

Incentives as a Means to Achieving Sustainable Land and Water Management in the Greater Mekong Sub-region: Developing a framework for Payments for Environmental Services in the hydropower sector in the region

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SUMMARY

It is well recognized that increased exploitation of land and water resources in upper catchments of Southeast Asia, with associated fragmentation of native vegetation, results in increased sediment discharge; elevated nutrient loads that act to reduce water quality; significant impacts on the storage capacity of dams; and measurable increases in the frequency of flash floods in upper catchments and declining base flows during the dry season. More specifically, unregulated, indiscriminate and illegal deforestation due to a combination of war, commercial interests and agriculture has resulted in a significant decline in forest cover impacting negatively on the health of critical upper catchments in the Greater Mekong Sub-region (GMS).

High rates of economic growth and escalating market demands for agricultural commodities are encouraging farmers to replace food crops for non-food crops, which lead to greater dependence on market forces (Burgers et al., 2005). There is evidence to suggest that a shift from food production to market-based commodities (i.e. cassava, maize, jatropha) has resulted in a greater degree of land degradation associated with inappropriate management systems for these crops that may be exacerbated with the current move towards bio-ethanol production (Valentin et al., 2007). It is argued that if incentives are not put in place to reward communities for adopting appropriate land management systems, further land degradation will occur with increased off-site consequences for lowland communities. The focus of this study is to assess the potential development of effective incentives that enhance the productivity and income generation opportunities of farmers in upper catchments in the Greater Mekong Sub-region (GMS) that result in equitable distribution of benefits to upstream and downstream communities and the adoption of sustainable land and water practices. More specifically the study targeted the hydropower sector as a potential recipient of environmental services (ES) associated with the sustainable management of upper catchments. The study specifically reviewed the potential role of payment for environmental services (PES) as an incentive-based mechanism to enhanced the productivity and income generation opportunities for disadvantaged rural farmers in upper catchments in the Greater Mekong Sub-region in ways that would result in equitable distribution of benefits to upstream and downstream communities and the adoption of sustainable land and water practices.

The specific objectives of the project were:

- In light of the current move to develop water resources for hydropower production (HP) in the Lao PDR and Vietnam, especially the need to maintain the integrity of the storage capacity of these investments, the management of sediment generation in upper catchments is critical. An assessment of the current and future HP development in the lower Mekong countries was undertaken and the potential benefits associated with the adoption of resource conserving practices by farmers and communities in the target areas; and identify factors/bottlenecks that influence adoption of sustainable land and water management practices.
- Develop a framework for the establishment of the concept of incentives that focuses on the adoption of more sustainable resource utilization that will

benefit both hydropower generators and communities that inhabit these upper catchments.

The study consisted of several components that contributed to an overall assessment of the possible role of incentive based mechanisms, i.e. PES and benefit sharing. The following activities were undertaken:

1. An assessment of hydropower development in the lower Mekong basin; a critical assessment of PES as a payment mechanism to support the adoption of sustainable land use management drawing upon published information; and a brief assessment of the processes of sedimentation. The aforementioned entailed a desktop approach using literature in the public domain.
2. A comprehensive field based survey was undertaken to assess the drivers that influence the adoption of sustainable land management practices based on a survey of four ASIALAND conservation farming villages (CFV's) in northern Lao P.D.R. This survey used traditional PRA and structured interviews of farmers in these villages with the objective of assessing the extent of adoption and continuance of technologies and techniques introduced during the project cycle.
3. In Lao PDR a case study of two villages, Lardthahea and Parkcheak, in the Pak Ou District, Luang Prabang Province was undertaken to assess current livelihood strategies and to gauge the community's feelings about the proposed hydropower development scheme.
4. An assessment of the biophysical and socio-economic status in the Da River watershed before and after the building of the Hoa Binh and Son La hydropower projects in Vietnam was undertaken.

The key findings of this study were as follows.

There is clear evidence to support the notion that inappropriate land management options implemented by resource poor farmers are having, and have had, significant negative off-site impacts that bring into question the long-term viability of resource utilization. One of these resource degrading impacts is accelerated sediment generation associated with inappropriate land use. This has had profound effects on water quality and sedimentation of storage structures. Clear evidence of this accelerated sedimentation of storage structures is present for the Hoa Binh Dam in northern Vietnam where it is estimated that the effective life of the facility will decline to half of its design capacity (i.e. 250 years) in less than 100 years.

A review of in Lao PDR of ASIALAND conservation farming villages (CFV's) several years after its conclusion confirmed perceptions and anecdotal evidence that support the lack of continued adoption of sustainable land use after the completion of the project. While interest in sustainable land management (SLM) technologies and willingness to participate in new projects were still high among the respondents, common criticisms made about technologies introduced by the ASIALAND network were that the practices were too labour intensive/time consuming and that the returns gained from implementing the technologies were too marginal. These clearly are fundamental constraints that limit adoption and out scaling amongst communities and the concepts of incentive based approaches that would effectively reward farmers/landowners for appropriate stewardship would potentially result in greater degrees of adoption and sustainable resource use.

Whilst PES is viewed as a voluntary, conditional transaction with at least one seller; one buyer; and a well defined environmental service and would appear to be a simplistic approach to addressing issues associated with sustainable resource use and rewarding land stewardship, in reality the scheme is complex with significant transaction costs. Further it is questionable whether such an approach is suited for the task at hand, in this case the sustainable management of upper watersheds within a HP context. In general, the introduction of PES in Southeast Asia, Vietnam being a prime target for these schemes, has been less than positive and hence it is questionable as to whether this form of incentive-based scheme would have applicability in the HP sector.

The concept of benefit sharing extends the narrow focus on displaced people and the resettlement host communities who are adversely affected by HP development. It includes other households and communities living in the project *impact zone* who have their resource access permanently reduced or transformed by the project in some degree. Essentially the philosophy is that all people living in the project impact zone, who host the project, are eligible to participate in benefit sharing and become long-term partners in the project they must live with. It transcends the narrow focus of a one-off compensation approach to addressing the impacts of dam building to one of providing continual pre-determined income streams for the life of the scheme to those who are influenced negatively by the project. It is inclusive and equitable and clearly represents a mechanism of equitable distribution of benefits to those who have lost or had to forego a livelihood. This clearly represents an approach that would fit the scope of a hydropower development and should be considered by LMB countries as an effective mechanism for distributing the benefits of HP to those affected adversely by it. Vietnam is currently embarking on pilot sites for assessing the role of benefit sharing and a legal framework for its implementation has been established. However, a major hurdle that is perceived in the implementation of such a mechanism is in the willingness of developers and investors to consider this approach in their planning process. This can be addressed through governments providing legislation for such mechanisms within their HP policies.

1. INTRODUCTION

In the tropical uplands of Southeast Asia, rapid changes in land use practices are taking place, the sustainability of which are in question. Three main forces are currently recognised as driving change: population pressure, government policy and market demand. In addition, two emerging driving forces have appeared: climate change and land degradation. It is well recognized that these five factors are interlinked and the relative importance of their role in influencing land use changes depends on the region in question (Valentin et al., 2008).

Continuing increases in population pressure result not only from natural growth but also from migration of adjacent lowland farmers. Declining crop productivity in lowland areas is forcing the continued expansion of cultivation to increasingly steep slopes, often involving the clearance of native upland vegetation (Valentin et al., 2008). In addition, government policies favouring the resettlement of remote and scattered villages, to provide improved access to education, health and markets, is leading to high local population densities in some regions (Lestrelin and Giordano, 2007). Very high rates of economic growth and escalating market demands for agricultural products are encouraging upland farmers to replace food crops for cash crops, which in turn may lead to their increased dependence on market forces (Burgers et al., 2005). Thus, even if market access conditions have greatly improved in recent decades, this has also meant that subsistence farmers increasingly need to generate additional sources of short-term income (Sidle et al., 2006).

As the pace of economic and social change in this region accelerates, large tracts of forest may be converted to agricultural land with potentially critical environmental implications that include a higher frequency of floods and droughts leading to crop failure. Upland soils have been subjected to misuse and unsustainable farming practices, resulting in land degradation. Uplands are eroded and nutrients depleted resulting in lost soil stability and permanent damage. As the land resource base becomes less productive, food security is compromised and competition for dwindling resources increases. Thus a downward spiral of hopelessness is created. However, as mentioned by Scherr (2000), it is both avoidable and reversible in many circumstances. Farmers often spontaneously seek innovations to stabilise or improve the resource base, or to compensate for their welfare effects by depending less on the degrading resource. Thus land degradation can lead to farmers giving up cultivation altogether or adopting new farming systems.

Land use changes have several on-site (i.e. at the scale of the cultivated fields) impacts such as the clearance and fragmentation of native vegetation, losses in biodiversity, changes to water regimes and soil degradation, all of which have been well documented (Gardner and Gerrard, 2003; Sidle et al., 2006). These problems may greatly affect individual land owners/users but may not represent the broader off-site and downstream impacts. Runoff and soil erosion are often not only the primary consequences and symptoms of land mismanagement but contribute to negative downstream off-site impacts such as flooding, pollution and siltation of water bodies and reservoirs. It is generally hypothesized that increased exploitation of land resources in headwater catchment areas, even as small as $<1 \text{ km}^2$, with associated fragmentation of native forest vegetation, can result in increased sediment discharge and elevated nutrient loads that act to reduce water quality and availability to downstream users (Bruijnzeel, 2004). Thus land degradation resulting

from changes in land use and/or climatic conditions is a concern not only to upland farmers but also to the users of water resources downstream, including hydropower developers, as it significantly influences the financial viability of these investments. Indeed, although land degradation is often associated with poverty (Pender et al., 2001; Penning de Vries et al., 2002), especially in mountainous regions dominated by people who are often politically disempowered and economically marginalized, public interest in the management of uplands emerged mainly from a realization that environmental degradation of these lands has an impact on the entire community (Lian, 1993).

Environmental management policy in developing countries has characteristically oscillated between command and control limitations imposed upon local people and indirect integrated conservation and development projects (ICDPs) (Wunder, 2006). ICDP proponents hypothesize that poverty alleviation programs will catalyze trickle-down improvements in sustainable land use, based on the theory that raising incomes is a critical precursor to the adoption of sustainable production techniques (Wunder 2006, Gillis and Vincent 2000). Both of these strategies have proven their inability to address “urgent, priority (environmental) issues” Chape (2001).

Moreover, Valentin et al. (2008) have shown in Southeast Asia (SEA) that the possible adoption of conservation practices was not correlated with households' income. Payment for environment services (PES) offers an alternative ongoing funding source for sustainable agriculture amongst poor and subsistence farmers in SEA. It is especially advantageous in situations where conventional instruments have failed, either from a lack of institutional capacity or political will, or where willingness and/or capacity of private landowners to finance ecosystem conservation are low (Bracer et al. 2007). Whether or not watershed services make good PES markets is a subject often debated. In a report prepared for CIDA, Robinson and Venema (2006) claim that hydrological watershed services are ‘ideal’ for PES because of the apparent ease in identifying direct and obvious users of water in a watershed, meaning buyers can be targeted. In many instances this is the case with a clear delineation between the beneficiaries of ES (often downstream domestic water users i.e. hydropower sector) and the providers (upstream farmers who modify land use). However, Wunder et al. (2005) as well as Jack et al. (2007) and Tomich et al. (2004) highlight difficulties specific to the watershed approach when addressing poor stakeholders. Thus, the question of whether watershed services can support PES is pertinent in the Mekong, where farmers are typically poor smallholders, while they produce significant externalities.

Of importance in assessing storage structures for HP generation is the off-site negative impacts of soil erosion on the hydrodynamic storage capacity and operation of these dams. McCully (1996) reported that major reservoirs in China have lost 23% annually of their storage capacity which has major implications with respect to the economic viability of these projects. A study by the US Army Corps of Engineers in 1993 revealed that reservoir siltation of the 135 MW Cerron Grande Dam in El Salvador reduced the operational life of the facility from a pre-construction expect life of operation of 350 years to a mere 30 effective years after significant sedimentation had occurred. Modern dams are now designed so as to include, in addition to the main water storage capacity that is used in power generation termed the ‘live storage’, ‘dead storage’ which lies beneath the elevation of the dam's lowest outlet. Hence, there is the ability of these modern dams to absorb eroded sediments without major losses of hydropower generation capacity. However, this increases the overall cost of such projects. It is of note that sediments do not

always get deposited as predicted. For example, the Tarbela Reservoir in Pakistan lost 12% of its live storage by 1992, whilst 55% of its dead storage was still devoid of sediments even after 18 years of operation clearly indicating the variability in the deposition within dams (McCully, 1996). In the new generation of dams, flushing mechanisms have been installed in order to remove sediments from the dam. This can have adverse impacts on water quality being delivered downstream of the HP installation.

As the lower Mekong basin countries embark on significant water resources development particularly in the hydropower sector there is concern over the potential implications of accelerated sedimentation on the hydrodynamic storage capacity of storage structures. It has been estimated that the total theoretical potential for hydropower (HP) production in the Greater Mekong Sub-Region (GMS) is approximately 53,000 MW with about 23,000 MW potentially being generated in the Peoples Republic of China (PRC) where the Mekong (known as the Lancang) River flows through Yunnan Province. In the lower Mekong Basin (LMB) it is estimated that 30,000 MW is technically available in the four countries with just under 13,000 MW in the mainstream (MRC 2003). The remaining potential capacity is located in the upper tributaries of the Mekong system. Lao PDR has the highest HP potential of the four LMB countries (Lao PDR 13, 000 MW; Vietnam 2,000 MW, Cambodia 2,200 MW, Thailand has already developed all of its feasible HP potential in the basin) (King et al., 2007). Hydropower represents one of the important renewable uses of water resources in the LMB to meet the increasing needs for energy and economic development in the riparian countries. Relatively little of the hydropower potential in the region has so far been developed and as population growth and economic development increases in the basin and individual personal wealth rises, demands for energy will increase dramatically over the next two decades.

Clearly addressing the potential negative impacts of sedimentation at the source would have positive benefits both from a financial perspective (the dam builder) and the long-term sustainability of the natural resource base. Whilst the sustainable management of agricultural uplands is achievable through the implementation of appropriate farming practices such as conservation agriculture, contour farming, etc., the adoption rate of these practices is extremely low within the region even though there has been a consistent flow of donor resources in research, extension and implementation. Two questions arise that have significant relevance in addressing the sustainable utilization of uplands: why is the adoption rate of improved conservative farming practices so low amongst farmers that inhabit the uplands of Southeast Asia? And are there opportunities in increasing adoption rates through an incentive-based approach? In the former case we can assess the factors that may contribute to the low adoption rate by revisiting previous projects that focused on promoting technologies and approaches for the sustainable utilization of land resources. In this respect the ASIALAND project offered an opportunity to explore this avenue. In brief the ASIALAND Network was established in 1988 and was completed in 2004. The Network developed and implemented conservation technologies for the Management of Sloping Lands for Sustainable Agriculture (ASL/SL). The project was implemented over 5 Phases with seven participating countries namely China, Indonesia, Laos, Malaysia, the Philippines, Thailand and Vietnam. During the first (1988-1991) and second (1992-1994) phases of ASIALAND, the project focused on the development of soil conservation technologies adapted to sloping lands conditions, this included, alley cropping,

grass strip cropping, agro-forestry, the establishment of hillside ditches and the introduction of diversified cropping systems. Once developed, the technologies were implemented for validation by participating countries. Implementation was conducted at research stations and farmers' fields with traditional farmer's practices being used as benchmarks to assess these improved practices. The criteria used to assess the new practices were their impact on productivity and livelihood stability of the technologies, land protection, economic viability and social acceptability. The final phase of this project specifically focused on the widespread adoption of improved sloping land practices through the establishment of Conservation Farming Villages (CFVs). Four such villages in northern Lao PDR formed the focus of a field based study to assess the impact and adoption rates of introduced practices to these CFVs several years after the end of the study. The approach taken was through structured questionnaires and interviews that were undertaken with villagers who had been involved in the project.

As it was assumed that adoption of sustainable land management practices by upland communities involved in the ASIALAND project was assumed to low, the focus of further research was to investigate alternative options that could be used to promote wider and sustained adoption. In this respect a desktop review of the literature was undertaken that specifically focused on the concepts of payment for environmental services (PES) and the challenges associated with the introduction of such schemes in developing countries. The review drew upon a wealth of published material with the clear objective of assessing this approach within the context of promoting sustainable management of upper watersheds within a hydropower window. This was followed up with field-based assessments of proposed HP developments in Lao PDR on the Nam Ou River and in the Da River basin in Vietnam. In the former case, selected villages were interviewed over the proposed dam development along with an assessment of their current livelihood options. In the latter case an assessment of the biophysical and socio-economic status in the Da River watershed before and after the building of the Hoa Binh and Son La hydropower projects was undertaken.

2. LITERATURE REVIEW

Land degradation is a significant threat to land and water resources productivity that has a direct impact on livelihoods. In this respect, soil erosion is widely recognized as a major cause of land degradation (Subayona et al., 2003), which ultimately leads to other forms of degradation including nutrient depletion due to loss of top soil layers, acidification, a decline in biological activity and diversity, and agrochemical pollution. Poor watershed management, such as inappropriate land use and reduced forest cover on sloping land, is a major driver of runoff and soil erosion. In comprehensive studies on erosion rates within the context of the Management of Soil Erosion Consortium (MSEC), sediment yields from upland rice production systems that are within a slash and burn enterprise in Lao PDR, have been recorded to be $5.7 \text{ Mg ha}^{-1} \text{ year}^{-1}$ at the catchment outlet (Valentin et al., 2008; Phommasack et al., 2000). These figures are consistent with data collected from catchments in similar environments in the Himalayan hills of Bangladesh ($1.2 \text{ Mg ha}^{-1} \text{ year}^{-1}$; 1 year of cultivation, 4 years of fallow; Gafur et al., 2003). Under these conditions, rotational shifting cultivation cannot be regarded as a major threat for soils as often presented by governments and international institutions. In contrast, annual crops cultivated semi-permanently with very short cycles, and

permanent cropping, as often encouraged by governments, are much more problematic in terms of erosion (Valentin et al., 2008). Thus, a minimum duration of fallow period is required to suppress weeds in order to continue rice cropping and this limits erosion frequency due to cropping to one year out of five. As demonstrated in the Laotian site, total sediment yield increases with the shortening of the fallow period and this effect is increased with the replacement of upland rice by Job's tears and maize. The average total sediment yield from the 27 catchments is $3.4 \text{ Mg ha}^{-1} \text{ yr}^{-1}$ in this study of Valentin et al. (2008). It exceeds the tolerable soil loss rate considered by most soil scientists, the threshold being $2.5 \text{ Mg ha}^{-1} \text{ yr}^{-1}$ (USDA, 1995).

A fundamental impediment to the adoption of more sustainable land management in upper catchments is the constraints of resource poor farmers in their ability to devote resources to implementing improved conservative technologies. These technologies invariably require greater inputs in the form of labour and/or financial commitments that often do not yield quick and tangible benefits to the farmer. In the planning horizons of resource poor farmers, interventions that do not yield appropriate benefits that are often viewed in the form of increased yields and/or incomes, will not be adopted. This would in part explain the lack of replication and adoption of conservative management strategies.

In an effort to value the biodiversity and services of ecosystems, the concept of ecosystem services (ES) has emerged in the current debate on reforming our approach to land stewardship. Simply put, ES regulate and support natural and human systems through cleansing, recycling and renewal of biological resources. These services are crucial for the sustainability of human development in economic, social, cultural and ecological terms (Daily et al., 1997). As global populations increase and economies expand, the consequences associated with these anthropogenic pursuits will have a negative impact on the services that ecosystems provide (Millennium Ecosystem Assessment, 2005).

It is well recognized that valuable services are provided by ecosystems that are often termed as intangible externalities. For example, a forest provides vital services that include watershed protection, biodiversity conservation and carbon storage. Degradation of the forest could lead to an inability of the system to provide these services that are reflected in local scale flooding and degradation of water supplies, to global scale climate change, and loss of ecosystem resilience, scenic beauty, and accessible sources of sustainable timber and non-timber forest products as well as all other services supported, directly or indirectly by well-functioning forest ecosystems. In summary, ecosystems and biodiversity provide a wide range of services through their bio-geochemical processes that are critical in supporting man (Kumar, 2005).

A unique feature of most of these services that emanate from ecosystems is that although they are acknowledged they are often unaccounted, un-priced and therefore remain out of the domain of the market. Conventionally such problems are treated as externalities where the markets fail, and decision-makers try to correct the market failure by creating a market-like situation.

Payment for environment services (PES) can be considered as one approach among a range of instruments that contribute to ensuring the continual flow of ecosystem services. In this respect these instruments have developed to regulate

human use of natural resources and therefore the flow of ecosystem services. The instruments include, but are not limited to:

- *Regulations and restrictions* that are sanctioned either culturally or through formal law (i.e. the establishment of protected areas). This may be enforced through cultural, social and legal means;
- *Increasing the level of information and awareness* by informing people on the importance of the continual flow of ecosystem service and the potential impact of their own activities upon these services with the assumption that awareness may induce behavioural changes; and
- *Economic instruments* in the form of *sanctions*, such as fines that discourage pollution or deforestation; *resource use fees*, such as licenses to be paid for the right to cut timber or use water; *incentives*, such as tax reductions; or *direct payments*, to encourage specific types of human activity such as maintaining forest cover (Ravnborg et al., 2007).

PES effectively constitutes one among several possible instruments that may be employed to ensure the continual flow of ecosystem services. The basic principle of PES is that those who provide environmental services should be compensated for the cost of doing so, whether these are direct costs of specific land use practices or more indirect opportunity costs of avoiding certain activities or types of land use. Payments may be monetary or in-kind, may involve the private sector or government financing, and can be made at local, national, and global levels (Grieg-Gran and Bann, 2003). Hence the basic notion underlying the concept of PES is that ecosystems such as natural forests, landscapes with mixed patterns of human use and natural vegetation, as well as intensively cultivated agricultural landscapes all provide important services to people – locally, regionally and globally – and that these services do not accrue to those directly or indirectly responsible for their provision (Ravnborg et al., 2007). A comprehensive discussion on PES and benefit sharing is presented in Annex 3.

3. METHODOLOGIES

Assessment of the hydropower development in the basin and a review of PES and benefit sharing:

This activity was undertaken within the context of a review of the literature on this topic. This included material within the public domain along with material in the grey literature. The study specifically focused on a review of PES with a strong focus on addressing some of the challenges associated with the implementation of PES and its role in poverty alleviation. Further examples are presented of PES based initiatives globally and an example is presented from Vietnam. The basic elements of benefit sharing are presented and examples globally are presented.

Assessment of the ASIALAND project through field based surveys:

A total of 42 villagers were interviewed in 4 villages located in Luang Prabang Province which used to be part of the ASIALAND network of Conservation Farming Villages - CFVs- (three in the lower Nam Ou river area in the Pak Ou district, namely, Ban Hatsoua, Ban Lathahae and BanPakchaek) and one along the road to Xayabury (Ban Silalek, Xieng Ngeun district).

Two questionnaires, including roughly 100 questions were used. The first questionnaire included 4 sections, the first concerning the household structure and

livelihood (general information about individual household members, landholdings of the household, crop and animal production in the Year 2007, non-farm/non-resource-based income in the Year 2007, household expenditure in 2007), the second about food security (in particular, level of rice sufficiency), the third about integrated farming (knowledge and practice by the household) and the fourth about the interviewee's perception of hydro-power development (knowledge of developments that might directly affect the household and understanding of likely consequences on the household's livelihood). The second questionnaire specifically focused on SLM and investigated the respondent's awareness, involvement, knowledge, general attitude and willingness to adopt SLM technologies.

The proportion of households that could be surveyed was limited: 18 out of 150 (12 %) in Ban Silalek, 11 out of 73 (15 %) households in Ban Hatsoua, 8 out of 107 households (7.5 %) in Ban Pakchaek, 5 out of 96 (5.2 %) households in Ban Lathahae. While relatively limited in size, this population sample is comparable to the 50 respondents interviewed in 2004 for the impact assessment of the ASIALAND program (Maglinao et al., 2005).

Respondents' age ranged from 25 to 78 in Silalek and 20 to 79 in the Nam Ou area, with a majority of respondents aged between 30 to 60 in both villages (i.e. 15 out of 18 respondents in Silalek and 19 out of 24 in the Pak Ou villages). Mean respondent's age was 46 and 45.5, in Silalek and the Nam Ou, respectively. There were very few respondents who were younger than 30 in both villages because young people are generally not considered to have the required skills to run farm activities and they were usually not responsible for working with official workers if their parents were available. The proportion of women versus men respondents was 22 and 42% in Silalek and the Pak Ou villages, respectively. Our sample is therefore somewhat biased, with obvious gender and age imbalance the overall population. However, this problem could not be circumvented as the chiefs of villages designated people who participated in interviews. In addition, it must be noted that: 1. in many households, the individual responsible for farming activities is often the most senior male and 2. participants in CF activities were also designated by heads of villages. This separation of tasks and responsibilities also explains why a substantial fraction of CFVs' population is unaware of SLM and CF technologies.

Field Report in Lao PDR on Incentives for Environmental Services: Case study of two villages-Lardthahea and Parkcheak, Pak Ou District, Luang Prabang Province, Lao PDR

The RRA and PRA method was used in study on farmers' livelihood, agricultural activities and income in 2008. It is comprised of field observation on agricultural production and potential of the studied villages. The study was divided in to the two periods: 8 days for pre-test and stakeholder interviews and 15 days for household interviews. Out of a total of 96 people interviewed 68 were men (70.8%) and the remaining (29.2%) women, all over 18 years of age. The study site was located in the north-west of Pak Ou district Luangprabang province. The study area consisted of two villages (Lardthahea and Parkcheak) which would potentially be affected by Nam Ou electro-power dam construction.

Assessment of the biophysical and socio-economic status in the Da river watershed before and after building Hoa Binh and Son La hydropower projects

This component of the study was undertaken as a desk top assessment using project material, previously published report and PhD Thesis from various sources.

4. RESULTS AND DISCUSSIONS

The results and discussion are presented in four sections that related to the various activities that were undertaken within the context of the study. These section are presented as distinct entities and a final synthesis section is presented pulls the outcomes from each of the previously discussed sections together.

Hydropower development in the Mekong Basin and sediment generation (See Annex 1)

As the economies of the lower Mekong basin (LMB) industrialize and demand for power increases, the under developed water resources of the region has been viewed as a potential source to meet this insatiable demand for energy. There are effectively two perspectives that drive energy and hydropower (HP) policy in the GMS, namely: (i) diversification and maximization of indigenous resource use in the power sector, reflecting a national-regional energy security focus; and (ii) the policy to increase electricity supply to emerging economies to underpin socio-economic growth and development (King et al., 2007).

An inventory of existing (or under construction) large HP projects in the GMS indicates that there are 82 currently underway with a further 179 large projects identified as potential sites (King et al., 2007). The Peoples Republic of China has built two main-stem dams, the Manwan (1,500 MW) and Dachaoshan (1,350 MW) on the Lancang (Mekong) River in Yunnan Province. The Manwan and Dachaoshan dams have relatively small active storage capacity and are largely operated as run-of the river schemes. Two more dams are under construction, Xiaowan (4,200 MW) and Jinghong (1,500 MW) as part of a planned cascade of 8 dams. The Xiaowan dam when completed will have 20 times the live storage capacity of the two completed dams.

The remaining existing HP dams in the Mekong basin, including those under construction, are all situated on the tributaries of the Mekong. Of this 11 schemes have been completed in the LMB, totalling 1,600 MW or approximately 5% of the overall potential. The largest schemes are located in Vietnam (Ialy, 720 MW) and Lao PDR (Theun Hinboun, 210 MW, Nam Ngum, 150 MW, and Houy Ho, 150 MW). In the GMS Vietnam has the highest number of existing large HP dams (30 existing and 65 potential sites identified). Of these, 26 potential sites are identified on tributaries of the Mekong (King et al., 2007).

In the LMB, a number of run-of-river hydropower projects have been identified on the mainstream Mekong but none has reached an advanced preparation stage. These dams were proposed back in the 1950's but over the past couple of years these plans have been revived due to the anticipated increased flow regimes in the dry season associated with the development of mainstream dams in Yunnan making these projects feasible.

The traditional beneficiary of hydropower development in the Mekong and strong justification for its development, has been flood control. Possibilities also exist for designing and operating hydropower facilities with benefits for other sectors (MRC, 2001). The principle of multiple use reservoirs is a case in point; another is safeguarding and promoting local fisheries and agriculture in dam design and operational directives. The Nam Ngum project in Laos is an example of a hydropower reservoir that has become an important source of fishing as well as a tourist attraction.

The potential environmental and socio-economic impacts of hydropower development projects and related activities include, but not limited to, the following:

- It is well recognized that the mountainous and upland regions of Lao PDR and Vietnam are rich in biodiversity. Relatively unspoiled pristine rain forests are found in these areas. Illegal or uncontrolled logging is a significant problem in the region and the development of HP often exacerbates the situation by improving access to these regions through the construction of roads. Destruction of these forests potentially has a dual negative impact. It reduces the biodiversity value of these national assets and endangers rare or threatened species. In addition, deforestation destroys the flood buffering capacity services of these ecosystems and soil protection capacity of the river catchment. This could increase sediment discharge from these watersheds that would result in accelerated siltation of dams.
- The Mekong and its tributaries have an abundance of fish and other aquatic species. It is estimated that more than 1,300 fish species are found in the Basin. It has been established that several of the key species and important components of fish production are dependent on specific flood patterns (pulse-floods), minimum flows and migration opportunities to maintain life cycles and production. The development of HP could have a negative impact on the fisheries resources of the basin and hence the livelihoods of some of the poorest communities in the basin who are dependent on them.
- The wetlands along the Mekong are also rich in biodiversity. They are inhabited by a large number of rare and threatened species and play a critical role as stop-over sites for migratory birds. For example it is estimated that the entire global population of the eastern sarus crane stays in the Mekong delta during the dry season. Changes in the functionality of these wetlands will have an impact of these ecosystem services.
- Changed flow regimes associated with infrastructure development will affect downstream regions and countries. Of particular concern are those areas within the delta where the ecological functioning of agriculture and aquaculture areas in the Mekong delta is intrinsically linked to seasonal flooding. Further, predicted rises in sea levels associated with climate change and changes in flow regimes associated with dam construction could have a profound impact on the agricultural productivity of the delta.
- Similarly the Lower Mekong Region evolved within the context of regular flooding. Consequently traditional land-use and ecological conditions have adapted and evolved to these seasonal flood patterns. However, extreme flood events pose a significant threat to human life and property. Therefore

finding ways to better control the hydrological regime is deemed to have a positive impact on livelihoods and human wellbeing. The development of upstream reservoirs associated with HP develop is seen as a means to achieving this goal.

- The mountainous parts of the region are inhabited by ethnic minority groups. Such groups are often difficult to relocate without damaging their cultural identity and integrity. Dam development necessitates the displacement of peoples and communities. Several issues have been identified that invariably are a consequence of development and discussed in brief below.

Displacement of communities disrupts age-old ways of life and livelihoods for communities and peoples. Resettlement and rehabilitation of displaced households invariably poses significant challenges that are often addressed in a piecemeal manner or are neglected. Resettlement is often plagued by a lack of adequate and productive land being made available to communities and individuals; people are often paid cash compensations which have limited and transient value; they are not compensated for common property resources which formed an important part of their livelihood in previous locations; and resettlement also causes the destruction of social capital of displaced people. Consequently, many displaced households have become socially and economically marginalized (Upadhyaya, 2006).

There are examples where the construction of dams has resulted in the scarcity of irrigation and drinking water to downstream communities areas. The drying up of rivers has changed microclimates, adversely affected religious and cultural sites, and diminished the aesthetic beauty of downstream areas. The livelihoods of people are often destroyed through the management of HP facilities that result in significant fluctuations in river height making fishing and agriculture a hazardous undertaking. Similarly, people are often adversely affected by the construction of transmission towers, transmission and distribution lines, roads, and canals (Upadhyaya, 2006).

With 35% of the Mekong's total annual flow, the Government of Lao PDR sees the development of this resource as an asset and has marketed itself as becoming the "Battery of Southeast Asia". With a modest domestic demand for electricity, the focus of HP development is on generating foreign exchange through the export of power to neighbouring countries of Thailand, Vietnam and China. Whilst plans for the development of this sector have been on going for several decades, implementation was thwarted in 1970's and 1980's by war and political instability and in the 1990's by the Asian financial crisis (Imhof et al., 2008). The development of HP facilities with planned and managed environmental impacts is seen as an ideal opportunity for Lao PDR to enhance its economic prosperity and improve the livelihoods of people (Pholsena and Phonekeo, 2004). Lao PDR possesses the largest HP potential in the LMB that is beyond its own needs and is centrally location in an ever expanding GMS regional market for electricity. Exports of electricity have been an important foreign exchange earner since 1971 and the Government of Lao PDR (GOL) is relying on expansion of this sector to further boost revenues to meet its social obligations (Pholsena and Phonekeo, 2004).

It is pertinent to discuss the role of foreign investment in the HP sector in Lao PDR as it reflects a swing away from what would be termed IFI's that have more stringent rules and requirements governing investments in HP development. When

the Asian financial crisis hit in 1997 there was a mass exodus of investors in the sector as demand for power in the region declined. By the end of the 1990's there were only two completed hydro-for-export projects, namely, the Theun-Hinboun Hydropower Project and Houay Ho Hydropower Project (Imhof et al., 2008). The Nam Theun 2 Power Company (NTPC) was one of the few foreign consortia to remain. However, as countries emerged from the Asian financial crisis, foreign hydropower developers have returned to Laos but are dominated by companies that have their constituents in Thailand, Vietnam, China, Russia and Malaysia displacing the tradition investors such as the World Bank and the Asian Development Bank. These new developers are more flexible with respect to their operations and are able move quickly and mobilize resources in a timely manner and have taken over projects that were abandoned by Western corporations during the Asian financial crisis (International Rivers, 2008). Companies and financing from Thailand now dominate the Lao hydro sector with Vietnam and China not far behind.

It is clear that new hydro companies and their backers are fast displacing traditional Western corporations and multilateral development banks that previous dominated the sector. These new companies are seen as more attractive partners to the GoL largely due to their access to financing (this may change under the current global crisis with respect to access to credit) and their limited or lack of social and environmental responsibilities as part of the loan agreements. The Nam Theun 2 project that has been heralded as a success with respect to safe guarding communities interests and the environment is often seen as a hindrance to development. It is of note that the Nam Theun 2 is the only existing and planned Lao dam in which the revenue management commitments have been proposed to help direct the GoL earnings towards poverty reduction expenditures (Imhof et al., 2008).

Viet Nam can be viewed as both a HP developer and importer of electricity. Potential HP is estimated to be approximately 20,600 MW of which 20% (4,200 MW) has been developed to date. With electricity demand growing at between 13-15% per annum associated with rising demands from the household and industrial sectors and export growth, it is anticipated that this growth will continue into the foreseeable future as Viet Nam achieves its goals in becoming an industrialized economy of the next 20 years. Approximately 70% of households have access to power services and the government has set a target of 76% of rural households being serviced by 2010 (King et al, 2007).

Viet Nam's HP resources are predominantly located in the Central and Northern regions with the Da, Sesan and Dongnai rivers forming the main HP generation systems in the north, central and south respectively. Currently there are more than 50 HP stations in operation, 10 of which are on tributaries of the LMB (King et al., 2007). Viet Nam contributes 11% of the flow of the Mekong from upland tributaries that drain west.

Projections suggest that about 13,000 MW of new HP would be added to the grid system up to 2020 that would represent approximately 65% of Viet Nam's economic hydropower potential. Since year-on-year demand growth has outstripped capacity to bring new generation projects on stream, Electricity Viet Nam (EVN) has negotiated the importation of electricity from the Peoples Republic of China to cover shortages in the northern provinces and accelerated transmission

connections to import power from Lao PDR from 2008 onwards. This has resulted in the active cooperation of Viet Nam in the formation of a regional grid and cross-border trade.

Faced with a rising fossil fuel bill, a need to diversify the energy mix, and internal opposition to the construction of new energy projects, Thailand's electricity utility EGAT has had to look elsewhere to source the country's current and future energy needs. Lao PDR has been a significant and willing provider of this energy deficit. It is viewed by some quarters that EGAT is exporting the social and environmental costs of energy production to its poorer neighbours (Imhof et al., 2008). Further the reliance of external sources of energy supply can also be viewed as carrying a degree of risk particularly in a region where there is still distrust between nations.

Thailand's 2007 Power Development Plan includes 4000 MW of power imports from Laos between 2008 and 2015, and additional 8700MW from unspecified neighbouring countries by 2021 (EGAT, 2008). Thailand's energy and construction companies, backed by the government, financial institutions and investors, are assisting in many of the new developments in the sector in order to secure a reliable and continuous supply to the Thailand grid. It is of note that Thailand's energy companies and commercial banks have yet to commit to international best practice standards. None of Thailand's commercial banks are signatories of the Equator Principles that ensure social and environmental principles as basic standards in loan agreements (Imhof et al., 2008). While a number of Thailand's energy companies have developed Corporate Social Responsibility policies, their narrow interpretation of environmental and social governance provide limited safeguards to affected communities.

Clearly HP is an important resource in the Mekong Basin. It has the potential to satisfy growing national and regional energy needs and to address some of the development challenges in the region. Populations living in the hydrological boundaries of these developments are in a unique and precarious position. These areas often exhibit some of the highest concentrations of poverty in the world; these upland communities are also the primary management agents for environmental resources which have profound effects on more populous downstream areas. Research and development efforts aimed at generating alternatives and alleviating poverty in these regions, while rightly targeting a crucial population, have often not fully recognized distinctions between uplands and lowlands, often leading to unintended and negative consequences.

The unsustainable utilization of upper watersheds by often marginalized and poor communities could have a significant impact in the financial viability of these investments. Land degradation is a significant threat to land and water resources productivity that has a direct impact on livelihoods. In this respect, soil erosion is widely recognized as a major cause of land degradation, which ultimately leads to other forms of degradation including nutrient depletion due to loss of top soil layers, acidification, declines in biological activity and diversity, and agrochemical pollution. Poor watershed management such as inappropriate land use and reduced forest cover on sloping land is a major driver of runoff and soil erosion.

Sediment transport and deposition resulting from soil erosion have impacts which are both socially and economically negative. These negative impacts include declining agricultural productivity, a reduction in storage capacity and delivery

facilities of dams and reservoirs, increasing pollution of drinking water, damage to irrigation infrastructures and a threat to aquatic ecosystems as well as human health.

In the context of this study the off-site negative impacts of soil erosion on the hydrodynamic storage capacity and operation of dams is critical. McCully (1996) reported that major reservoirs in China have lost 23 % annually of their storage capacity which has major implications with respect to the economic viability of these projects. A study of US Army Corps of Engineers in 1993 revealed that reservoir siltation of the 135 MW Cerron Grande Dam in El Salvador reduced the operational life of the facility from a pre-construction expect life of operation of 350 years to a mere 30 effective years after significant sedimentation had occurred. Modern dams are now designed so as to include, in addition to the main water storage capacity that is used in power generation termed the 'live storage', 'dead storage' which lies beneath the elevation of the dam's lowest outlet. Hence, there is the ability of these modern dams to absorb eroded sediments without major losses of hydropower generation capacity. It is of note that sediments do not always get deposited as predicted. For example, the Tarbela Reservoir in Pakistan lost 12% of its live storage by 1992, whilst 55% of its dead storage was still devoid of sediments even after 18 years of operation clearly indicating the variability in the deposition within dams (McCully, 1996). In the new generation of dams, flushing mechanisms have been installed in order to remove sediments from the dam. This can have adverse impacts on water quality being delivered downstream of the HP installation.

Clearly the fundamental challenge facing HP developers is the sustainable utilization of upper watersheds by communities who are dependent on the goods and services that are derived from the natural capital. Without the means to implement to implement land use practices that minimise the sediment generation the potential negative off-site impacts cannot be addressed. The following section assesses the impact of introduced land use practices that minimize sediment generation several years after the establishment of conservation farming villages in northern Lao PDR.

An assessment of the drivers that influence the adoption of sustainable land management practices based on a survey of four ASIALAND conservation farming villages (CFV's) in northern Lao P.D.R. (See Annex 2)

Conservation farming villages (CFVs) where established within the ASIALAND project of IBSRAM/IWMI from 1988 to 2004. The rationale for revisiting selected CFV's was that through an assessment of the current status of selected CFVs regarding the adoption of management practices introduced by the successive phases of the ASIALAND project, it should be possible to gain a clearer understanding of the essential parameters that control the adoption of the most suitable land management options that enhance livelihoods. The results of a survey conducted in four CFVs located in the Luang Prabang province are presented and their implication discussed for the successful implementation of incentives mechanisms for the effective delivery of environmental services.

A total of 42 villagers were interviewed in four villages located in Luang Prabang Province which used to be part of the ASIALAND network of Conservation Farming Villages - CFVs- (three in the lower Nam Ou river area in the Pak Ou district,

namely, Ban Hatsoua, Ban Lathahae and BanPakchaek) and one along the road to Xayabury (Ban Silalek, Xieng Ngeun district).

Only 2 out of 18 respondents in Silalek were illiterate, both were men; and 7 out of 24 were illiterate in the Nam Ou area, of which 4 were women. Almost all respondents had elementary education, 16 out of 18 in Silalek; and 22 out of 24 in Nam Ou. It is interesting to note that some housewives in the Nam Ou area claimed that participating in project activities was always decided by the head of the family (i.e. their husband) and that men always tried to take advantage of the opportunity to be involved in a project themselves before considering their wives. Housewives added that they were the ones who worked hard in the field so they should also be taught the new technologies. From interviews, we know that women only learned the new technologies from real practice on-farm, but not from participation in training courses or workshops. However, they have a level of familiarity with SLM which is at least as good as that of their husbands who used to participate in training, workshops, field visits etc.

Silalek respondents had more children than that in the Nam Ou area. There were 16 respondents who had 4 to 8 children (average 5) while in the Nam Ou area, there were 12 respondents who had less than 4 children and 12 respondents who had 4-7 children (average 4). As a result, families were larger in Silalek. A majority (13 out of 18 families) included 5-8 people, with an average of 7 members per family. The two largest families had 12 members. In the Nam Ou area, there were 16 out of 24 families who included 5-7 members. The other families included less than 5 members. Families included 5 members on average.

If children no longer attended school, they worked on farm at a younger age in Silalek than in the Nam Ou. Children started to work part time at the age of 7 and full-time at the age of 13 in Silalek. In the Nam Ou area, the youngest children found to work on farm part-time and full-time, were aged 13 and 15, respectively. Due to higher income, villagers from the Pak Ou district could support their children to study longer and even send them to Luang Prabang. All Lue people in the Nam Ou area are Buddhist, so boys can ordain as monks and have an opportunity to study at a low cost. Many of them thus develop the ability to speak and write English which opens professional perspectives for them to work in the country's biggest town or even to study abroad. In contrast, in Silalek, Khmu inhabitants worship Ancestors and their off-spring are rarely exposed to such opportunities. Therefore, most of Nam Ou respondents (23 out of 24) have only 2-3 full-time labourers per household and half of them have 1-2 part-time labourers. In Silalek, 17 out of 18 families had 2-5 full-time labourers, in which 3 families had 4-5. For part-time labour, there were 15 families who had 1-4 part-time labourers. The average full-time and part-time labour for Silalek was 3, and 2; and in the Nam Ou area there were 2, and less than 1, respectively.

Combining upland and lowland rice cultivation, most people at both sites (20 out of 24 in the Nam Ou area, and 14 out of 18 in Silalek) were rice-sufficient throughout the year. On average, families were rice-sufficient for 11 months of the year at both sites. The main threats to rice sufficiency were excessive weed pressure and insufficient labour in Silalek; In the Pak Ou district, the threats were insufficient labour and small plot size. To obtain rice for families, Silalek farmers sold non-timber forest products (NTFP) and livestock. Some villagers borrowed rice from the

village rice-bank. There is no rice-bank system in the Pak Ou villages. Their solution to solve rice shortage is to sell NTFP and poultry.

In Silalek cash crop production was less diversified than in the Pak Ou villages. Villagers from Silalek set aside some of their maize and rice harvest to be used as livestock feed. They made less income from their wet season harvest than Pak Ou district villagers. Cash crops in Silalek were mainly maize, Job's tear and surplus rice. The average income was 1,170,000 Kips (approximately USD1= 8500 Kips). Based on the wet season production, 11 families earned between 1,170,000 and 2,000,000 Kips, 5 families earned between 2,000,000 and 3,349 000 Kips, while 3 families did not make any or only marginal income. In the Pak Ou district, people derived income from a greater variety of crops, including Job's tear, maize, sesame, melon, and surplus rice. The average wet season income was 2,250,000 Kips. 10 families earned less than 2,000,000 Kips, 10 families earned between 2,000,000 and 9,290,000 Kips, and 4 families did not make any or only marginal income.

In Silalek, there were only two dry season cash crops: lowland rice and paper mulberry. The mean income derived from dry season farming was 208,000 Kips. Half of the respondents (9 out of 18) earned less than 500,000 Kips, 3 families earned more than 500,000 and up to 2,696,000 Kips, and 6 respondents did not sell any of their production. Again, in the Pak Ou district, the dry season production was more diversified than in Silalek, mostly due to readily access to gardening on river banks. The average cash income derived from dry season farming was 595,000 Kips. The dry season crops were maize, paper mulberry, sweet potato, and vegetables. 13 out of 24 respondents earned less than 500,000 Kips, 11 families earned between 500,000 and 1,640,000 Kips.

Due to more suitable conditions (access to better and larger locations), farmers interviewed in Silalek could earn more from livestock especially cattle, pigs, and poultry with a mean annual income of 3,600,000 Kips compared to 951,000 Kips in the Pak Ou district villages. Livestock in Silalek is based on free grazing in a large area located at a distance of about 15 km from the village (3 hours' walk). All villagers can keep as many of their cattle as they wish in this area. They all take regular turns to look after each other's cattle. Natural pasture is available throughout the year. In addition, pigs and poultry are not left to wander in the village as is the case in the Pak Ou district, but kept in a fenced area next to the village. According to interviewees, this method reduces the incidence of animal death from disease. This also reduces the risk of having large number of animals stolen. The Pak Ou district villages surveyed are located along Nam Ou River and National Road No. 13. In these villages, pigs and poultry are left wandering in the villages. The main problem reported by villagers is that many animals get run over by vehicles and die from diseases. Because of the absence of, or limited access to a suitable area amongst the 3 villages studied in the Pak Ou district, only one family owned two buffaloes.

Main sources of annual non-farm income in Silalek were: 1. NTFP (bamboo sprout, bloom grass, paper mulberry, wild vegetable, and *Peuakmeuak*: *tree bark*); and 2. salaries from jobs within or outside the village. More than half (11 out of 18 respondents) earned 500,000 Kips and less from non-farm income. The rest earned more than 500,000 and up to 30,000,000 Kips, the mean income being 6,550,000 Kips. In the Pak Ou district, 14 out of 24 respondents earned 500,000

Kips and less from non-farm activities. The others earned more than 500,000 up to 40,000,000 Kips. Most of this non-farm income is from fishing and gold panning in the Nam Ou river. The mean income was 8,880,000 Kips.

In Silalek, 8 out of 18 respondents owned agricultural assets, hand tractors and small rice mills, while only 2 owned tractors. One farmer earned 500,000 Kips and another earned 770,000 a year from renting these tractors. In the Pak Ou district, 14 out of 24 respondents owned agricultural assets such as tractors or small rice mills. There were three tractors but no one derived any income from renting them. Some rice mill owners earned income from renting their assets: out of 14 rice mill owners, five earned between 50,000 and 960,000 Kips through rental, with an average income of 478,000 Kips. Tractor's rental agreements at both locations only covered access to assets while the cost of gasoline remained at the charge of landowners renting the tractor. There was no set rental prices: the price for renting a tractor varied between 300,000 up to 800,000 Kips/ha in the Nam Ou and between 150,000 up to 800,000 Kips/ha in Silalek. Agreement between relatives usually resulted in more advantageous deals or even services free of charge between close relatives. As rice mills use electric power, service providers usually charge their customers to cover this expense either directly (cash) or indirectly (e.g. they sometimes choose to retain rice bran). Free service exists when rice is milled in little amount or when the service is provided to close relatives. Price varied from 2000-5000 Kips per 50 kg bag.

Main sources of income in Silalek were, in decreasing order of importance: non-farm income > animal husbandry > wet season production > dry season production > agricultural assets. In the Pak Ou villages, the ranking was similar except for wet season production which brought more income than animal husbandry. More than half of respondents in both zones (11 out of 18 in Silalek, and 14 out of 24 in Pak Ou district) earned less than 10 million Kips. The total yearly income varied hugely in both locations, from 96,000 to 40,000,000 Kips in Silalek, and 95,000 to 40,000,000 Kips in the Pak Ou district. The average annual income was similar in both locations: 11,700,000 and 12,700,000 Kips in Silalek and the Pak Ou district, respectively. Although the total income was similar at both locations, mean income per capita was less in Silalek (1,750,000 Kips/person/year) than in the Pak Ou district (2,360,000 Kips/person/year) because families were larger in Silalek. Most of households' per capita income (16 out of 18) was lower than 3,000,000 in Silalek whereas 16 out of 24 households got at least this amount and 8 got more in the Nam Ou area.

Most important and/or frequent expenses were for food, clothing, education, health/medical, travel to distant places, rituals, festivals, entertainment, and occasional expenses for repairing/building house, purchasing electronic appliance, and agricultural asset. Respondents in Silalek spent between 1,712,000 and 40,000,000 Kips in 2007, and on average, households spent as much as they earned, i.e. 11,700,000 Kips. A majority of households (14 out of 18) spent less than 15,000,000 Kips. In general, most of the expenditures are related to children education and daily needs, which amounts for more than in the Pak Ou district as families are larger. After finishing elementary school in the village, children have to stay in rented houses to continue secondary studies in Xieng Ngeun, about 25 km from Silalek. Children come back to help with farm work during weekends and summer holiday. In the Pak Ou district, households pay less for food because they can catch fish in Nam Ou River. For education, they also pay less because the

school is not as far as it is from Silalek and travel by motorcycle or bicycle is possible. In addition, some of the male youngsters study as Buddhist monks, which represents a very affordable education system. Among families interviewed there were 8 boys enrolled in this system. This can reduce parents' expenses and provide them with a better chance to access higher education. For secondary and higher education, the Pak Ou district villagers usually send their children to Luang Prabang, Vientiane and even to Thailand (one Master student). The majority of households interviewed in the Pak Ou district (16 out of 24) spent less than 10,000,000 Kips, the rest spent more up to 30,000,000 Kips. The average household expenses in the Nam Ou area amounted to 8,850,000 Kips

Awareness of Sloping Land Management (SLM) and/or Conservation Farming (CF) technologies was high overall, with a large majority of all interviewees aware of techniques such as, alley cropping and multiple cropping. Improved fallow and contour planting, on the other hand, were mentioned by only 27 and 12% of the interviewees, respectively.

Respondents at both sites had very similar degrees of familiarity with SLM practices. Based on a assessment of familiarity with SLM practices on a 5-level scale (5 being the highest and 1 the poorest), farmers in Silalek were slightly more familiar with SLM with an average score of 4.33 while it was 4.00 in the Pak Ou district. 12 out of 18 respondents were aware of SLM technologies in Silalek while only 13 out of 24 did in the Nam Ou area. This is most likely a consequence of the fact that Silalek served as a focus Conservation Farming Community for northern provinces and hosted field visits for a number of visiting parties during the course of the ASIALAND project. Silalek farmers were well trained and participated in many activities. In addition, they had many occasions to share their skills with many visitors. Unlike Silalek farmers, those in the Pak Ou district adopted SLM as demonstration plots only, so their participation in the ASIALAND project activities was less frequent than that of Silalek farmers.

The area to which SLM practices were applied on-farm was very different between the two study sites. More than half of the involved farmers in Silalek practiced SLM on at least 1 ha (11 out of 18 respondents) while only 7 out of 24 did so in the Pak Ou district. The majority of Silalek farmers who implemented SLM technologies (15 out of 18) did so on plots larger than 0.5 ha while in the Pak Ou district, 17 out of 24, applied SLM technologies on less than 0.5 ha. The mean area under SLM was 0.86 ha in Silalek and 0.46 ha in Pak Ou district. The reasons behind these differences were that i) there had been a history of cooperative projects in Silalek especially with IBSRAM, Lao Suez, Lao IRRI, and NAFReC and ii) Silalek farmers usually own larger total farm areas than in the Pak Ou district (see discussion in the next paragraph). This created very different situations at the two study sites, with better access to technical assistance and agricultural inputs in Silalek. As demonstration villages, the Pak Ou district villages have only received long-term support from the Lao IRRI and the NAFReC. As a consequence, Pak Ou district farmers did not consider SLM as much of a farming alternative as their Silalek counterparts: they tried it on smaller plots and kept most of their cropping land under traditional slash-and-burn cultivation which they trusted more.

A majority of respondents in Silalek (15 out of 18) owned 3-5 pieces of farm land with an average total area of 5 ha. In the Pak Ou district, only slightly more than half of the respondents (13 out of 24) owned an average of 3 plots totalling an

average 3.5 ha. This difference in access to cropping land is related to three features: location, living conditions, and dependence upon natural resources.

- Location: people in the Pak Ou district live near the Nam Ou River. They cannot cultivate large areas of land on the opposite side of the river due to constraints in crossing the river in the rainy season. On the village side, each family has relatively limited access to land.
- Dependence upon natural resources: many families in the Pak Ou district are food-sufficient and earn some additional income from fishing. Furthermore, many families derive their main income from gold panning.
- Living conditions: many families from the Pak Ou district area do not rely only on farm production for their livelihoods. Some families have already stopped slash-and-burn and turned to small businesses, for example, small shops, the manufacture of furniture, and trade.

Among respondents in Pak Ou district, there were a few families who gave their land back to the government because they did not want to have to pay taxes while they were just keeping them uncultivated. Such a situation was not observed in Silalek.

Although in Silalek, SLM was applied on larger plots and farmers were more familiar with SLM technologies than in the Pak Ou district, this innovation was adopted for a shorter average period of time than in the Pak Ou villages. In Silalek, 13 out of 18 respondents joined the project during the 1998-2000 period, but they practiced SLM only during the implementation of the ASIALAND. Half of them (7 out of 18) stopped within 3 years (mean = 4.5 years). Only four respondents kept less than half of the fruit trees introduced during the project (which used to be grown to serve as hedgerows) and even this was rather unintentional: these trees remain in fields which have now been returned to conventional slash-and-burn practices only because they grew tall enough to survive exposure to fire cleaning that takes place during slash-and-burn cycles. At the time of the interviews, most plots were under annual cropping (mainly corn, a cash crop Lao farmers have heavily invested in response to Thai market demand, essentially as part of short term rotations).

When asked about the reasons why they chose to continue or discontinue using the SLM techniques introduced to them through the ASIALAND network, farmers from the Pak Ou district and Silalek raised different concerns. In Silalek, the reasons farmers alluded to explain why they discontinued SLM were:

- They still relied heavily on shifting cultivation for their livelihoods because it was the only viable option for them, both economically and in terms of labour input; noticeably, many respondents indicated that, even when they experimented with SLM, they had to put every plot into a fallow-cycle that was subsequently slashed and burned to control high weed pressure.
- Pineapple introduced by the project rapidly became difficult to control and the system was not beneficial anyway: pineapple production only served household consumption. Fruit trees in the hedgerows did not seem to bring any income either.
- Reported cases of fruit theft appeared to become a recurrent problem too.
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In contrast, in the Pak Ou district, 19 out of 24 respondents joined the project during 2000-2002. 18 out of 24 plots remained under some sort of SLM practice for 5-8 years up to now (mean duration = 5.38 years), for example, agroforestry: mainly paper mulberry + fruit trees.

The survey conducted in 2008 at former Conservation Farming Villages setup and supported within the framework of the ASIALAND network in Laos showed that, only 4 years after the end of the project's final phase, abandonment of the soil conservation technologies it introduced was well underway, with 25 to 66% of the farmers who were practicing a form of SLM in 2004 having discontinued such activities by 2008. This contrasts sharply with the optimistic report of increasing SLM adoption by Lao farmers involved in the network between 2002 to 2004 undertaken by Maglinao et al. (2005).

While interest in SLM technologies and willingness to participate in new projects were still high among the respondents, common criticisms made about practices introduced by the ASIALAND network were that they were too labour intensive/time consuming and that the returns gained from their implementation were too marginal. Indeed, the results of our survey confirm that while they were generally all rice-sufficient, the vast majority of households from the studied villages made just enough cash income to cover their expenses (i.e. slightly under USD 1,400/household/year for an average household including 5 family members and with USD 1.00 = LAK 8,500.00, which is less than USD 1.00/person/day). Under such tight financial circumstances, it is no wonder that these communities are willing to adopt only the most lucrative and least labour intensive livelihood options accessible to them. This is most likely why we observed that, within the communities we surveyed, those who had more alternatives for non-farm income generation were also those most inclined to continue SLM: as they derive the main share of their cash income from gold panning, many households of the Pak Ou district can afford to maintain SLM plots because they do not rely exclusively on farm-income for their livelihood. In contrast, Silalek farmers, who rely more heavily on farm-income for their livelihood have no other options than to reorient their activities based on regional/global markets which currently leads them to discontinue SLM and to move to cash crops. Although a risky bet, as recently demonstrated by the enforcement of a ban on corn imports by the Government of Thailand which is going to badly hit Lao farmers (VT, 2008), it remains that cash crops are, for many Lao smallholders, synonymous with better income from minimal investments and would conform to the strategy of the Lao Government as one of its approaches to addressing poverty in rural areas. The drivers associated with moving to a cash crop enterprise and associated market uncertainties or loss of natural capital, raises the question of what counteracting mechanisms could be put in place to revert such a trend and create conditions for long term adoption of SLM. In fact, the ASIALAND network already raised this question by pointing out that the provision of incentives to farmers was still an unresolved issue by the end of the project's final phase (Maglinao et al. 2005): encapsulated in the notion of incentives is the *de facto* acknowledgement that SLM cannot be successfully implemented without sustained external support.

As a logical and practical extension of the idea of providing incentives to upland farmers to adopt SLM practices, we believe that the development of HP operations in many parts of Laos will be a unique opportunity to accommodate international, national and corporate interests with that of the affected communities. It is evident

from the example of the Pak Ou district where we have conducted part of our survey, that HP developments in this and similar areas, will greatly and negatively affect the livelihoods of local communities, as they will inevitably be deprived of essential sources of income (such as gold panning in the case of the Pak Ou district). However, the concept of benefit sharing, whereby HP companies will share a fraction of their benefits with the affected communities for the whole life cycle of the HP project, offers new avenues to compensate those communities for the losses inflicted to them through the implementation of contractual agreements for the provision of environmental services which will largely depend on the long term adoption of SLM practices.

The following conclusion can be gleaned from the study:

- At all sites, awareness of SLM and/or Conservation Farming (CF) technologies was high, but only 4 years after the end of the final phase of ASIALAND, abandonment of these technologies was well underway, with only 33% of the Silalek farmers who practiced alley- and multiple-cropping in 2004 were still currently practicing it. In the Pak Ou district, SLM has been abandoned at a much slower pace, with 75% of the farmers who practiced SLM in 2004 still involved in one form or another in conservation farming. In Silalek, **weed pressure** and excessive **labour requirements** were invoked as the major issues that forced farmers to discontinue SLM.
- By revisiting some of the questions used in 2004 by the coordinators of the last phase of ASIALAND, on the occasion of the project's final impact assessment, we found that respondents are more inclined to openly express critical opinions about the project when talking to investigators who have no direct ties with it. As a consequence of this behaviour and in contrast with the results published in the final ASIALAND report published in 2005, we found that, overall, more than 85% of the respondents prefer using traditional cultivation practices than adopt SLM techniques. About 25% of the respondents were inclined to grow low land rice as their first alternative to slash-and-burn agriculture, followed by livestock farming (in Xieng Ngeun district only) and commercial crop cultivation (maize, Job's tear, rubber, palm oil). Paper mulberry or growing fruit crops were only seen as alternatives of secondary importance.
- While interest in SLM technologies and willingness to participate in new projects were still high among the respondents, common criticisms made about technologies introduced by the ASIALAND network were that the practices were too **labour intensive/time consuming** and that the returns gained from implementing the technologies were too marginal.
- The survey of villages in the Pak Ou district proved very informative about the likely impact of hydropower (HP) developments on people's livelihoods, as it appears that families in this area derive a substantial fraction (sometimes, the main share) of their income from gold panning along nearby tributaries of the Nam Ou. It is evident that hydropower development in this area will greatly affect these communities' livelihoods (as the locations where people currently practice gold panning will be drowned once the dams are built).

- Strikingly, in the Pak Ou district, where many households rely on gold panning for their livelihoods, the SLM/CF adoption rate was substantially higher than in Silalek where people do not have access to such an alternative source of income. This observation strongly supports the hypothesis that sufficient and sustained income (or financial support) is a precondition to the implementation of sustainable/environmentally friendly land use. In the perspective of HP development in the area, the concept of benefit sharing, whereby HP companies will share a fraction of their benefits with the affected communities for the whole life cycle of the HP plants, appears very appropriate.

Possible mechanisms for sustainable development within the hydropower sector of Southeast Asia: An assessment of PES and benefit sharing. (See Annex 3)

In the entire debate on PES there are proponents and detractors of the concept. Supporters of the concept stress that there is an urgent need for innovation in the conservation of resources as current approaches provide too little value for declining funds; that PES can provide new (i.e. private sector) funding; and that poor communities selling these services will benefit with improved livelihoods – the concept is pro-poor (Wunder, 2005). In contrast, detractors stress that PES ‘will bring back the fences’ by decoupling conservation from development; that asymmetric power distribution means powerful conservation consortia may deprive communities of their legitimate land-development aspirations; and that commercial conservation may erode culturally rooted, not-for-profit values (Romero and Andrade, 2004; Karsentry and Nasi, 2004, Karsentry, 2004; Vogel 2002).

The basic principle of payments for environmental services (PES) is that those who provide environmental services should be compensated for the cost of doing so, whether these are direct costs of specific land use practices or more indirect opportunity costs of avoiding certain activities or types of land use. Payments may be monetary or in-kind, may involve the private sector or government financing, and can be made at local, national, and global levels (Grieg-Gran and Bann, 2003). Hence the basic notion underlying the concept of PES is that ecosystems such as natural forests, landscapes with mixed patterns of human use and natural vegetation, as well as intensively cultivated agricultural landscapes all provide important services to people – locally, regionally and globally – and that these services do not accrue to those directly or indirectly responsible for their provision (Ravnborg et al., 2007).

Wunder (2005) defined PES as a “voluntary, conditional transaction with at least one seller; one buyer; and a well defined environmental service”. The aforementioned definition encapsulates 5 criteria namely:

1. A voluntary transaction where
2. a well defined ES (or land use that is likely to secure that service)
3. is being bought by a (minimum of one) ES buyer
4. from a (minimum of one) ES provider
5. if and only if the ES provider secures the ES provision (conditionality).

Voluntary transactions: PES is defined as a voluntary transaction that distinguishes it from so-called command-and-control¹ mechanisms as it is assumed that the providers of the service(s) have '*real*' choices in how to manage the ecosystem. If one takes into account that nearly half of the legally protected forests areas are heavily used – illegally – for agricultural and forest product extraction (McNeely and Scherr, 2003), just as other types of regulations are only partially enforced (Ravnborg et al., 2007). This implies that potential ES providers might have *real*, but not *legal* choices in how to use natural resources. Thus it is argued by some that besides having *real* choices, potential ES providers also require *legal* choices in how to manage the ecosystem in question. In most countries, other types of economic instruments exist to promote the provision of ES in cases where potential providers do not have real and legal resource management choices. These include compensation to land owners for their potential loss of income which the restrictions may imply, e.g. as one-off compensations associated with the declaration of a specific protection status, or rewards to people for their continued contribution to achieving effective protection, e.g. through the granting of tax exemption for land within protected areas (Ravnborg et al., 2007).

Defined service: A defining attribute of PES is that there is a need for a clearly defined and measureable service (e.g. additional tons of carbon stored within the target area) or land-use caps that are likely to contribute to the provision of services (e.g. forest conservation areas assist in providing clean water). Due to the high degree of complexity that is innately an attribute of ecosystems and the services they provide, it may not be always possible to have a clearly defined and measureable service identified. Further what is being bought is expressed rather as a specific natural resource management practice known or assumed to lead to the provision of the desired ecosystem service. Examples of such cases include reforestation of riparian land that is important in water infiltration or leaving it fallow to avoid sedimentation as well as increase infiltration – all these practices are assumed or known to provide hydrological services (Ravnborg et al., 2007). Further the four previously identified categories of ecosystem services could effectively be addressed by a single ecosystem management intervention. This is referred to as 'bundling' of ecosystem services. For example the protection of traditional coffee plantation management systems, where coffee is cultivated ecologically in the understorey of natural forests, is likely to provide not only biodiversity services but also watershed and landscape beauty services (Perfecto et al., 1996).

It is also important to acknowledge that hydrological services are often based on beliefs rather than scientific proof (e.g. forest cover always increases water availability) (Kaimowitz, 2004; Calder et al., 2004). In this respect afforestation programmes have and are still being promoted within watershed development programmes that are based on 'hydrological services' and 'headwater conservation functions'. In Costa Rica, both government-led PES programmes and private agreements with the hydropower sector were initially based on this 'universally accepted' knowledge, although currently it is defended as a 'precautionary principle' in the absence of better – or more acceptable – scientific knowledge (Calder et al., 2004). Hence payments that build on scientifically unlikely events or on relationships that have been proven to be myth will tend to decrease the

¹ These regulations are tools for implementing legal instruments that prohibit environmentally damaging uses, expropriate owners, create strictly protected areas, and support other interventions targeted directly at resource protection. They do not aim to alter development paths or use economic incentives unless corruption turns these regulations into de facto unofficial taxes (Wunder, 2006).

robustness of PES and hence its sustainability. This is based on the fact that the less realistic the scientific basis of a PES scheme the more exposed it is to the risk of buyers questioning the rationale and abandoning services (Wunder, 2005).

It is also important to recognize that the types of ecosystem services highlighted above can be further characterized according to the degree of spatial boundedness of the beneficiaries of the ecosystem service². In this respect the principal beneficiaries of an ecosystem service can be either local e.g. beneficiaries in the area where the service is produced; regional e.g. beneficiaries distant from the area where the service is produced; or global e.g. beneficiaries who in principal many be located anywhere in the world. This spatial boundedness characteristic of the ecosystem service beneficiaries has important implications for the institutional arrangements between buyers and sellers of the service.

Buyers and sellers: PES requires a minimum of one buyer and one provider of the ecosystem service, although the transfer often occurs through an intermediary. Whilst this is an imperative in that it is often difficult to identify buyers and also to have buyers that have the capacity to purchase these services. A study undertaken in Latin America, Asia and Africa identified the lack of buyers as one of the biggest barriers associated with the adoption of PES (Waage, 2006). This was associated with buyers being unaware of the PES concepts whilst others thought that it is too risky a mechanism to trust. In the case of Africa difficulties in identifying buyers is clearly a factor in limiting its adoption particularly where urban water and electricity consumers are poorly organized and the presence of resourceful beneficiaries of 'local' ecosystem services, such as a steady flow of clean water, is scattered (Ravnborg et al., 2007). Until the emergence and organization of such local and regional buyers, PES schemes are more likely to be successful with respect to global rather than local and regional ecosystem services. This would also be the case where the potential buyer of the services is unable to afford the cost of that service which is often the case in rural areas where you have poor upstream and downstream communities.

In the context of qualifying as a PES scheme there is a need for a cash or in-kind transaction to occur. Several terms are currently being used to describe the form of remuneration in return for the provision of the ecosystem service. These range from payments (Wunder 2006), markets (Scheer et al., 2004), compensation (Rosa et al., 2004) to rewards (RUPES³ programme; van Noordwijk et al., 2004). Apart from the semantic differences between these terms, they also reflect more profound conceptual differences. Whereas the RUPES programme implies a right-based notion in that upland resource managers are entitled to receiving a reward for the environmental services they provide, irrespective of whether the continued provision of these services is threatened by competing land uses, the concept of 'compensation' implies that only those who incur costs associated with the provision of ecosystem services should be compensated (an amount equivalent of the cost incurred) (Ravnborg et al., 2007). In the case of the RUPES approach where the concept is that everybody who delivers a benefit should also be

² Rosa et al. (2004) distinguishes between ecosystem services based on what they call 'integrating levels' where level 1 refers to self-provisioning ecosystem services i.e. services that accrue directly to those responsible for their provision. Level 2 refers to ecosystem services that may be embedded into already marketed products, as when habitat protection is incorporated into coffee through the production and sale of shade-grown organic coffee. Finally, level 3 refers to ecosystem services which have not yet been incorporated into products and which new forms of 'compensation mechanisms' thus have to be identified.

³ Rewarding Upland Poor for Environmental Services.

rewarded, this general connotation runs the risk of raising excessive expectations, since services that are neither of high value and/or not threatened are unlikely to find buyers (Wunder, 2006).

The term 'markets' for ES has been widely used and implicitly conjures up the notion that there are multiple actors, choices and competition to some degree. Such markets do exist in developed countries, but in developing countries they seem remote (Wunder 2006). However, market mechanisms can face general restrictions in developing countries in that the localized nature of the eco-services often limits competition on the supply side, sometimes creating de facto monopolies (Wunder 2006). For example, take the case of an urban water utility: If it believes that the price for watershed protection charged by upstream farmers is too high, usually it cannot move to the next three watersheds for a better offer! Consequently the very nature of highly localized environmental services, combined with structural impediments to competition, severely restrict the scope for true market forces (Wunder and Vargas, 2005). It is also pertinent to note that in Bolivia and Vietnam "markets" can come to be ideologically equated with neoliberalism, creating a political alienation detrimental to promoting PES (Wunder and Vargas, 2005). In the Vietnam context Wunder and Vargas (2005) found that tiny payments for watershed protection are being routinely made, but to visualize them as money changing hands to buy a service was perceived as inappropriate, since it could be construed to be associated with corruption. Hence within the context of southeast Asia it may not be appropriate to use terms that may result in confusion and outright resistance. As will be discussed later in this manuscript, the concept of '*benefit sharing*' may be a more appropriate term.

Conditionality: Finally PES is defined as a conditional transaction that is contingent upon the continual provision of the service. This implies that users should only pay if the service is delivered or the resource management practice assumed to ensure the service is provided, and the providers will only provide the service if they receive the agreed payment. Consequently, monitoring of the operational and the environmental impact is of critical importance. However, in reality, many initiatives are loosely monitored or not at all, payments are up front instead of periodic and they are often made in good faith rather than being truly contingent on monitored service provision (Wunder, 2005).

The transaction can take different forms and include the following (Ravnborg et al., 2007):

To sellers:

- Direct compensation or payments: Compensation – either monetary or in kind – or incentive rates (e.g. tax exemption) are set and defined for a specified land use or management practice.
- Investment or development fund: Payments are collected from buyers and placed in a trust fund, which in turn is deployed by the PES scheme for investments in ES enhancing practices or activities. While flexible, the disadvantage is that the buyer committing resources to the fund do not know what type of services and benefits they will receive in return. This can in part be overcome by the buyers becoming trustees or members of the board of the trust fund.

To buyers:

- Customer-charged payments: participating utilities (e.g. water supply and electricity) and industries may charge their PES contributions directly, and explicitly, to their customers.
- Lump-sum contributions: Participating buyers may contribute annual lump sums (or one-off payments in the case of a trust fund). These payments may be set on the basis of negotiations that reflect how much buyers are willing to pay and how much is need to acquire the service; or as a fraction of the turn-over or profit of the participating utilities or industries.
- Taxed-based contributions: Public schemes may be financed through taxes. However to qualify as a 'payment', in contrast to a subsidy, the tax must be explicitly demanded and spent for the purpose of the ecosystem service to be acquired.

Despite the relative simplicity of the PES concept and the five defining criteria previously discussed, relatively few real-life PES schemes actually meet all these criteria. In an assessment of incipient PES initiatives in Bolivia, Robertson and Wunder (2005) did not find any which met all five criteria. As is inevitable when new approaches come into fashion, many ongoing and new initiatives are currently being (re)labelled as PES without necessarily meeting the criteria for qualifying as PES (Ravnborg et al., 2007). Such 'opportunistic' labelling may partly explain the shortcomings of so-called PES experiences in meeting the five criteria. However, beyond that, the shortcoming may also reflect real challenges facing efforts to use PES as an instrument to achieve the protection of ecosystems and the continued flow of ecosystem services (Ravnborg et al., 2007). Some of these challenges relate to the PES concept itself and could be considered 'internal' challenges, while others rather relate to the contexts within which PES is put into practice and could therefore be referred to as contextual challenges.

Incomplete knowledge on the links between desired ecosystem services and ecosystem management practices can lead to de facto non-conditionality.

In most cases, knowledge regarding the impact of specific changes and combinations of natural resource management practice on the provision of ecosystem services is only partial. This effectively means that PES arrangements have to be designed on the basis of *assumed* rather than *proven* causal relationships between the two (Ravnborg et al., 2007). Muñoz-Piña (2005) describe how the Mexican hydrological environmental services programme had to be launched on what they call a precautionary principle rather than based on a proven relationship between forests and water flows. This was, however, acceptable to the majority of the ultimate service buyers – the water tax payers – due to a strong perception by the public, civil society organizations and government officials that forests do play an important role in protecting water resources. Hence, in order to avoid the 'perfect' becoming the enemy of the 'good', such a pragmatic approach is advisable in many situations. However, the risk is that the conditionality criterion of a PES scheme is sacrificed, because buyers become trapped in an agreement through which they pay for a specific management practice rather than for the ecosystem service they demand. Therefore, PES agreements based on assumed rather than proven causal relationships between paid-for management practices and demanded ecosystem services need to be accompanied by mechanisms that regularly examine the validity of these assumptions and contain options for re-negotiating the agreement in case new knowledge renders these assumptions invalid (Ravnborg, et al., 2007).

Involving intermediaries without sacrificing the direct, voluntary transaction.

What can be described as 'a voluntary transaction between at least one buyer and at least one seller', often turns out to be a considerably more complicated transaction. Urban water consumers who want to ensure the continued provision of water for their water utility cannot themselves choose to deal with just one provider, if the catchment area for their water supply is owned and managed by thousands of independent land managers, nor would it make much sense if each of them opted to deal with all the catchment managers individually. Hence it is hard to imagine a PES scheme without the involvement of intermediaries. However, to minimize the risk that the involvement of intermediaries implies that no direct transaction takes place, and that the transaction becomes forced rather than voluntary, it is important to specify the accountability of the intermediaries involved. In this context, three broad roles can be distinguished for intermediaries in PES arrangements. One PES agreement might include one or more intermediaries involved in one or more of these three roles:

Intermediaries acting on behalf of numerous individual consumers of ecosystem services.

When users of ecosystem services consist of many individual users such as urban water or electricity consumers, intermediaries may conveniently act on behalf of the direct users of the ecosystem service, collecting user fees and negotiating agreements with service providers. In many cases, already existing public utilities will undertake this function, thus acting as the buyers of the ecosystem service on behalf of already known ecosystem service users. In other cases, eco-tourism agencies act as buyers of ecosystem services such as landscape beauty on behalf of future users of ecosystem (Ravnborg, et al., 2007).

Intermediaries acting on behalf of numerous providers of ecosystem services.

Intermediaries acting on behalf of individual providers of ecosystem services will often be needed in order to bring down transaction costs compared to a situation where each potential service provider has to enter individually into a PES agreement. In addition, certain ecosystem services cannot be provided by potential service providers individually, but require coordinated resource management to ensure their provision. Whereas carbon sequestration can be provided discretely by individuals who accept planting trees on a specified area of land, other services such as watershed protection and landscape conservation depend on the coordinated resource management among all or at least the majority/critical resource managers within a given area. Hence, intermediaries may be needed to ensure such coordination. Depending on the case, the role of the intermediary ranges from simply negotiating an ecosystem service provision contract with ecosystem service consumers on behalf of interested service providers, to also ensuring the existence of resource management coordination among resource users in a given area. Obviously, submitting to such coordinated resource management would be less 'voluntary' for some resource managers than for others within a given area. Thus, the legitimacy of the intermediary is critical, be it a community-based organization or an external NGO acting on behalf of the potential service providers (Ravnborg, et al., 2007).

Intermediaries acting as transfer agents, brokers between service buyers and providers.

In certain cases, intermediaries will work as brokers or transfer agents, establishing contacts between potential service providers and potential service buyers, either

directly or represented by their intermediaries. In Colombia, electricity consumers are required, through their hydropower company, to pay an environmental fee to a regional environmental agency acting as a transfer agent, responsible for investing in reforestation and watershed management, either directly to ecosystem service providers or, as often happens, through an intermediary acting on behalf of the service providers (Ravnborg, et al., 2007). This agency can be an NGO or a community-based organization, representing forest owners and watershed stewards.

The risk of endorsing illegal resource utilization

In many cases, part of the motivation for implementing PES schemes is that previous attempts to protect ecosystems and ensure the continued flow of ecosystem services have not yielded the desired outcome. For example in Mexico, despite regulations that prohibit land use changes in forest areas except when authorized by the government, the majority of the deforestation taking place over the past decades has occurred without such authorization (Muñoz-Piña *et al.*, 2005). Nevertheless, the Mexican Payment for Hydrological Environmental Services programme took the pragmatic decision to give incentives to forest owners to refrain from illegal deforestation.

Similarly, in Ecuador, the *páramo* is perceived to be under increasing pressure from grazing animals as well as from cultivation. The *páramo* is a neotropical ecosystem located in the high Andes region between the upper forest line (about 3,500 m altitude) and the permanent snow line (about 5,000 m). Besides having significant biodiversity, the *páramo* absorbs and gradually releases water, and rivers descending from the *páramo* are characterized by a high and sustained base flow. Thus, in Ecuador as in other northern Andean countries, *páramo* situated above 4,500 m is considered public land and is protected as an ecological reserve (Ravnborg et al., 2007). The fact that the *páramo* is being degraded reflects that while not having a *legal* choice, resource users have *real* land use choices with respect to the upper parts of the *páramo* due to lack of enforcement of existing regulations (Ravnborg, et al., 2007). Ongoing attempts to establish payments for ecosystem service schemes to pay local people for not cultivating or letting animals graze the upper *páramo* thus turn into *de facto* legitimization of illegal land use.

Since the basis in establishing a payment-for-ecosystem-services scheme is in many cases based on the fact that regulatory instruments have failed to produce the desired protection, the establishment of PES schemes often entails a dilemma. On the one hand, attempting to effectively alter resource managers' *de facto* resource use choices through offering the PES, while on the other hand, by doing so, implicitly making illegal resource use legitimate. This dilemma is often ignored or played down as a purely ethical dilemma due to pragmatic concerns about achieving effective conservation (Ravnborg, et al. 2007). However, there are at least two practical implications of *not* confronting this dilemma, each of which can undermine the effectiveness of a PES scheme in achieving conservation.

The first implication relates to situations where a PES scheme is considered an alternative to regulatory conservation instruments, without however modifying the regulatory conservation instruments. Given the voluntary nature of a PES arrangement, potential ecosystem service providers might decide *not* to participate, e.g. because they consider the benefits to be higher from the resource use alternative to that prescribed as part of the PES. Muñoz-Piña et al. (2005)

described some forest owners chose to continue previous, illegal practices of converting forest into pasture, often with the perspective of selling off the land within a relatively short time horizon, rather than enrolling their land into the medium-term Mexican Payment for Hydrological Environmental Services Programme.

Under such circumstances where the PES scheme is implemented as an *alternative* to more regulatory conservation instruments, and where resource managers may have real but not legal resource management choices, PES might turn into a mechanism that legitimizes illegal resource utilization, particularly by the more resourceful actors. Therefore, PES cannot stand alone as the instrument to promote conservation in such areas. The same applies in areas where resource managers have real and some legal, but not unlimited, resource management choices, such as in forest areas outside protected areas where logging is a permitted, but regulated activity (Ravnborg, et al., 2007).

A further practical implication of not confronting the dilemma between, on the one hand, effectively altering resource managers' *de facto* resource use through offering the PES, while on the other hand, thereby implicitly legitimizing illegal resource use, relates to the issue of scale. Due to economic or political factors, the coverage of a PES scheme may not match the ecosystem in question. In situations where resource use is partly or fully restricted and where the coverage of the PES scheme does not match – economically or geographically – the ecosystem in question, i.e. where only a fraction of the potential ecosystem service providers are or can become enrolled in the scheme, some resource managers are paid to refrain from illegal resource use while others are not. This means that e.g. in the relevant forest or protected area, authorities will have to force the remaining resource managers to abide by restrictions. The net conservation result of such partial PES schemes may thus very well turn out to be negative. Finally, paying resource managers for abstaining from illegal resource use may reduce consumers' willingness to pay for ecosystem services. As expressed by a Peruvian urban water consumer: "If you ask me to pay for my water, I will happily do so, but if you ask me to pay these illegal migrants not to illegally deforest the catchment, I would rather pay the police to throw them out and prevent more illegal immigrants from coming to deforest" (Ravnborg, et al., 2007).

PES is only one among several conservation instruments

In some situations PES is *unlikely* to be the most effective conservation instrument. There appears to be considerable convergence on this issue in the available literature. In general economic terms, at in contexts with high opportunity costs associated with non-desired resource management practices, PES will usually not be the answer. There will simply not be enough funding available to persuade resource users to change (Wunder, 2005). Even if sufficient funding were available, it should be considered whether this funding would be better spent by employing other conservation instruments that are based on direct control combined with other economic instruments, such as taxes and fees (Ravnborg, et al 2007).

In areas under transition as the ones where many of the ecosystems under threat are situated, opportunity costs are far from uniform across the area and among the resource managers. For example, studies undertaken in Nicaragua estimate that the opportunity costs associated with one hectare of land in the buffer zone to one of Nicaragua's best conserved tropical rainforests, varied between USD 70 for the

better endowed households with well-established livestock herds and USD 30 per hectare for land belonging to resource-poor farming households with none or only a few head of livestock (Ruiz, 2006, cited by Ravnborg, et al., 2007). Similar findings were arrived at in Guatemala (Mañez Costa and Zeller, 2003). However, in addition to variations in resource endowments of the resource managers, there is a temporal dimension that adds to this variation. While some farmers make their resource management decisions with respect to the medium and sometimes long term, others, be they farmers or not, make their resource management decisions with the aim of maximizing short-term gains, possibly with the perspective of quickly moving their operations to new areas. This makes it important to distinguish between different types of actors when assessing to which extent PES may constitute an effective conservation instrument (Ravnborg, et al., 2007).

The role of the state

Despite often invoking a 'non-state' image, the PES literature increasingly points to the key role played (or to be played) by the state. First of all, the importance of the state is increasingly being recognized with respect to its role in providing – and when necessary adjusting – the legal and regulatory framework to enable:

- the legal recognition of private PES arrangements;
- the regulation of the participation of intermediaries; and
- the legal arbitration in cases where external parties wish to denounce a PES arrangement, e.g. for causing environmental damage or violating rights (of access) to natural resources (Ravnborg et al., 2007).

Moreover, the state is increasingly being recognized as a direct party to PES arrangements, either as a buyer or, particularly in the case of trading schemes such as carbon sequestration, as a provider of ecosystem services.

Clearly there are several challenges that influence the successful nature of a PES-based system. Whilst it would appear that in the developed world the implementation and functional operation of such schemes has been shown to be effective in addressing issues of sustainable resource management, the implementation of such schemes appear to be more problematic. In a recently completed study of the potential for introducing PES based schemes in Southeast Asia (i.e. Thailand, Vietnam and Lao PDR) to improve catchment management concluded that several key elements favourable to the emergence of a PES market already exist in Southeast, and include the following:

- Most stakeholders, including farmers and Governmental agencies, have a clear perception of environmental issues. Farmers have even changed their practices in both Thailand Vietnam, without compensation as the result of a conflict-solving process at village level.
- Potential buyers were identified in the public and private sectors in Thailand and Vietnam;
- Public efforts are currently addressing erosion issues in Thailand and could eventually be redirected to a PES scheme if they were to prove to be economically efficient.
-

However, there were major impediments that limit the implementation of PES targeted to small-scale stakeholders including:

- Willingness to pay is consistently low in all three countries even where the environmental issues are the most severe or the potential buyers are powerful agribusinesses or GoAs; (T, V);
- The number of potential buyers are often too small in number to effect a significant change in biophysical attributes at the catchment level;
- The relationship between environmental service, user and provider is equivocal in a number of catchment management issues especially when the communities of providers and receivers overlap.

The authors conclude that while many catchment management issues are clearly outside the scope of PES, a large potential exists in Southeast Asia for implementing PES in the agricultural and rural development sector (Planchon et al., 2008 in press).

There are other incentive based schemes that have been used elsewhere in order to promote the sustainable utilization of resources. In the context of hydropower development the use of Benefit Sharing has been used effectively to promote the sustainable utilization of land resources in upper catchments as well as to specifically address development issues.

The concept of benefit sharing has become an accepted theme in international thinking with respect to sustainably developing hydropower projects that improves equity when allocating benefits and costs within society (Haas and Tung, 2007). The concepts of benefit sharing extends the narrow focus in thinking only about displaced people and the resettlement host communities as adversely affected. It includes other households and communities living in the project *impact zone* who have their resource access permanently reduced or transformed by the project in some degree. Essentially the philosophy is that all people living in the project impact zone, who host the project, are eligible to participate in benefit sharing and become long-term partners in the project they must live with (Haas and Tung, 2007).

There are numerous examples in developed and developing countries alike where local communities who give up their land entitlements or natural resource access for a hydropower project are provided with a monetary share of project revenues. Some groups may also receive non-monetary benefits, such as exclusive rights for reservoir fishing. The notion of benefit sharing goes beyond one time compensation and other short-term resettlement measures to recognize that local populations can claim entitlements to part ownership of the economic rent generated by the hydropower facility. These arrangements either implicitly or explicitly treat the local communities as “equity partners” in the hydropower project. And more generally, as people with a stake not only in the project’s successful operation, but also its successful integration into their community life as conditions evolve over time (Haas and Tung, 2007).

A variety of financing mechanisms are now employed in different countries to channel monetary benefits to local benefit-sharing measures. These include for example:

1. The redistribution of a small part of hydropower revenues to the affected communities or basin authorities in the form of royalties linked to power generation, water utilization or other resource use fees;

2. Part or full ownership of the project by the host community (direct equity sharing), for which their return on equity is used to finance the delivery of benefits programs;
3. Annual revenue transfers (from general taxes) to the affected municipalities, watershed management agencies and conservation authorities in the basin of the dam;
4. Levying property taxes on the land used for power facilities and reservoirs by local authorities, a measure that reduces local taxes and/or raises funds for development investment in the affected community areas;
5. Direct long-term contracts between the project owner and the affected communities;
6. Granting preferential electricity rates and fees for other water-related services to local companies and project-affected populations; and more recently,
7. Use of carbon financing from emission reduction purchase agreements (ERPAs) under the Clean Development Mechanism (CDM) of the Kyoto Protocol, for eligible projects.

Funds generated from one or more sources are typically earmarked for delivery to project affected groups through mechanisms suited to needs in the particular basin. The delivery mechanisms range from targeted increments in the funding of existing development initiatives of line ministries, or national programs, to establishment of permanent community-managed funds or Trusts. These mechanisms are sustainably financed from the sources noted previously. The measures supported are adapted to changing preferences as the development needs of beneficiaries evolve over time.

There are three main arguments for sharing a portion of the monetary benefits of hydropower generation with people displaced by the construction of the facility and its operation, and with people residing in the basin who are less directly impacted.

- First, hydropower projects may generate a significant economic rent, which can be shared with project-affected populations;
- Secondly, there are several ethical reasons for redistributing part of the monetary benefits to project-affected populations - the main one being that local populations who forgo water resource or land access should receive part of the monetary benefits that accrue to people and enterprises outside the affected area, who benefit directly from power services;
- Thirdly, recognizing the nature and scale of the investments in hydropower (which typically draw on the resources of the consumers and the taxpayers - irrespective of the financing method), the national investment in hydropower should be conceived as part of the strategy to foster local and regional development, apart from direct provision of water and energy services.

The growing emphasis on benefit sharing is in part prompted by the World Commission on Dams (WCD) final report, "Dams and Development: A New Framework for Decision Making (2000)". The WCD stressed the need to evaluate how dams affect livelihoods and existing rights and entitlements (for land and resource access of all types) and particularly, to ensure the impacts on communities upstream and downstream are considered, not just the displaced people. It proposed a "Rights and Risk" approach to assess the degree to which different groups are impacted and face impoverishment risks. Two of the WCD's

seven strategic priorities addressed the need, firstly, to recognize entitlements and share benefits, and secondly, to recognize the value of ecosystems services in sustaining rural livelihoods during planning and decision making about the management of all types of dams and reservoirs.

A common feature of successful programs is that the beneficiaries decide how funds will be used and the delivery of benefits is organized around their preferences. The role of central government is to provide the enabling policy and legal framework and establish rules on the level of benefit sharing (by prescription or negotiation) and the financing mechanisms. Local government, together with agencies, social organizations and civil society interests who work closely with project-affected groups would provide guidance and support to design the delivery mechanisms and actual participate in delivery of the measures in a manner appropriate to their normal roles.

A second common feature of many successful programs is the sustainability dimension. The inherent principle is local benefit sharing should be long-term in nature and continue over the economic life of the hydropower project. Moreover, the mechanisms and actual programs to deliver benefits must be adaptively managed as circumstances and development priorities in the basin evolve over time. This is important given the long life of most infrastructure projects.

Once the rationale for benefit sharing is established, two key questions need to be addressed. Firstly, what level of benefit sharing is appropriate to ensure a balance between a meaningful investment in the development needs of project affected people, on the one hand, and the impact on general electricity tariffs that all consumers will feel, on the other hand (e.g. the minimum amount of financing to achieve measurable improvement in the livelihoods and welfare of the project-affected groups)? This reflects the willingness of electricity consumers to share what may be presented as legitimate costs of hydropower development once they are informed. Government must balance these two considerations in framing the regulations. Secondly, what financing and delivery mechanism are most appropriate to achieve the desired development outcome and maintain public confidence in how the funds are utilized?

Within the accompanying Annex 3, examples of PES and benefit sharing are presented for the reader. Finally, it is argued that the use of benefit sharing as a means of sharing equity associated with hydropower generation is probably more appropriate than PES in the context of this sector.

Field Report in Lao PDR on Incentives for Environmental Services: Case study of two villages-Lardthahea and Parkcheak, Pak Ou District, Luang Prabang Province, Lao PDR.

A survey was conducted in two villages (Lardthahea and Parkcheak) in order to assess the current livelihood options of these communities and to gauge the perspectives of these communities with respect to proposed hydropower (Nam Ou Dam) development. . The survey was conducted over two 8 day periods and a single 15 days that included interviewing villagers (namely 96 and 45 respectively).

The Nam Ou hydropower project is designed to produce 1100 MW. It will be located at two sites in Phongsaly and Luangprabang provinces. An environmental

impact assessment is currently being undertaken by the Lao government and the developer, Sinohydro Corporation Limited. The village head of Lardthahea reported that the dam will be located in Houaylo village (Phatieung village) and the height of the wall will be 40 m.

Total lowland rice area of Park Ou district is about 1,433.11 ha. The harvested area in 2007 was 1,113.5 ha, with an average yield of 4.2 t/ha and total production of 4,676.7 t. The total upland rice cultivated area was 2,266.7 ha, of which 1,396 ha is under permanent field cropping and 849.15 ha under slash and burn. Upland rice yields were 1.5 t/ha and the total production of upland rice was 2,929.77 t. Irrigated area in Park Ou district is 133.5 ha, and yields of rice were 4.5 t/ha with a total production of 600.75 t. The total rice production in this district was 8,207.22 t and the average of rice per capita was 341.412 kg.

Most villagers in the study area practice slash and burn agriculture with large forest areas being destroyed each year. Crop production is dependent on these systems that effectively result in a low level of rice self-sufficiency due to poor upland rice yields. In addition they plant Job's tear, sesame, maize, paper mulberry and limited tree crops such as teak, rubber, *Aquillaria crassna*.

Other income generating activities outside of agriculture include the diving for gold in the Nam Ou River, fishing, handicraft making and transportation, retail selling and the collection the non-timber forest product for sale merchants and others. Diving for gold is the main activity during the dry season for male farmers in both villages and has been demonstrated to increase family incomes significantly. Contrasting this during the dry season the women of the village undertake almost all agricultural activities especially that includes the clear of land for next wet season. The collected gold is sold to merchants in the village. The average income from gold in Parkcheak village is about 7,642,000 kip /family/year and in Lardthahea village approximately 4,178,000 kip/family/year.

The development of the Nam Ou Dam would contribute to electrification of those communities in the area of the dam and also provided revenue streams from the export of power to China and Thailand. There are however possible impacts on land use, environment, socio-economic and livelihoods of people who live around the dam.

In discussions with the farmers through structured group meetings, the following concerns were highlighted by the farmers. Farmers in the study area have practiced agricultural production in the region for a considerable number of years. They have cultivated lowland and upland rice, commercial crops and vegetable to date. However, with the building of the dam production areas will be flooded thereby decreasing the potential area for food and cash crop production. Further the dam construction would affect the diving for gold by farmers in villages due to the high of water level, thus leading to a decrease in income and would limit their ways for increasing their income.

After Ou River electro-power dam construction, the farmers argued that there would be a decrease in forest area; the river banks would be flooded so that the agricultural areas will not be cultivated and that there would be an increase in soil erosion. This would all lead to a change in water ecology that would affect fish populations and hence lower fish catches. In some case certain fish species would

become extinct from the river. Farmers suggested that there would be an increase in water flows, especially downstream of the dam that affected fishing by farmers and other aquatic animals would be decreased; the transportation on the water way would be made difficult and would most likely have to be abandoned. They also suggested that the social and economic aspects of the villages would be affected, especially living condition, changes in physical relations and changes in society co-operation. More specifically the construction of the dam would affect village stability, with some households or entire villages having to be relocated. Although the Ou River dam construction will have an effect on farmer livelihoods, especially those that live near the dam and that there is a commitment for the project to support all farmers who are directly affected through increased incomes, land allocation and agricultural extension, the farmers feel that these will all fail due to limits in the knowledge and experiences of farmers in new technologies and systems. In general the farmers were pessimistic that the construction of the dam would have a significant impact on their livelihoods and that there was considerable concern amongst them with respect to their future.

Assessment of the biophysical and socio-economic status in the Da river watershed before and after building Hoa Binh and Son La hydropower projects (Annex 5)

The inappropriate use of land resources is common to many countries and is a challenge to resource managers who are faced with numerous demands and issues. Further, the complexity of these ecosystems and our lack of understanding of the cause and effects associated with changed land use add a further dimension and challenge in resource management decision making. In order to deal with complexity multi-purpose approaches are required that take into account the biological, biophysical, human and economic dimensions. Interventions associated with land and water resources should be carefully considered in order to avoid negative impacts on society, economics and environment.

Forest systems of the Da river basin play an important role in preventing and reducing natural disasters, flooding in the lower lands, preventing erosion and regulate water flows for hydropower projects, especially the Hoa Binh hydropower plant and cascade system of hydropower projects on the Da river in the years to come that include the Son La, Lai Chau, Huoi Quang, Ban Chat, Nam Na. Recent rapid declines of vegetation in the watershed, accelerated sedimentation of river bed and reservoir will reduce the generating capacity of hydropower plants and increase the potential danger of flooding in the lower regions of the basin and are viewed as the main challenges in the management of Da basin.

One of the main causes of these problems is the relationship between economic and social issues associated with land resources and forest management, the livelihoods of local people in the watershed and natural environment protection. Efforts have not been coordinated in a sustainable development framework. In this respect a study on motives for sustainable management of soil and water resources, based on developing a framework of payment for environment service was undertaken. This study contributes to an assessment of the change of social-economic-environmental state in the Da basin after the building Hoa Binh and Son La hydropower projects. The study aims to add further materials for promulgating state policies on Payment for Environment Service (PES), which has been initially tested by Vietnamese Government and other countries in the region.

The Da River is an important tributary of the Red river, contributing 43% of the total water volume. The Da River originates in China and has a length of 1,010 km and watershed area of 52,900 km². The Da River upper watershed is expansive and complicated region with natural, economic, and social resources that are important for Vietnam. These attributes include significant hydropower potential and multi-culture communities that comprise of approximately 30 ethnic groups. Therefore, the Da upper basin in particular and the North West in general are a strategic locality in the socio-economic development of Vietnam.

Plans for exploiting hydropower potential of the Da river was approved by the Government at the official document No 1320/CP on 10/22/2002. In this respect 3 hydropower systems were identified and included:

- (1). Hoa Binh hydropower project: has normal tail water level of 115m and completed in 1994;
- (2). Son La hydropower project: has normal tail water level of 205 – 215m, starting construction from 2005;
- (3). Lai Chau hydropower project: is the third layer on the Da river, has normal tail water level of about 295 m which is currently undergoing feasibility studies.

There are further important hydropower projects in the Da river watershed that include the Huoi Quang, Ban Chat and Nam Na.

The Hoa Binh dam has multiple functions that include flood prevention for the lower part of Da river, Red river and the capital of Hanoi. The Hoa Binh Hydroelectricity Project is the key electricity source project for Vietnam. The plant has 8 generators with the installation of 1,920 MW. Irrigation and drought-proofing for agriculture is a key function particularly during the dry season when water releases from the dam assist in irrigating crops downstream. In addition to the regulation of water flow in dry season for the lower part irrigation, the plant also helps to drive back salt water far away from the river mouths, thus increase the cultivation areas in these regions. The presence of Hoa Binh Hydroelectricity Project has contributed to the remarkable improvement of waterway transportation both above and below the dam.

A comprehensive discussion is presented on the biophysical and historical development of the Hoa Binh watershed that covers the physical attributes of the watershed, forestry and agriculture and the impact of changed land use on sediment generation in the basin. It is argued that reforestation of the catchment has had a significant impact on sediment yields to the river, although there is concern that current levels of sediment generation are still too high, thereby reducing the hydro dynamic capacity of the dam (dead volume) is less than half the expected design time. Result of research conducted by PhD Nguyen Kien Dung in 2000 – 2002⁴ have shown that with operations, and in the case that the Son La hydropower project is not constructed, the Hoa Binh reservoir may work effectively

⁴ PhD Nguyen Kien Dung “, Study and calculation on sedimentation and rising water level corresponding to different construction models of the Son La reservoir” 2002.

for 90 - 100 years. Due to 70% of sediments are deposited at the dead storage capacity, so it is estimated that until 2080 flood-defensive and net capacity of the reservoir will decrease by 74% and 75% from the initial design capacity. It is estimated that the lower part of Son La reservoir will work effectively for 80 years and annually deposit about 40.3 million m³ with 43% of sediments deposited within the dead capacity. In case there has Lai Chau reservoir, the Son La reservoir will work effectively for 100 years, annually deposit 32.3 million m³ with about 55.1% of sediments deposited in the dead capacity (the Lai Chau reservoir will work effectively for 50 years, annually deposit about 39.02 million m³ with 48% of sediments deposited at the dead capacity) Clearly there are concerns that the rates of sedimentation are extremely high and that addressing the fundamental contributing facts would significantly increase the viability of these investments.

The authors undertake a comprehensive analysis of the development of the watershed over time as a result of the building of the Hoa Binh dam and the changes in livelihoods of communities in the area. Further the authors discuss extensively the changes in forestry in the region as it is a significant income earning livelihood option and it is important in stabilizing landscapes and hence sediment generation. The following conclusions were made by the authors:

“Forest resources in Da's watershed has been exploited for a long time, losing hundreds of hectares of primeval forests and lowered the rate of forest coverage by the end of the 1980s and 1990s. Therefore the forest system has lost the ability to protect the environment and minimize the impact of natural disasters on people's production and life, especially the water regulation and river deposition of hydroelectric. The extremely serious problem is that annual natural disasters occur more and more often, requiring concrete and rapid action to establish sustainable environment and protect people's life, in which forest and forest land are the most important element.

Nowadays, people have acknowledged that forest resource's use value (including material value and ecological such as regulating the water, soil or climate) is not unlimited. Thanks to the capability of water keeping, forest and forest land can prevent drought, regulate stream flows to provide water for production and daily life from upper river areas to lower ones. They can also reduce the price of dyke maintenance, crops failure, and stabilize the capacity of hydroelectric plants. On the other hand, forest and forest land can also absorb poison and carbon dioxide, regulating the climate, purifies the water, preventing mud from depositing the lake and the reservoir bed, therefore cutting down the price for dredging and extending retaining dam's longevity. The ecological value of forest and forest land is more meaningful than those of material value such as woods, firewood or other forest products. In order to have a comfortable life, people should afforest and protect forest to enjoy its ecological value, protecting environment and satisfying human's needs.

So, forestry workers (or forest owners) put directly their capital and labour to afforest and protect forest, in order to create their ecological values. These values are contributed to every member of the community, and forest owners are given back the capital and labour they have invested. Forest's ecological value is a special product, accounting for 60-80% of the total economic value of forest. In fact, forest's value has been underestimated in relation to their actual worth.

Therefore, in order to protect the environment and sustainable exploit the Da River watershed, as well as build constructions to serve the socioeconomic development and people's livelihood and other economic branches in the region especially developing large hydroelectric plants such as Hoa Binh, it's necessary to do research on the mechanism to establish market and communicate forest value suppliers with users (for example: hydroelectric plants, water-using units). This procedure is called "Paying service of forest environment".

In 2008, Vietnamese government has implemented the pilot project of "Paying service of forest environment" in the watershed of Da River and Dong Nai River under the Decision 380/2008/QĐ-TTg. Based on this project's outcome, the Government will complement and officially promulgated the policy of paying service of forest environment in the next 2 years. Let's hope that this research will provide practical data for model implementation in Da River watershed as well as the paying service of forest environment in Vietnam.

5. CONCLUSIONS

The sustainable utilization of the uplands of Southeast Asia is a vexing problem facing all governments and development practitioners alike as they move towards sustainable utilization of natural resources. There is clear evidence to support the notion that inappropriate land management options implemented by resource poor farmers is having and has had, significant negative off-site impacts that bring into question the long-term viability of resource utilization. One of these resource degrading impacts is accelerated sediment generation associated with inappropriate land use. This has had profound effects on water quality and sedimentation of storage structures. Clear evidence of this accelerated sedimentation of storage structures is present for the Hoa Binh Dam in northern Vietnam where it is estimated that the effective life of the facility will decline to half of its design capacity (i.e. 250 years) in less than 100 years. This has serious implications with respect to the financial viability of these investments. Moreover in the current investment environment where private-public partnerships are being promoted to develop the hydropower potential of the region through build-operate-transfer agreements, national governments may in essence inherit non-viable assets on transfer. It is argued that the management of upper watersheds is critical for the long-term viability of the hydropower sector and that this should become the focus of mitigation strategies sustainable.

A range of development projects in the region promoting the sustainable management of uplands through improved farming practices have been undertaken. A review of one of these projects in Lao PDR (ASIALAND) several years after its conclusion confirmed perceptions and anecdotal evidence that support the lack of continued adoption of sustainable land use after the completion of the project. While interest in sustainable land management (SLM) technologies and willingness to participate in new projects were still high among the respondents, common criticisms made about technologies introduced by the ASIALAND network were that the practices were too labour intensive/time consuming and that the returns gained from implementing the technologies were too marginal. These clearly are fundamental constraints that limit adoption and out

scaling amongst communities and the concepts of incentive based approaches that would effectively reward farmers/landowners for appropriate stewardship would potential result in greater degrees of adoption and sustainable resource use.

The concept of payment for environmental services (PES) has been mooted globally as an instrument to promote and reward land users for sustainable resource management. The basis of PES is that there are buyers and providers of clearly defined ecosystem services with specific conditionalities associated with the delivery of these services. Whilst PES is viewed as a voluntary, conditional transaction with at least one seller; one buyer; and a well defined environmental service and would appear to be a simplistic approach, in reality the scheme is complex with significant transaction costs. Further it is questionable whether such an approach is suited for the task at hand, in this case the sustainable management of upper watersheds within a HP context. For example PES schemes are easier to implement if there is secure individual land tenure and a legal and functional framework governing land rights. Further, rural populations in developing countries predominantly are dependent on subsistence based production systems or the extraction of natural resources. When land is dedicated to remunerated conservation through direct payments, the original owners may become dispossessed if their land rights are not secure in the first place. These are just two examples of significant hurdles that need to be addressed in developing countries in order for PES to be effectively implemented. In general, the introduction of PES in Southeast Asia, Vietnam being a prime target for these schemes, has been less than positive and hence it is questionable as to whether this form of incentive based scheme would have applicability in the HP sector.

The concept of benefit sharing extends the narrow focus on displaced people and the resettlement host communities who are adversely affected by HP development. It includes other households and communities living in the project *impact zone* who have their resource access permanently reduced or transformed by the project in some degree. Essentially the philosophy is that all people living in the project impact zone, who host the project, are eligible to participate in benefit sharing and become long-term partners in the project they must live with. It transcends the narrow focus of a one off compensation approach to addressing the impacts of dam building to one of providing continual pre determined income streams for the life of the scheme to those who are influenced negatively by the project. It is inclusive and equitable and clearly represents a mechanism of equitable distribution of benefits to those who have lost or had to forego a livelihood. This clearly represents an approach that would fit the scope of a hydropower development and should be considered by LMB countries as an effective mechanism for distributing the benefits of HP to those affected adversely by it. Vietnam is currently embarking on pilot sites for assessing the role of benefit sharing and a legal framework for its implementation has been established. However, a major hurdle that is perceived in the implementation of such a mechanism is in the willingness of developers and investors consider this approach in their planning process. This can be addressed through governments legislating for such mechanisms within their HP policies.

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ANNEX 1

Hydropower development in the Mekong Basin and sedimentation

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1.1. Hydropower potential in the Greater Mekong Basin

The Mekong River Commission (MRC) estimates that the total theoretical potential for hydropower (HP) production in the Greater Mekong Sub-Region (GMS) is approximately 53,000 MW with about 23,000 MW potentially being generated in the Peoples Republic of China (PRC) where the Mekong (known as the Lancang) River flows through Yunnan Province. In these upper stretches of the basin the river passes through highly incised gorges with steep gradients.

In the lower Mekong Basin (LMB) it is estimated that 30,000 MW is technically available in the four countries with just under 13,000 MW in the mainstream (MRC 2003). The remaining potential capacity is located in the upper tributaries of the Mekong system. Lao PDR has the highest HP potential of the four LMB countries (Lao PDR 13, 000 MW; Vietnam 2,000 MW, Cambodia 2,200 MW, Thailand has already developed all of its feasible HP potential in the basin) (King et al., 2007). Hydropower represents one of the important renewable uses of water resources in the LMB to meet the increasing needs for energy and economic development in the riparian countries. Relatively little of the hydropower potential in the region has so far been developed and as population growth and economic development increases in the basin and individual personal wealth rises, demands for energy will increase dramatically over the next two decades.

An inventory of existing (or under construction) large HP projects in the GMS indicates there are 82 currently underway with a further 179 large projects identified as potential sites (King et al., 2007). The PRC has built two main-stem dams, the Manwan (1,500 MW) and Dachaoshan (1,350 MW) on the Lancang (Mekong) River in Yunnan Province. The Manwan and Dachaoshan dams have relatively small active storage capacity and are largely operated as run-of the river schemes. Two more dams are under construction, Xiaowan (4,200 MW) and Jinghong (1,500 MW) as part of a planned cascade of 8 dams. The Xiaowan dam when completed will have 20 times the live storage capacity of two completed dams.

The remaining existing HP dams in the Mekong basin, including those under construction are all situated on the tributaries of the Mekong. The MRC has reported that 11 schemes have been completed in the LMB, totalling 1,600 MW or approximately 5% of the overall potential. The largest schemes are located in Vietnam (Ialy, 720 MW) and Lao PDR (Theun Hinboun, 210 MW, Nam Ngum, 150 MW, and Houy Ho, 150 MW). In the GMS Vietnam has the highest number of existing large HP dams (30 existing and 65 potential sites identified). Of these, 26 potential sites are identified on tributaries of the Mekong (King et al., 2007).

In the LMB, a number of run-of-river hydropower projects have been identified on the mainstream Mekong but none has yet reached an advanced preparation stage. These dams were proposed back in the 1950's but over the past couple of years these plans have been revived due to the anticipated increased flow regimes in the dry season associated with the development of mainstream dams in Yunnan making these projects feasible. Agreements to conduct feasibility studies on five

mainstream run-of-river dams have been signed for the Pak Beng, Xayabouri, Pak Lay and Don Sahong in Laos PDR and Sambor in Cambodia (TERRA 2007). Many potential projects have been identified on the tributaries but only a few have been implemented.

There are effectively two perspectives that drive energy and HP policy in the GMS:

1. Diversification and maximization of indigenous resource use in the power sector, reflecting a national-regional energy security focus.
2. The policy to increase electricity supply to emerging economies to underpin socio-economic growth and development (King et al., 2007). In the following sections the impacts and drivers of HP development in the LMB are discussed with a specific focus on HP developments in Lao PDR which has the greatest exploitable HP potential and Vietnam. The demands for power in Thailand are discussed along with its role in HP development in neighbouring countries.

1.2. Impacts and drivers of hydropower development in the LMB

The traditional beneficiary of hydropower development in the Mekong and strong justification for its development, has for all intense and purpose been flood control. Possibilities also exist for designing and operating hydropower facilities with benefits for other sectors (MRC, 2001). The principle of multiple use reservoirs is a case in point; another is safeguarding and promoting local fisheries and agriculture in dam design and operational directives. The Nam Ngum project in Laos is an example of a hydropower reservoir that has become an important source of fishing as well as a tourist attraction.

The potential environmental and socio-economic impacts of hydropower development projects and related activities include the following:

- It is well recognized that the mountainous and upland regions of Laos and Vietnam are rich in biodiversity. Relatively unspoiled pristine rain forests are found in these areas. Illegal or uncontrolled logging is a significant problem in the region and the development of HP often exacerbates the situation by improving access to these regions through the construction of roads. Destruction of these forests potentially has a dual negative impact. It reduces the biodiversity value of these national assets and endangers rare or threatened species. In addition, deforestation destroys the flood buffering capacity services of these ecosystems and soil protection capacity of the river catchment. This could increase sediment discharge from these watersheds that would result in the siltation of dams.
- The Mekong and its tributaries have an abundance of fish and other aquatic species. It is estimated that more than 1,300 fish species are found in the Basin. From a biodiversity standpoint the aquatic flagship species are: the giant catfish, giant Mekong barb, freshwater dolphin and Siamese crocodile. All these species are threatened by extinction. It has been established that several of the key species and important components of fish production are dependent on specific flood patterns (pulse-floods), minimum flows and migration opportunities to maintain life cycles and production. The development of HP could have a negative impact on the fisheries resources

of the basin and hence the livelihoods of some of the poorest communities in the basin who are dependent on them.

- The wetlands along the Mekong are also rich in biodiversity. They are inhabited by a large number of rare and threatened species and play a critical role as stop-over sites for migratory birds. For example it is estimated that the entire global population of the eastern sarus crane stays in the Mekong delta during the dry season. Changes in the functionality of these wetlands will have an impact on these ecosystem services.
- Changed flow regimes associated with infrastructure development will affect downstream regions and countries. Of particular concern are those areas within the delta where the ecological functioning of agriculture and aquaculture areas in the Mekong delta is intrinsically linked to seasonal flooding. Furthermore, predicted rises in sea levels associated with climate change and changes in flow regimes associated with dam construction could have a profound impact on the agricultural productivity of the delta.
- Similarly the Lower Mekong Region evolved within the context of regular flooding. Consequently traditional land-use and ecological conditions have adapted and evolved to seasonal flood pattern. However, extreme flood events pose a significant threat to human life and property. Therefore finding ways to better control the hydrological regime of the river will have a positive impact on livelihoods and human wellbeing. The development of upstream reservoirs associated with HP develop is seen as a means to achieving this goal.
- The mountainous parts of the region are inhabited by ethnic minority groups. Such groups are often difficult to relocate without damaging their cultural identity and integrity. Dam development necessitates the displacement of peoples and communities. Several issues have been identified that invariably are a consequence of development and discussed in brief below:

Displacement of communities: Displacement disrupts age-old ways of life and livelihoods for communities and peoples. Resettlement and rehabilitation of displaced households invariably poses significant challenges that are often addressed in a piecemeal manner or are neglected. Resettlement is often plagued by a lack of adequate and productive land being made available to communities and individuals. People are often paid cash compensations which have limited and transient value; they are not compensated for common property resources which formed an important part of their livelihood in previous locations and resettlement also causes the destruction of social capital of displaced people. Consequently, many displaced households have become socially and economically marginalized (Upadhyaya, 2006).

Adverse downstream impacts: There are examples where the construction of dams has resulted in the scarcity of irrigation and drinking water to downstream communities areas. The drying up of rivers has changed microclimates, adversely affected religious and cultural sites and diminished the aesthetic beauty of downstream areas. The livelihoods of people are often destroyed through the management of HP facilities that result in significant fluctuations in river height making fishing and agriculture a hazardous undertaking. Similarly, people are often

adversely affected by the construction of transmission towers, transmission and distribution lines, roads, and canals (Upadhyaya, 2006).

1.3. Hydropower profile of Lao PDR

The Lao People's Democratic Republic (Lao PDR) is a landlocked country; covering an area of 236,800 km². The Lao PDR is in the watershed of the Mekong River, which forms about half of its border with Thailand. The country is predominantly mountainous, with 80 percent of its land surface consisting of hills and mountains rising 100 to 3,000m above the plains of the Mekong River with only about 10% suitable for farming enterprises. These alluvial plains range in elevation up to about 200m above sea level. Lao PDR is located in Southeast Asia, bordered by Vietnam to the East, Cambodia to the South, Thailand to the west and south, and Burma and China to the north. Increasingly it is being recognized that 'Landlocked' can be re-interpreted as 'Land linked', changing the emphasis from 'regional exclusion' to 'regional inclusion'. It is comprised mainly of mountainous and hilly areas.. The narrowly based economy is one of the least developed in Asia with an approximate per capita gross national product of about US\$ 300 per annum (Pholsena and Phonekeo, 2004). In 2003, the agricultural sector contributed about 50% to GDP, followed by the service sector 30% and the industrial sector at 20%.

With 35% of the Mekong's total annual flow, the Government of Lao PDR see the development of this resource as an asset and has marketed itself as becoming the 'battery of Southeast Asia". With a modest domestic demand for electricity in Laos, the focus of HP development is on generating foreign exchange through the export of power to neighbouring countries of Thailand, Vietnam and China. Whilst plans for the development of this sector have been planned for several decades, implementation was thwarted in 1970's and 1980's by war and political instability and in the 1990's by the Asian financial crisis (Imhof et al., 2008).

The development of HP facilities with planned and managed environmental impacts is seen as an ideal opportunity for Lao PDR to enhance its economic prosperity and improve the livelihoods of people (Pholsena and Phonekeo, 2004). Lao PDR possesses the largest HP potential in the LMB that is beyond its own needs and is centrally located in an ever expanding GMS regional market for electricity. Exports of electricity have been an important foreign exchange earner since 1971 and the Government of Lao PDR (GOL) is relying on expansion of this sector to further boost revenues to further its social obligations (Pholsena and Phonekeo, 2004).

The theoretical HP potential of Lao PDR is estimated to be 26,000 MW, excluding mainstream generating facilities on the Mekong, while the exploitable HP, including a share of mainstream Mekong installation is 23,000 MW.

Currently 41% of households in Lao PDR are electrified and the Government has committed itself to increasing the electricity access to 90% of households by 2020, based primarily on grid extension and HP development. In developing policy goals for HP development in Lao PDR, the GOL has included the following objectives (Pholsena and Phonekeo, 2004):

1. Increase foreign exchange through export earnings to finance GOL's economic and social programs;

2. Increase access to electricity by grid extension and off-grid rural electrification;
3. Satisfy domestic demand;
4. Maintain an affordable tariff to promote economic growth and social development;
5. Operate EdL on sound commercial principles;
6. Replace dependence on imported fuels for energy generation.

Under GOL policy, HP projects are classified into two distinct categories according to their primary purpose:

- a) Domestic generation projects: The primary purpose is to supply national markets. EdL using concessionary finance typically builds and operates these plants. Availability of capital normally limits the size to 100 MW.
- b) Export generation projects: Export projects are primarily implemented by IPP groups specifically to meet commitments under inter-governmental MOU's. These projects are large, generally in excess of 100 MW due to power purchases having expressed little interest in smaller increments and low export tariffs generally require economies of scale for the project to be viable (Pholsena and Phonekeo, 2004).

Because of its geographic location and mountainous nature which is conducive for HP production, Lao PDR views itself as being the hub of power trade with markets in Thailand and Vietnam. These markets are large compared with the potential supply for Lao PDR. In 1993 an MOU was signed with the Thai Government to supply 1,500 MW to Thailand by the year 2000, this being superseded in June 1996 by a further agreement to supply 3,000 MW by 2006. In 1995 a MOA was signed with the Vietnamese Government for electricity sales of 1,500 MW and 2,000 MW by the year 2010. In the case of Cambodia, the GOL signed an agreement on power sector cooperation with the Government for least-cost supply of electricity to areas along the common border. The Nam Thuen II scheme is the first significantly large HP project for cross-border trade in the GMS that is based on the concept of build, operate and transfer (BOT).

The prime markets for the export of power from Lao PDR are Thailand and Vietnam. These markets are large compared with the potential supply from Lao PDR and trade is therefore constrained by price and supply capability rather than demand. Opportunities are also influenced by other factors that include progress in establishing regional 500 kV transmission interconnections and the timing and nature of power market reforms in the GMS countries (King et al., 2007).

Scarcity of finance for investment in power generation has presented bottlenecks in the development of this sector. Historically, financing for such large projects have been met by International Financial Institutions (IFIs), however their support for increasing generation capacity has been limited in recent years. The participation of the private sector has therefore been sought and promoted through a Build-Own-Operate-Transfer (BOOT) approach. Lao PDR has 6 HP projects in operation accounting for 2% of the countries HP potential. There are officially six HP projects are under construction or soon to be commissioned that include the following three:

- Xeset 2 (76 MW) expected to begin operation by August 2009, serving markets in Lao PDR and Thailand;

- Nam Theun 2 (1,088 MW) developed as an independent power producer (IPP) to serve markets in Lao PDR and Thailand starting in 2009. NT2 is the largest project in Lao PDR and is significant to the Mekong system as it will account for 12% of the active storage capacity in the Mekong Basin when it is operational;
- Nam Ngum 2 (615 MW and IPP) to serve markets in Thailand and expected to be in operation by 2013.

There are a further 16 projects at pre-construction or advanced planning stages; 36 project MOU's signed; and 6 projects proposed for the Mekong mainstream in Laos/Lao-Thai border.

It is pertinent to discuss the role of foreign investment in the HP sector in Lao PDR as it reflects a swing away from what would be termed IFI's that have more stringent rules and requirements governing investments in HP development. When the Asian financial crisis hit in 1997 there was a mass exodus of investors in the sector as demand for power in the region declined. By the end of the 1990's there were only two completed hydro-for-export projects, namely, the Theun-Hinboun Hydropower Project and Houay Ho Hydropower Project (Imhoh et al., 2008). The Nam Theun 2 Power Company (NTPC) was one of the few foreign consortia to remain. However, as countries emerged from the Asian financial crisis, foreign hydropower developers have returned to Laos but are dominated by companies that have their constituents in Thailand, Vietnam, China, Russia and Malaysia displacing the tradition investors such as the World Bank and the Asian Development Bank. These new developers are more flexible with respect to their operations and are able move quickly and mobilize resources in a timely manner and have taken over projects that were abandoned by Western corporations during the Asian financial crisis (International Rivers, 2008). Companies and financing from Thailand now dominate the Lao hydro sector with Vietnam and China not far behind. Chinese companies are involved in three hydropower projects currently under construction – Xeset 2, Nam Ngum 5 and Nam Lik 1-2 projects – and have signed MoU's to evaluate a further 10 (Imhof et al., 2008). The Vietnam-Laos Joint Stock Electricity Investment and Development Company have begun construction of the 250 MW Xekaman 3 project in southern Laos in 2006, with plans to export the electricity to Vietnam.

It is clear that new hydro companies and their backers are fast displacing traditional Western corporations and multilateral development banks that previous dominated the sector. These new companies are seen as more attractive partners to the GoL largely due to their access to financing (this may change under the current global crisis with respect to access to credit) and their limited or lack of social and environmental responsibilities as part of the loan agreements. The Nam Theun 2 project that has been heralded as a success with respect to safe guarding communities interests and the environment is often seen as a hindrance to development. It is of note that the Nam Theun 2 is the only existing and planned Lao dam in which the revenue management commitments have been proposed to help direct the GoL earnings towards poverty reduction expenditures (Imhof et al., 2008).

Domestic electricity demand has been growing at a rate of 13% in the 1990's and Lao PDR has the lowest tariffs in GMS. The development of HP in Lao PDR has a focus on IPP and private sector financing models to encourage domestic supply

and export. This is facilitated through licensing agreements that are laid out in the Electricity Law (1997). The Ministry of Industry and Handicrafts (MIH) is responsible for overseeing the implementation of power policies. Electricity du Laos (EdL) is responsible for the generation from its own plants, transmission and distribution but also purchases power from IPPs.

1.3. Hydropower in Viet Nam

Viet Nam can be viewed as both a HP developer and importer of electricity. Potential HP is estimated to be approximately 20,600 MW of which 20% (4,200 MW) has been developed to date. With electricity demand growing at between 13-15% per annum associated with rise demand from the household sector, rising industrial sector and export growth, it is anticipated that this growth will continue into the foreseeable future as Viet Nam achieves its goals in becoming an industrialized economy of the next 20 years. Approximately 70% of households have access to power services and the government has set a target of 76% of rural households being serviced by 2010 (King et al, 2007).

Viet Nam's HP resources are predominantly located in the Central and Northern regions with the Da, Sesan and Dongnai rivers forming the main HP generation systems in the north, central and south respectively. Currently there are more than 50 HP stations in operation, 10 of which are on tributaries of the LMB (King et al., 2007). Viet Nam contributes 11% of the flow of the Mekong from upland tributaries that drain west.

Projections suggest that about 13,000 MW of new HP would be added to the grid system up to 2020 that would represent approximately 65% of Viet Nam's economic hydropower potential. Since year-on-year demand growth has outstripped capacity to bring new generation projects on stream, Electricity Viet Nam (EVN) has negotiated the importation of electricity from the Peoples Republic of China to cover shortages in the northern provinces and is expected to accelerate transmission connections to import power from Lao PDR from 2008. This has resulted in the active cooperation of Viet Nam in the formation of a regional grid and cross-border trade.

1.4. Hydropower in Thailand

Faced with a rising fossil fuel bill, a need to diversify the energy mix, and internal opposition to the construction of new energy projects, Thailand's electricity utility EGAT has had to look elsewhere to source the countries current and future energy needs. Lao PDR has been a significant and willing provider of this energy deficit. It is viewed by some quarters that EGAT is exporting the social and environmental costs of energy production to its poorer neighbors (Imhof et al., 2008). Further the reliance of external sources of energy supply can also be viewed as carrying a degree of risk particularly in a region where there is still distrust between nations. The largest market for power is Thailand, but the country has very limited remaining hydropower resources that are considered exploitable from an environmental point of view. Thailand has no new major hydropower plants scheduled for development other than extension of the capacity of the pumped storage project now under construction at Lam Takhong and a new pumped storage plant at Kiridharn (outside the LMB). As a net importer of HP generated in the GMS and it may play an important role in connecting the Mekong region grid to

the ASEAN grid that will serve power markets further south into Malaysia. Thailand is also important with respect to cross-border trade with Cambodia.

Since Thailand is currently dependent on imported fossil fuels that are subject to significant price volatility, securing long-term HP supply contracts with known price conditions is an attractive option. Consequently environmental criteria and financing mechanisms introduced in the GMS grid pricing structures (to internalize environmental costs and social mitigation) and harmonization of environmental provisions in cross-border power trade has been of interest to Thailand (King et al., 2007). A clear strategic objective of the Ministry of Energy in Thailand is to execute aggressive policies for the provision of electricity from neighboring countries that include Myanmar, Lao PDR and southern Peoples Republic of China. Hence Thailand will become a significant regional player in the importation of electricity from GMS countries.

Thailand's 2007 Power Development Plan includes 4000 MW of power imports from Laos between 2008 and 2015, and additional 8700MW from unspecified neighboring countries by 2021 (EGAT, 2008). Thailand's energy and construction companies, backed by the government, financial institutions and investors, are assisting in many of the new developments in the sector in order to secure a reliable and continuous supply to the Thailand grid. It is of note that Thailand's energy companies and commercial banks have yet to commit to international best practice standards. None of Thailand's commercial banks are signatories of the Equator Principles that ensure social and environmental principles as basic standards in loan agreements (Imhof et al., 2008). While a number of Thailand's energy companies have developed Corporate Social Responsibility policies, their narrow interpretation of environmental and social governance provide limited safeguards to affected communities.

2. Sedimentation and erosion

2.1. Background

The World Bank and the International Monetary Fund have identified the challenges of managing an economy that is largely dependent on revenues that are generated predominantly from natural resources. Commodity price volatility, the influence of extreme climatic events (floods and droughts), upward pressure on inflation and fluctuations in the exchange rates are all factors that could lead to the view that the natural resources sector could be more of a curse than a blessing, particularly in a country such as Lao PDR where there is a heavy reliance on this sector to drive economic growth (World Bank, 2008). Hence it is important that the development of natural resources (i.e. water resource for hydropower) is undertaken with due care so as to ensure sustainability and equity to all those that are affected by these development. Further it is important to ensure that there are productive linkages between the resource and non-resource sectors of the economy in order to ensure that there are no negative impacts on critical sectors such as agriculture and manufacturing (Cavallo et al., 2008).

In general land degradation is often related to poverty (e.g. Pender et al. 2001; Penning de Vries et al. 2002; Valentin et al. 2006). In South and Southeast Asia, Sherr and Yadav (1999) have estimated that the total economic loss from soil degradation ranges from 1 to 7% of the gross agricultural domestic product.

Bandaragoda (2001) estimated that in South and Southeast Asia approximately 46% of total land area is affected by human-induced soil degradation, and of this, about 90% has already undergone some decline in agricultural productivity. Conservation Agriculture (minimum or zero-tillage cultivation with cover crop and/or crop residues, and crop rotation) is now widely considered as a viable concept for practicing sustainable agriculture as it significantly reduces soil erosion, runoff, and maintains soil carbon at appropriate levels. In 2003, about 72 million ha globally were cultivated under conservation agriculture: 47.5 % in Latin America, 36.7 % in USA and Canada, 12.5% in Australia, while only 3.3 % in the rest including Europe, Africa and Asia (Derpesch, et al. 2003). This section outlines the specific threat of land use change on sediment generation and its impacts on storage capacity of water structures.

2.2. Sediment generation and its impacts on land and water resources

2.2.1. Soil Erosion

Land degradation is a significant threat to land and water resources productivity that has a direct impact on livelihoods. In this respect, soil erosion is widely recognized as a major cause of land degradation (Subayona et al., 2003), which ultimately leads to other forms of degradation including nutrient depletion due to loss of top soil layers, acidification, a decline in biological activity and diversity, and agrochemical pollution. Poor watershed management such as inappropriate land use and reduced forest cover on sloping land is a major driver of runoff and soil erosion.

Sediment transport and deposition resulting from soil erosion have impacts which are both socially and economically negative. These negative impacts include declining agricultural productivity, a reduction in storage capacity and delivery facilities of dams and reservoirs, increasing pollution of drinking water, damage to irrigation infrastructures, and a threat to aquatic ecosystems as well as human health (Chandrapatya and Noble, 2004; Tognetty and Johnson, 2008; Wani et al., 2001; Senanarong et al., 2001; Sherr and Yadav, 1999).

Of importance in assessing storage structures for HP generation is the off-site negative impacts of soil erosion on the hydrodynamic storage capacity and operation of these dams. McCully (1996) reported that major reservoirs in China have lost 23 % annually of their storage capacity which has major implications with respect to the economic viability of these projects. A study of US Army Corps of Engineers in 1993 revealed that reservoir siltation of the 135 MW Cerron Grande Dam in El Salvador reduced the operational life of the facility from a pre-construction expect life of operation of 350 years to a mere 30 effective years after significant sedimentation had occurred. Modern dams are now designed so as to include, in addition to the main water storage capacity that is used in power generation termed the 'live storage', 'dead storage' which lies beneath the elevation of the dam's lowest outlet. Hence, there is the ability of these modern dams to absorb eroded sediments without major losses of hydropower generation capacity. It is of note that sediments do not always get deposited as predicted. For example, the Tarbela Reservoir in Pakistan lost 12% of its live storage by 1992, whilst 55% of its dead storage was still devoid of sediments even after 18 years of operation clearly indicating the variability in the deposition within dams (McCully, 1996). In the new generation of dams, flushing mechanisms have been installed in order to

remove sediments from the dam. This can have adverse impacts on water quality being delivered downstream of the HP installation.

2.2.2 Factors contributing to accelerated soil loss

There are a number of factors that drive water erosion processes that can be categorized into rainfall intensity, soil texture, slope gradient, ground vegetation cover and land use. In an undisturbed forest, the mineral soil is effectively protected by litter and organic layers. These layers protect the soil by absorbing the impact (kinetic energy) of raindrops. In addition, these organic layers impart a higher degree of porosity and are highly permeable. Thus only the most severe rainfall events can lead to runoff generation and erosion.

Soil loss resulting from erosion processes are of major importance for the hydropower sector fall into three principal categories: tillage erosion, water erosion, and landslide erosion. The conversion of forests to agricultural land that is commonly observed in slash-and-burn systems and the subsequent intensive cultivation is one of the main causes of soil erosion in upper catchments of Southeast Asia. Clearing of surface vegetation and litter predisposes the soil to wind and water and mechanical erosion that includes tillage erosion. Even where machinery is not used, the study of Dupin et al. (2002) has shown that significant tillage erosion rates can be observed that range from 1.8-21.3 ton/ha/yr on steep slopes in the northern Lao PDR (Table 2.1). These erosion results are from manual land preparation and from repeated weeding operations (hoeing).

Table 2.1: Annual tillage erosion associated with hand weeding operations in northern Lao PDR under Job's tear and upland rice on contrasting slope gradients (Dupin et al., 2002).

Slope Gradient (%)	Annual tillage erosion rates (ton/ha/yr)	
	Job's tear	Upland rice
30	1.8	1.8
40	2.5	2.6
50	3.6	3.7
60	5.0	5.2
70	7.1	7.4
80	9.9	10.5
90	13.9	15.0
100	19.6	21.3

Some soil particles that become detached due to the impact of rain drops are suspended in surface runoff flows. Surface runoff waters often contain contaminants such as silt, fertilizers, pesticides, animal waste, organic matter and possible microbial contaminants. In underdeveloped countries where people mainly depend on surface water for their daily needs, waterborne diseases are known to be transported by runoff water (especially in flood prone areas) and represent a significant health hazard. A study undertaken along a stream in the uplands of Lao PDR by J. Cuny (2007) revealed that there are more bacteria present in the river associated with runoff events than during periods of normal flow. The average total colonies of bacteria increased from 1152 – 42469 TC/ml and *E. Coli* increased from >23 – 452 MPN/100 ml. These bacteria induce diseases such as typhoid, diarrhea, pneumonia, respiratory disease, and worms. Hence surface runoff and associated bacterial loads pose a significant health risk along with associated environmental impacts.

Surface runoff associated with rainfall events and the utilization of uplands often contributes to flooding in the lower reaches of the catchment or river system.

Flooding itself has several positive impacts in that it provides nutrients and important sediments to the floodplain thereby increasing the fertility of these areas. Furthermore the deposition of sediments in deltaic systems is of paramount importance in that they allow for the growth and maintenance of these systems. However, where damming of a river occurs, sediment deposition can have a negative impact on the storage capacity as discussed previously. Some of the benefits that accrue due to floods have been identified as:

- Enhancing fish productivity which is a significant protein source for poor farmers;
- Sedimentation associated with flooding is a natural fertilizer for farm land;
- The flushing of toxicity acid sulphate soils (Minh, 1998).

Sheet erosion occurs when the soil is detached by raindrops and transported downhill by water flowing overland without any well defined channels. Sheet erosion is initiated when low soil infiltration rates does not match the rainfall intensity. The loose soil particles are transported down slope by broad sheets of rapidly flowing water filled with sediments and other contaminants.

Rill erosion develops when surface water flow is concentrated and intense enough to detach soil particles and creates pathways or channels a few centimeters to 30 cm depth (Figure 2.1). The pathways or channels operate as both sediment sources and sediment transportation systems. Rill erosion is the intermediate process between sheet and gully erosion.

Figure 2.1: Rill erosion on a slash-and-burn rice field, Houay Pano, Luang Prabang, Lao PDR.



Photo by H. Robain, IWMI-MSEC, 2007

Gully erosion is an extremely destructive form of soil erosion generated by the concentration of high energy runoff water which detaches and transports large amounts of soil. Gullies sometimes evolve from rill erosion and channels that are deeper than 0.5 M. Gully erosion threatens roads, fences, buildings, soil productivity and limits land use. Soil volumes eroded by gully erosion can cause siltation of waterways, roads, dams and reservoirs. Suspended sediments (sometimes contaminated with nutrients and pesticides) can affect surface water

quality, and may pollute groundwater. Gullies will cause wider impact especially in steep pasture or cultivated lands when runoff enters a gully from the sides, causing secondary gullies or branching (Carey, 2006).

Stream channel erosion consists of both stream bed and stream bank erosion. Stream bank erosion takes place when streams begin cutting deeper and wider channels as a result of increased peak flows or the removal of local protecting vegetation. Stream bed erosion occurs when flows cut into the bottom of the channel. This erosion process will continue until the channel reaches a stable slope. As the stream bed erodes, and the channel deepens, the sides of the channel become unstable; leading to stream bank erosion as well.

In comprehensive studies on erosion rates within the context of the Management of Soil Erosion Consortium (MSEC), sediment yields from upland rice production systems that are within a slash and burn enterprise in Lao PDR, have been recorded to be $5.7 \text{ Mg ha}^{-1} \text{ year}^{-1}$ at the catchment outlet (Valentin et al., 2008; Phommasack et al., 2000). These figures are consistent with data collected from catchments in similar environments in the Himalayan hills of Bangladesh ($1.2 \text{ Mg ha}^{-1} \text{ year}^{-1}$; 1 year of cultivation, 4 year of fallow; Gafur et al., 2003). Under these conditions, rotational shifting cultivation cannot be regarded as a major threat for soils as often presented by governments and international institutions. In contrast, annual crops cultivated semi-permanently with very short cycles, and permanent cropping, as often encouraged by governments, tend to be much more problematic in terms of erosion (Valentin et al., 2008). Thus, a minimum duration of the fallow period is required to suppress weeds in order to continue rice cropping and this limits erosion frequency due to cropping to one year out of five. As demonstrated in the Laotian site, total sediment yield increases with the shortening of the fallow period and this effect is increased with the replacement of upland rice by Job's tears and maize. The average total sediment yield from the 27 catchments is $3.4 \text{ Mg ha}^{-1} \text{ yr}^{-1}$ in this study of Valentin et al. (2008). It exceeds the tolerable soil loss rate considered by most soil scientists, the threshold being $2.5 \text{ Mg ha}^{-1} \text{ yr}^{-1}$ (USDA, 1995).

In continuous cropping systems, cassava is often used as the ultimate crop because it is less nutrient demanding than cereal crops. Cassava was associated with high soil losses because it is a very erosive plant due to the large drops favoured by its architecture (e.g., Moench, 1991) and provides only low soil cover (approx. 50%; Nguyen et al., 2008) even at their peak growth. In addition, rather deep tillage is needed to harvest the tubers. Cassava is often the ultimate crop before abandonment of the plot, thus ending a long period of continuous cropping, made worse by the fact that exhausted soils with lower organic carbon content are more erodible (Rachman et al., 2003).

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ANNEX 2

An assessment of the drivers that influence the adoption of sustainable land management practices based on a survey of four ASIALAND conservation farming villages (CFV's) in northern Lao PDR

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Executive summary

- An assessment of drivers that influence the adoption of sustainable land management (SLM) adoption was carried out in June and July 2008, in four villages located in two districts of the Luang Prabang province, northern Lao P.D.R. One village (Ban Silalek, Xieng Ngeun district), was populated by Khmu and Hmong ethnics, while in the three other villages (Pak Ou district), inhabitants belonged almost exclusively to the Tai Lue group.
- At all sites, awareness of SLM and/or Conservation Farming (CF) technologies was high, but only 4 years after the end of the final phase of ASIALAND, abandonment of these technologies was well underway, with only 33% of the Silalek farmers who practiced alley and multiple-cropping in 2004 were still currently practicing it. In the Pak Ou district, SLM has been abandoned at a much slower pace, with 75% of the farmers who practiced SLM in 2004 still involved in one form or another in conservation farming. In Silalek, **weed pressure** and excessive **labour requirements** were invoked as the major issues that forced farmers to discontinue SLM.
- By revisiting some of the questions used in 2004 by the coordinators of the last phase of ASIALAND, on the occasion of the project's final impact assessment, we found that respondents are more inclined to openly express critical opinions about the project when talking to investigators who have no direct ties with it. As a consequence of this behaviour and in contrast with the results published in the final ASIALAND report published in 2005, we found that, overall, more than 85% of the respondents prefer using traditional cultivation practices than adopt SLM techniques. About 25% of the respondents were inclined to grow low land rice as their first alternative to slash-and-burn agriculture, followed by livestock farming (in Xieng Ngeun district only) and commercial crop cultivation (maize, job's tear, rubber, palm oil). Paper mulberry or growing fruit crops were only seen as alternatives of secondary importance.
- While interest in SLM technologies and willingness to participate in new projects were still high among the respondents, common criticisms made about technologies introduced by the ASIALAND network were that the practices were too **labour intensive/time consuming** and that the returns gained from implementing the technologies were too marginal.
- The survey of villages in the Pak Ou district proved very informative about the likely impact of hydropower (HP) developments on peoples' livelihoods, as it appears that families in this area derive a substantial fraction (sometimes, the main share) of their income from gold panning along nearby

tributaries of the Nam Ou. It is evident that hydropower development in this area will greatly affect these communities livelihoods (as the locations where people currently practice gold panning will be drowned once the dams are built).

- Strikingly, in the Pak Ou district, where many households rely on gold panning for their livelihoods, the SLM/CF adoption rate was substantially higher than in Silalek where people do not have access to such an alternative source of income. This observation strongly supports the hypothesis that sufficient and sustained income (or financial support) is a precondition to the implementation of sustainable/environmentally friendly land use. In the perspective of HP development in the area, the concept of benefit sharing, whereby HP companies will share a fraction of their benefits with the affected communities for the whole life cycle of the HP plants, appears very appropriate.

Introduction

One of the conclusions of the inception meeting held in Vientiane in December 2007 was that it was essential for the team to survey the current status of conservation farming villages (CFVs) involved in the ASIALAND project of IBSRAM/IWMI from 1988 to 2004. The rationale behind this conclusion is that through an assessment of the current status of selected CFVs regarding the adoption of management practices introduced by the successive phases of the ASIALAND project, it should be possible to gain a clearer understanding of the essential parameters that control the adoption of the most suitable land management options that enhance livelihoods. It was decided at the time of the inception meeting that this assessment would be undertaken under the form of a structured regional survey of selected villages in Thailand, Lao PDR and Vietnam. However, time and resource constraints forced us to focus on the Lao case only. Here, we present the results of the survey conducted in four CFVs located in the Luang Prabang province and discuss their implication for the successful implementation of incentives mechanisms for the effective delivery of environmental services.

Site Description

A total of 42 villagers were interviewed in 4 villages located in Luang Prabang Province which used to be part of the ASIALAND network of Conservation Farming Villages - CFVs- (three in the lower Nam Ou river area in the Pak Ou district, namely, Ban Hatsoua, Ban Lathahae and Ban Pakchaek) and one along the road to Xayabury (Ban Silalek, Xieng Ngeun district).

Figure 1. Location of surveyed CF villages (sources: Google Earth, UNOSAT)



Methodology

Two questionnaires, including roughly 100 questions were used (Annex 1). The first questionnaire included 4 sections, the first concerning the household structure and livelihood (general information about individual household members, landholdings of based income in the Year 2007, household expenditure in 2007), the second about food security (in particular, level of rice sufficiency), the third about integrated farming (knowledge and practice by the household) and the fourth about the interviewee's perception of hydro-power development (knowledge of developments that might directly affect the household and understanding of likely consequences on the household's livelihood). The second questionnaire specifically focused on

SLM and investigated the respondent's awareness, involvement, knowledge, general attitude and willingness to adopt SLM technologies.

Number of surveyed households

The proportion of households that could be surveyed was limited: 18 out of 150 (12 %) in Ban Silalek, 11 out of 73 (15 %) households in Ban Hatsoua, 8 out of 107 households (7.5 %) in Ban Pakchaek, 5 out of 96 (5.2 %) households in Ban Lathahae. While relatively limited in size, this population sample is comparable to the 50 respondents interviewed in 2004 for the impact assessment of the ASIALAND program (Maglinao et al., 2005).

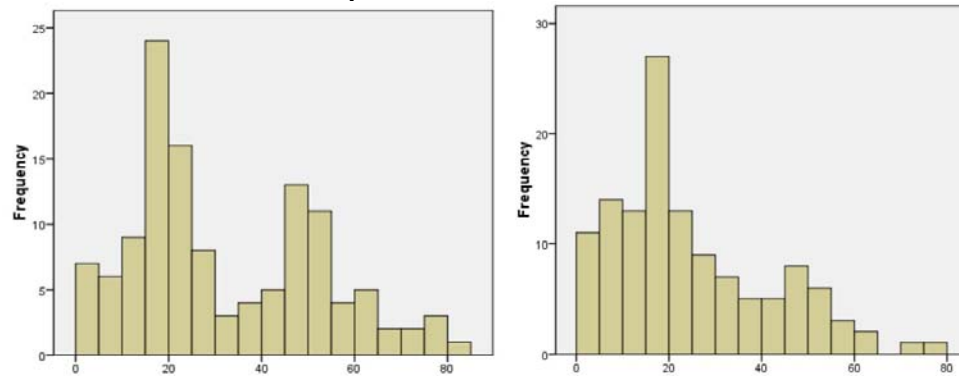
Respondents' age and gender

Respondents' age ranged from 25 to 78 in Silalek and 20 to 79 in the Nam Ou area, with a majority of respondents aged between 30 to 60 in both villages, (i.e, 15 out of 18 respondents in Silalek and 19 out of 24 in the Pak Ou villages). The mean respondent's age was 46 and 45.5, in Silalek and the Nam Ou, respectively. There were very few respondents who were younger than 30 in both villages because young people are generally not considered to have the required skills to run farm activities and they were usually not responsible for working with official workers if their parents were available. The proportion of women versus men respondents was 22 and 42% in Silalek and the Pak Ou villages, respectively. Our sample is therefore somewhat biased, with obvious gender and age imbalance in the overall population (see Table 1; Figure. 2). However, this problem could not be circumvented as the chiefs of villages designated people who participated in interviews. In addition, it must be noted that: 1. In many households, the individual responsible for farming activities is often the most senior male and 2. Participants in CF activities were also designated by heads of villages. This separation of tasks and responsibilities also explains why a substantial fraction of CFVs' population is unaware of SLM and CF technologies.

Table 1. Selected household and population characteristics of the surveyed villages

Village name	Household	Total population	% Female	Mean age (median)	Children 0-5 yr (%)	Children 6-14 yr (%)	Leu (%)	Hmong (%)	Khmer (%)	Religion
Hatsua	73	288	49.65	31.2 (24)	7.64	23.26	87.5	0	12.5	Buddhism
Pakchaek	107	520	53.27		-	-	100	0	0	Buddhism
Lathahae	96	513	53.61		15.79	18.91	100	0	0	Buddhism
Silalek	150	930	48.39	23.8 (19)	18.17	9.46	0	45.91	54.09	Cult of ancestors

Figure 2. Populations' age structure in the Pak Ou villages (Left) and Silalek (Right), based on data collected about respondents' families



Results

Socio-economic background of the surveyed populations

Respondents' literacy, and educational level

Only 2 out of 18 respondents in Silalek were illiterate, both were men; and 7 out of 24 were illiterate in the Nam Ou area, of which 4 were women. Almost all respondents had elementary education, 16 out of 18 in Silalek; and 22 out of 24 in Nam Ou.

Gender equity regarding access to training and participation in projects

Some housewives in the Nam Ou area claimed that participating in project activities was always decided by the head of the family (i.e. their husband) and that men always tried to take advantage of the opportunity to be involved in a project themselves before considering their wives,. Housewives added that they were the ones who worked hard on the field so they should also be taught the new technologies. From our interviews, we know that women only learned the new technologies from real practice on-farm, but not from participation in training courses or workshops. However, they have a level of familiarity with SLM which is at least as good as that of their husbands who used to participate in training, workshops, field visits etc.

Number of respondents' children and family members

Silalek respondents had more children than those in the Nam Ou area. There were 16 respondents who had 4 to 8 children (average 5) while in the Nam Ou area, there were 12 respondents who had less than 4 children and 12 respondents who had 4-7 children (average 4). As a result, families were larger in Silalek. A majority (13 out of 18 families) included 5-8 people, with an average of 7 members per family. The two largest families had 12 members. In the Nam Ou area, there were 16 out of 24 families who included 5-7 members. The other families included less than 5 members. Families included 5 members on average.

Ages of family members

18 respondents represented 125 family members in Silalek. Figures were: 24 respondents for 123 family members in Pak Ou villages. At both sites, there were many people aged between 10 and 25 (52 people in Silalek and 49 in Nam Ou), but the number of people aged 25 to 45 was quite low (Figure 2). There were less people aged 30-45 than people aged 45-60 (12/28) in the Nam Ou area. In

contrast, there were the same proportions of these age categories in Silalek (17/17). If the age pyramids were balanced, there should be more people aged 30 to 45 than people 45 and older. This feature of population structures in the studied villages is related to the fact that, after finishing higher education (20 – 25 year old), many young people choose to work in Luang Prabang, the nearby World Heritage town rather than come back to work on a farm in their hometown (see discussion in next paragraph).

Farm labour

If children no longer attended school, they worked on farm at a younger age in Silalek than in the Nam Ou. Children started to work part time at the age of 7 and full-time as the age of 13 in Silalek. In the Nam Ou area, the youngest children found to work on a farm part-time and full-time, were aged 13 and 15, respectively. Due to higher income (see next section), villagers from the Pak Ou district could support their children to study longer and even send them to Luang Prabang. All Lue people in the Nam Ou area are Buddhist, so boys can ordain as monks and have an opportunity to study at a low cost. Many of them develop the ability to speak and write English which opens professional perspectives for them to work in the country's biggest town or even to study abroad. In contrast, in Silalek, Khmu inhabitants worship Ancestors and their off-spring rarely get such opportunities. Therefore, most of Nam Ou respondents (23 out of 24) have only 2-3 full-time labour per household and half of them have 1-2 part-time labourers. In Silalek, 17 out of 18 families had 2-5 full-time labourers, in which 3 families had 4-5. For part-time labour, there were 15 families who had 1-4 part-time labourers. The average full-time and part-time labour for Silalek was 3, and 2; and in the Nam Ou area there were 2, and less than 1, respectively.

Rice sufficiency

Combining upland and lowland rice cultivation, most people at both sites (20 out of 24 in the Nam Ou area and 14 out of 18 in Silalek) were rice-sufficient throughout the year. On average, families were rice-sufficient for 11 months of the year at both sites. The main threats to rice sufficiency were excessive weed pressure and insufficient labour in Silalek; In the Pak Ou district, the threats were insufficient labour and small plot size. To obtain rice for families, Silalek farmers sold non-timber forest product (NTFP) and livestock. Some villagers borrowed rice from the village rice-bank. There is no rice-bank system in the Pak Ou villages. Their solution to solve rice shortage is to sell NTFP and poultry.

Analysis of income derived from 2007 production only (Exclusive for self-consumed production)

Cash income from wet season farming

In Silalek cash crop production was less diversified than in the Pak Ou villages. Villagers from Silalek set aside some of their maize and rice harvest to be used as livestock feed. They made less income from their wet season harvest than Pak Ou district villagers. Cash crops in Silalek were mainly maize, Job's tear and surplus rice. The average income was 1,170,000 Kips (approximately USD1= 8500 Kips). Based on the wet season production, 11 families earned between 1,170,000 and 2,000,000 Kips, 5 families earned between 2,000,000 and 3,349 000 Kips. Whilst 3 families did not make any or only marginal income. In the Pak Ou district, people derived income from a greater variety of crops, including Job's tear, maize, sesame, melon, and surplus rice. The average wet season income was 2,250,000

Kips. 10 families earned less than 2,000,000 Kips, 10 families earned between 2,000,000 and 9,290,000 Kips and 4 families did not make any or only marginal income.

Cash income from dry season farming

In Silalek, there were only two dry season cash crops: lowland rice and paper mulberry. The mean income derived from dry season farming was 208,000 Kips. Half of the respondents (9 out of 18) earned less than 500,000 Kips, 3 families earned more than 500,000 and up to 2,696,000 Kips, and 6 respondents did not sell any of their production. Again, in the Pak Ou district, the dry season production was more diversified than in Silalek, mostly due to readily access to gardening on river banks. The average cash income derived from dry season farming was 595,000 Kips. The dry season crops were maize, paper mulberry, sweet potato, and vegetables. 13 out of 24 respondents earned less than 500,000 Kips, 11 families earned between 500,000 and 1,640,000 Kips.

Cash income from animal production

Due to more suitable conditions (access to better and larger locations), farmers interviewed in Silalek could earn more from livestock especially cattle, pigs, and poultry with a mean annual income of 3,600,000 Kips compared to 951,000 Kips in the Pak Ou district villages. Livestock in Silalek is based on free grazing in a large area located at a distance of about 15 km from the village (3 hours walk). All villagers can keep as many of their cattle as they wish in this area. They all take regular turns to look after each other's cattle. Natural pasture is available throughout the year. In addition, pigs and poultry are not left to wander in the village as is the case in the Pak Ou district, but kept in a fenced area next to the village. According to interviewees, this method reduces the incidence of animal death from disease. This also reduces the risk of having large number of animals stolen. The Pak Ou district villages we surveyed are located along Nam Ou River and National Road No. 13. In these villages, pigs and poultry are left wandering in the villages. The main problem reported by villagers is that many animals get run over by vehicles and die from diseases. Because of the absence of, or limited access to a suitable area amongst the 3 villages studied in the Pak Ou district, only one family owned two buffaloes.

Non-farm income

The main sources of annual non-farm income in Silalek were: 1. NTFP (bamboo sprout, bloom grass, paper mulberry, wild vegetable, and *Peuakmeuak*: *tree bark*); and 2. salaries from jobs within or outside the village. More than half (11 out of 18 respondents) earned 500,000 Kips and less from non-farm income. The rest earned more than 500,000 and up to 30,000,000 Kips, the mean income being 6,550,000 Kips. In the Pak Ou district, 14 out of 24 respondents earned 500,000 Kips and less from non-farm activities. The others earned more than 500,000 up to 40,000,000 Kips. Most of this non-farm income is from fishing and gold panning in the Nam Ou River. The mean income was 8,880,000 Kips.

Income from agricultural assets

In Silalek, 8 out of 18 respondents owned agricultural assets, hand tractors and small rice mills, while only 2 owned tractors. One farmer earned 500,000 Kips and another earned 770,000 a year from renting these tractors. In the Pak Ou district, 14 out of 24 respondents owned agricultural assets such as tractors or small rice mills. There were three tractors but no one derived any income from renting them.

Some rice mill owners earned income from renting their assets: out of 14 rice mill owners, five earned between 50,000 and 960,000 Kips through rental, with an average income of 478,000 Kips. Tractor rental agreements at both locations only covered access to assets while the cost of gasoline remained at the charge of landowners renting the tractor. There were no set rental prices. The price for renting a tractor varied between 300,000 up to 800,000 Kips/ha in the Nam Ou and between 150,000 up to 800,000 Kips/ha in Silalek. Agreement between relatives usually resulted in more advantageous deals or even services free of charge between close relatives. As rice mills use electric power, service providers usually charge their customers to cover this expense either directly (cash) or indirectly, e.g. they sometimes choose to retain rice bran. Free service exists when rice is milled in little amount or when the service is provided to close relatives. Price varied from 2000-5000 Kips per 50 kg bag.

Total income

The main sources of income in Silalek were, in decreasing order of importance: non-farm income > animal husbandry > wet season production > dry season production > agricultural assets.

In the Pak Ou villages, the ranking was similar except for wet season production which brought more income than animal husbandry. More than half of respondents in both zones (11 out of 18 in Silalek, and 14 out of 24 in Pak Ou district) earned less than 10 million Kips. The total yearly income varied hugely in both locations, from 96,000 to 40,000,000 Kips in Silalek and 95,000 to 40,000,000 Kips in the Pak Ou district. The average annual income was similar in both locations 11,700,000 and 12,700,000 Kips in Silalek and the Pak Ou district, respectively. Although the total income was similar at both locations, mean income per capita was less in Silalek (1,750,000 Kips/person/year) than in the Pak Ou district (2,360,000 Kips/person/year) because families were larger in Silalek. Most of households' per capita income (16 out of 18) was lower than 3,000,000 in Silalek whereas 16 out of 24 households got at least this amount and 8 got more in the Nam Ou area.

Total expenses

Most important and/or frequent expenses were for food, clothing, education, health/medical, travel to distant places, ritual, festival, entertainment, and occasional expenses for repairing/building house, purchasing electronic appliances, and agricultural asset. Respondents in Silalek spent between 1,712,000 and 40,000,000 Kips in 2007, and on average, households spent as much as they earned, i.e. 11,700,000 Kips. A majority of households (14 out of 18) spent less than 15,000,000 Kips. In general, most of the outgoings are related to childrens education and daily needs, which amounts for more than in the Pak Ou district as families are larger. After finishing elementary school in the village, children have to stay in rented houses to continue secondary studies in Xieng Ngeun, about 25 km from Silalek. Children come back to help with farm work during weekends and summer holiday. In the Pak Ou district, households pay less for food because they can catch fish in Nam Ou River. For education, they also pay less because the school is not as far as it is from Silalek and travel by motorcycle or bicycle is possible. In addition, some of the male youngsters study as Buddhist monks, which represents a very affordable education system. Among families interviewed there were 8 boys enrolled in this system. This can reduce parents expenses and provide them with a better chance to access higher education. For secondary and higher education, the Pak Ou district villagers usually send their children to Luang

Prabang, Vientiane and even to Thailand (one Master student). The majority of households interviewed in the Pak Ou district (16 out of 24) spent less than 10,000,000 Kips. The rest spent more up to 30,000,000 Kips. The average household expenses in the Nam Ou area amounted to 8,850,000 Kips

Awareness, involvement, knowledge, general attitude and willingness to adopt SLM technologies: Drivers of the adoption of sustainable land management

SLM Familiarity

Awareness of Sloping Land Management (SLM) and/or Conservation Farming (CF) technologies was high overall, with a large majority of all interviewees aware of techniques such as, alley cropping and multiple cropping. Improved fallow and contour planting, on the other hand, were mentioned by only 27 and 12% of the interviewees, respectively.

Respondents at both sites had very similar degrees of familiarity with SLM practices. Based on an assessment of familiarity with SLM practices on a 5-level scale (5 being the highest and 1 the poorest), farmers in Silalek were slightly more familiar with SLM with an average score of 4.33 while it was 4.00 in the Pak Ou district. 12 out of 18 respondents were aware of SLM technologies in Silalek while only 13 out of 24 did in the Nam Ou area. This is most likely a consequence of the fact that Silalek served as a focus Conservation Farming Community for Northern provinces and hosted field visits for a number of visiting parties during the course of the ASIALAND project. Silalek farmers were well trained and participated in many activities. In addition, they had many occasions to share their skills with many visitors. Unlike Silalek farmers, those in the Pak Ou district adopted SLM as demonstration plots only, so their participation in the ASIALAND project activities was less frequent than that of Silalek farmers.

Area to which SLM practices were applied on-farm

The area to which SLM practices were applied on-farm was very different between the two study sites. More than half of the involved farmers in Silalek practiced SLM on at least 1 ha (11 out of 18 respondents) while only 7 out of 24 did so in the Pak Ou district. The majority of Silalek farmers who implemented SLM technologies (15 out of 18) did so on plots larger than 0.5 ha while in the Pak Ou district, 17 out of 24, applied SLM technologies on less than 0.5 ha. The mean area under SLM was 0.86 ha in Silalek and 0.46 ha in Pak Ou district. The reasons behind these differences were that: 1. There had been a history of cooperative projects in Silalek especially with IBSRAM, Lao Suez, Lao IRRI, and NAFReC. 2. Silalek farmers usually own larger total farm areas than in the Pak Ou district (see discussion in the next paragraph). This created very different situations at the two study sites, with better access to technical assistance and agricultural inputs in Silalek. As demonstration villages, the Pak Ou district villages have only received long-term support from the Lao IRRI and the NAFReC. As a consequence, Pak Ou district farmers did not consider SLM as much of a farming alternative as their Silalek counterparts. They tried it on smaller plots and kept most of their cropping land under traditional slash-and-burn cultivation which they trusted more.

Total farming land

The majority of respondents in Silalek (15 out of 18) owned 3-5 pieces of farm land with an average total area of 5 ha. In the Pak Ou district, only slightly more than half of the respondents (13 out of 24) owned an average of 3 plots totaling an

average 3.5 ha. This difference in access to cropping land is related to three features: location, living conditions, and dependence upon natural resources.

- Location: people in the Pak Ou district live near the Nam Ou River. They cannot cultivate large areas of land on the opposite side of the river due to constraints in crossing the river in the rainy season. On the village side, each family has relatively limited access to land.
- Dependence upon natural resources: many families in the Pak Ou district are food-sufficient and earn some additional income from fishing. Furthermore, many families derive their main income from gold panning.
- Living conditions: many families from the Pak Ou district area do not rely only on farm production for their livelihoods. Some families have already stopped slash-and-burn and turned to small businesses, for example, small shops, the manufacture of furniture, and trade.

-
Among respondents in Pak Ou district, there were a few families who gave their land back to the government because they did not want to have to pay taxes while they were just keeping them uncultivated. Such a situation was not observed in Silalek

Number of seasons during which SLM had been applied on-farm.

Although in Silalek, SLM was applied on larger plots and farmers were more familiar with SLM technologies than in the Pak Ou district, this innovation was adopted for a shorter average period of time than in the Pak Ou villages. In Silalek, 13 out of 18 respondents joined the project during the 1998-2000 period, but they practiced SLM only during the implementation of the ASIALAND. Half of them (7 out of 18) stopped within 3 years (mean = 4.5 years). Only four respondents kept less than half of the fruit trees introduced during the project (which used to be grown to serve as hedgerows) and even this was rather unintentional. These trees remain in fields which have now been returned to conventional slash-and-burn practices only because they grew tall enough to survive exposure to fire cleaning that takes place during slash-and-burn cycles. At the time of the interviews, most plots were under annual cropping (mainly corn, a cash crop Lao farmers have heavily invested in response to Thai market demand, (Figure 3. VT (2008)) essentially, as part of short term rotations.

Figure 3. Discontinued SLM in Xieng Ngeun district: one of many plots planted with corn in Ban Silalek



Figure 4. Ongoing SLM in Pak Ou district.



Agroforestry system (pineapple along contour lines + fruit trees).



Paper mulberry

When asked about the reasons why they chose to continue or discontinue using the SLM techniques introduced to them through the ASIALAND network, farmers from the Pak Ou district and Silalek raised different concerns (Tables 2a to 2d). In Silalek, the reasons farmers alluded to explain why they discontinue SLM were:

- They still relied heavily on shifting cultivation for their livelihoods because it was the only viable option for them, both economically and in terms of labour input. Noticeably, many respondents indicated that, even when they experimented with SLM, they had to put every plot into a fallow-cycle that was subsequently slashed and burned to control high weed pressure.
- Pineapple introduced by the project rapidly became difficult to control and the system was not beneficial anyway. Pineapple production only served household consumption. Fruit trees in the hedgerows did not seem to bring any income either.
- Reported cases of fruit theft appeared to become a recurrent problem too.

In contrast, in the Pak Ou district, 19 out of 24 respondents joined the project during 2000-2002. 18 out of 24 plots remained under some sort of SLM practice for 5-8 years up to now (mean duration = 5.38 years), for example, agroforestry: mainly paper mulberry + fruit trees (Figure 4).

Table 2a. Reasons for continuing SLM (Pak Ou district)	
13	Self-consumption or source of extra income (fruit and/or paper mulberry).
2	Do not want to waste investments made (time and project's support). Willingness to transmit knowledge and benefits to next generation.
1	Source of animal feed.
1	Source of extra income and willingness to stop slash-and-burn cultivation.
1	Good for soil fertility.

Table 2b. Reasons for discontinuing SLM (Pak Ou district)	
3	Lack of motivation due to low return on investment.
2	Too labour intensive.
1	Weed pressure/canopy closure of other perennials

Table 2c. Reasons for continuing SLM (Silalek)	
4	Fruit trees are tall enough to stand up to fire.
2	Self-consumption of fruit and source of extra income (sale of fruit and/or paper mulberry).

Table 2d. Reasons for discontinuing SLM (Silalek)	
5	Excessive weed pressure, only slash-and-burn is viable.
2	Too labour intensive.
1	Excessive weed pressure plus theft of fruits.
1	End of support from the ASIALAND network.
1	No need for forage (natural forage sufficient).
1	Excessive weed pressure and end of support from project.
1	Land owner took the land back.

General attitude towards and willingness to adopt SLM technologies

The 2008 a survey confirmed the need for better coordination between governmental and non-governmental agencies in the promotion of SLM to communities as well as the ineffectiveness of printed information as a dissemination platform on SLM to farmers (questions 3 and 6, Table 3). One important finding of the survey is that, when asking the same (or very similar) questions as that were submitted on the occasion of the impact assessment of the ASIALAND Network conducted in 2004 (Maglinao et al., 2005) regarding farmers' general attitude towards and willingness to adopt SLM technologies, we were given overwhelmingly different answers (Table 3). If one likely explanation for some of these discrepancies can be that some questions did not fully make sense to some respondents (for example, it is not so surprising that respondents have answered questions 1 and 2 in Table 3, in a radically different manner than they did in 2004, now that the project is terminated), it remains that some other discrepancies are most likely linked to the fact that respondents do not necessarily provide the same answers to the same questions depending on their interlocutor. Specifically, the comparison of answers given in 2008 to questions 5, 7 and 8 with that given to the same questions in 2004 shows that when talking to investigators who have no direct ties with the project under scrutiny, a majority of respondents are inclined to openly express critical opinions about the project, its implementation and outcomes.

Table 3. General attitude towards SLM

Statement	Agree			
	Average	Nam Ou	Silalek	2004
1. I would rather get information on the SLM technologies from the IEC materials of the ASL Project than from other sources.	17.07	21.74	11.11	100
2. I would rather get information about SLM from farmer-volunteers than from the non-farmers.	12.2	21.74	0	80
3. The government and non-governmental organizations should be partners in promoting conservation farming in my community.	90.48	86.96	94.44	100
4. I would rather solve the problems in my farm myself than seek the help of other people.	59.52	52.17	66.67	22
5. I would rather get information on SLM technologies from a government than from a non-government extension worker.	28.57	17.39	44.44	100
6. I prefer attending hands-on training and demonstration to reading information materials on SLM technologies	95.24	91.3	100	100
7. I would rather burn the crop residues than plow them back to the soil.	73.81	52.17	100	19
8. I would rather use traditional cultivation practices than adopt sloping land management techniques*	85.71	78.26	100	21

*Original question in Maglinao et al. (2005) was: "I prefer traditional cultivation practices to the sloping conservation farming system because it is faster to get income from the agricultural products". Answers given in 2008 need to be compared to answers given in 2004 to the following questions: 1. It is difficult for farmers to use soil conservation practices if the government will not provide subsidies and 2. Soil conservation practices require more labour and therefore are difficult to adopt which 87% and 51% agreed with, respectively.

Discussion and conclusions

The survey conducted in 2008 at former Conservation Farming Villages setup and supported within the framework of the ASIALAND network in Laos showed that only 4 years after the end of the project's final phase, abandonment of the soil conservation technologies it introduced was well underway, with 25 to 66% of the farmers who were practicing a form of SLM in 2004 having discontinued such activities by 2008. This contrasts sharply with the optimistic report of increasing SLM adoption by Lao farmers involved in the network between 2002 to 2004 made by Maglinao et al. (2005).

While interest in SLM technologies and willingness to participate in new projects was still high among the respondents, common criticisms made about practices introduced by the ASIALAND network were that they were too labour intensive/time consuming and that the returns gained from their implementation were too marginal. Indeed, the results of our survey confirm that while they were generally all rice-sufficient, the vast majority of households from the studied villages made just enough cash income to cover their expenses (i.e. slightly under USD 1,400/household/year for an average household including 5 family members and with USD 1.00 = LAK 8,500.00, which is less than USD 1.00/person/day). Under such tight financial circumstances, it is no wonder that these communities are willing to adopt only the most lucrative and least labour intensive livelihood options accessible to them. This is most likely why we observed that, within the communities we surveyed, those who had more alternatives for non-farm income

generation were also those most inclined to continue SLM: as they derive the main share of their cash income from gold panning, many households of the Pak Ou district can afford to maintain SLM plots because they do not rely exclusively on farm-income for their livelihood. In contrast, Silalek farmers, who rely more heavily on farm-income for their livelihood, have no other option than to reorient their activities based on regional/global markets which currently leads them to discontinue SLM and to move to cash crops. Although a risky bet, as recently demonstrated by the enforcement of a ban on corn imports by the Government of Thailand which is going to badly hit Lao farmers (VT, 2008), it remains that cash crops are, for many Lao smallholders, synonymous with better income from minimal investments and would conform to the strategy of the Lao Government as one of its approaches to addressing poverty in rural areas. The drivers associated with moving to a cash crop enterprise and associated market uncertainties or loss of natural capital, raises the question of what counteracting mechanisms could be put in place to revert such a trend and create conditions for long term adoption of SLM. In fact, the ASIALAND network already raised this question by pointing out that the provision of incentives to farmers was still an unresolved issue by the end of the project's final phase (Maglinao et al. 2005): encapsulated in the notion of incentives is the *de facto* acknowledgement that SLM cannot be successfully implemented without sustained external support.

As a logical and practical extension of the idea of providing incentives to upland farmers to adopt SLM practices, we believe that the development of HP operations in many parts of Laos will be a unique opportunity to accommodate international, national and corporate interests with that of the affected communities. It is evident from the example of the Pak Ou district where we have conducted part of our survey, that HP developments in this and similar areas, will greatly and negatively affect the livelihoods of local communities, as they will inevitably be deprived of essential sources of income (such as gold panning in the case of the Pak Ou district). However, the concept of benefit sharing, whereby HP companies will share a fraction of their benefits with the affected communities for the whole life cycle of the HP project, offers new avenues to compensate those communities for the losses inflicted to them through the implementation of contractual agreements for the provision of environmental services which will largely depend on the long term adoption of SLM practices.

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ANNEX 3

Possible mechanisms for sustainable development within the hydropower sector of South East Asia: An assessment of PES and benefit sharing

Andrew Noble

“The self organizing principles of markets that have emerged in human cultures over the past 10,000 years are inherently in conflict with self-organizing principles of ecosystems that have evolved over the past 3.5 billion years. The rules governing the dynamics of ecosystems, within which all human activity take place, are ultimately a function of biological laws, not a function of human-created economic systems” Gowdy and McDaniel 1995.

1. Background

The words of McDaniel (1995) are poignant in that they clearly highlight a fundamental divergence in our endeavors to create wealth and human wellbeing at the expense of natural resources. The loss of biodiversity is the most fundamental crisis facing the human species. Wilson (1992) and others have convincingly argued that human activities are currently causing the sixth major biodiversity extinction of the past 500 million years. These are thought provoking comments that clearly indicate we are faced with significant challenges as a species that requires a change from ‘business as usual’.

In an endeavor to satisfy man’s insatiable demand for food and fibre, pristine forests have been converted to agriculture, resulting in dramatic declines in the functionality of ecosystems and the services they provided.

In an effort to value the biodiversity and services of ecosystems, the concept of ecosystem services (ES) has emerged in the current debate on reforming our approach to land stewardship. In a simplistic manner ES regulate and support natural and human systems through cleansing, recycling and renewal of biological resources. These services are crucial for the sustainability of human development in economic, social, cultural and ecological terms (Daily et al., 1997). As global populations increase and economies expand, the consequences associated with these anthropogenic pursuits will have a negative impact of the services that ecosystems provide (Millennium Ecosystem Assessment, 2005).

It is well recognized that valuable services are provided by ecosystems that are often termed as intangible externalities. For example, a forest provides vital services that include watershed protection, biodiversity conservation, and carbon storage. Degradation of the forest could lead to an inability of the system to provide these services that are manifest in local scale flooding and degradation of water supplies, to global scale climate change, to loss of ecosystem resilience, scenic beauty, and accessible sources of sustainable timber and non-timber forest products as well as all other services supported, directly or indirectly by well-functioning forest ecosystems. In summary ecosystems and biodiversity provide a wide range of services through their bio-geo-chemical processes that are critical in supporting man (Kumar, 2005).

A unique feature of most of these services that emanate from ecosystems is that although they are acknowledged they are often unaccounted, unpriced and

therefore remain out of the domain of the market. Conventionally such problems are treated as externalities where the market fails, and decision-makers try to correct the market failure by creating a market-like situation. In order to address this inadequacy the value of services are estimated through various valuation techniques that are often based on the preferences of individuals (Kumar, 2005). A further complication in the concept of markets for ecosystem services is that most of the vulnerable segments of society, primarily in developing or emerging countries, depend on these services directly or indirectly for their livelihoods (Kumar, 2005). It is clearly evident from the literature that the value of these ecosystem services where they can be quantified can be significant. For example crops pollinated by wild bees and honey bees in the United States are estimated to represent a monetary value of USD 30 billion (Myers, 1996).

The Millennium Ecosystem Assessment (MEA, 2005) distinguishes four types of ecosystem service that is based on functionality:

- The provisioning of services such as food, timber, water and fibre;
- Regulating services such as the regulation of floods, drought, land degradation and disease;
- Supporting services, such as soil formation and nutrient cycling; and
- Cultural services, such as recreational, spiritual, religious and other non-material benefits (MEA, 2005).

It is important to note that in the PES literature attempts have been made to distinguish between ecosystem services on the basis of resource contents of the services. Four such services have therefore been predominantly identified, namely:

- Hydrological services (watershed protections), e.g. downstream water users pay upstream farmers to adopt landuses that limit deforestation, soil erosion, flooding risks, etc.
- Carbon sequestration, e.g., an electricity company in the northern hemisphere pays farmers in the tropics to plant and maintain additional trees;
- Biodiversity protection e.g., conservation donors pay local people to set aside or naturally restore areas to create a biological corridor; and
- Landscape beauty e.g., a tourism operator pays a local community not to hunt in a forest in which tourists view wildlife (Wunder, 2005; Pagiola et al., 2005; Grieg-Gran et al., 2005).

Partial trade-offs between services are also likely. For example, a fast-growing plantation that maximizes carbon sequestration is probably not particularly biodiversity-rich, water-enhancing or aesthetically pleasing to tourists. Further other environmental services other than those listed above could potentially be traded (i.e. wilderness areas providing pollination services for agriculture) (Wunder, 2005). Supporters of the concept stress that there is an urgent need for innovation in the conservation of resources as current approaches provide too little value for declining funds; that PES can provide new (i.e. private sector) funding; and that poor communities selling these services will benefit with improved livelihoods – the concept is pro-poor (Wunder, 2005). In contrast, detractors stress that PES ‘will bring back the fences’ by decoupling conservation from development; that asymmetric power distribution means powerful conservation consortia may deprive communities of their legitimate land-development aspirations; and that commercial

conservation may erode culturally rooted, not-for-profit values (Romero and Andrade, 2004; Karsentry and Nasi, 2004, Karsentry, 2004; Vogel 2002).

In the following narrative we attempt to define the concept of PES; assess the extent of the practice from a global perspective with specific reference to SEA; explore some of the issues and challenges that face PES; and examine the role of PES as a pro-poor instrument. A brief discussion of benefit sharing is made in the context of the HP sector.

The Concept of Payment For Environmental Services

The emergence of direct economic incentives for the conservation of environmental services indicates a shift from the predominantly used command-control mechanisms (i.e. establishment of parks and logging bans) to a more flexible and efficient ecosystem protection (Landell-Mills and Porras, 2002). Pagiola and Platais (2002) point to several advantages to PES that include more efficient, sustainable and mutually beneficial arrangements between environmental-service providers and users. Rosa et al., (2004) emphasize the potentially positive social outcomes that, monetary benefits aside, can be achieved through increased cooperation among participants in a PES system, including improved internal organization and strengthened land tenure.

Historically, the dual objectives of increased conservation and improved livelihoods have been the focus of Integrated Conservation and Development Projects (ICDP's). However, many of these projects have not reached their full potential. Critics attribute this failure to the assumption that enhanced economic development leads directly to improved conservation outcomes (Ferraro 2000; Ferraro and Simpson 2000).

Payment for environment services can be considered as one approach among a range of instruments that contribute to ensuring the continual flow of ecosystem services. In this respect these instruments have developed to regulate human use of natural resources and therefore the flow of ecosystem services and include, but not limited to:

- *Regulations and restrictions* that are sanctioned either culturally or through formal law (i.e. the establishment of protected areas). This can be enforced through cultural, social and legal means;
- *Increasing the level of information and awareness* by informing people on the importance of the continual flow of ecosystem service and the potential impact of their own activities upon these services with the assumption that awareness may induce behavioral changes; and
- *Economic instruments* in the form of *sanctions*, such as fines that discourage pollution or deforestation; *resource use fees*, such as licenses to be paid for the right to cut timber or use water; *incentives*, such as tax reductions; or *direct payments*, to encourage specific types of human activity such as maintaining forest cover (Ravnborg et al., 2007).

PES effectively constitutes one among several possible instruments that may be employed to ensure the continual flow of ecosystem services.

The basic principle of payments for environmental services (PES) is that those who provide environmental services should be compensated for the cost of doing so, whether these are direct costs of specific land use practices or more indirect opportunity costs of avoiding certain activities or types of land use. Payments may be monetary or in-kind, may involve the private sector or government financing, and can be made at local, national, and global levels (Grieg-Gran and Bann, 2003). Hence the basic notion underlying the concept of PES is that ecosystems such as natural forests, landscapes with mixed patterns of human use and natural vegetation, as well as intensively cultivated agricultural landscapes all provide important services to people – locally, regionally and globally – and that these services do not accrue to those directly or indirectly responsible for their provision (Ravnborg et al., 2007).

Wunder (2005) defined PES as a “voluntary, conditional transaction with at least one seller; one buyer; and a well defined environmental service”. The aforementioned definition encapsulates 5 criteria namely:

1. A voluntary transaction where
2. a well defined ES (or land use that is likely to secure that service)
3. is being bought by a (minimum of one) ES buyer
4. from a (minimum of one) ES provider
5. if and only if the ES provider secures the ES provision (conditionality).

Each of these criteria is discussed in brief for clarity.

Voluntary transactions: PES is defined as a voluntary transaction that distinguishes it from so-called command-and-control⁵ mechanisms as it is assumed that the providers of the service(s) have ‘*real*’ choices in how to manage the ecosystem. If one takes into account that nearly half of the legally protected forests areas are heavily used – illegally – for agricultural and forest product extraction (McNeely and Scherr, 2003), just as other types of regulations are only partially enforced (Ravnborg et al., 2007). This implies that potential ES providers might have *real*, but not *legal* choices in how to use natural resources. Thus it is argued by some that besides having *real* choices, potential ES providers also require *legal* choices in how to manage the ecosystem in question. In most countries, other types of economic instruments exist to promote the provision of ES in cases where potential providers do not have real and legal resource management choices. These include compensation to land owners for their potential loss of income which the restrictions may imply, e.g. as one-off compensations associated with the declaration of a specific protection status, or rewards to people for their continued contribution to achieving effective protection, e.g. through the granting of tax exemption for land within protected areas (Ravnborg et al., 2007).

Defined service: A defining attribute of PES is that there is a need for a clearly defined and measureable service (e.g. additional tons of carbon stored within the target area) or land-use caps that are likely to contribute to the provision of services (e.g. forest conservation areas assist in providing clean water). Due to the high degree of complexity that is innately an attribute of ecosystems and the services

⁵ These regulations are tools for implementing legal instruments that prohibit environmentally damaging uses, expropriate owners, create strictly protected areas, and support other interventions targeted directly at resource protection. They do not aim to alter development paths or use economic incentives unless corruption turns these regulations into de facto unofficial taxes (Wunder, 2006).

they provide, it may not be always possible to have a clearly defined and measureable service identified. Further, what is being bought is expressed rather as a specific natural resource management practice known or assumed to lead to the provision of the desired ecosystem service. Examples of such cases include reforestation of riparian land that is important in water infiltration, or leaving it fallow to avoid sedimentation as well as increase infiltration – all these practices are assumed or known to provide hydrological services (Ravnborg et al., 2007). Further the four previously identified categories of ecosystem services could effectively be addressed by a single ecosystem management intervention. This is referred to as ‘bundling’ of ecosystem services. For example the protection of traditional coffee plantation management systems, where coffee is cultivated ecologically in the under storey of natural forests, is likely to provide not only biodiversity services but also watershed and landscape beauty services (Perfecto et al., 1996).

It is also important to acknowledge that hydrological services are often based on beliefs rather than scientific proof (e.g. forest cover always increases water availability) (Kaimowitz, 2004; Calder et al., 2004). In this respect afforestation programmes have and are still being promoted within watershed development programmes that are based on ‘hydrological services’ and ‘headwater conservation functions’. In Costa Rica, both government led PES programmes and private agreements with the hydropower sector were initially based on this ‘universally accepted’ knowledge, although currently it is defended as a ‘precautionary principle’ in the absence of better – or more acceptable – scientific knowledge (Calder et al., 2004). Hence, payments that build on scientifically unlikely events or on relationships that have been proven to be myth will tend to decrease the robustness of PES and hence its sustainability. This is based on the fact that the less realistic the scientific basis of a PES scheme the more exposed it is to the risk of buyers questioning the rationale and abandoning services (Wunder, 2005).

It is also important to recognize that the types of ecosystem services highlighted pervious can be further characterized according to the degree of spatial boundedness of the beneficiaries of the ecosystem service⁶. In this respect the principal beneficiaries of an ecosystem service can be either local e.g. beneficiaries in the area where the service is produced; regional e.g. beneficiaries distant from the area where the service is produced; or global e.g. beneficiaries who in principal many be located anywhere in the world. This spatial boundedness characteristic of the ecosystem service beneficiaries has important implications for the institutional arrangements between buyers and sellers of the service.

Buyers and sellers: PES requires a minimum of one buyer and one provider of the ecosystem service, although the transfer often occurs through an intermediary. Whilst this is an imperative in that it is often difficult to identify buyers and also to have buyers that have the capacity to purchase these services. A study undertaken in Latin America, Asia and Africa identified the lack of buyers as one of the biggest barriers associated with the adoption on PES (Waage, 2006). This was associated with buyers being unaware of the PES concepts whilst others thought that it is too risky a mechanism to trust. In the case of Africa, difficulties in identifying buyers is

⁶ Rosa et al. (2003) distinguishes between ecosystem services based on what they call ‘integrating levels’ where level 1 refers to self-provisioning ecosystem services i.e. services that accrue directly to those responsible for their provision. Level 2 refers to ecosystem services that may be embedded into already marketed products, as when habitat protection is incorporated into coffee through the production and sale of shade-grown organic coffee. Finally, level 3 refers to ecosystem services which have not yet been incorporated into products and which new forms of ‘compensation mechanisms’ thus have to be identified.

clearly a factor in limiting its adoption particular where urban water and electricity consumers are poorly organized and the presence of resourceful beneficiaries of 'local' ecosystem services, such as a steady flow of clean water, is scattered (Ravnborg et al., 2007). Until the emergence and organization of such local and regional buyers, PES schemes are more likely to be successful with respect to global rather than local and regional ecosystem services. This would also be the case where the potential buyer of the services is unable to afford the cost of that service which is often the case in rural areas where you have poor upstream and downstream communities.

The UN Economic Commission for Europe (UN, 2006) based on the types of buyers and sellers have distinguished between public, private and trading schemes in their draft code of conduct regarding PES in integrated water resources management:

- Public schemes are those in which a municipality or a local or national government act as the sole or primary purchaser of a specified ecosystem service or a related land use or management practice. Public schemes tend to be local or regional schemes.
- Private schemes are those in which both buyers and sellers are private entities (companies, NGOs, farmer associations or cooperatives, private individuals). Private schemes tend to be local.
- Trading schemes refer to markets in which established rights (or permits) and/or quotes can be exchanged, sold or leased. Trading schemes such as the CDM tend to be global schemes.

In the context of qualifying as a PES scheme there is a need for a cash or in-kind transaction to occur. Several terms are currently being used to describe the form of remuneration in return for the provision of the ecosystem service. These range from payments (Wunder 2006), markets (Scheer et al., 2004), compensation (Rosa et al., 2004) to rewards (RUPES⁷ programme; van Noordwijk et al., 2004). Apart from the semantic differences between these terms, they also reflect more profound conceptual differences. Whereas the RUPES programme implies a right-based notion in that upland resource managers are entitled to receiving a reward for the environmental services they provide, irrespective of whether the continued provision of these services is threatened by competing land uses, the concept of 'compensation' implies that only those who incur costs associated with the provision of ecosystem services should be compensated (an amount equivalent of the cost incurred) (Ravnborg et al., 2007). In the case of the RUPES approach where the concept everybody who delivers a benefit should also be rewarded, this general connotation runs the risk of raising excessive expectations, since services that are neither of high value and/or not threatened are unlikely to find buyers (Wunder, 2006).

The term 'markets' for ES has been widely used and implicitly congers up the notion that there are multiple actors, choices and competition to some degree. Such markets do exist in developed countries, but in developing countries they seem remote (Wunder 2006). However, market mechanisms can face general restrictions in developing countries in that the localized nature of the eco-services often limits competition on the supply side, sometimes creating de facto monopolies (Wunder 2006). For example, take the case of an urban water utility. If

⁷ Rewarding Upland Poor for Environmental Services.

it believes that the price for watershed protection charged by upstream farmers is too high, usually it cannot move to the next three watersheds for a better offer! Consequently the very nature of highly localized environmental services, combined with structural impediments to competition, severely restrict the scope for true market forces (Wunder and Vargas, 2005). It is also pertinent to note that in Bolivia and Vietnam “markets” can come to be ideologically equated with neo-liberalism, creating a political alienation detrimental to promoting PES (Wunder and Vargas, 2005). In the Vietnam context Wunder and Vargas (2005) found that tiny payments for watershed protection are being routinely made, but to visualize them as money changing hands to buy a service was perceived as inappropriate, since it could be construed to be associated with corruption. Hence within the context of Southeast Asia it may not be appropriate to use terms that may result in confusion and outright resistance. As will be discussed later in this manuscript, the concept of ‘*benefit sharing*’ may be a more appropriate term.

Conditionality: Finally PES is defined as a conditional transaction that is contingent upon the continual provision of the service. This implies that users should only pay if the service is delivered or the resource management practice assumed to ensure the service is provided, and the providers will only provide the service if they receive the agreed payment. Consequently, monitoring of the operational and the environmental impact is of critical importance. However, in reality, many initiatives are loosely monitored or not at all, payments are up front instead of periodic and they are often made in good faith rather than being truly contingent on monitored service provision (Wunder, 2005).

The transaction can take different forms and include the following (UN, 2006; Ravnborg et al., 2007):

To sellers:

- Direct compensation or payments: Compensation – either monetary or in kind – or incentive rates (e.g. tax exemption) are set and defined for a specified land use or management practice.
- Investment or development fund: Payments are collected from buyers and placed in a trust fund, which in turn is deployed by the PES scheme for investments in ES enhancing practices or activities. While flexible, the disadvantage is that the buyer committing resources to the fund do not know what type of services and benefits they will receive in return. This can in part be overcome by the buyers becoming trustees or members of the board of the trust fund.

To buyers:

- Customer-charged payments: participating utilities (e.g. water supply and electricity) and industries may charge their PES contributions directly, and explicitly, to their customers.
- Lump-sum contributions: Participating buyers may contribute annual lump sums (or one-off payments in the case of a trust fund). These payments may be set on the basis of negotiations that reflect how much buyers are willing to pay and how much is need to acquire the service; or as a fraction of the turn-over or profit of the participating utilities or industries.
- Taxed-based contributions: Public schemes may be financed through taxes. However to qualify as a ‘payment’, in contrast to a subsidy, the tax must be

explicitly demanded and spent for the purpose of the ecosystem service to be acquired.

PES based systems and their implementation

Payment for environmental services belongs to a family of approaches that make use of economic incentives as the core instrument in its implementation. It is effectively a shift from the predominant use of a command-and-control mechanism (i.e. the establishment of a national park or logging ban) to a more flexible and efficient ecosystem protection mechanism (Landell-Mills and Porras, 2002). Landell-Mills and Porras (2002) show that under the right conditions PES systems result in more conservation and improved livelihoods for poor people.

Historically the dual objectives of increased conservation and improved livelihoods have focused on Integrated Conservation and Development Projects (ICDP) that whilst having a clear object have not delivered the desired outcomes. These systems have failed since the assumption that enhanced economic development automatically leads to improved conservation outcomes is flawed (Ferraro, 2000; Ferraro and Simpson, 2000). Within the context of the PES system the payment option is implemented in recognition of existing 'hard trade-offs' between conservation and development (Wunder et al., 2005). Conversely, if both service provider and user have full overlapping interests e.g. both would naturally choose to conserve the same forest areas, then there is no rationale for introducing a PES scheme. It is important to bear in mind that a basic precept in a PES based scheme is that conflicts of interests provide the rationale for PES.

Examples of PES globally

Several PES systems have been implemented in developed countries that have focused on agro-environmental services and on regenerating forests by subsidizing the abandonment of marginal agricultural areas (i.e. the conservation reserve program (CRP) in the USA). In the tropics the most prominent PES system was implemented in Costa Rica that entailed the enrolment of landowners into a scheme where they agreed to conserve forests or establish forest plantations or agroforestry area. In return landowners received a per-hectare annual payment from a State-run national forest fund, which receives its funding from a tax on fossil fuels, from international loans, as well as from specific environmental-service users such as hydroelectricity generators and breweries (Wunder et al., 2005). In Ecuador, the water consumers in the town of Pimmanpiro pay upstream farmers not to deforest and degrade the watershed that is generating the bulk of their drinking water (Echavarria et al., 2004). Further examples of PES associated with C sequestration, ecotourism and biodiversity protection are evident in the literature and have benefited from these payment schemes. The sources of funding for these schemes varies and includes CDM through to the production of bird-friendly coffee in El Salvador where the product is sold to environmentally conscious consumers paying a premium over normal coffee. These premiums in turn flow back to the producers financing their extra costs of producing environmentally friendly coffee (Pagiola, et al., 2004). There are numerous examples where markets for ecosystems have been created that are effective or promising within different contexts and situations (see Kumar 2005; IUCN 2004)

There are several lessons that can be gleaned from these pilot schemes. It is important to spatially target priority areas. In many cases those receiving the PES funds may not have had genuine intentions of putting the land to alternative use, thus implying limited additions of the scheme i.e. the PES systems buy less extra environmental protection than would have been possible with increased targeting (Ibarra 2003; Zbinden and Lee 2005). Two global examples of PES that have been documented are presented below.

a) Cauca Valley, Colombia

In the late 1980s, private farmers initiated a voluntary system of payment for water use in the Cauca Valley, Colombia. The payment system was designed to improve the livelihoods of the upland poor as part of a strategy for sustainable watershed management. The uplands of the Desbaratado Watershed in the Cauca Valley were inhabited by poor farmers. Seventy-two % lacked sanitary facilities and 83 % had no electricity, but most held titles to their land (Echavarría 2002). Overgrazing and deforestation on the slopes of the watershed had led to erratic stream flows and destructive seasonal flooding in the lower basin, the effects of which were being felt by landowners downstream. These landowners consisted mainly of wealthy sugarcane growers who had invested in costly farming technologies, including laser leveling, subsurface drainage and irrigation systems (Echavarría 2002). With the threat of continually escalating costs to protect their investment, the farmers became interested in regulating the stream flow by restoring and improving management of the lands in the upper watershed. They subsequently organized into twelve Water User Associations (WUA's) and instituted voluntary user fees to finance upland watershed management.

The WUAs came to the conclusion that the surest route to achieving long-term land-use change in the upper watershed was to improve the livelihoods of the land users. With the aid of the government, planners met with upland communities to identify community priorities for development. The result of these meetings was a series of programs with wide-ranging social benefits, including:

- A “social programme,” providing education and skills training;
- A “production programme,” which includes building home gardens to improve diets and increase earnings, as well as reforestation and crop-planting projects;
- An “infrastructure program,” which focused on improving sanitary and drinking water facilities, building roads, and constructing erosion control structures (Echavarría 2002).

From 1995 to 2000, an estimated US\$1.5 million was invested in the upper watershed – all from the water fees assessed by the WUAs (Echavarría 2002). So far, the environmental commitment of downstream users has remained strong, and upland projects have continued even in the face of armed guerilla activity in the region. Considering the length of the project, this suggests that benefits on both sides have been worthwhile.

b) Chiapas, Mexico: Scolel Té

The Scolel Té project in Chiapas, Mexico, represents one of the first efforts to make the international market for carbon storage benefit poor communities. Companies interested in offsetting their greenhouse gas emissions can purchase carbon credits from a local organization, Fondo BioClimático, with two-thirds of the

revenue going to farmers (Scherr et al., 2004). The largest buyer thus far has been the Fédération Internationale de l'Automobile, which purchased over 13,000 tons of credits to offset some of the emissions from professional auto racing (IUCN 2003:1). Farmers who join the Scolel Té scheme must draw up a management plan for their land and agree, to the extent possible, to maintain the trees on their land over the long-term. Fondo BioClimático provides technical support and training to participants in managing their land. Scolel Té is more than a strict reforestation program. It also allows participants to plant "live fences," shade-grown coffee plantations, and mixed agroforestry plantations. In addition to the PES payment they receive, farmers can make money on regulated sales of timber as well as non-timber products. They also commonly plant food crops under the trees until the canopy closes over (IUCN 2003). Because of this variety of income sources, the programme is more attractive to farmers.

Since its inception in 1996, Scolel Té has gained more than 700 participants in 40 communities. In 2002, sales of carbon credits at US\$12 per ton amounted to \$180,000, translating into \$120,000 distributed among the participants. The project has also enabled farmers to penetrate markets in sustainable timber, organic coffee, and other agroforestry products. For many, access to these valuable markets has been the more important route to greater income (Rosa et al., 2004). The project has generated positive environmental benefits locally as well. Plantings on denuded hillsides are helping to reduce erosion and improve soil quality.

Local examples of PES

Yen Binh reforestation program, Vietnam. There are several examples of PES based systems that have been established in the region. These schemes have been of mixed success and have focused largely in Vietnam (Wunder et al., 2005). An example of one of these schemes established in Vietnam is drawn from Yen Bai Province.

Yen Bai is located in the upland region of the Red River Basin, approximately 200 km northwest of Hanoi and is one of the poorest provinces in the northern mountainous area of Vietnam. The province is inhabited by several ethnic minorities including the H' mong, Dao, Tay, Thai, Nung, San Chay, Phu La and Kinh. In the 1960's approximately 60% of the province was forested. During the 1970's and 1980's the forest cover of the province declined to 30% by the early 1990's. In order to reverse the decline in forest cover and to resort the forest cover to 60% by 2010, State Forest Enterprises (SFE's) have embarked on an ambitious reforestation program in which households in the Tan Huong commune (Yen Binh District) signed reforestation and protection contracts with the Yen Binh's SFE. Farmers were paid approximately USD 155 per hectare for reforestation which included USD 116 for tree planting and USD 39 for tending the forest for the first 3 years after planting. The income generated through these reforestation contracts was quite significant at the household level. Further, households also received financial and technical support for reforestation for production purposes. In contrast, for protection contract the payment that contract households received was USD 1.6 per hectare per year.

In the aforementioned case the a reason for the reforestation and protection was in part driven by the protection of a hydroelectric dam from sedimentation caused by upland agriculture on degraded lands. However, there are a number of myths

regarding the generalized hydrological benefits of forests. In particular the assumed hydrological benefits of upstream reforestation for the protection hydroelectric dams from siltation. For example, an in-depth study from a watershed in Central America has shown that well-managed pasture can be as effective as forests in controlling erosion, consumes less water than tree cover, and provides higher incomes to land users (Aylward, et al., 1999). Wunder et al. (2005) argue that in terms of reducing flood risk, the massive Vietnamese reforestation efforts are unlikely to have any mitigating impact on large-scale catastrophic flood events, but they may reduce the severity of more localized floods in smaller watersheds.

Challenges and issues associated with PES

There are legal and social hurdles that inhibit the implementation of PES schemes in developing countries (Kiss, 2002). PES schemes are easier to implement if there is secure individual land tenure and a legal and functional framework governing land rights. Further, rural populations in developing countries predominantly are dependent on subsistence based production systems or the extraction of natural resources. When land is dedicated to remunerated conservation through direct payments, the original owners may become dispossessed if their land rights are not secure in the first place.

Despite the relative simplicity of the PES concept and the five defining criteria previously discussed, relatively few real-life PES schemes actually meet all these criteria. In an assessment of incipient PES initiatives in Bolivia, Robertson and Wunder (2005) did not find any which met all five criteria. As is inevitable when new approaches come into fashion, many ongoing and new initiatives are currently being (re)labelled as PES without necessarily meeting the criteria for qualifying as PES (Ravnborg et al., 2007). Such 'opportunistic' labeling may partly explain the shortcomings of so-called PES experiences in meeting the five criteria. However, beyond that, the shortcoming may also reflect real challenges facing efforts to use PES as an instrument to achieve the protection of ecosystems and the continued flow of ecosystem services (Ravnborg et al., 2007). Some of these challenges relate to the PES concept itself and could be considered 'internal' challenges, while others rather relate to the contexts within which PES is put into practice and could therefore be referred to as contextual challenges.

Internal challenges

Incomplete knowledge on the links between desired ecosystem services and ecosystem management practices can lead to de facto non-conditionality.

In most cases, knowledge regarding the impact of specific changes and combinations of natural resource management practice on the provision of ecosystem services is only partial. This effectively means that PES arrangements have to be designed on the basis of *assumed* rather than *proven* causal relationships between the two (Ravnborg et al., 2007). Muñoz-Piña (2005) describe how the Mexican hydrological environmental services programme had to be launched on what they call a precautionary principle rather than based on a proven relationship between forests and water flow. This was, however, acceptable to the majority of the ultimate service buyers – the water tax payers – due to a strong perception by the public, civil society organizations and government officials that forests do play an important role in protecting water resources. Hence, in order to

avoid the 'perfect' becoming the enemy of the 'good', such a pragmatic approach is advisable in many situations. However, the risk is that the conditionality criterion of a PES scheme is sacrificed, because buyers become trapped in an agreement through which they pay for a specific management practice rather than for the ecosystem service they demand. Therefore, PES agreements based on assumed rather than proven causal relationships between paid-for management practices and demanded ecosystem services need to be accompanied by mechanisms that regularly examine the validity of these assumptions and contain options for re-negotiating the agreement in case new knowledge renders these assumptions invalid (Ravnborg, et al., 2007).

Involving intermediaries without sacrificing the direct, voluntary transaction.

What can be described as 'a voluntary transaction between at least one buyer and at least one seller', often turns out to be a considerably more complicated transaction. Urban water consumers who want to ensure the continued provision of water for their water utility cannot themselves choose to deal with just one provider, if the catchment area for their water supply is owned and managed by thousands of independent land managers, nor would it make much sense if each of them opted to deal with all the catchment managers individually. Hence it is hard to imagine a PES scheme without the involvement of intermediaries. However, to minimize the risk that the involvement of intermediaries implies that no direct transaction takes place, and that the transaction becomes forced rather than voluntary, it is important to specify the accountability of the intermediaries involved. In this context, three broad roles can be distinguished for intermediaries in PES arrangements. One PES agreement might include one or more intermediaries involved in one or more of these three roles:

Intermediaries acting on behalf of numerous individual consumers of ecosystem services.

When users of ecosystem services consist of many individual users such as urban water or electricity consumers, intermediaries may conveniently act on behalf of the direct users of the ecosystem service, collecting user fees and negotiating agreements with service providers. In many cases, already existing public utilities will undertake this function, thus acting as the buyers of the ecosystem service on behalf of already known ecosystem service users. In other cases, eco-tourism agencies act as buyers of ecosystem services such as landscape beauty on behalf of future users of ecosystem (Ravnborg, et al., 2007).

Intermediaries acting on behalf of numerous providers of ecosystem services.

Intermediaries acting on behalf of individual providers of ecosystem services will often be needed in order to bring down transaction costs compared to a situation where each potential service provider has to enter individually into a PES agreement. In addition, certain ecosystem services cannot be provided by potential service providers individually, but require coordinated resource management to ensure their provision. Whereas carbon sequestration can be provided discretely by individuals who accept planting trees on a specified area of land, other services such as watershed protection and landscape conservation depend on the coordinated resource management among all or at least the majority/critical resource managers within a given area. Hence, intermediaries may be needed to ensure such coordination. Depending on the case, the role of the intermediary ranges from simply negotiating an ecosystem service provision contract with ecosystem service consumers on behalf of interested service providers, to also

ensuring the existence of resource management coordination among resource users in a given area. Obviously, submitting to such coordinated resource management would be less 'voluntary' for some resource managers than for others within a given area. Thus, the legitimacy of the intermediary is critical, be it a community-based organization or an external NGO acting on behalf of the potential service providers (Ravnborg, et al., 2007).

Intermediaries acting as transfer agents, brokers between service buyers and providers.

In certain cases, intermediaries will work as brokers or transfer agents, establishing contacts between potential service providers and potential service buyers, either directly or represented by their intermediaries. In Colombia, electricity consumers are required, through their hydropower company, to pay an environmental fee to a regional environmental agency acting as a transfer agent, responsible for investing in reforestation and watershed management, either directly to ecosystem service providers or, as often happens, through an intermediary acting on behalf of the service providers (Ravnborg, et al., 2007). This agency can be an NGO or a community-based organization, representing forest owners and watershed stewards.

Contextual challenges

The risk of endorsing illegal resource utilization

In many cases, part of the motivation for implementing PES schemes is that previous attempts to protect ecosystems and ensure the continued flow of ecosystem services have not yielded the desired outcome. For example in Mexico, despite regulations that prohibit land use changes in forest areas except when authorized by the government, the majority of the deforestation taking place over the past decades has occurred without such authorization (Muñoz-Piña *et al.*, 2005). Nevertheless, the Mexican Payment for Hydrological Environmental Services programme took the pragmatic decision to give incentives to forest owners to refrain from illegal deforestation.

Similarly, in Ecuador, the *páramo* is perceived to be under increasing pressure from grazing animals as well as from cultivation. The *páramo* is a neo-tropical ecosystem located in the high Andes region between the upper forest line (about 3,500 m altitude) and the permanent snow line (about 5,000 m). Besides having significant biodiversity, the *páramo* absorbs and gradually releases water, and rivers descending from the *páramo* are characterized by a high and sustained base flow. Thus, in Ecuador as in other northern Andean countries, *páramo* situated above 4,500 m is considered public land and is protected as an ecological reserve (Ravnborg et al., 2007). The fact that the *páramo* is being degraded reflects that while not having a *legal* choice, resource users have *real* land use choices with respect to the upper parts of the *páramo* due to lack of enforcement of existing regulations (Ravnborg, et al., 2007). Ongoing attempts to establish payments for ecosystem service schemes to pay local people for not cultivating or letting animals graze the upper *páramo* thus turn into *de facto* legitimization of illegal land use.

Since the basis in establishing a payment-for-ecosystem-services scheme is in many cases based on the fact that regulatory instruments have failed to produce the desired protection, the establishment of PES schemes often entails a dilemma. On the one hand, attempting to effectively alter resource managers' *de facto*

resource use choices through offering the PES, while on the other hand, by doing so, implicitly making illegal resource use legitimate. This dilemma is often ignored or played down as a purely ethical dilemma due to pragmatic concerns about achieving effective conservation (Ravnborg, et al. 2007). However, there are at least two practical implications of *not* confronting this dilemma, each of which can undermine the effectiveness of a PES scheme in achieving conservation.

The first implication relates to situations where a PES scheme is considered an alternative to regulatory conservation instruments, without however modifying the regulatory conservation instruments. Given the voluntary nature of a PES arrangement, potential ecosystem service providers might decide *not* to participate, e.g. because they consider the benefits to be higher from the resource use alternative to that prescribed as part of the PES. Muñoz-Piña et al. (2005) described some forest owners chose to continue previous, illegal practices of converting forest into pasture, often with the perspective of selling off the land within a relatively short time horizon, rather than enrolling their land into the medium-term Mexican Payment for Hydrological Environmental Services Programme.

Under such circumstances where the PES scheme is implemented as an *alternative* to more regulatory conservation instruments, and where resource managers may have real but not legal resource management choices, PES might turn into a mechanism that legitimizes illegal resource utilization, particularly by the more resourceful actors. Therefore, PES cannot stand alone as the instrument to promote conservation in such areas. The same applies in areas where resource managers have real and some legal, but not unlimited, resource management choices, such as in forest areas outside protected areas where logging is a permitted, but regulated activity (Ravnborg, et al., 2007).

A further practical implication of not confronting the dilemma between, on the one hand, effectively altering resource managers' *de facto* resource use through offering the PES, while on the other hand, thereby implicitly legitimizing illegal resource use, relates to the issue of scale. Due to economic or political factors, the coverage of a PES scheme may not match the ecosystem in question. In situations where resource use is partly or fully restricted and where the coverage of the PES scheme does not match – economically or geographically – the ecosystem in question, i.e. where only a fraction of the potential ecosystem service providers are or can become enrolled in the scheme, some resource managers are paid to refrain from illegal resource use while others are not. This means that e.g. in the relevant forest or protected area, authorities will have to force the remaining resource managers to abide by restrictions. The net conservation result of such partial PES schemes may thus very well turn out to be negative. Finally, paying resource managers for abstaining from illegal resource use may reduce consumers' willingness to pay for ecosystem services. As expressed by a Peruvian urban water consumer: "If you ask me to pay for my water, I will happily do so, but if you ask me to pay these illegal migrants not to illegally deforest the catchment, I would rather pay the police to throw them out and prevent more illegal immigrants from coming to deforest" (Ravnborg, et al., 2007).

PES is only one among several conservation instruments

In some situations PES is *unlikely* to be the most effective conservation instrument. There appears to be considerable convergence on this issue in the available

literature. In general economic terms, at in contexts with high opportunity costs associated with non-desired resource management practices, PES will usually not be the answer. There will simply not be enough funding available to persuade resource users to change (Wunder, 2005). Even if sufficient funding were available, it should be considered whether this funding would be better spent by employing other conservation instruments that are based on direct control combined with other economic instruments, such as taxes and fees (Ravnborg, et al 2007).

In areas under transition as the ones where many of the ecosystems under threat are situated, opportunity costs are far from uniform across the area and among the resource managers. For example, studies undertaken in Nicaragua estimate that the opportunity costs associated with one hectare of land in the buffer zone to one of Nicaragua's best conserved tropical rainforests, varied between USD 70 for the better endowed households with well-established livestock herds and USD 30 per hectare for land belonging to resource-poor farming households with none or only a few head of livestock (Ruiz, 2006, cited by Ravnborg, et al., 2007). Similar findings were arrived at in Guatemala (Mañez Costa and Zeller, 2003). However, in addition to variations in resource endowments of the resource managers, there is a temporal dimension that adds to this variation. While some farmers make their resource management decisions with respect to the medium and sometimes long term, others, be they farmers or not, make their resource management decisions with the aim of maximizing short-term gains, possibly with the perspective of quickly moving their operations to new areas. This makes it important to distinguish between different types of actors when assessing to which extent PES may constitute an effective conservation instrument (Ravnborg, et al., 2007).

The role of the state

Despite often invoking a 'non-state' image, the PES literature increasingly points to the key role played (or to be played) by the state. First of all, the importance of the state is increasingly being recognized with respect to its role in providing – and when necessary adjusting – the legal and regulatory framework to enable:

- the legal recognition of private PES arrangements;
- the regulation of the participation of intermediaries; and
- the legal arbitration in cases where external parties wish to denounce a PES arrangement, e.g. for causing environmental damage or violating rights (of access) to natural resources (Ravnborg et al., 2007).

Moreover, the state is increasingly being recognized as a direct party to PES arrangements, either as a buyer or, particularly in the case of trading schemes such as carbon sequestration, as a provider of ecosystem services.

The role of PES in poverty reduction

Based on the evidence presented and the experiences of a number of practitioners, the following interrelated features of PES schemes have been identified as contributing to what can be termed as pro-poor outcomes:

- Eligibility criteria determining who has access to participate as potential ecosystem service providers;
- The type of ecosystem service and paid-for management practice;
- The institutional options for dealing with transaction costs;

- The type and level of payment; and
- The general level of legal and institutional equity

These are briefly discussed below.

Eligibility criteria determining who has access to participate as potential ecosystem service providers

In most cases, the provision of ecosystem services depends on a particular form of land management, and thus requires that potential service providers are in a position to control access to and use of the land. This requirement has been interpreted as a need to demonstrate formal land titles to be eligible as potential service providers. This obviously limits the access of the poor to participate as potential ecosystem service providers *viz-à-viz* the non-poor. However, even if, as argued by Wunder (2005), this condition can often be relaxed as long as potential providers can demonstrate widely recognized land claims which effectively enable them to control the access to and use of the land, a large share of the rural poor suffer from a lack of formal and actual access to land. Thus, in the context where significant numbers of the poor do not have access to land, this obviously limits the opportunities for pro-poor outcomes of PES schemes based on the participation of the poor as ecosystem service providers. Ways of easing this anti-poor bias include setting a maximum limit on the amount of land which one landowner may enroll in a PES scheme as well as targeting regions with less skewed land distribution.

The form of ecosystem service

Ecosystem services which are spatially bound, e.g. hydrological services, landscape beauty or habitat protection, and depend upon the management of a specific area and thus require buyers to work with the poor as ecosystem service providers than in the case where ecosystem services are not spatially bound, such as carbon sequestration (Rosa *et al.*, 2003; Wunder 2005). Moreover, ecosystem services intended to be provided through pure conservation, limit the opportunities for small-scale landowners to participate *viz-à-viz* ecosystem services provided through management practices which provide ecosystem services at the same time as directly contributing to securing their livelihood (Ravnborg, et al., 2007).

Institutional options for dealing with transaction costs

The high transaction costs associated with dealing with many small-scale ecosystem service providers as opposed to few large-scale providers tend to work to the disadvantage of pro-poor PES outcome based on the poor participating as service providers. Thus, in order to promote the participation of the poor as ecosystem service providers, it is necessary to identify institutional options for moving the unavoidable transaction costs from dealing with many small-scale providers instead of few large-scale providers from the buyers to sellers. Such options include allowing communities, rather than only individuals, to register as service providers, possibly combined with support for strengthening community-level organization, including their legal recognition (Ravnborg et al., 2007).

Type and level of remuneration

Despite different terminology used to refer to the remuneration of ecosystem services, broad agreement seems to exist that also non-monetary remuneration of ecosystem services may be relevant. Identifying types of remuneration that are attractive to the poorer segment of the potential service providers, as opposed to non-poor segment, constitutes a way of increasing the pro-poor impacts of the PES

scheme. Facilitating the granting of secure access and ownership rights, e.g. to forest as in the case from the Philippines (Kerr *et al.*, 2006), provides an example of such non-monetary remuneration which may be more attractive to the poor than to the non-poor (Ravnborg *et al.*, 2007).

A further option to increase pro-poor PES impacts is by carefully determining the level of remuneration. The appropriate level of remuneration is highly context-specific and depends among other things upon the opportunity cost per unit of land belonging to the poor and the non-poor, respectively. In situations where the opportunity costs per unit land belonging to non-poor households is high compared to land belonging to poor households, pro-poor PES impacts may be ensured by keeping the payment amount in the lower range of opportunity cost (Ravnborg, *et al.*, 2007). However, the opposite situation may also exist, particularly in contexts with highly skewed land distribution, where poor landowners have relatively high opportunity costs per land unit but command only small pieces of land, whereas the average opportunity cost per unit land belonging to large-scale landowners is relatively low. In such situations, a payment at the lower range of opportunity cost would only be attractive to the large-scale land owners; therefore, a higher per unit payment would probably have to be combined with a maximum limit on the amount of land to be enrolled in a PES scheme (Ravnborg *et al.*, 2007).

Clearly there are several challenges that influence the successful nature of a PES based system. Whilst it would appear that in the developed world the implementation and functional operation of such schemes has been shown to be effective in addressing issues of sustainable resource management, the implementation of such schemes appear to be more problematic. In a recently completed study of the potential for introducing PES based schemes in Southeast Asia (i.e. Thailand, Vietnam and Lao PDR) to improve catchment management concluded that several key elements favorable to the emergence of a PES market already exist in Southeast, and include the following:

- Most stakeholders, including farmers and Governmental agencies, have a clear perception of environmental issues. Farmers have even changed their practices in both Thailand and Vietnam, without compensation as the result of a conflict-solving process at village level.
- Potential buyers were identified in the public and private sectors in Thailand and Vietnam;
- Public efforts are currently addressing erosion issues in Thailand and could eventually be redirected to a PES scheme if they were to prove to be economically efficient.

However, there were major impediments that limit the implementation of PES targeted to small-scale stakeholders including:

- Willingness to pay is consistently low in all three countries even where the environmental issues are the most severe or the potential buyers are powerful agribusinesses or GoAs; (T, V);
- The number of potential buyers are often too small in number to effect a significant change in biophysical attributes at the catchment level;
- The relationship between environmental service, user and provider is equivocal in a number of catchment management issues especially when the communities of providers and receivers overlap.

The authors conclude that while many catchment management issues are clearly outside the scope of PES, a large potential exists in Southeast Asia for implementing PES in agricultural and rural development sector (Planchon et al., 2008).

There are other incentive based schemes that have been used elsewhere in order to promote the sustainable utilization of resources. In the context of hydropower development the use of Benefit Sharing has been used effectively to promote the sustainable utilization of land resources in upper catchments as well as specifically address develop issues. Benefit sharing is discussed briefly below.

Benefit Sharing

Many dams, particularly those providing hydropower, generate direct monetary revenues. These revenues invariably form the income stream of dam or power plant owners, whether a private, public or cooperative company. Some of these revenues are usually transferred to various levels of government in the form of taxes, royalties and other mechanisms. Historically, hydropower developments in the early 1900s were effectively local in nature with small projects supplying local communities and industries with local impacts and provided local benefits. As dams grew in size and electricity networks developed, hydropower dams began serving regional and national interests, often to the detriment of local residents. Today, there is a growing consensus that local stakeholders should share the benefits of such projects in addition to being compensated for the inevitable environmental and social costs of developing such projects.

The concept of benefit sharing has become an accepted theme in international thinking with respect to sustainably developing hydropower projects that improves equity when allocating benefits and costs within society (Haas and Tung, 2007). The concepts of benefit sharing extends the narrow focus in thinking only about displaced people and the resettlement host communities as adversely affected. It includes other households and communities living in the project *impact zone* who have their resource access permanently reduced or transformed by the project in some degree. Essentially the philosophy is that all people living in the project impact zone, who host the project, are eligible to participate in benefit sharing and become long-term partners in the project they must live with (Haas and Tung, 2007).

There are numerous examples in developed and developing countries alike where local communities who give up their land entitlements or natural resource access for a hydropower project are provided with a monetary share of project revenues. Some groups may also receive non-monetary benefits, such as exclusive rights for reservoir fishing. The notion of benefit sharing goes beyond onetime compensation and other short-term resettlement measures to recognize that local populations can claim entitlements to part ownership of the economic rent generated by the hydropower facility. These arrangements either implicitly or explicitly treat the local communities as “equity partners” in the hydropower project. And more generally, as people with a stake not only in the project’s successful operation, but also its successful integration into their community life as conditions evolve over time (Haas and Tung, 2007).

A variety of financing mechanisms are now employed in different countries to channel monetary benefits to local benefit-sharing measures. These include for example:

8. The redistribution of a small part of hydropower revenues to the affected communities or basin authorities in the form of royalties linked to power generation, water utilization or other resource use fees;
9. Part or full ownership of the project by the host community (direct equity sharing), for which their return on equity is used to finance the delivery of benefits programs;
10. Annual revenue transfers (from general taxes) to the affected municipalities, watershed management agencies and conservation authorities in the basin of the dam;
11. Levying property taxes on the land used for power facilities and reservoirs by local authorities, a measure that reduces local taxes and/or raises funds for development investment in the affected community areas;
12. Direct long-term contracts between the project owner and the affected communities;
13. Granting preferential electricity rates and fees for other water-related services to local companies and project-affected populations; and more recently,
14. Use of carbon financing from emission purchase reduction agreements (ERPAs) under the Clean Development Mechanism (CDM) of the Kyoto Protocol, for eligible projects.

Funds generated from one or more sources are typically earmarked for delivery to project affected groups through mechanisms suited to needs in the particular basin. The delivery mechanisms range from targeted increments in the funding of existing development initiatives of line ministries, or national programs, to establishment of permanent community-managed funds or Trusts. These mechanisms are sustainably financed from the sources noted previously. The measures supported are adapted to changing preferences as the development needs of beneficiaries evolve over time.

There are three main arguments for sharing a portion of the monetary benefits of hydropower generation with people displaced by the construction of the facility and its operation, and with people residing in the basin who are less directly impacted.

- First, hydropower projects may generate a significant economic rent, which can be shared with project-affected populations;
- Secondly, there are several ethical reasons for redistributing part of the monetary benefits to project-affected populations - the main one being that local populations who forgo water resource or land access should receive part of the monetary benefits that accrue to people and enterprises outside the affected area, who benefit directly from power services;
- Thirdly, recognizing the nature and scale of the investments in hydropower (which typically draw on the resources of the consumers and the taxpayers - irrespective of the financing method), the national investment in hydropower should be conceived as part of the strategy to foster local and regional development, apart from direct provision of water and energy services.

The growing emphasis on benefit sharing is in part prompted by the World Commission on Dams (WCD) final report, "Dams and Development: A New

Framework for Decision Making (2000)". The WCD stressed the need to evaluate how dams affect livelihoods and existing rights and entitlements (for land and resource access of all types) and particularly, to ensure the impacts on communities upstream and downstream are considered, not just the displaced people. It proposed a "Rights and Risk" approach to assess the degree to which different groups are impacted and face impoverishment risks. Two of the WCD's seven strategic priorities addressed the need, firstly, to recognize entitlements and share benefits, and secondly, to recognize the value of ecosystems services in sustaining rural livelihoods during planning and decision making about the management of all types of dams and reservoirs.

Benefit sharing – a global perspective

Over the last 2-3 decades many countries with hydropower resources have introduced policies to share the monetary benefits of hydropower development with local communities. Typically the national legislation sets out the basic principle for revenue sharing, with formulae to calculate the amounts and the percentage allocation to different groups. In some countries the levels of benefit sharing are negotiated. But often the specific uses of funds and delivery mechanisms are not specified in legislation. They are developed for each project situation, consistent with the national framework and detailed regulations – which may be defined at national, provincial, sector or basin levels.

Contrary to the misconception that only rich countries can afford to introduce benefit sharing measures, experience over the last decade shows that societies with low national incomes or a large disparity in income between urban and rural areas, often gain the most. A number of developing countries have also pioneered new approaches to sustainably finance benefit sharing from power revenues. For instance, starting in the 1980's at the Danjiangkou dam in China, a portion of the revenue from hydropower generation was placed in a "remaining problems fund". These funds were made available to help households and communities that had been resettled around the reservoir margin to fund income-generating enterprises that re-established livelihoods. The fund was not only used to finance resettlement costs and livelihood restoration for people impacted by the new construction activities, but also to rectify problems associated with previous resettlement.

India is among the most recent countries to adopt benefit sharing in the power sector. India has announced its new hydropower policy in 2008 will incorporate provisions for 2% of revenue from hydropower projects to be allocated to local area development funds or Trusts. The media articles in November 2007, cite Power Ministry officials as proposing to raise the quantum of free power allocated to Indian States from hydro from 12% to 13%, with the additional 1% to be exclusively earmarked for local area development. The States are also asked to contribute 1% of their existing 12% "free power allocation" to the same local area development fund, thus completing the 2%. The media reports the Power Ministry has proposed the local area development fund would be in the form of an annuity for the life of the project. A Standing Committee headed by an officer of the State government would operate the fund and it would have male and female representatives from the project affected people along with one executive from the project developer.

In Brazil, rather than taxing revenue on the sale of energy, the national Constitution (1988) taxes the water used to generate electricity. This is part of a general

resource use tax that applies to other resources as well, including petroleum and mineral resources. Under a Constitutional provision, forty-five percent (45%) of income generated from the water-use tax annually goes to municipalities losing land to reservoir inundation (proportioned based on the area affected); forty-five percent (45%) goes to the state or provincial authorities where the project is located; and ten percent (10%) goes to the federal government to finance regulatory functions (i.e. 8% to the Federal Electricity Regulatory Agency (ANEEL) and 2% to the Ministry of Science and Technology).

Several countries also specify that payments for managing ecological functions and the environment services transformed by hydropower project must be provided through hydropower revenues. This is on top of support for social development needs of the communities that host the project. For example, in Columbia, legislation stipulates that 3% of revenues from hydropower projects must be transferred annually to the watershed agency of the dam to fund watershed management activities working with basin communities. The funds must be used to protect the environment in the watershed upstream of the dam and in downstream areas influenced by flow changes. A further 1.5% of project revenues must be transferred to the municipalities that border the reservoir, and 1.5% to the municipalities in the watershed upstream of the dam. These funds are allocated to finance infrastructure projects identified in municipal development plans.

In Nepal, the Local Self-Governance Act (1999) provided that 10% of direct monetary benefits from all development projects, including hydropower are to be allocated at local levels. The electricity regulation authority of Nepal initially collected royalties directly from hydropower producers, based on a royalty or resource use tax formula defined in the Electricity Act. This portion of the tax received locally was considered to be, "compensation for the harm inflicted by hydropower projects on the people and natural resources of the District". In 2004, the formula was altered such that 50 percent of the royalty (or tax) levied on generation is now to be distributed in equal proportions to the District where the project is located and the directly affected villages. Village Committee structures decide how the money is to be used. The Government initiated a dialogue process with the National Association of Villages and the District Development Committees (DDC) to make provisions for transparency and social accountability in the use of these funds.

In Lao PDR, one of the aims of the export-oriented Nam Theun 2 project is "to generate revenues that will be used to finance spending on priority poverty reduction and environmental programs in Lao PDR through environmentally and socially sustainable exploitation of NT2's hydropower potential". Specific revenue and expenditure management arrangements are set out in the project agreements. These provide a framework for the application of revenues when Nam Theun 2 is commissioned. The Government of Lao PDR has identified five indicative programs for distribution of these funds on the basis of the National Growth and Poverty Eradication Strategy (NGPES), namely: basic education; basic health care; rural roads; local development initiatives identified through a participatory decision-making process; and environmental protection initiatives.

A common feature of successful programs is the beneficiaries decide how funds will be used and the delivery of benefits is organized around their preferences. The role of central government is to provide the enabling policy and legal framework

and establish rules on the level of benefit sharing (by prescription or negotiation) and the financing mechanisms. Local government, together with agencies, social organizations and civil society interests who work closely with project-affected groups would provide guidance and support to design the delivery mechanisms and actual participate in delivery of the measures in a manner appropriate to their normal roles.

A second common feature of many successful programs is the sustainability dimension. The inherent principle is local benefit sharing should be long-term in nature and continue over the economic life of the hydropower project. Moreover, the mechanisms and actual programs to deliver benefits must be adaptively managed as circumstances and development priorities in the basin evolve over time. This is important given the long-life of most infrastructure projects.

Once the rationale for benefit sharing is established two key questions need to be addressed. Firstly, what level of benefit sharing is appropriate to ensure a balance between a meaningful investment in the development needs of project affected people, on the one hand, and the impact on general electricity tariffs that all consumers will feel, on the other hand (e.g. the minimum amount of financing to achieve measurable improvement in the livelihoods and welfare of the project-affected groups). This reflects the willingness of electricity consumers to share what may be presented as legitimate costs of hydropower development once they are informed. Government must balance these two considerations in framing the regulations. Secondly, what financing and delivery mechanism are most appropriate to achieve the desired development outcome and maintain public confidence in how the funds are utilized?

Finally, it is argued that the use of benefit sharing as a means of sharing equity associated with hydropower generation is probably more appropriate than PES in the context of this sector.

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