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CAPACITY CONSTRAINTS IN OPERATIONALISATION OF PAYMENT FOR ECOSYSTEM SERVICES (PES) IN INDIA: EVIDENCE FROM LAND DEGRADATION

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ABSTRACT

The understanding of the requirement for PES and necessary capacity of stakeholders to conceive, design and execute PES, are critical to its successful operationalisation. Identification and assessment of capacity needs are also prerequisite for PES especially in a developing country like India where institutional setting and functioning are far from the desirable level. In this background, the paper begins with an introduction of the basic concept and centrality of economic valuation in PES. Next, the paper discusses the status of the land degradation problem in India and how the PES can prove to be an efficient tool to manage the declining ecosystem services due to increasing land degradation in the Country. By identifying the direct and indirect drivers of land degradation, the stage is set for designing of appropriate response options for halting the degradation of land which is not only the base of agrarian economy of India but source of livelihood options for the poor. In the subsequent section, the paper assesses the required capacity to operationalise PES in the states where the problem of land degradation is acute. This has been done on the basis of wider consultation with land users (farmers), conservation agencies, Departments of Land Agriculture and related R&D agencies through a structured questionnaire in group meetings in different parts of the Country during 2006–2007. The necessary capacity on behalf of stakeholders like the Local, State and National level institutions have been mapped out. The result from the survey suggests that while the capacity to understand the ecosystem services is adequate, the capacity to do valuation of incremental change in the ecosystem services is not sufficient and the State still needs to invest significant amount of resources before this tool can be used to manage the land based ecosystem services in India. Copyright © 2010 John Wiley & Sons, Ltd.

KEY WORDS: payment for ecosystem services (PES); valuation; condition of additionality; ecosystem services of land; land degradation; India

INTRODUCTION

Payment for services provided by ecosystems known as payment for ecosystem services (PES) has emerged as one of the innovative responses to manage ecosystems. Payment for ecosystem services (PES refers to the payment made for using ecosystem service or the land to secure that service (UNEP/IUCN, 2007). Payments are found to be valuable when land cannot be purchased and set aside for conservation. Although the efficiency of this response is still being scrutinized and examined, it has by and large been agreed by the practitioners as well as ecological economists that in many cases, this arrangement can yield favourable result for efficiency and conservation goal if certain institutional requirements are in place (Heal, 2001; Pagiola, 2008; McNeeley, 2007; Kumar, 2008; Kumar and Muradian, 2008; Kosoy *et al*., 2008). The PES has largely been used for hydrological services, carbon and biodiversity.

PES has been embraced by practitioners because it encourages conservation what is worth conserving and it ignores what is not worth conserving. Additionally, PES is not based on whims of donors or NGOs, but self-interest of service users and providers. It is not surprising that decision makers have increasingly started using this tool. Some of the examples include Alternatives to slash-and-burn, UNDP/UNEP Poverty and Environment Initiative, Equator Initiative, GEF small grants programme, Country poverty reduction strategies, TNC Great Rivers Partnership and USAID and Development (Kumar, 2005). One of the main reasons behind growing acceptance of PES is its ability to deliver the cost effective management option of ecosystems. However, the PES would provide cost effective response to management of ecosystems provided the transaction and operational costs are outweighed by the costs of damage. In this paper the feasibility of PES in India as a response to land

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degradation has been assessed. But before that, the critical precondition of PES-economic valuation of ecosystem services emanating from cultivated ecosystems has been critically evaluated. Subsequently, the paper discusses the extent and severity of land degradation identifying the drivers of change in India. As the part of management strategy, PES can be designed with the intention to create incentive structure for the farmers to adopt sustainable land tillage practices and precision agriculture. The paper through a structured questionnaire evaluates the capacity constraint in implementing the PES to address the challenge of land degradation.

PES AND ECONOMIC VALUATION

The use of payment mechanism has a good potential for management of cropland and cultivated ecosystems where tillage practices, nutrients load (use of fertilizer) and irrigation pattern can be suitably rewarded or punished by the Local government bodies depending upon its impact on the soil, water and nutrients of the land which would in turn affect the capability of land to provide the services. The practices used will also influence the quality of flow of services like ground water and fertility of land like soil formation and nutrient retention popularly known as supporting service of land based ecosystems. In applying the PES for management of land based ecosystem services there are a number of requirement and assumptions which would be needed. Some of them are credible estimates of additional flow of benefits and necessary institutional capacity to come on the common negotiating table and minimum social trust (Vatn, 2010).

In execution of PES, economic valuation of additional flow of service is critical. Most ecosystem services (particularly the regulating services) occur as non-market externalities, which makes their monetary valuation difficult. The economic approach to valuing ecosystem services in monetary terms is based on the conceptualisation of ecosystems as capital stock. Formation of values is influenced by the robustness and accuracy of the various market and non-market based valuation methodologies in capturing the services from the ecological production functions. This is especially true for hydrological services, nutrient load and waste minimisation services. Understanding ecological production functions through collaborative effort between economists and ecologists provides the necessary and basic information on issues critical for carrying out the valuation exercise.

Some of the relevant issues needed for good valuation include:

(a) State of the ecosystem and corresponding functional form of the ecological production function.
(b) Drivers of change, their impact on the ecosystem and the resultant change(s) in the flow of ecosystem services.
(c) Units and measurement of ecosystem services.
(d) Additional perturbations creating changes in the flow of ecosystem services (basically marginal change in ecosystem benefits as a response to marginal change in drivers).
(e) Spatial and temporal considerations relating to ecosystem change.
(f) Gainers and losers in the process of ecosystem change.
(g) Property rights for the ecosystem services.

Economic valuation of additional flow of services done through a transparent process, would greatly help in deciding the payment structure however, there are evidences where PES can be in place without going for economic valuation (Kosoy and Corbera, 2010). Initial condition and state of land (cultivated ecosystems) would enable the owner to discern the base flow of services. Any incremental intervention arising out of management policy can shed light on the relationship with payment scheme. This is also known as marginal change in ecosystem services and benefits. Scales of human intervention (administrative unit) and ecosystem services are important consideration as they always appear at different levels (Wilbanks, 2006). Also, losers and gainers in this process of change due to policy response are different actors, so a clear cut marking of stakeholders along with the ownership/property right over services (land) would help in designing suitable PES scheme.

Valuation is only one element in the effort to improve the management of ecosystems and their services. Economic valuation may help to inform management decisions, but only if decision-makers are aware of the overall objectives and limitations of valuation such as the assumptions on which the valuation is based and related veracity of information. A typical number might not reveal the local institutional set up. Economic value of a service might come up very high but it may not prove to be enough for beneficiary and provider to trust each other on delivery and payment if enabling institutions are absent. The main objective of valuation of ecosystem services is to indicate the overall economic efficiency of the various competing uses of a particular ecosystem. The underlying assumption would be that the ecosystem resources should be allocated to those uses that yield an overall net gain to society, as measured through valuation in term of the economic benefit of each use adjusted by its costs. Some of the key messages emerging from the valuation of environmental services are:

(a) Valuation of ecosystem services has to be context specific, ecosystem specific and guided by the percep-

tion of beneficiaries besides the opportunity costs of sustainable farming.
(b) There should be more focus on the valuation of marginal changes of ecosystems rather than on the value of 'total' ecosystem.
(c) Initial condition and state of the ecosystem is important in valuation of ecosystems.
(d) Valuation should be done for ecosystem services assuming they are independent of each other.
(e) Establishing property rights for the ecosystem is critically important for valuation.
(f) While doing valuation, issues of irreversibility and resilience must be kept in mind; clear cut bio-physical linkages and relationships would not only facilitate the valuation exercise but would ensure its credibility in public policy.
(g) Uncertainty is one of the key challenges in valuation of ecosystem services requiring the incorporation of sensitivity analysis.
(h) Stakeholder participation and embedded outcomes in the institutional processes would enable valuation that is more authentic and acceptable to the decision makers.

The services from agro-ecosystems might be treated as externalities from the farmers' perspective and even if identified and acknowledged they tend to be under-produced and undervalued. There have been innovative response policies to sustain these services through valuation and payment for those services by the beneficiaries to the providers thus inducing farmers to adopt practices that generate higher levels of services (Ferraro, 2001; Landell-Mills and Porras, 2002; Pagiola *et al*., 2007; Ghazoul *et al*., 2009; Layton and Siikamaki, 2009).

LAND DEGRADATION IN INDIA

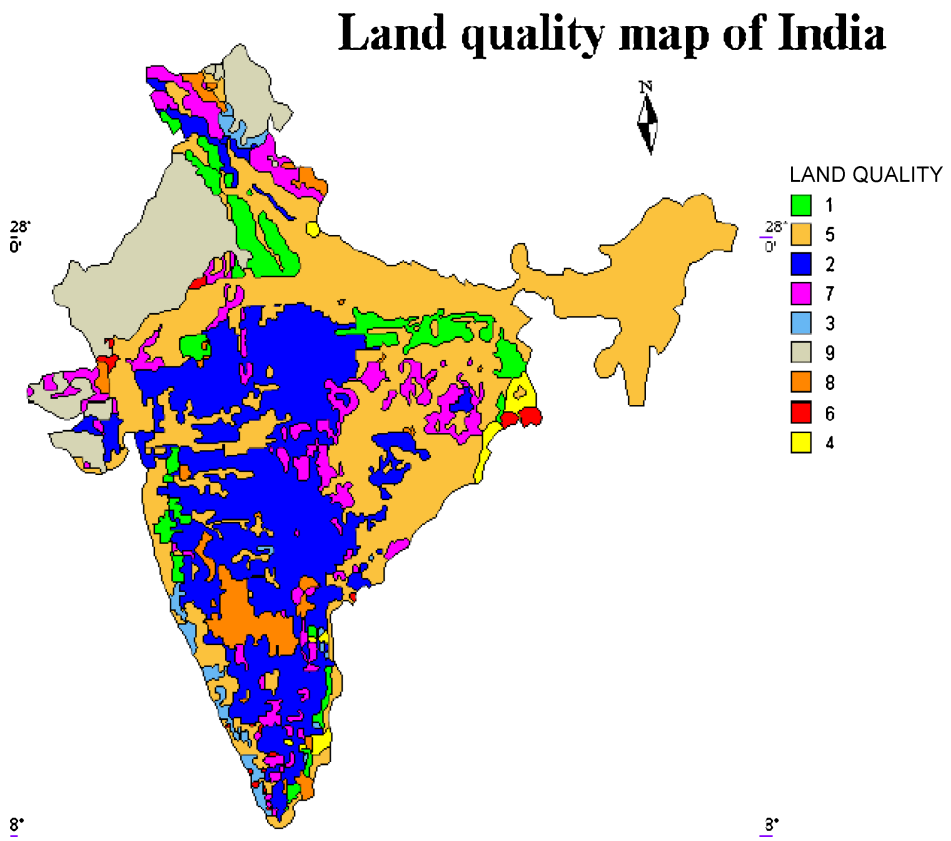
Land degradation and desertification are one of the most serious environmental problems humanity is facing today. Globally almost 18 per cent of the Earth's vegetated land have been degraded as a result of human activity. There are three types of major land degradation in India—soil erosion, soil salinity and waterlogging. In India, 173·64 mha, or 53 per cent, of the total geographical area is affected by the problem of declining capability to deliver various ecosystem services (Government of India, Ministry of Environments and Forests, 2006a,b). State of the Environment Report estimates that out of 306 mha of reported area, 146·82 mha of land is degraded in varying degrees (MoEF, 2009). Unsustainable agricultural practices are some of the major drivers for the land degradation. Table I provides the various estimated of land degradation in the Country.

The information presented in Table I suggests that there has been a multiplicity of approaches for assessing land degradation in India. A number of agencies have been involved in estimating land degradation or wasteland. The estimates however, vary significantly in terms of definition, coverage, methodology, and periodicity. Most of the statistics published by different organizations on degraded lands are only estimates lacking scientific base for data acquisition and does not have spatial extent. The wasteland map of the Department of Land Resources cannot be considered as such a base data for degraded lands. Some of the categories of the wastelands, such as the steep sloping lands, scrub and without scrub lands, snow covered lands, etc. have been recognized, as wastelands, which may not necessarily, be the degraded lands (Ministry of Agriculture, GoI, 2006a,b). There is thus a need to evolve a scientific approach for mapping degraded land to overcome the fallacies of various statistics.

Table I. Surveys/estimates of degraded lands in India

Agency/organisation	Year	Extent (in million ha)	Criteria for delineation
National Commission on Agriculture (NCA)	1976	175·00	Based on secondary data only
Society for Promotion of Wastelands Development	1984	129·58	Based on secondary collected data
Ministry of Agriculture, GOI	1985	173·64	Based on the land degradation statistics for the Provinces of India
National Remote Sensing Agency	1985	53·3	Mapping on 1:1 million scale based on remote-sensing techniques
National Bureau of Soil Survey and Land use Planning (NBSSLUP)	1994	187·70	Mapping on 1:4·4 million scale based on Global Assessment of Soil Degradation (GLASOD) guidelines
Ministry of Agriculture, Department of Agriculture and Cooperation	1994	107·43	Based on the land degradation statistics for the States
Department of Land Resources	2000	63·84	Mapping on 1:50 000 scales. Thirteen categories of Wastelands delineated
Department of Land Resources	2005	55·27	Mapping on 1:50 000 scale
Ministry of Environment and Forests	2009	146·82	N.A.

Source: Ministry of Agriculture, 2006 and 2009.



Map 1. Land Quality Map of India (Source: Sharma, 2006). Notes: Categories 1-3, Good Condition Land; Categories 4-6, Bad; Categories 7-9, Very Bad.

In India arid zone covers about 320 000 km^2 (12 per cent of the geographical area). Besides, there's an additional 70 300 km^2 area of cold desert. Rajasthan occupies the greater part of the Indian arid landscape and about 60 per cent area of the State, lying west of the Aravallis followed by Gujarat (19 per cent), Punjab and Haryana (9 per cent) and Karnataka and Andhra Pradesh (10 per cent). Recently, a pilot project was taken up by Indian Space Research Organization (ISRO) to evolve and standardize the methodology for desertification status mapping (DSM). The study areas pertaining to different agro-ecological zones in both hot and cold regions were selected for carrying out the pilot project. A comprehensive national level classification system and the methodology for desertification status mapping has been evolved and standardized IRS-LISS III data has been successfully used to prepare Desertification Status Maps for the study areas pertaining to both hot and cold desert regions of India on 1: 50 000 scale (ISRO, 2006). While the western parts of India especially Rajasthan and Gujarat cover a greater portion of desert land, resultant force of primary and proximate drivers cause drought or drought like situation in other states as well. The highest percentage of good soil is in Andhra Pradesh, wherein 66·27 per cent of the land is classified into first three land quality classes. However, the share of good quality soil is merely 10·14 per cent in Orissa. Southern and northern region have good soils and eastern region has poor soils (Sharma, 2006). Sharma (2006) has classified the area of some of the States in India into two, as (i) good soils and (ii) poor soils. These States were selected on the basis of agricultural production during the period 1973–1974 to 2003–2004. The area under first three land quality classes has been classified to be under good soils and the rest in the poor soils.

As per various estimates, about 45 per cent of the total geographical area of the country is degraded due to different degrading agents. The states suffering from severe degradation are Mizoram (89 per cent), Himachal Pradesh (75 per cent), Uttar Pradesh including Uttaranchal (76 per cent) and Kerala (67 per cent). Water erosion is widespread in Madhya Pradesh including Chhattisgarh, Andhra Pradesh and Uttar Pradesh including Uttaranchal, Maharashtra,

Karnataka, Jammu and Kashmir, Gujarat and Orissa. The wind erosion is conspicuous in Rajasthan and Jammu and Kashmir (cold desert). The areas under waterlogging are more in Uttar Pradesh, Kerala, Bihar including Jharkhand and Andhra Pradesh. Large areas in the states of Rajasthan, Uttar Pradesh and Maharashtra are under saline/alkaline soils. Finally, acid soils are prominent in Madhya Pradesh including Chhattisgarh, Arunachal Pradesh, Mizoram, Meghalaya and Bihar including Jharkhand.

The governments at various levels have designed the response strategies ranging from technical to legal to economic responses to halt the pace of land degradation (NAP, 2001). The reward for sustainable land management practices has also been envisioned. If the government at centre and more at state level encourages sustainable land practices through reward for the enhanced ecosystem services, the upward spiral of land degradation can be halted. Before we explore the possibility of applying PES and potential constraint in its execution it would be important to analyse the drivers of land degradation in the country. There are two types of drivers of land degradation in India direct and indirect.

Direct drivers are:

(a) Cultivation of soils that are fragile, or exposed to erosion by wind or water; reduction in the fallow period of soils, and lack of organic or mineral fertilizers;
(b) overgrazing;
(c) urbanisation;
(d) overexploitation of woody resources;
(e) uncontrolled use of fire for regenerating pasture, for hunting, for agricultural clearing, or for setting certain social conflicts;
(f) unsustainable agricultural practices;
(g) irrigation of soils prone to salinisation, alkalinisation or even waterlogging.

Indirect drivers of land degradation are:

(a) The need for immediate requirement of increased production of grains and meat arising out of demographic change.
(b) Trade and globalisation, primarily international competition and unfavourable terms of exchange.
(c) Insufficient knowledge of the long-term consequences of applying particular technologies.

PES AS RESPONSE MEASURE

As a management strategy, PES is designed with the intention to reward the farmer, land user for sustainable tillage and ecosystem service enhancing fertilizer, irrigation, pesticides and post-harvest (fallow) practice. The result of such practice in terms of nutrient cycling, prevention of soil erosion are clearly acknowledged by the State and farmers but the farmers are too preoccupied with the short term goal of greater productivity. Poverty among the land users could be another reason for this myopic vision.

As discussed above, the PES would require the clear understanding of structure, functions and subsequent services (outcome of functions and processes). As a result of sustainable farming practices including sustainable irrigation, reduced fallow period and organic manure, would lead to reduced erosion, waterlogging, maintenance of nutrients and moisture retention. These benefits would accrue to the owner and farmers and nearby fellow farmers. The benefit has long duration nature and if the farmer is not the owner, adoption of such practices might not be possible. Even for those farmers, who are aware of the consequences of their unsustainable farming practices, the goal can still be short term profit maximisation (Kumar, 2004). The State can have better information on ecological implications and she will have to place incentive structure in the form linking it with norms of tillage, fertilizer use and types of irrigation (e.g. drip vs. tube well).

For land based ecosystem services, the spatial scale and hierarchy of decision making units should be clearly understood by the agents involved in the PES. As given in the figure below (Figure 1), the dynamic complex of micro-orgasms and landscape metric should be assessed as it enters the domain of different beneficiaries. The land owners are the local beneficiaries and variety of seeds and storage of carbon are national and global benefits.

The benefits of these services ranging from soil microorganism to terrestrial scale would be going to the local farmers, regional agencies, national government or global community. The incremental impact of land management practices of farmers should be evaluated explicitly if

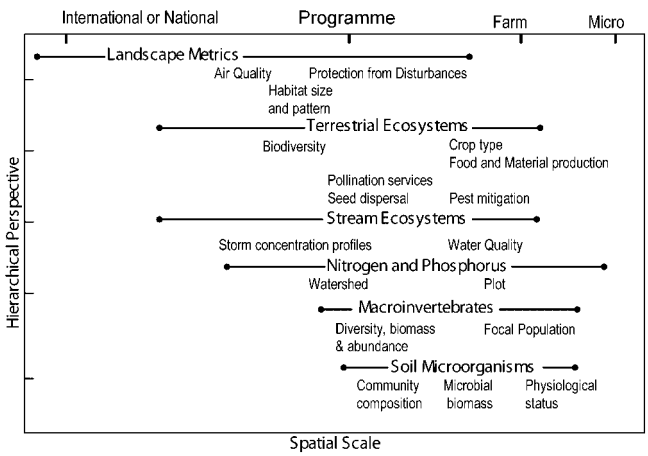


Figure 1. Spatial scale of metrics that relate to environmental services from agriculture (*source*: Dale and Polasky, 2007).

the reward (or compensations) arrangement needs to work effectively. While estimation of economic values of environmental services from agricultural land would provide the credibility to the decision making process, adequate caution should be taken in using those values.

Under PES Scheme, it is essential for beneficiaries or service buyers to develop a baseline in order to assess PES additionality—failing to do so, can waste all PES funding by paying for things that would have happened anyway. The PES payments need to be applied strategically so that additionality can be demonstrated clearly (Wunder, 2007). This can be done through the extension programmes by creating awareness and suitable outreach activities of the state Agricultural Department (Extension and Outreach Division) in various states of India. Thus emphasis on identifying the 'additional services' is required and this

Table II. Mechanisms for the delivery of environmental services through PES scheme

Service	Delivery *via* PES	Spatial focus of PES	Collective action	Measurable	Basis of payments
Pollination	Through effects on habitat/resource quality and distribution	Landscape level	Preferable	Difficult, some proxy measure would be required	Targeted changes to management practices
Water regulation	Through establishment of buffer zones and appropriate cropping and management; flood land areas for flood water storage	Catchment level and individual farm level	Buffer zones would ideally be established at the catchment level		Targeted changes to management practices; direct payment for flood land areas
Water purification	Buffer zones and appropriate cropping and management; reduced stocking density	Catchment level and individual farm level	As above	Improved water quality can be determined but difficult to attribute to individual action	Targeted changes to management practices
Carbon sequestration	Through less intensive land use; forestry or grassland, minimise cultivation and incorporate crop residues, utilise field margins	Global but action at individual farm level	No	Changes in soil carbon can be measured. But must establish baseline. Proxy, measures carbon in vegetation	Targeted changes to management practices or payment linked to measured levels of soil carbon; reward structure must be long-term
Peatland	Re-vegetation and re-wetting, removal of drainage gullies, extensive management				
Erosion regulation	Appropriate management, incorporation of crop residues, cover and/or inter cropping, retain hedgerows	Farm level	Not needed	Difficult to accurately measure erosion and hard to establish baseline levels	Targeted changes to management practices
Waste regulation	Utilise biosolids and other similar organic material as fertiliser on appropriate crops	Farm level	Not needed		Reward per unit of biosolid or organic material used as percentage of fertiliser input
Biodiversity	Preservation of habitat status, species and genetic diversity	Landscape and farm level	Preferable	Species number and diversity; habitat quantity and quality	Targeted changes to management practices and/or direct link between species number and payment; increased reward for improved habitat quality
Landscape preservation	Preservation of hedgerow, dry-stone walls, architectural features, etc.; as a side-effect of other service delivery	Landscape	No	Arbitrary and subjective	Targeted changes to management practices

Source: Adapted from Rowlett *et al*. (2008).

Table III. List of total respondents

Category	Number
Government	15
NGO	33
R&D Institutions and Universities	18
Civil Society	8
Total	74

needs to be clearly specified and spelt out. On payment, it should be no less than the difference in returns compared to the landowners' best alternative land use (or they will not participate), and no more than the value of the benefit provided (or it would not be worthwhile to provide the service). Estimation of economic value proves to be too hard for some of the services especially for biodiversity conservation for this reason, and to limit budgetary requirements, all existing PES programs implicitly or explicitly base payments on the opportunity costs of the main alternative land. Therefore identification of opportunity costs must be carried out (Table II).

The design of PES including the payment, delivery, basis and its status (measurable/non-measurable) would greatly facilitate the execution of PES. Following Table III provides a glimpse of the possible mechanism.

Once this step is spelt out, the most defining character of PES for land based ecosystem services would be feature of prevailing market. A review of PES for land based ES suggests that it could succeed where the agents and instruments of market had relatively robust characters, Institution's—formal and informal were in place and various enabling conditions were relatively developed. Such cases are less frequent especially in case of developing countries where functioning of market even for normal factors like capital and labour are far from perfect, degree of governance is low and social and institutional developments are nascent. In such situations functioning of market for ecosystems services is difficult to realize. However, a careful analysis suggests that proper focus on instruments, which can enable the market, may be a desirable action on behalf of governments, social planning bodies or similar institutions.

CAPACITIES REQUIRED FOR EXECUTION OF PES FOR LAND BASED ECOSYSTEM SERVICES IN INDIA

A comprehensive survey of capacity needs for management of land degradation was carried out by the Ministry of Environment and Forests (MoEF), Government of India during 2006–2007 (http://ncsa.undp.org/). This exercise was concerned with a country's capacity—the abilities of individuals, groups, organizations and institutions to address the priority environmental issues as part of efforts to achieve sustainable development. This effort was part of bigger assessment on India's capacity requirements to implement the three 'Rio Conventions' – biodiversity (CBD), land degradation (UNCCD) and climate change (UNFCC). The capacity needs were identified in four stages.

In a diverse country like India, PES would not succeed if the necessary institutional and individual capacity needs are not met. In order to understand the types of capacity need at various levels, a detailed baseline survey and group focal meetings were conducted in states of West Bengal, Rajasthan, Gujarat, Maharashtra and Tamilnadu. Please refer to questionnaire in Supplementary Appendix I. These are the states where the degradation is apparent in most serious form. The survey was conducted for government agencies, NGO and R&D Institutions of the State (land is a state issue in India) to assess the following capacity:

(a) Capacity to conceptualise and formulate policies, legislations, strategies and programmes related to PES.
(b) Capacity to implement National Action Programme to combat land degradation.
(c) Capacity to undertake international cooperation and develop sub-regional and/or regional action programmes.

    a. S*cientific and technical*.

(d) Information collection, analysis and exchange the hierarchy of ecological scale.
(e) Capacity to do economic valuation of ecosystem services.
(f) Transfer, acquisition, adaptation and development of technology.

    a. S*upporting measures*.

(g) Capacity building, education and public awareness.
(h) Financial resources and Financial mechanisms.

The assessments of capacities under each broad head have been done after reviewing the details of successful execution of PES for similar institutional set up elsewhere. However, in the Indian context, a few subheads need particular attention in. These are:

(a) Effective participation at all levels and of all sections in PES.
(b) Lands that are not yet degraded and any need for PES there.
(c) Traditional knowledge.

METHODOLOGICAL APPROACHES

The assessment of capacity to undertake PES response to address land degradation requires some comparison and nominal measurement of capacities. But before that, a

refinement of definition of capacities was made. A department or personnel may have high technological, financial and other required capabilities. But without commitment, it will not be delivering the services it can. Alternatively, a set of officials or group of workers may have high commitment. But without the necessary resources like skill and finance, it cannot perform to its potential. Therefore, Capacity is defined as consisting of two components: capability and commitment. A high level of one without a matching high for the other does not imply a high capacity. Both capabilities and commitments to each key capacity needs would be expressed in a 3-point scale:

$$\text{Poor} \tilde{:} 1 \quad \text{moderate} : 0 \quad \text{excellent} : +1$$

The idea is that one poor capacity and one excellent together can be considered moderate capacity. The scores can be aggregated.

The database for assessment consists of the three volume National Action Programme reports of the government of India—especially the volume I on the status of desertification, and the linkage and stocktaking studies. In addition, some recent reports containing assessments of capacities have been consulted. Considering that the existing capacities in any particular need may not be uniform over time and space in this vast and complex country we made some categories. Two types of divisions were included:

I.	By levels:	Centre, State and Local levels
II.	By region:	
		1. *Core dryland region*: west and north India
		2. *Peripheral dryland region*: south and east India

Assessment in the 3-point scale was done for each capacity needs—separately for (i) capability and (ii) commitment—of each obligation, for each of the five regions. For each capacity requirement we got 10 readings. Altogether, we made above 600 assessments. Thus each capacity need had 10 scores in 3 point scale. Their aggregates were grouped as:

Serial no.	Includes scores	Characterisation
1	+5 to +10	Strong
2	0 to +4	Sufficient
3	−5 to −1	Deficient
4	−10 to −6	Very weak

From a review of the database, we assigned a score, in a 3-point scale, for capability and commitment to each key capacity need, separately for 5 divisions (Centre, States and Local separately for the core and peripheral regions). The necessary workshops were organised by the Ministry of Environment and Forests in 2006–2007. In addition, six workshops were organized in different parts of India and each workshop included on average 75 stakeholders who could potentially be involved in PES in their respective region. The questionnaires were circulated in the workshops and the respondents were briefed on the requirements of the questionnaire there itself. Please see the Table III. Answers were sought on the basis of pre-defined codes specified for each question in the questionnaire. These codes were further categorized as high, medium, low and missing. The team has received a total of 74 questionnaires and the same have been used for further analysis.

The Table IV below gives the stakeholder responses received in all the workshops attended and organized by the team.

Table IV. Capacity to implement PES at the sub-regional and/or regional level

Category	0	High	Medium	Low	Total
Government					
Count	3	1	10	1	15
Per cent of total	4	1	14	1	20
NGO					
Count	1	7	9	16	33
Per cent of total	1	9	12	22	45
R&D Univ.					
Count	0	10	8	0	18 per cent
Per cent of total		14	11		24
Civil Soc.					
Count	3	1	4	0	8
Per cent of total	4	1	5		11
Total					
Count	7	19	31	17	74
Per cent of total	9	26	42	23	100

Note: 0 stands for missing.
High and medium represent sufficient capacities and low represents capacities, which require immediate attention.

Table V. Clarity on PES requirements in the context of India

Category	0	High	Medium	Low	Total
Government					
Count	0	8	5	2	15
Per cent of total		11	7	3	20
NGO					
Count	9	3	13	8	33
Per cent of total	12	4	18	11	45
R&D Univ.					
Count	3	4	6	5	18 per cent
Per cent of total	4	5	8	7	24
Civil Soc.					
Count	0	4	3	1	8
Per cent of total		5	4	1	11
Total					
Count	12	19	27	16	74
Per cent of total	16	26	36	22	100

Note: 0 stands for missing.
High and medium represent sufficient capacities and low represents capacities, which require immediate attention.

Based on the responses received on the questionnaires certain key capacities have been identified. The results drawn from the survey are presented in Tables IV–VIII.

Capacity to provide scientific and technical education and training to decision makers, managers and personnel who are responsible for the collection and analysis of data for the dissemination and use of early warning information on drought conditions and also the capacity to inform public of the status and usefulness of PES.

On the whole, Indian institutions seem to be well equipped to meet the PES requirement. We assigned, for nearly 80 per cent of the requirements, the existing (key) capacities in India for meeting the PES as adequate—either moderate or excellent. The rest—a little above 20 per cent of requirements, were regarded as relatively poor. This was true for both capabilities and commitments. In some of the requirements capabilities were regarded as adequate but commitments low. In some others commitments were assessed high capabilities low. But overwhelmingly (in 85 per cent) commitments match capabilities in each (key and special) capacity needs.

Except for the arid states, very little interest has been shown for use of PES over lands that are not yet degraded. Till mid-1980s the thrust was mainly on promoting agricultural growth under assured irrigation areas. In more recent years drought prone areas and improving productivity in rain fed agriculture have drawn interest. These were motivated by general recognition of the adverse impact of degradation on human well being, leading to poverty—containing land degradation programmes did not appear as

Table VI. Capacity to source funds for initial action on PES

Category	0	High	Medium	Low	Total
Government					
Count	2	4	5	4	15
Per cent of total	3	5	7	5	20
NGO					
Count	8	3	18	4	33
Per cent of total	11	4	24	5	45
R&D Univ.					
Count	1	2	8	7	18 per cent
Per cent of total	1	3	11	9	24
Civil Soc.					
Count	0	2	1	5	8
Per cent of total		3	1	7	11
Total					
Count	11	11	32	20	74
Per cent of total	15	15	43	27	100

Note: 0 stands for missing.
High and medium represent sufficient capacities and low represents capacities, which require immediate attention.

Table VII. Capacity to collect, analyze exchange information among various stakeholders like private sector, NGOs, State Institutions and Central Government Departments

Category	0	High	Medium	Low	Total
Government					
Count	0	6	4	5	15
Per cent of total	0	8	5	7	20
NGO					
Count	2	9	14	8	33
Per cent of total	3	12	19	11	45
R&D Univ.					
Count	5	5	4	4	18 per cent
Per cent of total	7	7	5	5	24
Civil Soc.					
Count	0	3	4	1	8
Per cent of total		4	5	1	11
Total					
Count	7	23	26	18	74
Per cent of total	9	31	35	24	100

Note: 0 stands for missing.
High and medium represent sufficient capacities and low represents capacities, which require immediate attention.

Table VIII. Linking national, regional and sub-regional data and information centres more closely with global information sources

Category	0	High	Medium	Low	Total
Government					
Count	1	5	7	2	15
Per cent of total	1	7	9	3	20
NGO					
Count	3	7	11	12	33
Per cent of total	4	9	15	16	45
R&D Univ.					
Count	1	4	5	8	18 per cent
Per cent of total	1	5	7	11	24
Civil Soc.					
Count	1	0	4	3	8
Per cent of total	1		5	4	11
Total					
Count	6	16	27	25	74
Per cent of total	8	22	36	34	100

Note: 0 stands for missing.
High and medium represent sufficient capacities and low represents capacities, which require immediate attention.

the mainstay in poverty reduction strategy. This led us to classify resource allocation by the Centre for designing PES as low commitment though capability was not low. Neither did the centre promote awareness or participation for preventive work on vulnerable land. The core dryland region and the states did better by responding to the local needs and urgency.

The concerned agencies in the field are capable of preparing long term flexible strategies, promote policies, design institutional and legal frameworks for PES and make regular review and progress report. But much of the commendable work remains in isolation—a comprehensive PES for sustainable land use policy is yet to come into place. Drought preparedness and management, alternative livelihood projects, sustainable agricultural practices, and mechanisms for assisting environmentally displaced persons are not fully developed. But the capacity of the institutions to estimate the economic value of soil and water retention function as a consequence of different farming practice is more than adequate. The capacity for valuation is better developed in the coastal areas than the arid areas.

DISCUSSION AND CONCLUSIONS

The tool of PES can prove effective in management of land degradation in country like India where it appears to be

serious problem in turn posing a serious threat to food security for the growing population in the long run. A detailed survey of the capacity to undertake and execute the eight aspects of PES of the existing relevant institutions in India at state and central levels reveal interesting results. Most of the valuation remains total economic value and impact of marginal action in the field is either not understood or poorly understood. Valuation was nonetheless regarded and accepted a potent tool for designing response policies by 90 per cent respondent at all India basis. In absence of a comprehensive approach the weaknesses are more manifest in lower levels, at the Local levels and in the peripheral dryland region. In core dryland region both resource availability and participation may be regarded as adequate. But in the peripheral dryland regions, effective participation at all levels and of all sections for combating desertification suffers from both capability and commitment. Mainstreaming is moderate. Besides, the measures used are generally the forest and water management measures. Multifarious needs for combating desertification are not met. Multiplicity of laws and programmes, in absence of coordinated approach and prioritisation seem to have led to limited achievements despite substantial amount of resources allocated for several related programmes.

Implementation ability in India is high. The success waits for mainstreaming of PES work. At present, except in the states of the core region, nowhere else does it feature with prominence. Promoting awareness and participation for PES is required along with mainstreaming.

Information collection systems are well established with their reach in remote areas and linking all levels. Modern technology and standards are used. But the content awaits improvement. Much relevant information like land converted from agriculture to aquaculture, some grassland in arid regions, abandoned mine lands, land degraded due to mining and industrial projects, flood induced degradation etc. are not available. Needless to add, subsequent change (loss) in ecosystem services is either poorly known or entirely unknown. The information collected is of technical nature. Information collection machinery does not address the needs of Local communities, or use non-governmental expertise. Nor is the dissemination to State and Local levels adequate. Poor integration between information generation and policy formulation affects the merits of the programmes.

In the matter of institution building, training and development of relevant local and national capacities for implementing the PES, the conditions in the core dryland region is not unsatisfactory. But this is not yet an integral part of capacity building works in the periphery or even for the centre. The general institutional situation in the country is such that the multiple causes of desertification may be addressed and different sections may be involved. But there is not much effort to create awareness and facilitate the participation of local populations and nongovernmental organizations for PES. Adequate resources, in accordance with the circumstances, are not allocated for training and understanding of PES and how it can work.

Ecosystem service of the cultivated and other lands related research as well as technical and scientific cooperation is mostly confined to central laboratories. Regional and local research capabilities are not very high. Research priorities reflecting different local conditions, and addressing the specific needs of local populations are low. Neither is there much exploration of the relationship farming practices and ecosystem services nor is there much effort at any level to integrate, enhance and validate traditional and local knowledge in improving the use of PES. Beyond the central institutions very few others benefit from bilateral and multilateral arrangements.

Considering the variety of relevant ecosystem services and its beneficiaries spread at different spatial scale, for example lowland and upland, Indian's mobilization of financial resources appear to be adequate. A satisfactory mechanism also exists for facilitating necessary funding at the State and Local levels, or for participatory programmes involving non-governmental organizations. However, there is not much success in developing innovative methods and incentives for mobilizing resources. Private sector participation is often mentioned. But little has been done to motivate the private sector players, to create incentives for them, or to extend legal support for their possible efforts. As such, private sector shows little commitment, to engage only casually in combating desertification. We used a particular score for assigning a capacity need at a particular level and a region. These are obtained by aggregating the scores over all requirement and capacity needs for successful implementation of PES. Since it is an aggregate over all capacity requirements, the weights influence the data. Hence we used only the eight key capacities, and excluded the subheads needing special attention.

The depiction of strengths and deficiencies clearly indicate that the country is strong in large number of capacities especially in terms of opinion building and informing the stakeholders about the usefulness of the PES. However, valuation of incremental change in ecosystem services appears to be wanting. The value of ecosystem services considers the impact of small change in the state of the world and not the state of the world itself (Barbier *et al*., 2009). For example, the marginal value of one unit of ecosystem service does not depend on the total value. The economic value of any asset, including a natural asset like an ecosystem, is only perceived and revealed where the flow of services proves to be beneficial to people. People would be willing to pay for services when they have to incur costs to get these services from alternate sources. The value of ecosystem services is essentially a marginal concept arising

out of scarcity and depends on the ecosystem condition and the social-cultural context in which people make choices. Thus, those undertaking valuation should focus on ecosystems that are socially important, evaluate ecological responses in economic value-relevant terms and consider the possible use of a broad range of valuation methodologies to estimate values (EPA, 2009). Obviously, operationalising the valuation of ecosystem service is a problem even for the global scientific community not to mention the people potentially involved with the PES in India.

There are other inadequacies that need immediate attention. This essentially should be done by first, mainstreaming PES as a potent response for major natural resource sectors including land; second, the requirement of policy coherence across Ministries and National R&D Institutions would strengthen the case for PES. Third, additional financial support in certain critical areas of Land Degradation especially for the services which are difficult to monetise, the incentive could be designed based on expert's opinion. Fourth, capacity building for acknowledging complexities and interdependence of natural and manmade drivers of land degradation and learning from International experiences in PES can be quite helpful.

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REFERENCES

Barbier EB, Baumgärtner S, Chopra K, Costello C, Duraiappah A, Hassan R, Kinzig A, Lehman M, Pascual U, Polasky S, Perrings . 2009. The valuation of ecosystem services. In *Biodiversity, Ecosystem Functioning, and Human Well-Being*, Naeem SD, Bunker E, Hector A, Loreau M, Perrings C (eds). Oxford University Press: Oxford.

Dale VH, Polasky S. 2007. Measures of the effects of agricultural practices on ecosystem services. *Ecological Economics* **64**: 286–296.

EPA. 2009. Valuing the protection of ecological systems and services, a report of the EPA Science Advisory Committee, EPA-SAB-09-012, May 2009, www.epa.gov/sab.

Ferraro P. 2001. Global habitat protection: limitations of development interventions and a role for conservation performance payments. *Conservation Biology* **15**: 1–12.

Ghazoul J, Garcia C, Kushlappa CG. 2009. Landscape labeling: a concept for next-generation payment for ecosystem services scheme. *Forest Ecology and Management* **258**: 1889–1895.

Government of India. 2006a. From Hariyali to Neeranchal—Report of the Technical Committee on Watershed Programmes in India. Department of Land Resources. Ministry of Rural Development. [http://www.wassan.org/Parthasarathy_Committee.htm]

Government of India. 2006b. Approach to the mid-term Appraisal of the Tenth Plan (2002–2007). Planning Commission: New Delhi.

Heal G. 2001. Protecting natural capital through ecosystem service districts. *Stanford Environmental Law Journal* **20**: 333–354.

Space Application Centre (ISRO). 2006. Desertification Monitoring & Assessment Using Remote Sensing & GIS: A Pilot Project under TPN-1 UNCCD. Ministry of Environment and Forests. Government of India: Ahmedabad.

Kosoy N, Corbera E, Brown K. 2008. Participation in payments for ecosystem services: Case studies from the Lacandon rainforest, Mexico. *Geoforum* **39**: 2073–2083.

Kosoy N, Corbera E. 2010. Payments for ecosystem services as commodity fetishism. *Ecological Economics* **69**: 1228–1236.

Kumar P. 2004. Economics of soil erosion, Concept, New Delhi.

Kumar P. 2005. *Market for Ecosystem Services*. IISD: Winnipeg, Canada.

Kumar P. 2008. Payment for ecosystem services: emerging lessons. *Ecological Economics* **4**: 2–14.

Kumar P, Muradian R (eds). 2008. *Payment for Ecosystem Services*. Oxford University Press: Delhi.

Landell-Mills N, Porras I. 2002. *Silver Bullet or Fools' Gold? A Global Review of Markets for Forest Environmental Services and their Impact on the Poor.* IIED: London.

Layton DF, Siikamaki J. 2009. Payment for ecosystem services programmes: predictinglandowner enrolment and opportunity costs using a Beta-Binomial Model. *Environment and Resources Economics* **44**: 415–439.

McNeely JA. 2007. A zoological perspective on payments for ecosystem services. *Integrative Zoology* **2**: 68–78.

Ministry of Environment and Forests. 2009. State of Environment, Government of India, New Delhi. 10.

National Action Programme to Combat Desertification (NAP). 2001. Status of Desertification. Vol-I. Ministry of Environment and Forests. Government of India: Lodi Estate; New Delhi.

Pagiola S. 2008. Payments for environmental services in Costa Rica. *Ecological Economics* **65**: 712–724.

Pagiola S, *et al*. 2007. Paying for the environmental services of silvopastoral practices in Nicaragua. *Ecological Economics* **64**: 374–385.

Rowlett A, Haines-Young R, Potschin M, Kumar P. 2008. Delivering environmental services through agri-environment programmes: a scoping study, Ref: EO0300011 CEM, the University of Nottingham: Nottingham.

Sharma P. 2006. Agricultural Productivity and Land Quality Linkages in India: a State-wise Analysis. Paper presented at the ninth biennial conference of the International Society for Ecological Economics. 16–18 December. New Delhi.

UNEP/IUCN. 2007. Developing international payments for ecosystem services: towards a greener world economy (www.unep.ch/etb/areas/pdf/IPES).

Vatn A. 2010. An institutional analysis of payments for environmental services. *Ecological Economics* **69**: 1245–1252.

Wilbanks TJ. 2006. How scales matter: some concepts and findings. In *Bridging Scales and Knowledge Systems*, Reid WV, *et al*. (eds). Island Press, Washington DC.

Wunder S. 2007. The efficiency of payments for environmental services in tropical Conservation Biology. *Conservation Biology* **21**: 48–58.