PAYMENT FOR ENVIRONMENTAL SERVICES: THE CONCEPT AND ITS APPLICATIONS

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Abstract

This paper reviews the concept and applications of Payment for Environmental Services (PES). Payment for environmental services (PES) is an increasingly popular policy instrument in the developing countries. PES is a market-based approach to conservation financing based on the twin principles that those who benefit from environmental services should pay for them, and that those who contribute to generating these services should be compensated for providing them. PES has helped Costa Rica, once known as having one of the world's highest deforestation rates, to achieve negative net deforestation in the early 2000s. The impact of this program can be seen in terms of increased forest cover, improved water quality, more carbon sequestration, conservation of biodiversity and more employment opportunities for workers. In India, examples of PES can be seen only at the local level in the villages of Himachal Pradesh and Sikkim. A review of studies has given which aimed to determine the willingness to pay of people for particular environmental services. But Insecure and ill-defined property rights, lack of sufficient credit and technical services to farmers and the existing socio-economic, religious and political differences can be the challenges against implementation of PES in India. In order to secure active involvement and support from Government of India for large scale projects, more research in both natural and social sciences need to be undertaken on relevant PES models and strengthening of institutions and capacity building is also required.

1. Introduction

Millennium Ecosystem Assessment (MEA-2005) was a major assessment of the effects of human activity on the environment which included over 1300 scientists from 95 countries. It popularized the term ecosystem services. It has defined them as those benefits that people obtain from the ecosystems. These benefits are categorized mainly into three categories-

1. Direct benefits:
    - Provisioning services: These services are having value in the market. e.g. water, food etc.
    - Regulating services: e.g. regulation of land degradation, floods etc.
2. Indirect benefits:
    - Supporting services: e.g. formation and storage of organic material, processes of photosynthesis, soil creation, nutrient cycling etc.
3. Non-material benefits:
    - Cultural services: e.g. recreational opportunities, aesthetic pleasure and cultural and spiritual sustenance etc.

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Agricultural ecosystems are the largest managed ecosystems in the world. Out of the total land area of about 13 billion hectares, crop and pasture occupy almost 5 billion hectares.
Over the years consumption of ecosystem goods is favored over the conservation of ecosystem services. All of us have taken them as granted. MEA has found that over 60% of the ecosystems studied are being degraded faster than they can recover.

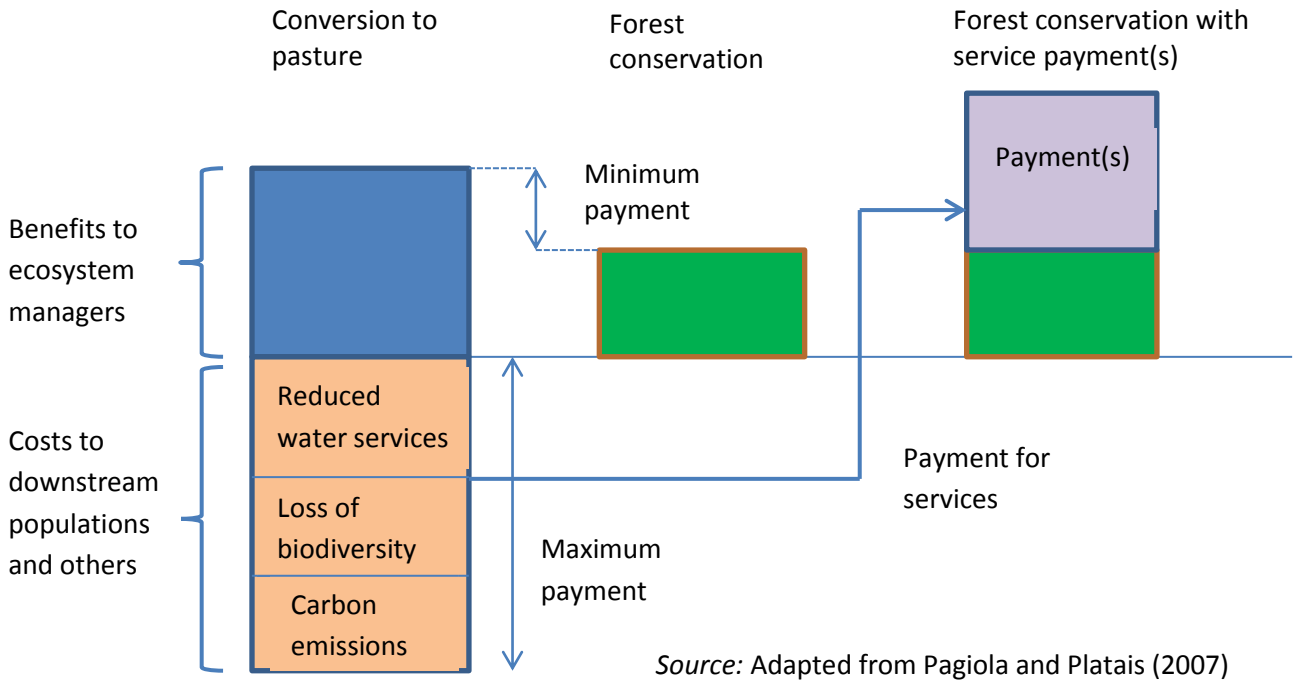
If we look from an economic perspective, degradation occurs because of non-excludability or free riders and non-rivalry problems of ecosystem services, resulting in the externalities. As public goods, ecosystem services have been undervalued till now as there are no such institutions that can internalize the value of these services. Payments for Environmental Services (PES) are discussed as a novel conservation approach and ''probably the most promising innovation in conservation since Rio 1992'' as it attempts to overcome the problem of externalities (**Engel et al., 2008**).

Environmental services are the subset of ecosystem services. It includes all of the ecosystem services except provisioning services. Therefore PES includes those ecosystem services which are not marketed yet. Payment for environmental services (PES) is defined as a market based mechanism to translate external, non-market values of the environment into financial incentives so that provisions for such services are ensured. The central principle behind it is that those who provide environmental services should be compensated for doing so and those who receive the services should pay for their provision (**Pagiola & Platais**). **Wunder (2005)** has defined PES as "a voluntary transaction where a well-defined environmental service (or a land-use likely to secure that service) is being 'bought' by a (minimum one) service buyer from a (minimum one) service provider, if and only if the service provider secures service provision (conditionality)".

Therefore, if market forces reward investments in ecosystem services, a positive feedback loop will start in which there will be increased investments in ecosystem services, lead to increased production of ecosystem goods. This will automatically fuel sustainable economic growth and ecological restoration.

(Fig.1) By converting land to pastures, land owners will realize some benefits. In turn this land conversion will costs to downstream people in terms of reduced water services, loss of biodiversity and carbon emissions. In contrast, land owners are receiving less benefit from using their land for forest conservation but it is providing benefits to the downstream people in terms of water filtration, reduction in biodiversity and carbon storage. Here land owners will be induced to adopt conservation if there will be any provision of payments by the downstream people to them. The payment offered to land owners must exceed the additional benefit they would receive from the alternative land use (or they would not change their behavior) and must be less than the value of the benefit to service users (or users would not be willing to pay for it).

Fig 1. The logic of payments for environmental services



Source: Adapted from Pagiola and Platais (2007)

But in practice it is not so simple. One particular kind of land practice provides several environmental services. First we have to identify them and then valuation of those environmental services is to be done. The most important step is to identify those people who are actually receiving the environmental benefits and are willing to pay for that. Then payment is to be done by the willing buyers to the willing sellers.

2. Economic conceptualizations of PES

There are two conceptualizations of PES:

Coasean conceptualization: According to the Coase theorem, "given low or no transaction costs and clearly defined and enforceable property rights, no governmental authority is needed to overcome the problem of internalizing external effects". He has restricted the task of government to the initial allocation of property rights. Here the actual service users pay to the service providers.

Pigouvian conceptualization: It is based on the ''Pigouvian philosophy of taxing negative or subsidizing positive externalities ''. Here the government is considered as a ''third party acting on behalf of the service buyers'' (**Engel et al., 2008**).

Table 1. A comparison of the Coasean and Pigouvian concepts

	Coasean conceptualization	Pigouvian conceptualization
Also called	User financed PES programs	Government financed PES programs
Efficiency	More efficient (we can observe directly whether the service is being delivered or not and also possibility of re-negotiation is there.)	Less efficient
Implementation	Where local monopsony or oligopsony is there[a]	Where beneficiaries cannot be excluded at all or at reasonable costs.
Payers	Service users	Government
Nature of goods	Focuses on the provision of 'club goods' [b]	Public goods
Example	The water bottler 'vittel' in France is paying to farmers for maintaining high water qualities.	Costa Rica's PSA program, Mexico's PSA-H program etc.

[a] = because if number of buyers increases, free riders problem as well as transaction cost increases.

[b] = club goods are an intermediate category between public and private goods, that can be consumed by many individuals (the members of the club) without affecting the consumption of others, but whose consumption by non-members can be prevented.

3. Methods of valuation of environmental services

3.1 Revealed preference methods

Market price method: It is mainly used to obtain the value of provisioning services (e.g. food), since the commodities produced by provisioning services are often sold on. It is done with the help of market prices. Sometimes also used in case of cultural (e.g. recreation) and regulating services (e.g. pollination).

Productivity approach: It is used to value those ecosystem services (e.g. regulating services) that contribute to the production of commercially marketed goods. E.g. valuation of soil fertility which has improved crop yield, is to be done by the increased income of the farmers.

Surrogate market approaches

i. **Travel cost:** It is used to value recreational sites on the basis of the amount of time and money people spend while travelling to the site.

ii. **Hedonic pricing:** It utilizes information about the implicit demand for an environmental attribute of marketed commodities. e.g. by estimating the demand function of real estate, valuation of environmental attributes which has surrounded the real estate, i.e. clean air, presence of water and aesthetic views is to be done.

3.2 Cost based methods

Replacement cost: It estimates the costs incurred by replacing ecosystem services with artificial technologies, e.g. valuation of ground water recharge is done by estimating the cost of obtaining water from another source.

Mitigation or restoration cost: It estimates the cost of mitigating the effects caused by to the loss of ecosystem services or the cost of getting those services restored, e.g. valuation of flood barriers is done by estimating the cost of preventive expenditure.

Avoided cost: It estimates costs that would have been incurred in the absence of ecosystem services, e.g. valuation of flood control services is done by estimating the damage if flooding will occur.

3.3 Stated preference approaches

Contingent valuation method (CV): It uses questionnaires to ask people how much they would be willing to pay to increase the provision of an ecosystem service, or alternatively, how much they would be willing to accept for its loss or degradation.

Choice modeling (CM): In this method respondents are asked to choose alternative choice sets which have different combination of price and ecosystem attributes.

Group valuation: In this method stated preference techniques are combined with elements of deliberative processes from political science. It is a way to tackle shortcomings of traditional monetary valuation methods. Main methods within this approach are *Deliberative Monetary Valuation (DMV)*, which aims to express values for environmental change in monetary terms, and *Mediated Modeling,* which is used to assess any value that a group of stakeholders could identify and build into a model, and can be used to assess the value of biodiversity from a stakeholder's perspective in developing countries.

4. Options for payment

Payment may be done in following forms:

Direct financial payments: Payment is done in the form of monetary compensation.

Financial support for specific community goals: such as building of a clinic or school for compensating the provision of environmental services.

In-kind payments: such as beehive and training of bee-keeping for improved water management in Bolivia.

Recognition of rights: such as increased land rights and increased participation in decision-making processes.

Table 2. Examples of PES from worldwide

Scheme	Services	Buyer	Level	Funding	Selection of sellers	Payment
Pimampiro in Ecuador 2000	Watershed	Municipal govern-Ment	Local	Water fee, interest on the capital fund, seed capital donation(IAF+ FAO)municipality support, CEDERENA support	Nueva America community	US$6-12/ha/ year
PROFAFOR in Ecuador 1993	Carbon sequestra-tion	Private company	Regional (selected provinces)	DUTCH electricity generating board	Plantation sites are selected on the basis of Biophysical conditions (slopes, soil, altitude), economic criteria(locally marketability of timber)	US$ 100-200/ha fees, 70-100% value of harvested wood, 100% non-wood and sub-products
Conservation reserve program (CRP) in USA 1985	Watershed, bio diversity, soil	Centre, state	National	FSA (farm service agency) via the commodity credit corporation (CCC)	- Producer must have owned or operated the land for at least 12 months prior to CRP, - Land must be either crop land or marginal pasture land	Rental payments: - Maintenance incentive payments - 5$/acre/year - Cost share assistance- not more than 50% of participants ' costs - Other incentives -20% of the annual payments for continuous sign-up practices
Vittel in France 1993	Watershed	Private company	Local	Nestlé Waters, through its intermediary 'Agrivair'	farmers must: - Give up maize cultivation for animal feed - Only one cattle head per hectare - Lower agrochemical use - Improve waste management	- land debt is abolished and farmers have additional land to farm - Farmers receive a subsidy (on average about 200 Euros /ha/year for five years) - 150,000 euros per farm to cover the cost of all new farm equipment

5. Case study on Payment for Environmental Services in Costa Rica

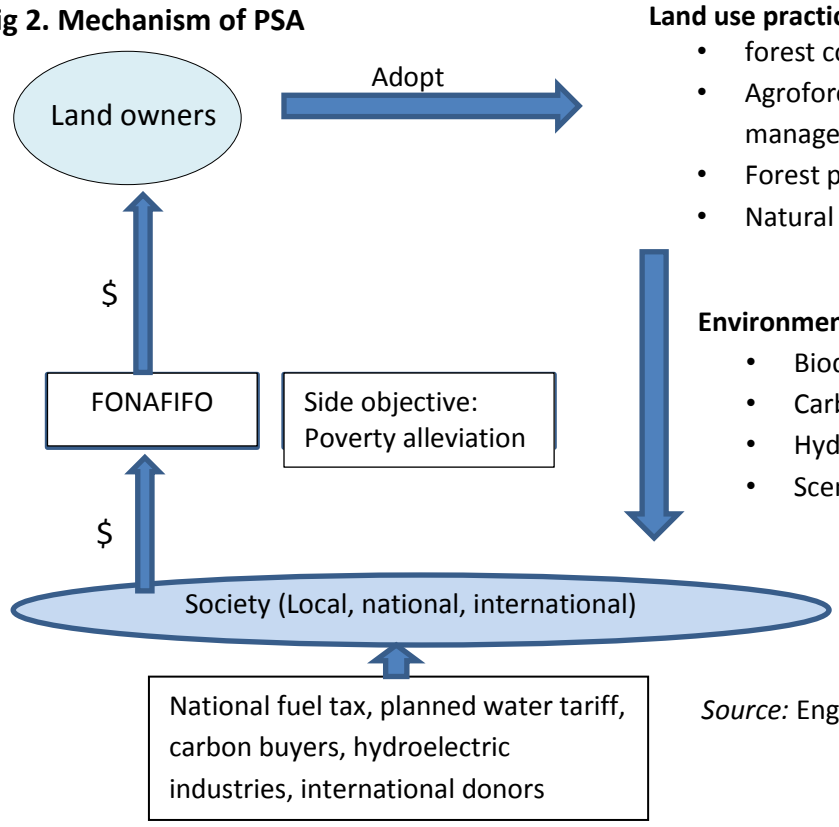
5.1 PSA (Pago por Servicios Ambientales)

Costa Rica has a long history of payment for afforestation programe. It provided tax credit in 1979 which were replaced by the forest payment certificates during 1986 to 1995. In 1996, the country shifted to PSA (Pago por Servicios Ambientales). Costa Rica pioneered the use of payments for environmental services (PES) in developing countries by establishing a formal,

country-wide program of payments viz. PSA. It has helped the country, once known as having one of the world's highest deforestation rates, to achieve negative net deforestation in the early 2000s. In 1996, Costa Rica developed PSA for hydrologic, aesthetic/ landscape beauty, biodiversity conservation, and carbon sequestration services. The PSA was different from earlier forest management programs in the following two ways:

- Conceptually: instead of funding only the timber industry, PSA acknowledges all the benefits that a forested land provides and gives them economic value.
- Financially: instead of receiving financing from the general budget, PSA obtained funding from tax on fuel, water tariff and voluntary payment from beneficiaries.

Fig 2. Mechanism of PSA



Source: Engel, Wunscher, and Wunder (2007)

The above diagram is showing the PSA mechanism. Land owners adopt a particular land practice which provides different environmental services to the society. Here FONAFIFO is a semi-autonomous agency which manages the program. It obtains funds from different sources as illustrated above and pays to land owners.

For different type of contracts different amount of payment is offered based on the opportunity cost of particular land (Table 3).

Table 3. PSA contracts

Modality	Status	Criteria	Current payments
Forest protection	Dates from forest law 7575 to present	2 to 300 ha enrolled, up to 600 ha within indigenous areas	$64/ha/year for 5 year period; renewable
Reforestation	Dates from forest law 7575 to present	Between 1 to 300 ha enrolled; maximum 50 ha enrolled; minimum 50 ha enrolled	$16/ha over 10 year period
Natural forest regeneration	Dates from 1st mention in 2005 to present	Minimum of 2 ha	$41/ha/year for 5 year period; renewable
Agro forestry systems	Dates from 2003 to present	350 to 3500 trees per participants; up to 336000 trees per joint project, cooperative or indigenous reserve; specific requirements per ha	$1.30 per tree; over 3 year period
Forest management	Dates from forest law 7575 until 2002	Criteria determined by conservation area	$343 per ha over 5 year period

Source: Bryan Johns (2012)

5.2 Impact of the PSA program

5.2.1 Area enrolled

At the end of 2005, about 270,000 ha was enrolled in the program. Forest conservation has consistently been the most popular contract, accounting for 91% of the area covered since 1998, and for 95% of the enrolled area at the end of 2005. Total area contracted in the PSA program because of reduced net value of payments and high transaction cost. However, total active contracts under PSA are increasing from 1998 onwards (Pagiola, 2008).

5.2.2 Impact on household budget and poverty

Miranda et al. (2003) has done the analysis of Virilla watershed and found that PSA represents approximately 16% of the household budget. The proportion is largest for properties of over 130 ha (34%) and smaller for properties of 30 ha or less (4%), where other economic activities are more prevalent. The proportion of PES of average income for the landowners who declared that PES represents their main activity, second and third activity is 37%, 12% and 18% respectively (Table 4). They also found that approximately half of the respondents (47 per cent) have used more laborers as a result of joining the PES scheme. The same number of landowners (47 per cent) reported that they have used their existing workers.

Table 4. Proportion of income from PES by property size

	Income (US$ PER YEAR)			**Proportion of PES budget within HB**		
	Payments	Income	Proportion of PES within HB	Main	Second	Third
Less than 10 ha	882	22000	4%		2%	5%
11 to 30 ha	931	22000	4%		5%	1%
31 to 80 ha	1900	19557	9%		9%	
81 to 130 ha	2022	15200	18%	37%	6%	14%
More than 131 ha	11252	20663	34%		41%	30%
Total	**4243**	**19787**	**16%**	**37%**	**12%**	**18%**

Source: Miranda et al. (2003)

The evidence on the impact of the PSA Program on the poverty has been mixed. Several studies (Miranda et al., 2003) found that the major portion of program benefits tend to go to larger and relatively better-off farmers. On the contrary, Munoz (2004) found that the PSA Program plays an important role in the livelihood of poor land holders in the Osa Peninsula.

5.2.3 Impact on the forest cover and carbon emission reduction

Arriagada et al (2008) have analyzed the effect of PSA on forest cover by propensity score matching (PSM) in the Sarapiqui region of north eastern Costa Rica. PSM is used to estimate the difference in outcomes between the participants and the non-participants of PSA. Here propensity score is the probability of participating in PSA. By using all the three methods of PSM, i.e. nearest neighbor, radius matching and kernel matching they found the impact of participating in PSA ranges from 0.9-1.2 ha indicating very less impact on the forest cover. Here it may also be noted that at the time of introduction of PSA, deforestation was already in declining trend because before PSA there were already some schemes of payment for reforestation and forest management.

Tattenbach et al. (2006) found that 644 million m^3/year of water for consumptive uses and 7224 million m^3/year of water for hydropower production are being protected from a deterioration in quality. He also found that about 65% of PSA conservation contracts were in biodiversity priority areas. The 21,000 ha of plantation under the PSA program sequestered a cumulative total of about one million tonne of carbon during 1998-2005.

6. PES in India

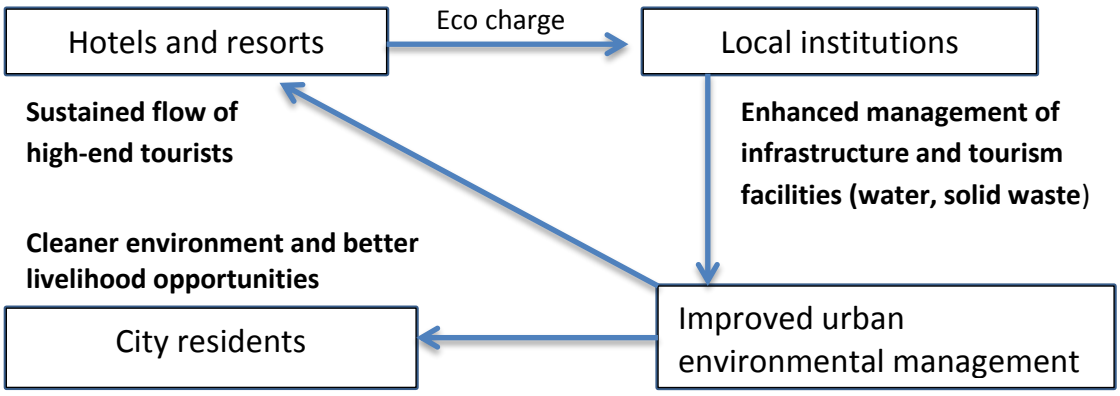
6.1 Recreation and landscape services

Although PES in India has not formally implemented at the national level but at the local level in some villages this scheme has been adopted. Examples can be seen in the villages of Himachal Pradesh and Sikkim.

Kuhan village in Kangra district of Himachal Pradesh receives high rainfall and yet faces water shortage. In 2003 village pooled resources and with the help of watershed development project constructed a checkdam on Gulana Khad, a nullah (creek). As a result, crop production increased six times with the available irrigation. But in 2005 this reservoir collected silt and its capacity got halved. Then with the help of Winrock International, villagers identified the problem and it was the silt coming from grazing land of Ooch village. As a solution, both villages reached a formal agreement (coasean bargaining). Ooch banned grazing for 8 years and planted saplings of fruits, trees, bamboo etc. In exchange for it, Kuhan paid for the saplings and provided irrigation water to them. Because of this silt road in the nullah reduced and the villagers rejoiced again. This is showing a clear example of PES in India.

WWF (World Wide Fund for nature)- India initiated a project in 2008 to examine the potential PES models for selected forest ecosystem services in Gangtok (Sikkim), Shimla (Himachal Pradesh) and Munnar (Kerala) in collaboration with the Institute of Economic Growth and supported by the World Bank (WWF, 2008).

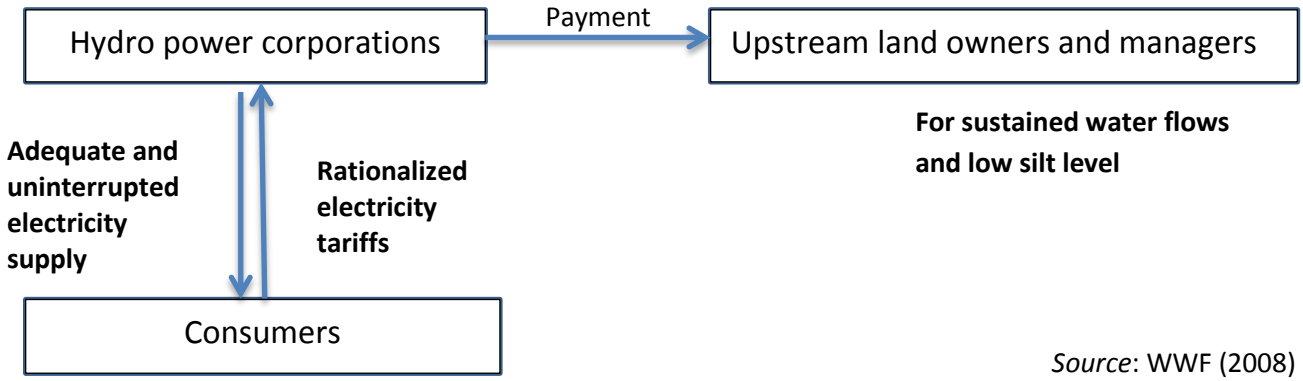
Fig 3. PES Model for Recreation Services in Gangtok, Munnar and Shimla



Source: WWF (2008)

Hotels and resorts can provide payment in the form of eco charge to the local institutions for the enhanced management of infrastructure and tourism facilities. This will improve urban environment which will benefit hotels and resorts because of high flow of tourists. City residents will also get benefit in form of cleaner environment and better livelihood opportunities.

Fig 4. PES model for water supply services in Sikkim, Munnar and Shimla



Source: WWF (2008)

Hydro power corporations can also provide payment to upstream land owners for sustained water flows and low silt level so that they can provide adequate and uninterrupted electricity supply to the consumers.

PES model for landscape beauty in Sikkim

Similarly in this model also trekking and tour service providers can provide payment to the local communities for maintenance of trekking trails and management of natural areas. Because of this tourism department will also be benefitted in terms of increased tourist flow.

6.2 Willingness to pay and willingness to accept

Some studies have been conducted in India for determining willingness to pay (WTP) and willingness to accept (WTA) of the people for the environmental services. These are as follows:

Economic value of irrigation water

Venkatachalam and Narayanamoorthy (2012) studied farmer's preferences measured in terms of WTP and WTA compensation for voluntary exchange of irrigation water. They selected a sample of 310 farmers across all the canal systems in the Bhivani basin. Using field surveys they identified 125 potential buyers and 129 potential sellers, remaining 54 farmers were not willing to participate in water exchange.

Table 5. Change in the WTP values across three rounds

Elicitation round	No. of farmers	Mean value (Rs.)	Median value (Rs.)	Standard deviation
WTP1	125	272.44	250	156.80
WTA1	129	318.44	260	195.31
WTP2	125 (110 farmers revised)	308.12	250	169.53
WTA2	129 (42 farmers revised)	301.97	250	190.51
WTP3	125 (24 farmers revised)	312.64	250	170.14
WTA3	129 (10 farmers revised)	300.03	250	190.25

Source: Venkatachalam and Narayanamoorthy (2012)

Contingent valuation method was used for valuation of irrigation water. In the first round, from the identified buyers and sellers, their initial WTP and WTA values for specific amount of water was asked. Then in the second round, among all the sellers whose WTA value was highest was communicated to all the buyers and asked if they want to revise their WTP. Similarly, WTP value of that respondent whose bid was lowest among all the buyers was communicated to sellers and asked if they want to change their WTA value. In the third round, same procedure was repeated and the mean value of WTP and WTA converged to a common value. The results showed that out of all the buyers, 64% of them were willing to pay the equilibrium price of Rs.300 and 63% of sellers are willing to accept this amount as compensation. This means that water trade will take place among 63% of the farmers who were willing to participate in water trade.

Willingness to pay for restoration of natural ecosystem

Ekka and Pandit analyzed the willingness to pay of people of Gosaba islands of Sundarban Mangroves for its conservation and also analyzed the effect of covariates on WTP. WTP was the dependent variable and explanatory variables were divided into quantitative, binary and categorical variables. Step-wise logistic regression was used to determine which independent variables were predictor of people's WTP. The cases where the respondents were WTP was given value of 1 and 0 for those who were not WTP.

Table 6. Individual's willingness to pay

WTP bid value(Rs.)	Accepted (WTP=1)	Rejected (WTP=0)	Total
10	119(40.07)	27(16.67)	146
20	81(27.27)	29(17.90)	110
30	56(18.86)	27(16.67)	83
50	16(5.39)	19(11.73)	35
70	6(2.02)	9(5.56)	15
100	5(1.68)	11(8.02)	16
120	6(2.02)	7(3.09)	12
150	4(1.35)	10(6.17)	15
200	2(0.67)	7(4.32)	9
250	1(0.34)	6(3.70)	7
300	1(0.34)	5(3.09)	6
500	0(0.00)	5(3.09)	5
>500	0(0.00)	0(0.00)	0
Total	**297(64.71)**	**162(35.29)**	**459(100.00)**

(Figures in parentheses indicate percentage to their respective total)

Source: Ekka and Pandit (2012)

Around 64.71% of the respondents agreed to pay for conservation of mangroves at different bid levels and 35.29% of respondents did not agree to pay at specified bid level. With the help of logistic regression they found that only 3 variables were making significant contribution to the

WTP, i.e. the bid value that the respondents were willing to pay, respondent's perception regarding mangrove degradation and mode of payment.

7. Conditions for successful PES

Following conditions are necessary for the successful implementation of PES:

- Flexibility in the model.
- Clearly defined and secure property rights over environmental resources.
- Proper assessment of environmental services generation and their appropriate valuation.
- There is always the need to substantially reduce transaction costs so that the schemes are economically viable for both sellers and buyers.
- Multiple sources of revenue can help in reducing uncertainty in the flow of financial resources.
- A continuous provision of environmental services.
- Lack of transparency and trust between buyers and providers may hinder the success of PES schemes.
- In common lands when it is necessary to bring all the landowners under new land-use norms, lack of consensus on the part of the landowners may obstruct the progress of the schemes.
- User-financed PES schemes are likely to perform better than government-financed ones.
- Adoption of PES is higher when NGOs and civil society institutions, particularly community-based organizations, are present.
- Environmental service providers should be provided with adequate technical assistance.

8. Challenges and conclusions

For successful implementation of PES, India faces the following challenges:

- Insecure and ill-defined property rights.
- Organize large numbers of small landholders and alter their land-use pattern.
- Provision of easy access to credit markets and sufficient technical and extension services to farmers.
- Ensuring the participation of all sections of the people from such a diversified society.
- Existing socio-economic, religious and political differences are likely to limit its effectiveness.

If these challenges are met, then certainly there is a potential to introduce PES in India. FAO has identified that agriculture can provide a better mix of ecosystem services to meet society's changing needs if better incentives are provided. In order to secure active involvement and

support from the Government for large scale projects, more studies need to be undertaken on relevant PES models and more information is needed through research in both natural as well as social sciences. Institutions and capacity building also required to be strengthened.

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