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**PAYMENT FOR ECOSYSTEM SERVICES (PES)
AS TOOL FOR MAE LAO WATERSHED CONSERVATION***

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The responsibility for the text rests entirely with the author(s). The views expressed are those of the author(s) and not necessarily those of the Department.

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ABSTRACT

This case study refers to the role of Payment for Ecosystem Services (PES) as an economic tool in supporting and promoting sustainable development locally. It was developed for using in both undergraduate and graduate courses in natural resource and environmental economics and economic valuation of ecosystem goods and services. Students should be able to apply their knowledge in basic economic concepts of demand and supply, economic valuation of ecosystem goods and services, as well as basic watershed ecology in analyzing a practical situation provided in the case.

Main contents of this case study comprise four parts. The first part is the general information about the study area and the community conservation practices in case of Mae Lao Watershed, Thailand. The second part deals with Payment for Ecosystem Services (PES) in theory and in practice. The third part consists of questions for discussion and group exercises for students to practice. The final part contains the information of teaching note about learning objectives, student audience and background readings.

Keywords: Payment for Ecosystem Services (PES), watershed conservation, Mae Lao, ecosystem service valuation, contingent valuation method (CVM)

JEL Classification: Q51, Q58

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I. THE CASE

Background of study area

The Mae Lao watershed is located in the Mae Lao sub-river basin of Mae Kok River basin, Chiang Rai province, Thailand. Mae Lao sub-river basin covers four districts namely: Wiang Pa Pao, Mae Srouy, Mae Lao, and Muang districts, summing up to 22 sub-districts. This forms the watershed area of the Mae Lao sub-river basin where Mae Lao River is the main stream of the sub-basin. The river is originated from Doi Nang Kaew Mountain of Phi Pun Nam mountain range lying north-south and forming the border of Chiang Rai and Chiang Mai provinces. Main streams of the sub-basin are Nam Mae To, Houy Hin Lad, Nam Mae Chang, Nam Mae Lao, and Nam Mae Chedee with at least 40 small streams from the Mae Lao River. The river is 137 km long flowing up north through those four districts of Chiang Rai province. Mae Lao River reaches Kok River Sob Lao sub-district of Muang district of Chiang Rai province.

The total area of Mae Lao sub-river basin is approximately 318,000 ha (**Figure 1**). Its area under watershed class 1 and 2, where conservation measures and limited uses of other activities applied, is approximately 166,454 ha (52% of the total area). Agricultural land comprises 58,421 ha (18% of the total area). Land use of Mae Lao watershed area comprises mainly rice production, vegetables, and fruit trees-perennial crops at about 11.50, 0.23, and 0.55%, respectively. About 20% of the total agricultural area is utilized for field crops (Department of Water Resource, 2006).

The upper part of Mae Lao sub-river basin which is located in the southern part of Chiang Rai province is considered the upper reach of the sub-basin with highest elevation of 1,872 MSL. It is the catchment area of many small rivers supplying the water that supports the livelihood of the people in the watershed. The government through the National Resource and Environmental Committee Office has designated these mountainous areas as the protected areas for the supply of water, limiting uses for other activities.

Table 1 Areas and number of households in Mae Lao Sub-river basin by sub-districts, 2005

District	Sub-district	Total area (ha)	Agricultural area (ha)	Household
Wiang Papao	San Salee	2,118.40	553.60	2,376
	Wiang	6,082.08	2,892.80	3,500
	Ban Poang	3,984.16	1,324.16	3,409
	Pa Ngiew	8,247.84	2,278.24	2,227
	Wiang Kalhoang	6,888.64	3,721.28	2,451
	Mae Che Dee	5,804.32	3,720.64	3,135
Mae Suai	Mae Souy	3,695.36	1,750.56	1,688
	Pa Daed	16,915.68	10,081.28	5,178
	Mae Prig	1,268.96	126.40	723
	Sri Touy	5,946.08	3,608.00	2,399
	Ta Kaw	7,338.40	4,132.16	2,891
	Chedee Luang	1,999.84	1,031.84	1,594
Mae Lao	Dong Ma Da	16,230.56	4,329.60	3,190
	Chom Dok Kaew	4,000.16	3,178.72	3,170
	Bua Sa Li	6,289.60	2,918.40	2,505
	Pa Ko Dam	10,382.08	4,021.44	3,059
	Pong Phrae	4,055.52	2,048.64	2,596
Phan	Than Tong	2,038.56	1,691.68	1,790
Muang	Mae Kon	1,846.24	1,120.16	1,455
	Pah Or Don Chai	2,105.28	1,345.92	1,058
	Ta Sai	9,243.52	1,729.92	1,572
Total	22	129,687.52	58,420.80	53,900

Source: Ministry of Interior, 2005.

The situation

The upper part of Mae Lao sub-river basin (Mae Lao watershed area) is mostly protected forest and a headwater source area classified as the watershed class 1A and 1B. The area is considered the Conservation Forest Zone which includes national forest reserves and national parks. The national forest reserves in Mae Lao include Pa Mae Lao Phang Kwa, Pa Mae Lao Phang Sai, Pa Mae Pun Noi, Pa Mae Pun Luang, and Pa Houy Pong Mhen. These legally designated areas are protected under the National Forest Reserve Act of 1964 under the responsibility of the Department of National

Park, Wildlife and Plant Conservation (DNWP), Ministry of Natural Resource and Environment (MNRE).

In general, the upland area classified as watershed class 1A, 1B, and 2 are under the responsibility of the Mae Lao-Kok Watershed Management Center no. 9 situated in Chiang Rai province, the direct line agency under Watershed Management Division, DNWP. Some parts of Mae Lao watershed have been protected and designated as the national parks under National Park Act of 1961. They are Khun Chae National Park and Doi Luang National Park. Management of each national park is under the chief of National Park, National Park Division, Natural Resources Conservation Office, Department of National Park, Wildlife, and Plant Conservation (DNWP).

Royal Project Foundation (RPF) also plays an active role in watershed management of Mae Lao. Based on the initial goal to eliminate opium cultivation and to improve the living standard of highland people in the mountainous areas of Thailand, RPF supports highland people to produce valuable crops for economic benefits and provides them the necessary infrastructure such as village roads, small irrigation systems and village electricity. Regarding the natural resource conservation and the improvement of the watershed area, land use management and soil conservation practices in the already slashed and burned areas are implemented. The appropriate zones between cultivation area and forest area are established.

The policies towards watershed protection in Thailand have relied strongly on a nation-wide top-down and command-and-control approach for the past decades. During recent years, decentralization in combination with participation of local communities in watershed management has been promoted nationwide. Various national policies have been implemented following the 1997 'People's' Constitution, which outlining the rights and responsibilities of local communities in managing their natural resources, as well as rights to access environmental information and participation in environmental decision-making processes.

Mae Lao watershed ecosystem goods and services

Upland local villagers depend on forest ecosystem for their livelihoods to varying degrees for subsistence and income. Besides natural products provided on-site, the ecosystem services such as watershed protection,

biodiversity protection, and carbon storage have been recognized. Many studies state that these services are very important to both on-site and external beneficiaries because they support ecological balance, serve as the base for economic activities, and provide amenity for society.

As most forested watershed, Mae Lao watershed provides several kinds of water-related ecosystem services. Forests slow the rate of runoff in a watershed and reduce soil erosion and sedimentation of waterways (EFTEC, 2005; Johnson, et al, 2002; Wonder, et al 2005). In this study, even though there is no scientific evidence linking water and forest, it is agreed that forest, in addition to all other functions, retain rainfall, filtering the water and releasing it gradually. Most often, the hydrological services of the forests may not be appreciated until deforestation results in flood and degradation of water quality, increasing the vulnerability of downstream populations and threatening their health and livelihoods (Pagiola and Platais, 2002).

In Mae Lao watershed, the Mae Lao River and its tributaries are the most important source of water supply for people living in the area. Thus, one of the significant environmental services of Mae Lao watershed protection is the provision of water supply in terms of quantity, quality, and timing. The benefits derived from the watershed protection services have been contributed to the service providers themselves and the people living downstream. Among them the main beneficiaries are those residents and farmers living downstream. Thus, land use and the forest protection and conservation activities in the upper watershed directly affect the provision and maintenance of these watershed services.

People perception on the link of watershed protection and supply of water downstream was investigated. All of them expressed their views that the quantity, quality, and regularity of water supply depend on the protection level of the upper watershed. Some of them expressed that forest fire if occurs in the headwater forest can cause the dryness of water in the upper stream that directly affect the water supply downstream. When asked about their support to people who protect the forest upstream, they express their positive view that the support can be done with the arrangement from the water user group to people who protect the watershed, probably through local government such as Tambon Administration Organization (TAO) or Sub-district head. In addition, they also express their strong view that the

watershed protection activities should be continued for the benefit of every one.

Community conservation practices

In Mae Lao watershed, it is a tradition for upstream local communities to establish their own community-protected forests above their villages when they first settled. This is based on the belief that the forests especially the headwater forests are sources of drinking water and water supply for irrigation during the dry season. It is also a traditional practice for them to conserve the community forests for their direct utilization such as sources of timber and non-timber forest products. They also develop the community conservation rules for the sustainable utilization of the forests.

Results from the stakeholder interview indicate that on-site benefits from the forest protection activities are recognized significantly. Construction of forest fire protection zone directly reduces risk of crop and forest damages that usually occurs during the dry season. When soil erosion protection activity is practiced in the sloped area, it will reduce the loss of agricultural productivities in rainy season. In the upper areas of the watershed, most of the villagers use rainwater and streams water near the village for drinking, domestic purposes, and to supply their agricultural production. They realize the significance of watershed protection as source of water supply.

Various types of watershed conservation practices have been carried out to protect and improve the forest ecosystem such as watershed forest rehabilitation, soil and water resource conservation, and forest fire protection. In Mae Lao watershed, tree planting is the main measure applied for ecosystem improvement and watershed forest rehabilitation. Vetiver grass planting along the sloped area is commonly introduced to local people as a soil conservation measure by Watershed Management Units and Royal Project Development Centers. Construction of check dams across the stream has been the traditional practice for water conservation. Construction of firebreak and regular guarding around the production area and the headwater forests are commonly practiced in the collective way. Among these, traditional ways of conservation strategies based on cultural traditions play significant roles in the protection of forest ecosystem. For example, any use and any harm to the spirit forests are prohibited. This type of forests is believed to harbor spirits that protect the village from any harm such as plagues, fires, and other natural disasters.

Thereby collective efforts carried out by service providers in Mae Lao watershed can be categorized as follows:

- (1) Watershed protection activities, activities are such as
 - Survey, monitoring and guarding forests
 - Forest fire break construction and patrol
 - Forest fire extinction
 - Protection of watershed forest from intrusion and conversion
 - Protection of wildlife from hunting and illegal forest product collection and logging
 - Protection of soil from erosion by constructing contour and planting vertiver grass
 - Protection of water quality in the watershed forest
 - Protection of fishery resources in the natural steam
 - Conducting forest ordination and other cultural ceremony for forest protection
 - Identification of the forest boundary and agricultural zone
- (2) Watershed enrichment and restoration activities, such as
 - Construction of check dam
 - Repairing and maintenance of check dam
 - Replanting and rehabilitating of forest
- (3) Watershed planning activities, such as
 - Meeting for development/conservation of watershed protection
 - Determining the community rules and regulations in watershed protection/development
 - Making a sign for displaying rules and regulation of the forest conservation
- (4) Watershed supporting activities, such as
 - Supporting in cash/in kinds for watershed forest conservation activities
 - Conducting other cultural ceremony to strengthen community unity in watershed conservation activities.

The term “service providers” means upstream people who carry on activities contributed directly to the protection and improvement of forest ecosystem. Their activities lead to enhancing or maintaining of watershed services to external beneficiaries. Although these people are the “land users” in the area, the services they provide are not intended to focus on activities related to

their land uses. Thus, the provision of watershed services focused in this study is rather collective action than private action.

2. PAYMENT FOR ECOSYSTEM SERVICES (PES)

The concept

One of the important reasons for environmental degradation is the perception that many of nature's services are free – no one owns them or is rewarded for them and local villagers have little or sometimes no incentive to protect them.

A Payment for Ecosystem Services (PES) is an innovative mechanism to secure and improve the provision of ecosystem goods and services through the transfer of financial resources. It is often known as Compensation and Rewarding for Ecosystem Services (CRES) as defined by World Agroforestry Center. The basic concept is that those who get benefits from the ecosystem services should compensate or reward to those who are in the position to provide the services. PES can take various forms such as direct payments, financial incentives, or in kinds. In general, it is PES if:

- Those who provide ecosystem services receive payment for doing so
- Those who benefit from ecosystem services should pay for the provision
- Payments are conditional for both parties
- Participation is voluntary for both parties

Although PES is still the new concept in Thailand, however the approach has been piloted in many neighboring countries including Nepal, Indonesia, Philippines, India as a mechanism to address sustainable watershed management. Most recently, the government of Vietnam has launched a two-year pilot PES policy for forest environmental services to be implemented from January 2009 in the Son La and Lam Dong provinces. Payments from private and government entities have been mobilized to compensate poor watershed residents for growing less-destructive crops, reporting illegal forest clearing, and other upland watershed conservation activities.

PES can take a variety of forms as voluntary transactions involving farmers, communities, consumers, corporations and governments. Several payment programmes for environmental services are currently being implemented

around the world, mainly as part of forest conservation initiatives. However, relatively few programmes for environmental services have targeted to service providers who live in valuable and fragile ecosystem such as Mae Lao watershed.

The practice

Although in Thailand, the concept of PES has not yet been officially applied at the policy level for watershed management, results from Mae Lao watershed study (2006) found that watershed conservation activities have been practiced voluntarily by local villagers over periods. In Thailand, supports of watershed conservation programs are normally top-down and mainly focused on targeted activities. Most of the payments are in the form of the government funds in support of conservation activities assigned by the government agencies. For example, part of the regular budget funded by the Watershed Management Unit (WMU), the local line agency of DNWP is used for supporting community to carry on watershed conservation activities. Funding for natural resource conservation to community-based organizations are considered another form of existing PES schemes operated through the Community Organization Development Institute (CODI) in the form of project grant on the basis of empowering community organizations.

Another type of PES-related scheme which is normally found is in form of non-financial rewards including award/certificate/announcement, and support for study visit/training and financial reward such as project grants from both government and non-government agencies. Service providers sometimes request support from Tambol Administration Organization (TAO) for a certain conservation activity such as reforestation or forest fire extinction.

Thus, PES/CRES in Thailand can be considered as a special case that is 'Supply-side PES' where the government is mainly the buyer of services. Direct beneficiaries have not been officially involved in the buying process at all. It is found that their funding is limited with no regularity of these rewards or support/fund.

Survey results of upstream people living in Mae Lao watershed regarding the preferable types of potential PES/CRES scheme are presented as follows:

- Wages/cash compensation for labor work in conservation activities

- Forest conservation fund for support of conservation activities
- Training/ knowledge provision on watershed conservation
- Training/ knowledge provision on income generating activities for those who conduct conservation activities
- Reward/honorable certificate for those who conduct conservation activities

3. QUESTIONS AND EXERCISES

Discussion questions

Questions required for all levels

- (1) Identify the goods and services contributed by watershed ecosystem (watershed functions)
- (2) Determine the major problems related to watershed management from the case study
- (3) Illustrate how the positive externality and market failure can occur in watershed conservation in general and from the case study
- (4) Define the basic concept of PES/CRES and discuss how it is related to “Coase theorem”
- (5) Define the service providers and beneficiaries in the case study and identify their practical potential roles in PES/CRES
- (6) Identify the opportunity cost of service providers in conducting watershed forest conservation
- (7) Discuss the possibility and constraints to develop PES/CRES in the study area

Additional questions for graduate students

- (8) Discuss how the sustainable financing of PES/CRES can be obtained.
- (9) Suggest the possible PES/CRES mechanisms in supporting the service providers in the study area
- (10) Discuss the possibility that PES/CRES can help achieve poverty alleviation for upstream communities.

Exercises

Additional **exercises** for graduate course in “economic valuation for natural resources and environment”

Exercise 1

Local villagers in the Mae Lao watershed have initiated the “soil and water conservation program” in the community. Those activities are such as

- Tree planting for ecosystem improvement and watershed forest rehabilitation,
- Vetiver grass planting for soil conservation in erosion prone areas,
- Check dam construction for water conservation, and
- Fire protection including fire break construction and patrol

The community found that their livelihood have been enhanced as a result of the program. Among other things, they found the increased natural products as sources of subsistence and income such as water for domestic and irrigation purposes, fishery products, non-timber forest products, and crop productivities, etc. The conservation committee would like to prove that their conservation activities lead to the increased value of these ecosystem goods and services.

Please select the appropriate economic analysis and valuation technique that can provide answers to the community. Technically, you are going to assess the net benefits from conservation program received by community. Specifically, please answer the followings:

- the appropriate valuation technique and reasons for selection
- economic framework for analysis
- data requirement and sources
- steps of analysis to reach the answer

Exercise 2

Mae Lao watershed, like any other watersheds, is the area of land and forest that feeds water into the rivers. As the watershed determines water flows, the quality and quantity of water available to downstream users in the watershed

depends not only on types and distribution of vegetation or the underlying geology, but also the conservation practices of upstream villagers to maintain and enhance the watershed ecosystem. As an economist, you want to provide information on the amount of benefits that could potentially be gained by water users downstream. Knowing the households' willingness to pay for these watershed services, you will be capable of estimating the potential revenues in support of the future "Payment of Ecosystem Services (PES)" program, specifically to finance the watershed conservation activities practiced by upstream communities of Mae Lao watershed.

Applying contingent valuation method (CVM), the survey was conducted to assess the willingness to pay for these watershed services of downstream water users. The total population (water users) of 10,000 was randomly selected. With the total sample of 500, all agreed with the PES program in establishing the watershed protection fund for Mae Lao. These samples were divided into five groups equally to answer the bid value below. Number of samples with positive response ("yes" answer) to each bid was reported.

Bid value (Baht/household/year)	Sub-sample	No. of samples answered "yes"
20	100	90
40	100	80
60	100	60
80	100	40
100	100	20
Total sample	500	-

- (1) Please show how to use the non-parametric estimation to assess the mean willingness to pay for a sample household.
- (2) Please calculate the potential fund available for watershed protection in the PES program. Provide assumptions you deem necessary.

4. TEACHING NOTE

Learning objectives

This case offers a look at the economic tool known as Payment for Ecosystem Services (PES). It is to be used as a basis for students to identify and discuss the relevant issues relating to the introduction of PES for watershed conservation in Thailand. The case also helps students in applying their knowledge in basic economic concepts of demand and supply, ecosystem goods and services, as well as economic valuation of ecosystem goods and services in analyzing a practical situation provided in the case. Upon completion of this case study, students will be able to:

1. understand the concept of PES/CRES in watershed conservation
2. identify and evaluate the environmental benefits and costs of watershed conservation
3. suggest the opportunities and constraints for PES/CRES in achieving environmental goal and enhancing poverty alleviation.

Intended Student Audience

The case study is developed for classroom discussion or as a homework assignment for students who are in the program of natural resource and environmental economics or natural resource management. Specifically, it is written for the 3rd – 4th year undergraduate students majoring in agricultural and resource economics or the 1st – 2nd year graduate students majoring in agricultural and resource economics or natural resource management at Kasetsart University in Thailand.

The case study is intended to be used as a supplement of undergraduate course 119351 (agricultural resource economics), graduate course 119551 (advanced agricultural resource economics), and graduate course 119555 (economic valuation for natural resource and environment) taught at Department of Agricultural and Resource Economics, Faculty of Economics, Kasetsart University of Thailand. It can also be part of the courses in the subjects related to natural resource and environmental economics and natural resource management under the general topics such as “sustainable development” or “economic tools for ecosystem conservation”.

Background readings

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Suggested readings for valuation methodologies

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