnam, and of the interviews with concerned GO and NGO officials, all led to the conclusion that there are a number of constraints that explain the lack of fundamental conditions for PES schemes in the Vietnamese context.

Firstly, there are no private ownership and use rights to protection forest lands. All land is state-owned and the use purposes of the lands are pre-determined and restricted by the government. Land with (watershed) protection value, special use forest and protection forest, is not normally allocated to households. Households and villages cannot make their own decisions regarding the use of protection forests. This counts against the PES approach, since such schemes are explicitly designed as a mechanism to influence resource-use choices.

Secondly, there has been limited ES market development in Vietnam. The focus on forest environmental services has been exclusively on watershed protection; other services from forests outside of protected areas and protection forests have largely been ignored.

Thirdly, the prevailing "command and control" tools are working relatively well in Vietnam. The provision of environmental services is taken care of by the government. Therefore, there is no incentive for the State to investigate an experimental idea like PES.

Fourthly, concern about environmental services from production forest – the main place where the fundamental conditions for PES are met - is incipient and the services themselves have been largely ignored. Furthermore, the transaction costs of PES schemes have been high. This is because ES providers have generally been poor, "small" and often located in areas with complicated topography.

A number of potential positive factors for PES in Vietnam were explored. Firstly, forest environmental services are now officially recognized in Vietnam. Secondly, the country's need for more forest environmental services is increasing. Thirdly, there exists PES-related experiences in Vietnam. These could be used to start PES or PES-hybrid initiatives when further enabling factors for PES appear. Fourthly, the participation rate in PES schemes is potentially high. Fifthly, international carbon trading and CDM is focusing on reforestation and afforestation. This could offer a significant source of finance for reforestation and PES initiatives in Vietnam.

9.2 Recommendations

Though the property rights system in Vietnam is complicated, and awareness and concern about PES remains limited, a lot of useful work could be done in Vietnam to bring PES or PES-alike initiatives into the command and control system. However, more

experimental policy/program trials should be tried to gain further experience and knowledge before any large-scale implementation of a PES is tried in Vietnam.

Forest environmental services, especially watershed protection from production forest, should remain the priority for any PES experiment. Future experiments should not only be targeted at small farmers but also at SFEs who manage a large area of production forest. It might be easier to work with SFEs and there would also be opportunities to reduce TC.

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APPENDIXES

Appendix Table 1: Annual income of households before the payment

	HH Income (Mill. VND)	By sources (%)			
		Crop production	Animal production	Forestry	Other
All	**10.3**	**26.5**	**24.9**	**19.9**	**28.7**
Non-adopter	**7.6**	**22.2**	**26.6**	**21.8**	**29.4**
Batch 1	*7.9*	*21.8*	*27.2*	*21.6*	*29.4*
Batch 2	*7.4*	*22.6*	*26.1*	*22.0*	*29.4*
Adopter	**11.5**	**28.0**	**22.9**	**19.8**	**29.4**
Batch 1	*11.6*	*25.9*	*24.8*	*24.2*	*25.1*
Batch 2	*11.4*	*30.3*	*20.7*	*14.8*	*34.2*
Control	**13.4**	**28.9**	**26.1**	**18.0**	**27.0**

Source: Field survey

Appendix Table 2: Land use of households before being involved in the experiment

	Mean landholding (ha)	By use (%)			
		Annual crops	Perennial crops	Forest	Other
All	2.7	7.1	16.0	75.1	1.8
Non-adopter	1.6	16.4	11.5	69.9	2.3
Batch 1	*1.6*	*15.5*	*11.2*	*70.9*	*2.5*
Batch 2	*1.6*	*17.2*	*11.8*	*68.9*	*2.1*
Adopter	3.4	4.2	17.0	76.9	1.8
Batch 1	*3.2*	*4.6*	*15.5*	*78.2*	*1.8*
Batch 2	*3.6*	*3.9*	*18.5*	*75.7*	*1.9*
Control	3.5	4.2	18.2	76.2	1.4

Source: Field survey