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# Feasibility of Payments for Watershed Services

## Part I: A methodological review and survey of experiences in India and Asia

**IND 3025 0/52 "Development of Tools and Methodologies to Implement the Payment for Environment Services (PES) concept in Watersheds in India" between Norwegian Institute for Water Research (NIVA) and Centre for Interdisciplinary Studies in Environment and Development (CISED), Bangalore, India**

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# REPORT

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Abstract

The following report is a literature review in the India PES Project "Development of Integrated Tools and Consulting Services for Watershed Management, and Payments for Environmental Services in India", supported by the Royal Norwegian Ministry of Foreign Affairs (MFA). This report (Part I) contains a review of seminal papers on Payments for Ecosystem Services. The literature is reviewed for feasibility criteria of establishing PES with a focus on watershed services. The feasibility criteria reviewed include biophyiscal, institutional and economic constraints on the establishment of systems for payments of watershed services (PWS). Examples of currently functioning PWS are reviewed from India and Asia.

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India PES Project

# Feasibility of payments for watershed services

## Part I: A methodological review and survey of experiences in India and Asia

# Preface

The following report is a literature review in the India PES Project "Development of Integrated Tools and Consulting Services for Watershed Management, and Payments for Environmental Services in India", supported by the Royal Norwegian Ministry of Foreign Affairs (MFA). Part I of the literature review contained here reviews seminal papers on payments for ecosystem services from the point of view of institutional, biophysical and economic feasibility of PES. Part II is a companion report which provides a review of organisations currently working in PES, as well as an evaluation of the expertise required to carry out rapid feasibility appraisals. Part I has been written by Nadine Reis and Gudmund Synnevåg Sydness and edited by David N. Barton.

Oslo, March 2007

*David N. Barton*

# Contents

# 1 Introduction

## 1.1 Aims and Scopes of the report

Two sub-objectives of the "India PES"[1] project are to:

1. Identify potential clients and demonstrate PES tools which could lead to business for the two partners
2. To strengthen co-operation between NIVA and south Asian partners for joint consultancies.

The project has chosen to focus on markets for watershed services. The evaluation of "business opportunities" for NIVA and CISED are therefore also two-fold. Firstly, a case must be made for the feasibility of markets for watershed services based on theory and the study of its implementation in case studies in areas and for services similar to those studied in the Malabrabha River Basin. Can a convincing case be made for markets for watershed services based on existing experiences in India and South-East Asia? What do these cases tell us about the financial, institutional and biophysical[2] limitations that must be overcome for markets for watershed services to function? Are these limitations common across countries, and geographical scales for the same types of watershed services? An evaluation of the market opportunities for payments for watershed services constitutes Part I of the review.

If the broad pre-conditions for establishing and then sustaining markets for watershed services can be identified, a case may also be made for market opportunities of a second kind, involving consulting services in how to carry out such feasibility studies. A number of research institutes and consultancies in Asia have conducted case studies, often in cooperation with northern hemisphere counterparts. The second part of this report (Part II) constitutes an evaluation of which institutes and companies have been most involved in studying markets for watershed services, which agencies have and are financing such studies, and what are fields of expertise may be required to conduct rapid feasibility appraisals of the kind discussed in Part I of the report. The competencies NIVA and CISED will be able to offer in this regard are also being developed in the Malaprabha River Basin through land-use studies, hydrological modelling, economic valuation of natural versus artificial irrigation water and stakeholder and institutional analyses. The Part II report has been prepared before these activities have concluded.

## 1.2 Terminology - what are payments for watershed services?

The development of market mechanisms within Watershed Management has become increasingly popular in the last years as it forms the great white hope for the solution of water related conflicts and for the future financing of watershed protection works on a catchment level. The instrument is usually transcribed and promoted as 'Payments for Watershed Services' (PWS). 'PWS' can be defined as payments or direct compensations by the beneficiaries of a watershed service for the maintenance or provision of the service to the providers of the same. However, it still often remains unclear what is exactly meant by this term and how, if at all, a PWS mechanism differs from community-based

[1] Development of Tools and Methodologies to Implement the Payments for Environmental Services Concept in Watersheds in India, supported by the Royal Norwegian Ministry of Foreign Affairs.

[2] Environmental constraints as well as limitations in knowledge of biophysical linkages.

arrangements for the management of water resources. Is it justified to refer to PWS as an *alternative* to government or community-based management? To what extent is the use of the term 'market' – the exchange of goods or services based on prices set by the laws of supply and demand – appropriate in the context of services provided by watersheds? The goal of this chapter is to provide answers to these questions in order to clarify the conceptual basics of the term 'PWS'.

The idea of PWS is based on two facts: First, in many watersheds, costs and benefits of watershed protection are distributed unequally among communities and/or households, because providers of a watershed service are not identical with the beneficiaries of the service. This can lead to a reinforcement of social inequalities and conflicts. For example, an upstream change to more sustainable land use methods often implies forgone benefits for the affected households, while it benefits downstream communities. Second, a growing lack of finance for sustainable water resource management due to decreasing investments in rural development and conservation programmes by governments worldwide forces project managers to look for innovative financing options (GUTMAN 2003).

### 1.2.1 Watershed services

Hydrological processes like soil erosion, sediment transport, water flow, groundwater recharge etc. will become watershed services if they have socio-economic impacts. This can happen directly through consumption, or indirectly through the household production function or as factor inputs in production. (AYLWARD 1998; LELE 2006) Several watershed services are associated with upstream-downstream linkages that imply that service providers cannot be service users and that might thus be provided by means of a payment mechanism between upstream communities and downstream beneficiaries. The most common of these watershed services are:

- Water flow regulation (maintenance of dry season flows and flood control)
- Erosion and sedimentation control
- Improved water quality (nutrient load control, chemical load control, salinity control)
- Increased water supply (surface or groundwater)

The services of improved quantity/quality of waters within irrigation systems are also included under this perspective.

### 1.2.2 Watershed services and 'markets'

Whether a PWS scheme can be implemented between private sellers and buyers depends on the existence of a market for these services. For a good or service to be traded freely in a market, it has to fulfil two basic preconditions: First, it has to be *exclusive*, i.e. there must exist the possibility of excluding someone from the provision of the good/service that does not pay for it. This is essential for a market to emerge, because otherwise there will not be a willingness to pay. Second, it has to be *rival:* The supply of the good or service has to be limited in the way that consumption by one individual reduces the availability for others. If this is not given, there will be no competition for consumption and thus no mechanism to establish a price. Rivalry is also referred to as subtractability.
All goods and services can be structured along their degree of excludability and rivalry; this will determine, whether it can be traded in a market or if a market fails to deliver payments for the good/service. Four types of goods and services can be distinguished, as demonstrated by means of forest goods and services in Table 1.

| | **Rivalry** | |
|---|---|---|
| **Excludability** | *low* | *high* |
| *low* | Public goods, e.g. carbon sequestration | Common pool resources, e.g. community woodland |
| *high* | Toll/club goods, e.g. forest park roads | Private goods, e.g. timber and NTFPs |

**Table 1: Excludability and rivalry of forest goods and services (source: LANDELL-MILLS/PORRAS 2002)**

The classification of different watershed services along their degree of excludability and rivalry in consumption will tell us, to which extent these services can be traded in a market between private buyers and sellers.

***Increased rainfall***

Increased rainfall is always non-excludable and non-rival, because everyone benefits without the benfits of others being reduced.

***Water flow regulation (maintenance of dry season flows for water supply and flood control)***

The regulation of water flow – this can be the maintenance of dry season flows and/or the prevention of floods – is always non-excludable, because everyone who lives downstream will automatically benefit from the service. At the same time it is also non-rival, because everyone is able to benefit whithout the benefit to other individuals being reduced.

***Erosion and sedimentation control***

The excludability of erosion and sedimentation control depends on the specific characteristics of the resource system and of the beneficiaries.
The reduction of landslides can be characterised like flood control and will always be non-exclusive. However, a reduction of sedimentation can for example be made exclusive, if people are charged for the access to a lake, which maintains its recreational value this way. Sedimentation control will also be exclusive, if it occurs in an irrigation system, where access to the water is regulated, or if there is only one beneficiary (e.g. a hydropower company). But all these services are non-rival, because if they are once provided, everyone will benefit without reducing the benefits of others.

***Improved water quality (nutrient load control, chemical load control, salinity control)***

A similar classification like for sedimentation control applies for the service of improved water quality in terms of a reduced flow of nutrients, chemicals or salinity. These services are non-rival, because water quality will not be reduced if used by one individual. They are non-exclusive in the sense that all individuals that have access to the water source will benefit from improved water quality. On the other hand, the service can be made exclusive if it is possible to exclude individuals that do not contribute to the improved quality from access to the water source.

***Increased water supply (ground and surface water)***

Ground and surface water are both typical CPRs, because they are rival, but non-exclusive in the first instance[3]. The central problem about the management of water resources, so-called 'free-riding', is closely connected to this fact: If no-one can be excluded from using a water resource, there will be no incentive to contribute to the supply of the same. In contrary, there will be a steady incentive to benefit from others' efforts. If all resource appropriators decide to 'free-ride' in a situation of rivalry, everyone will be worse off in the end (OSTROM 1990). In order to overcome the problem of 'free-riding', it is necessary to regulate exclusion through mechanisms that are accepted by all individuals that use the resource (see chapter 1.3).

Irrigation systems also fall in this category. In this case rivalry refers to the fact that water abstracted from canals for crop irrigation to a large extent cannot be used by others (except for a small return flow when irrigation is sub-optimal). The second CPR-characteristic of irrigation water relates to the cost of excluding other potential beneficiaries from access to the resource. When faced with the possibility to extract irrigation water, farmers face the temptation of becoming 'free-riders', i.e. gaining benefits from the resource without contributing to the costs of providing, maintaining and regulating the the irrigation infrastructure (DOLŠAK/OSTROM 2003).

### 1.2.3 Conclusion

Along the characteristics of excludability and rivalry, three types of watershed services could be identified.

First, watershed services that are public goods. This applies to the protection from natural disasters, like the protection from floods, droughts and landslides. These services are non-rival and it is impossible to exclude someone from the benefits they provide. A market-based mechanism for the payment of upstream providers of these services can therefore not be implemented, and a PWS-scheme will only function, if a public authority sets incentives for upstream communities to supply the service.

Watershed services that are public goods but can be transferred into toll/club goods (by making them exclusive) build a second category. Services related to improved water quality, like reduced sedimentation or reduced flow of nutrients, chemicals or salinity can be made exclusive through regulating the access to the water body, but they will always remain non-rival. Like in the case of public goods, a payment mechanism for the provision of these services will be most likely to function if a government agency pays upstream providers and regulates the downstream access to the water body by setting the prices. If there is only one private beneficiary (e.g. a hydropower company or a tourist rafting company), the service will automatically be exclusive – this can be assumed to be the easiest case to deliver payments for a watershed service, as there is no need for downstream institution building. In irrigation systems, payments could also be delivered, if the community manages to exclude community members that do not pay – in this case the service is similar to a CPR, even if it is non-rival.

The third category of watershed services is CPRs. The characteristics of a CPR – rivalry and non-excludability – apply to all watershed services related to the increase of water supply. In contrary to public goods, they can be traded between private buyers and sellers, but only if the access to the service on the buyers side is made exclusive. Under which circumstances can beneficiaries exclude someone from the service, who does not contribute to its supply? Three prerequisites have to be met (OSTROM 1990):

[3] However it has to be mentioned that groundwater is often exclusive in the sense that exclusion comes along with poverty, because digging a well involves costs that cannot be covered by the poor.

1. *Cleary defined boundaries*: Clear definition of who has the right to utilise the service, and clear definition of the boundaries of the common pool resource itself
2. *Monitoring*
3. *Graduated sanctions*

Individuals who make use of the watershed service will only be able to reach excludability, if they establish an institution that secures clearly defined boundaries and adequate tools for monitoring and sanctioning – i.e. if they cooperate.

On the suppliers' side, cooperation is in most cases necessary irrespective of the characteristics of the watershed service. This is due to the fact that the service usually cannot be provided by a few singled landholders. In developing countries, uphill providers will most likely be landholders with small parcels and a measurable environmental benefit for downstream communities will only be ensured if they collaborate (CFA).

Summing up, it can be said that it depends on the degree of excludability and rivalry of a watershed service, whether a PWS-system can be based on a direct transfer mechanism between upstream and downstream individuals/communities/corporations, and to which extent the action of government agencies is required.
A number of watershed services are found to be public goods, and government agencies will therefore have to take over the role of the buyer. Other watershed services are also non-rival, but they can be made exclusive and are then able to deliver payments. In the case of watershed services that are CPRs, the establishment of a market-like mechanism relies heavily on the level of cooperation on the beneficiaries' side. In contrary to a market for a private good or service, where competition is the main driver, a 'market' for these watershed services cannot emerge without cooperation occurring first.

The use of the term 'market' is rather illusive in the context of PWS. Concerning public goods like the protection from floods, a market arrangement will be unable to deliver payments for the provision of the service, and incentives for the provision of the service will have to be set by public authorities. If the demand for a service only comes from one single buyer, there will be no competition and the mechanism can thus not be defined as a 'market'. In the case of the allocation of CPR, the term 'market' may also be misleading, because the fundamental basis for such a PWS-system is cooperation, not competition.

The key question is therefore not, whether markets should be introduced instead of cooperative institutions or government regulations, as they do not represent an *alternative* for the management of water resources. The question is rather, whether 'market-like' mechanisms are an appropriate tool for resolving the problem of unequal cost and benefit sharing in watershed management *within* a certain institutional framework based on cooperation or public regulation. If institutions for CPR-management do not exist or work properly, a PWS-system may also be the right tool to *promote* cooperation among water users.

In the light of the CPR-characteristics of many watershed services, also within irrigation systems, the framework of E. OSTROM (1990) constitutes a useful starting point for possible characteristics of functioning systems for PWS, or what OSTROM terms 'general design principles'.

## 1.3 The Ostrom Framework

### 1.3.1 The 'theory of the commons'

In her 1990 book '*Governing the commons'*, Elinor OSTROM proposes eight general principles for the design of long enduring institutions to manage CPR.

The basic assumption in OSTROM's 'theory of the commons' is that individuals may overcome the problems associated with the use of CPR (see chapter 1.2.2) through well designed institutions.
This assumption is opposed to the perception that the common use of natural resources, which are of limited availability, will automatically lead to its degradation and thus to the 'tragedy of the commons'. In the theory of the 'tragedy of the commons', constituted by HARDIN (1968), it is assumed that all individuals always act in their own self-interest and that the common interest of preserving the natural resource base is therefore undermined. This is pointed out by means of the following example:

> "Picture a pasture open to all. It is to be expected that each herdsman will try to keep as many cattle as possible on the commons… […] As a rational being, each herdsman seeks to maximise his gain… Adding together the component partial utilities, the rational herdsman concludes that the only sensible course for him is to add another animal to his herd, and another, and another… Each man is locked into a system that compels him to increase his herd without limit – in a world that is limited. Ruin is the destination towards which all men rush."

In his 'theory of collective action', OLSON (1965) argues in a similar way. The author presumes that rational individuals in a community, which is based on economic interests, do not act in a way that allows pursuing a common goal. The presence of a common goal would accordingly not be sufficient to really generate collective action for realising this goal.

OSTROM disagrees with the view that individuals using a CPR will generally not cooperate in order to pursue a common goal. She does not refuse the presented models as being wrong, but points out that they are based on certain extreme conditions that do not always exist in reality: In the 'tragedy of the commons', individuals distrust each other, act independently from each other and are not able to communicate and to conclude binding agreements with each other – they are not organised. In contrary, the author assumes that individuals are able to liberate themselves out of the dilemma situation. They are confronted with a problem of organisation, and from this point of view, resource degradation is the result of insufficient institutional regulation. Hence, the central analytical question is how institutions have to be designed in order to allow individuals to conclude credible agreements with each other and coordinate their actions, thus to cooperate. From a synthesis of a number of empirical case studies, OSTROM identifies a series of principles that are present in all scenarios that have over a long time period been able to successfully (i.e. sustainably) manage their CPR-system by means of local institutions (see Table 2).

| |
|---|
| *1. Clearly defined boundaries*<br>Individuals of households who have rights to withdraw resource units from the CPR must be clearly defined, as must the boundaries of the CPR itself. |
| *2. Congruence between appropriation and provision rules and local conditions*<br>Appropriation rules restricting time, place, technology, and/or quantity of resource units are related to local conditions and to provision rules requiring labour, material, and/or money. |
| *3. Collective-choice arrangements*<br>Most individuals affected by the operational rules can participate in modifying the operational rules. |
| *4. Monitoring*<br>Monitors, who actively audit CPR conditions and appropriator behaviour, are accountable to the appropriators or are the appropriators. |
| *5. Graduated sanctions*<br>Appropriators who violate operational rules are likely to be assessed graduated sanctions (depending on the seriousness and context of the offense) by other appropriators, by officials accountable to these appropriators, or both. |
| *6. Conflict-resolution mechanisms*<br>Appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials. |
| *7. Minimal recognition of right to organise*<br>The rights of appropriators to devise their own institutions are not challenged by external governmental authorities. |
| *8. Nested enterprises (for CPRs that are parts of larger systems)*<br>Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organised in multiple layers of nested enterprises. |

**Table 2: Design principles illustrated by long-enduring CPR institutions (according to Ostrom 1990)**

These design principles provide an idea of how institutions, which are able to manage CPR in a sustainable way, have looked like in reality. However, it cannot be reconstructed anymore how institutions in these cases were built up. The next chapter deals with OSTROM's theoretical approach to answer the question, which conditions facilitate or favour the change of existing institutional regulations that do not function for people and the environment.

### 1.3.2 Conditions of institutional change

When presented to the thought of institutional change, farmers in the field will have to either support the continuance of the status quo institutional setting, or they can support an institutional change. The decision to support or not support an institutional change thereby depends on their view and weight of expected costs and benefits of such a change. How an individual evaluates expected costs and benefits depends in turn on the available *information*. Information and communication are therefore essential elements in any situation of institutional choice (see also chapter 2.2).

OSTROM proposes a set of summary variables that will affect the individual's decision to support or not support the change from the status quo. The summary variables include the benefit the farmer will have from the change, the cost the farmer will have to endure from a change, the degree of shared

norms within the affected groups, and the future possibilities of the farmer given the present day or the proposed institutional settings.

However, a field setting needs to have certain characteristics for the researcher to be able to predict the values of the summary variables. According to OSTROM these are:

1. Accurate summary measures must exist for each of the variables
2. Individuals completely and accurately translate information about net benefits and net costs into expected benefits and expected costs
3. Individuals do not behave in a strategic manner

If these three conditions are met, the field researcher would only have to ascertain the values of the summary variables to predict individual strategies. However, unfortunately few or no field settings can be characterised by the conditions above, and consequently one must go beyond the summary variables and identify the situational variables that affect them.

***Situational variables that affect net benefits of alternative rules***

To get an overview of the situational variables that affect the net benefits of the proposed rules the researcher needs to consider the following questions:

- What are the predicted average flows and the predicted values for the CPR in the future under a proposed set of rules, as compared with the status quo rules?
- How variable is the flow of the CPR expected to be under a new set of rules compared with the status quo rules?
- What quality differences will occur under a proposed set of rules compared with the status quo?
- Will conflict be reduced, stay the same or increase under a proposed set of rules, as compared with the status quo rules?
- How long is the resource itself likely to generate resource units?

***Situational variables that will affect net costs of alternate rules***

If the up front costs of transforming the rules are greater than the benefits of the same transformation, no more cost calculations will be done and the change in rule will not be imposed.

Two major types of cost influence institutional change:

*1. Transformation cost*

These are costs are costs devoted to the process of considering a change of rules. Transformation costs are believed to be positive proportional with the numbers of individuals making institutional choices, the heterogeneity of interests, and the proportion of individuals that are minimally required to make institutional change. Transformation costs are also believed to be lower with skilful leaders, and are considered up-front costs.

Situational variables affecting transformation costs:

- Numbers of decision makers
- Heterogeneity of interests

- Rules in use for changing rules
- Skills and assets of leaders
- Proposed rule
- Past strategies of appropriators
- Autonomy to change rules

*2. Transaction costs - Monitoring and enforcement cost*

These costs are the costs of making sure all involved are changing their behaviour according to the new set of rules that are proposed implemented. In many cases monitoring can be done by the participants themselves, while performing their daily activity, or participants must set aside time for this purpose, which hold an alternative value. The responsibility of monitoring and enforcement tasks might be shared by the participants or performed by an outside body.

***Situational variables affecting the monitoring and enforcement costs***

- Size and structure of the CPR
- Exclusion technology
- Appropriation technology
- Marketing arrangement
- Proposed rules
- Legitimacy of rules in use

***Situational variables affecting the degree of shared norms***

Appropriators who live near the CPR from which they appropriate and who interact with each other in many situations apart from the sharing of the resource are likely to develop strong social norms that will enhance the trust the appropriators have in each other. This feeling of community will make it easier to cooperate in the sharing of the CPR because one individual “knows” the other, and trust him in taking part in the process of sustainable use of the CPR. The degree of shared norms together with information of opportunities elsewhere also affects the discount rate of the appropriators. The individuals living close to the CPR who trust the CPR to also supply their children will have lower discount rate then individuals who have business away from the CPR. Those who take their business elsewhere will not value future appropriation of the CPR simply because they do not rely on it to secure their future.

The situational variables can be summarized as:

- Appropriators live near CPR
- Appropriators involved in many situations together
- Information made available to the appropriators about opportunities that exist elsewhere.

The variables affecting the decision of an individual in a situation of institutional choice are summarised and illustrated in Figure 1.

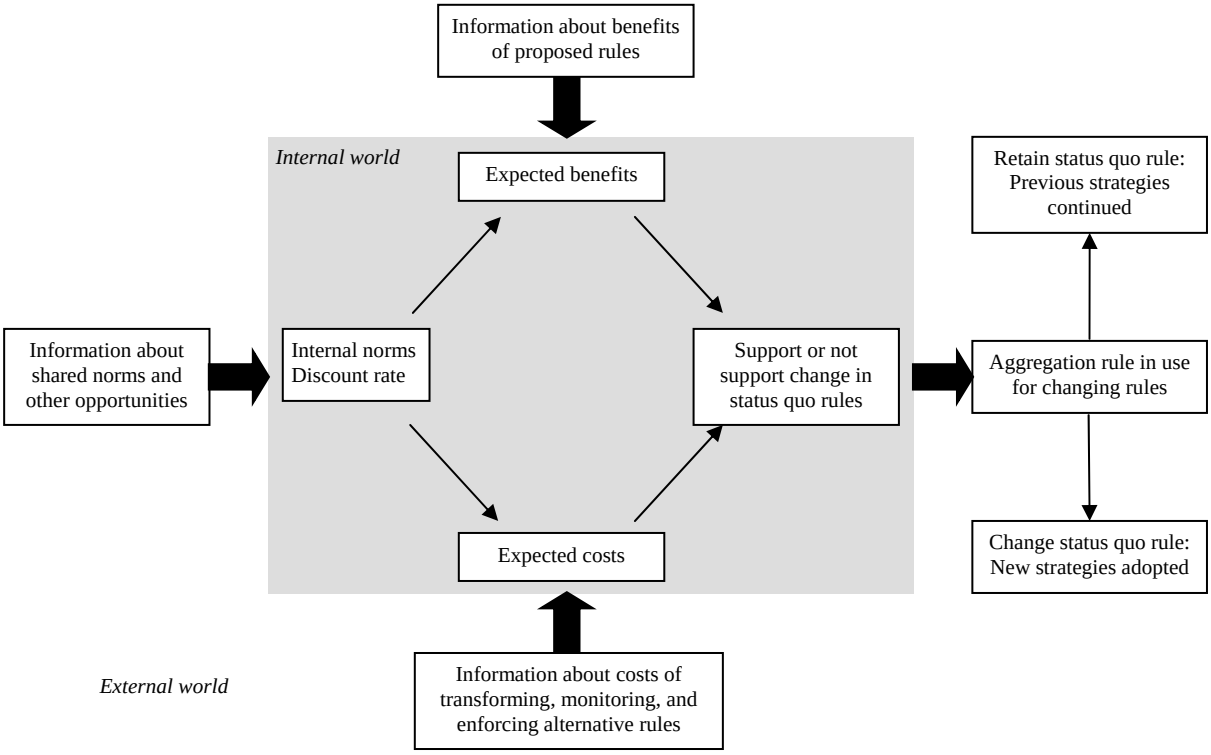


**Figure 1: Variables affecting individuals' institutional choice (according to OSTROM 1990)**

### 1.3.3 The relevance of Ostrom's framework for PWS

The resource systems investigated and characterised by OSTROM for developing her framework are local CPR-pools, where resource providers and beneficiaries are identical. In this respect, they differ from the initial situation in a PWS-context, which is based on the fact that they are not identical. In spite of this, OSTROM's framework is still relevant in a PWS-scheme, where the watershed service is a CPR - particularly for establishing downstream management institutions.

For upstream service sellers, the necessary level of cooperation does not go beyond a common cooperative – the goal of cooperation is to commonly sell a service and thus to generate income. Downstream communities are however faced with a typical 'tragedy of the commons' – situation. It only differs from the classical OSTROM-cases in that service users do not contribute to the provision of the service themselves, but have to make their payment/contribution to another upstream community that provides the service. The difficulties of CPR-management remain, and individual beneficiaries have to implement common actions in order to secure the provision of the watershed service. Moreover, the criteria may also be useful for the institutional design of intermediary organisations were negotiations between buyers and sellers take place. In this context, OSTROM's framework is highly relevant for implementing PWS. An attempt to apply the criteria in a PWS-system is made in chapter 2.2.

However, it has to be mentioned that the problems concerning OSTROM's framework itself remain, too. First, there is the question of how to transfer the criteria into reality: How can institutions for CPR-management be built up, and can 'common action' be induced from the outside at all? Second, it is also unclear to what extent OSTROM's criteria apply in scales larger than local communities. These questions have not been satisfactorily answered so far. Still, the 'theory of the commons' forms one of

the most useful approaches for tackling the problems of collective action in natural resource management today, and it should therefore be made use of in the feasibility analysis of PWS-schemes.

# 2 Success factors and limitations to the establishment of markets for watershed services

The aims of this chapter are to evaluate the conditions under which market-based approaches for providing watershed services are likely to be successful, and to assess the factors that constrain the implementation of a PWS mechanism.

## 2.1 Biophysical limitations

According to LANDELL-MILLS/PORRAS (2002), a series of watershed services have been the subject of present market-based arrangements worldwide, the most common being services related to water quality, water table regulation and aquatic habitat protection.

The most important biophysical fact influencing the success of a PWS scheme is a clear link between the applied activities and the provision of the service. It is essential that PWS is based on site-specific hydrological data, and not on general assumptions about land-water-linkages. Reliable data on land-water-relations is important because it influences the credibility of service providers and thus the beneficiaries' willingness to pay. Especially in developing countries, a lack of information in this regard is often a critical limitation to implementing PWS (LANDELL-MILLS/PORRAS 2002). If a management activity associated with the delivery of the service was identified, the service must then be well defined and made measurable. A general assumption is that water quality or sedimentation problems can be tackled easier by PWS than water flow problems, because it is less problematic to monitor and evaluate them (HOPE ET AL. 2005). The reason for this is that it is less difficult to measure the impacts of upstream land-use methods on downstream water quality/sedimentation than on the change of water flow.

The geographical scale and characteristics of the watershed on which PWS is based also have an impact on how easy or difficult it is to measure the relations between upstream land-use and certain watershed services downstream. It can be assumed that it will be the more difficult to establish a clear connection, the further the geographical distances between providers and beneficiaries are. Still, the examples of successful PWS schemes (see PAGIOLA 2002; ALBÁN/WUNDER n.y.; MUÑOZ ET AL. 2005; MUNAWIR ET AL. 2003) likewise refer to local, catchment and even national levels.

FAO/REDLACH (2004) point out that PWS is an instrument to encourage landowners to implement practices which *conserve* natural resources and not a tool for integral environmental *restoration* – this is said to often surpass the capacities of PWS.

While the 'conservation' motive may be possible to monitor for ecosystem services like carbon sequestration or even biodiversity, a case is more difficult to make for how conservation land uses provide *additional* watershed services relative to some baseline development/land use scenario. Some commonly held assumptions, or 'myths', regarding land-water-linkages have been compiled by the FAO:

| Myth | Possible reality |
|---|---|
| Reforestation increases water availability | Reforestation may decrease water availability |
| Vegetative cover reduces the probability of big floods | Vegetative may not have a significant impact on big floods |
| Reforestation reduces erosion | Reforestation may increase erosion (depending on the forest species used) |
| Grazing and shifting agriculture are the major causes for the increase in sedimentation | Climatic variations may be the major cause for sedimentation build-up |
| Forests increase rainfall | Forests may have little impact on rainfall, particularly at a local scale |

**Table 3: Common land-water myths (source: FAO 2004)**

CALDER (2005) discusses these myths in greater detail and argues that they are reinforced by the media and can persist because they contain a fraction of truth. The following discussion of the myths or "mother statements" regarding the watershed services provided by forests is taken from CALDER (2005).

***Forests increase rainfall***

CALDER (2005) has reviewed literature and concluded that forests in some cases might lead to higher rainfall, due to the height of the trees that will lead to an increased orographic effect. However due to the increased evaporation from forest canopies, total availability of water resources will be reduced. The research reviewed by the author points in the direction that the effect of forest on rainfall is small, but can not be neglected totally from a water resource perspective.

***Forests reduce runoff***

New understanding indicates that in both wet and dry climates evaporation from forests is likely to be higher than from shorter crops and consequently runoff will be reduced from areas under forestation, contrary to the common belief. There are however some exceptions:

- Cloud forests where cloud water deposition may exceed interception losses
- Very old forests. Less evaporation due to smaller leaf area index
- Broadleaf tree-species growing on chalk soil.

Earlier catchment experiences by BOSCH/HEWLETT (1982) have reached similar conclusions.

Soil cover and characteristics of the soil are in some studies found to be important factors in relation to runoff. RAO ET AL. (1998) have studied runoff patterns from alfa-soil which is abundant in the semi-tropics. The authors argue that the surface crust formed on alfasoil greatly affects the infiltration rate in the soil. The regression analysis performed on the data showed that when the soil was covered by less than 30% with organic residue or amendments, the rainfall amount was the best predictive parameter for estimating runoff. When the soil was covered by more than 30%, rainfall amount and intensity, soil cover, and time from the beginning of the experiment were needed to estimate the runoff. Loss of rainwater as runoff on the structurally unstable crusting alfasoils was reduced effectively by maintaining high soil cover. Therefore, from a management point of view, the amount

of water available to the crop can be increased by application of straw and farmyard manure. (RAO ET AL. 1998)

In the case of existing irrigation reservoirs, these are likely to receive upstream runoff containing nitrogen and phosphorus. A Japanese case study by NAKASONE/KURODA (1999) suggests a strong relationship between upstream landuse and water reservoir quality. To control eutrophication, measures must be taken to reduce N and P inputs from watersheds. Limiting the use of Nitrogen fertilizer was found to be the most important factor in regard to controlling the eutrophication of irrigation reservoirs. Next was the importance of building adequate sewage systems, and preserving the forested area between the irrigation reservoir and the upland fields. In addition, wetland in the watershed area, where nitrogen concentrations were found to be high (paddy), must be preserved. (NAKASONE/KURADA 1999)

In trying to predict the runoff from tropical watersheds, PANDEY ET AL.(2003) have developed a model that is suggested for use in Indian watersheds.

***Forests regulate flows***

BOSCH/HEWLETT (1982) have done extensive research on the relation between forest and annual flow. The authors have summarized results of 94 catchment experiments and found that in none of the experiments water yield has increased with increases in forest cover. The approximate magnitude of changes can also be estimated. For example, pine and eucalyptus forest types on average cause a 40mm change in water yield per 10% change in cover.

It is important to underline the importance of distinguishing total annual flow and seasonal flows (BRUNIJNZEEL 2000, CALDER 2005). CALDER argues that competing processes might result in either reduced or increased dry season flow. He suggests that the geological conditions, which determine groundwater storage capacity, may be a critical factor in determining the range of low flow response following a change in vegetation cover. In none of the cases evidence of the "sponge effect" – this terms the process that forested soil stores water for then to gradually release it - can be found. CALDER argues that a forestation cannot be expected to increase dry season flows.

PAGIOLA ET AL. (2002) have reached a different conclusion. They conclude that the evidences point towards a strong link between deforestation, rising water tables and increased dry season flow. However in some cases dry season flow has been reduced after the removal of forest. The authors state that factors that influence the outcome are tree species and the nature of land use that replaces the forest.

***Forests control erosion***

Water is the principal agent of erosion and is responsible for 56% of the world's man induced soil degradation. Erosion by water occurs mainly as a result of sheet erosion, channel erosion or mass movement. Sheet erosion begins with drops of water striking the ground, releasing kinetic energy that breaks the bonds between soil particles. Movement of water across the ground is necessary for the transportation of soil particles. Channel erosion includes bed and bank erosion, and can cause land degradation of land and sedimentation down-stream. Mass movement is associated with landsides caused by steep topography or tectonic movement. (CALDER 2005).

Forests themselves do not necessarily reduce erosion. According to CALDER (2005), the effect on erosion provided by forests is dependent on the tree species and the ground cover. Case studies from Karnataka watershed in India have shown that canopies of Caribbean pine and eucalyptus, species exotic to India, have moderating effects on erosion in high intensive storms, while the canopy of the

indigenous teak do not help preventing erosion. Drops from the teak will always reach terminal velocity, which is more erosive than natural rainfall. CALDER also states the importance of ground cover vegetation to break the speed of falling drops and therefore reducing erosion.

It is also argued that the clearest evidence of forest is in reducing sheet erosion. Research suggests that there are several important determinants of erosion rates. These are: Understory vegetation, soil composition, climate, raindrop size, terrain and slope gradient. Reviews of case studies from Malaysia suggest that selective logging might lead to higher erosion rates compared to cocoa and oil plant plantations (PAGIOLA ET AL. 2002).

Some authors argue that ground cover is the chief determinant of erosion rates. Case studies performed by CHOMITZ/KUMARI (1998) have shown that ground cover rather than canopy is the chief determinant of erosion. Erosion rates in plots under current slash-and-burn cultivation are ten times as high as in natural forest. In plantations where weeds and litter have been removed, erosion is more than a hundred times greater than in natural forests. The authors further argue that road construction, annual cropping and plantations that remove litter can generate considerable erosion.

The erosive effect of plants and ground cover has been examined by MOSS ET AL. (1987). Their findings conclude that the height of plants is the chief determinant of erosion rates. Experimental studies have shown that erosion effect increases above the height of 2m, and it was found that drops that were released below the height of 0,3m had no noticeable effect on erosion.

***The role of forests and evaporation: climate matters***

CALDER argues that when considering the evaporation rate from different forest surfaces, the climate is an important factor. Approaches using energy balance and aerodynamic transport equations place great emphasis on climatic “demand led” terms, which makes them appropriate for use in areas where moisture is abundant. In many parts of the world with dry climates however, moisture is scarce and evaporation from surfaces to the atmosphere is based on “supply led” terms. CALDER separates between short and tall crops, in wet-temperate, dry-temperate, wet-tropical, and dry-tropical areas.

In conclusion, the watershed services forests provide are very site specific and depend on the characteristics of (among others) climate, tree species and the size of their leaves, root depth, soil conditions, slope and soil cover. Documenting their existence through baseline monitoring and modelling of the effects of land use changes is perhaps the prime challenge to the feasibility of PWS.

## 2.2 Institutional limitations

Which kind of institutional regulation is required for a PWS-system depends first of all on the characteristics of the watershed service and the beneficiaries (as discussed in chapter 1.2). If the watershed service, which is supposed to be provided through a PWS-system, is a public good (and the government is the buyer), or if there is only one private buyer, the institutional design of PWS will be less difficult as institution building in downstream communities is not necessary.

In many cases however – so in the case of NIVA’s ‘India-PES’ project - , watershed services are related to the supply of water and thus to the problems of managing a CPR. As discussed in chapter 1.2, appropriate institutions are an essential basis for introducing ‘market-like’ mechanisms in this context. The following presentation of institutional limitations and success factors within PWS refers to the framework of E. OSTROM (see chapter 1.3).

***Clearly defined boundaries***

In order to exclude 'free-riders' it is necessary to define, which individuals or households are beneficiaries of the watershed service. It also must be defined, who the (potential) providers of the services are. This is not easy in many cases, and it will get more difficult and costly the larger the size of the watershed is. According to LANDELL-MILLS/PORRAS (2002), most buyers and sellers of watershed services have so far been private individuals or corporations, whereas on the suppliers' side, individual landowners are the dominating actors.

***Congruence between appropriation and provision rules and local conditions***

The institutional mechanisms in a PWS-system must be appropriate for the participants' capacities (FAO/REDLACH 2004). This is especially relevant in the context of poor people's livelihood strategies (see chapter 2.4).
A characteristic of a CPR is that it exhibits a high form of uncertainty in the flow of the stocks of the resource and in the effects that resource removal has. An important question is then how to devise institutions that are flexible enough to ensure the individual's incentive for contribution in the management of the resource. Local conditions can change, and over time experiences are made and lessons learned regarding the convenience of applied mechanisms. It is therefore necessary to ensure enough *flexibility* in a programme, so that adjustments can be made (CFA).

***Collective-choice arrangements***

Broad participation on the suppliers' and the beneficiaries' side is required in a PWS-system. In this context it is important that all buyers and sellers are involved in all stages and that they have decision autonomy about their institutional mechanisms. This is because all stakeholders will have to find the mechanisms in their own interest to accept and follow the rules and regulations of the scheme (CFA). The bigger the watershed is and the more stakeholders the system involves, the more difficult it will be to negotiate a mechanism, which is accepted by all.

***Mechanisms for monitoring, sanctioning and conflict resolution***

Effective mechanisms for monitoring, sanctioning and conflict resolution are a substantial basis within a PWS management institution in order to secure that all households comply with the rules and regulations they have agreed on. A basis for this is the availability of appropriate infrastructure for these mechanisms (CFA). According to OSTROM (1990), in most institutions, which have managed CPR in a sustainable way over a long period of time, monitoring and sanctioning are not undertaken by external agents, but by the participants themselves. In other functioning cases, agents who monitor a system are officials that are accountable to the participants. If a government agency fulfils these functions, it will therefore be essential to ensure that they are fully transparent and impartial (CFA). Transparency is a key element to ensure the participants' trust in the monitoring system. Institutions that are transparent and empower people to voice their discontent are particularly necessary in order to tackle corruption, which is at the core of the governance problem in the water sector worldwide (STÅLGREN 2006). Monitoring systems must also be capable to detect unintended effects of a PWS scheme, because there is the danger that perverse incentives arise for households not included in the system, such as deforestation or destruction (FAO 2004).

***Minimal acceptance of right to organise***

The right of participants to decide about their own mechanisms to govern the PWS-system may not be questioned by external governmental authorities. This is often a major obstacle in watershed

management, because reluctance to stakeholder participation is common in government agencies that were formerly in charge of decision making. Involving these authorities is often based on the assumption that they share the stakes (FAO-SARD-M).

***Additional aspects in the context of PWS***

One key institutional factor in PWS is the connection between buyers and sellers. Effective *intermediary organisations* are in this context helpful to decrease transaction costs (WAAGE ET AL. 2006; LANDELL-MILLS/PORRAS 2002/GUTMAN 2003). According to the study of LANDELL-MILLS/PORRAS (2002), intermediary-based transactions have so far been the most commonly applied mechanism for implementing a PWS-scheme. Most often NGOs and community organisations have been used as intermediaries. They usually take over the function of channelling the payments from downstream to upstream.

Another fundamental key to making PWS institutions work is a functioning *information flow* among the stakeholders and the involved public institutions. This applies before the implementation of the system, where the initiative has to be widely publicised and discussed, and after implementation in order to sustainably ensure acceptance and proper operation through transparency (FAO 2004; CFA). An obstacle for the communication in a watershed may be the gaps between three types of knowledge on watershed functions:

- Public/policy ecological knowledge
- Scientists' (modellers') ecological knowledge
- Local ecological knowledge.

It is required that these three knowledge groups get connected and interact with each other (JEANES ET AL. 2006).

A basic institutional condition for PWS on the suppliers' side and one of the most common constraints in developing countries are *clearly defined property rights*. This is also the case in India, where there is usually no clear, secure or fair tenure for local forest dwellers. For most forests, there is no legal demarcation of access boundaries between villages or patch-wise assignments of rights to specific groups or individuals (Lele 2006).
On the other hand, securing of property rights can also be a good incentive for applying watershed protection works, as the example of Vietnam showed (DUNG THE/THANH HA/QUOC CHINH 2004; see chapter 3.3).

Even if the discussed success factors are given it is important not to forget that PWS is a *political process*, which means that the relevance of interest and power structures may not be underestimated. Especially in developing countries, highly unequal social conditions often prevail. PWS will only be positive for suppliers however, if they have the adequate capacity to negotiate with (often more powerful) beneficiaries and get a fair price for their services (FAO-SARD-M; GEOGHEGAN 2005). This can be a major constraint, if there are big class or caste differences between buyers and sellers. It is emphasised by the FAO (2004) that in contexts of highly unequal power or income distribution, markets are usually not the appropriate instruments to solve social conflicts. Power structures can also constrain the implementation of biophysically suitable watershed protection works, if beliefs associated with power prevail over scientific knowledge. Reliable technical knowledge should therefore always be part of all negotiation processes (HOPE ET AL. 2005).

*Cultural factors* can also influence the feasibility of PWS. If there is a strong resistance against the idea of water services being a market good rather than a right, other mechanisms may be more effective because they generate less opposition (FAO 2004). General cultural resistance can also exist

against the idea that downstream communities should decide what land use upstream communities adopt (LANDELL-MILLS/PORRAS 2002).

## 2.3 Financial/economic limitations

One of the biggest constraints to PWS is the *high transaction costs* that have to be overcome before the implementation of a scheme, which is likely to be successful. The main reasons are:

- Extensive biophysical studies on local land-water linkages are necessary in order to document the 'additionality' of certain land-uses.
- Socioeconomic appraisals have to be conducted in order to identify potential buyers and sellers, opportunity costs of service provision and beneficiaries' 'willingness to pay' for the service.
- In many cases, property rights are unclear and need to be regulated.
- If the stakeholders are not organised yet, institutions have to be built up.
- Within these institutions, broad participation is essential on both the suppliers and the beneficiaries side (see chapter 1.2.3). This involves high costs and is very time-consuming; e.g. in a project in Ghana, costs for participation accounted for 66% of the project costs and 80% of the project time4.
- Necessary capacity building on negotiation, financial accounting, contract formulation, technical skills etc. is costly.

  (FAO/REDLACH 2004; WWF 2006; LANDELL-MILLS/PORRAS 2002)

PWS can thus be very expensive compared to other management options and it is a challenge to design the system in a way that secures that transaction costs do not surpass the generated benefits. Transaction costs will diminish substantially if the stakeholders are already organised and if some kind of payment mechanism (e.g. a water fee) already exists (WWF 2006).

Another critical limitation to PWS is that there must be an actual *demand* for the service, i.e. there must be the *willingness to pay* to ensure a sustainable efficient allocation of resources. A generally perceived and recognisable problem must therefore be located at the outset of every PWS project (HOPE ET AL. 2005). Moreover, the willingness to pay must be high enough to exceed forgone opportunity costs of the service providers (CFA). There are many reasons, why potential buyers of a watershed service lack the willingness to pay. The most common reasons are (LANDELL-MILLS/PORRAS 2002; WUNDER/DUNG THE/IBARRA 2005; GEOGHEGAN 2005):

- Stakeholders are used to receiving the service for free.
- Stakeholders see watershed services as a benefit that the state must provide.
- Stakeholders lack the necessary finance to pay; this may also be the case if the government is the potential buyer.

Potential buyers' willingness to pay also depends on earmarking of created funds. They have to be used to address the identified problem, and not go into general revenue, as beneficiaries must be convinced that their payments will not be misused (CFA, LANDELL-MILLS/PORRAS 2002).

[4] LANDELL-MILLS/PORRAS (2002) quoted after MAGRATH, P. ET AL. (1997): Cost-benefit analysis of client participation in agricultural research: A case study from Ghana. London (=AgREN Network Paper No. 74b).

The next hurdle before the implementation of a PWS system is the question of financing *investment costs*, which is often necessary for watershed protection works, e.g. for terracing of slopes. In these cases it is essential that enough start capital is available, because a change in land-use must take place in an area that is large enough to have a measurable impact. However, access to financing and lending is difficult in many rural regions of developing countries (FAO/REDLACH 2004).

Concerning the *financial sustainability* of a PWS programme, it must be ensured that the system can be maintained with local financial resources. This is highlighted in the literature because some existing schemes are highly dependent on external funding (FAO 2004; DUNG THE/THANH HA/QUOC CHINH 2004). Sustainability is also influenced by choosing the right form of compensation. Cash payments obviously seem to be the best incentive for service suppliers, but they also involve the risk of becoming unsustainable if they are not well managed (FAO/REDLACH 2004). Hence, compensations do not necessarily consist of cash payments, but have to be adapted to the specific context. In some cases, people prefer e.g. road improvements, more secure land tenure etc. (HOPE ET AL. 2005).

## 2.4 PWS and poverty alleviation

This chapter deals with the question under which conditions PWS is an instrument that benefits the poor, and explores possible opportunities and constraints for implementing a pro-poor PWS scheme. The topic is highly relevant because frequently the impacts that market based instruments can have on the livelihoods of marginalised groups are neglected. On the other hand, PWS is also often overestimated as a strategy for poverty reduction.

There are several poor groups in society whose livelihood may be affected, positively or negatively, by a PWS programme. They can be divided into four groups:

1. upstream landholders
2. upstream landless
3. service users
4. consumers (applies to all poverty groups)

One of the difficulties of a pro-poor PWS programme seems to be the danger that it may have positive welfare effects for one poverty group while making others worse off. It is therefore important to consider possible impacts on all of these groups.

***PWS and poor upstream landholders***

When PWS is discussed as an instrument for poverty reduction, it is usually referred to *poor upstream landholders* as the main target group. In this context, PWS may have a series of potential positive impacts: The diversification of income sources through PWS and the regularity of the received payments can build an important contribution to the improvement of livelihoods for poor service providers as vulnerability is decreased (LANDELL-MILLS/PORRAS 2002). Another potential positive impact which is highlighted in the literature is the effect PWS can have on the social capital of poor people, because internal organisation is promoted (PAGIOLA/ARCENAS/PLATAIS 2004). The case of Adilabad (see chapter 3.1.5) offers an idea of how PWS could combine watershed protection and poverty reduction. However, the challenge to design PWS in a way that allows poor people to participate in the programme must not be underestimated. All constraints discussed above fall hardest on the poor, and hence they often lack the access to the market. The following aspects seem to be the most relevant:

- Poor people more often lack secure *land property* rights than better-off community members. Moreover, they have smaller plots, which complicates the coordination of supply and increases transaction costs in relation to the potential gain (LANDELL-MILLS/PORRAS 2002/FAO-SARD-M).

- The financing of necessary investment costs to participate in a PWS programme is a major obstacle. The poor are predominantly affected of lacking access to credit (PAGIOLA/ARCENAS/PLATAIS 2004; FAO-SARD-M).

- Poor people often lack the necessary skills to participate in PWS schemes. This concerns technical skills as well as management capacities (LANDELL-MILLS/PORRAS 2002/FAO-SARD-M). It is also important to bear in mind that illiteracy is wide spread among the poor. This was a problem in Vietnam, where many households did not know what their PWS contract contained as they were not able to read it (DUNG THE/THANH HA/QUOC CHINH 2004).

- Power issues (as discussed in chapter 2.2) are particularly important to consider in the context of marginalised groups. Due to their lack of education and political power, the poor may be forced into unfavourable deals when negotiating with more powerful downstream communities (LANDELL-MILLS/PORRAS 2002).

There are a number of suggestions on how to ensure that poor upstream households are able to participate in a PWS scheme. *In general, transaction costs have to be kept as low as possible* (PAGIOLA/ARCENAS/PLATAIS 2004). This means for example that *commodities* should be defined in a simple way that is adapted to poor people's livelihood strategies:

- They need to be flexible in order to allow participants to respond to unexpected shocks.

- A shorter duration of contracts may help reduce risks for sellers and buyers. (LANDELL-MILLS/PORRAS 2002/GUTMAN 2003)

The same applies for *payment-mechanisms*: Considering local capacities and likely implementation costs, simple payment mechanisms are usually most appropriate.
For poor households with small parcels of land being able to compete, it is essential to support cooperative institutions to secure their bargaining power (GUTMAN 2003). It is also essential to formalise property or tenure rights, if they are not clear (LANDELL-MILLS/PORRAS 2002).
As poor people often lack the necessary skills to access a market, investments have to aim on improving their skills in marketing, negotiation, financial accounting, agricultural techniques etc.
Further, to be able to participate in a PWS system that promotes a change in agricultural production activities (in contrary to a system that promotes reduced agricultural activity), access to start-up capital is necessary. It is therefore reasonable to provide access to credits; although it is questionable, whether a PWS-system will be capable of addressing this problem, if rural banks do not exist.
A recommendation that is usually made in the context of improving poor people's access to markets, and which also applies in the context of PWS, is to establish a market support centre. This will be the central spot, where information on prices and transaction is distributed for free and which serves as a contact point. It can also be a bureau for advice on the design of contracts and other managerial issues (LANDELL-MILLS/PORRAS 2002; GUTMAN 2003).
A danger that has to be considered is that a PWS-programme may raise the interest of powerful people in appropriating the marginal lands of the poor due to the increased value (GRIEG-GRAN/PORRAS/WUNDER 2005).

***PWS and the upstream landless poor***

It is very important to consider the possible impacts of a PWS-scheme on the landless, because being the poorest of the poor, their livelihoods will be affected the most by an intervention like PWS. Investigations show that Indian watershed development projects have generally had mainly negative impacts for landless people. The projects most successful in terms of environmental conservation and productivity thereby had the most negative effects on the landless poor, and especially on poor women. This is due to the fact that watershed development is often connected with the closure of common lands that the landless usually depend on (KERR 2002; SENGUPTA ET AL. 2003).
In this context, PWS has the potential to benefit landless people: They may be potential sellers of watershed services, if they use common land that provides these services. In this case it will be essential though to clearly define who is part of the group that processes the common lands. PWS will also affect the livelihoods of the landless in a positive way, if it increases the demand in labour (GRIEG-GRAN/PORRAS/WUNDER 2005). The case of Adilabad (see chapter 3.1.5) offers a promising example of how watershed protection can help to reduce poverty by generating employment. On the other hand, a PWS project has to watch out for the danger that it reduces employment opportunities by promoting less agricultural activity and thus deteriorates the situation of the landless.

***PWS and poor service users***

Environmental degradation does not affect all social groups to the same extent. It is the poor that are hurt the most by declining watershed services. GEOGHEGAN (2005) therefore argues that PWS-programmes must be constructed in ways that are in favour of marginalised groups.
A poor downstream farmer will benefit from a PWS-system, if the increase in income through improved watershed services exceeds the costs he has to pay for these services. This depends on factors such as the type of watershed service itself and the structure of the applied tariff system. However, it is a challenge to design a tariff system that ensures the equal access of poor users to the watershed service. Even if costs are linked to farm size or the volume of water used, poor households are likely to be disadvantaged because they have to spend a larger share of their income. Besides, in settings of highly unequal economic power among beneficiaries, poor households may not benefit because funds are only channelled towards the interests of wealthy users due to their ability to make higher contributions (LANDELL-MILLS/PORRAS 2002).
One possibility of solving the problem of unequal benefit sharing is the de-linking of land and water rights, like it was applied in the Indian village of Sukhomajri (see chapter 3.1.1). If every household is given the same share of water in return for a certain payment or labour contribution, even landless people will be able to benefit from the improved watershed services by selling their rights. However, the experiences with transferring the system to other villages have not been promising. In many cases, villagers could not be convinced to share water rights equally (KERR 2002). Differences in class and caste seemed to be a major obstacle; in the villages of Harijan and Lavana (Indian State of Haryana), the model did not take off because higher castes were unwilling to buy water from “untouchables” (SENGUPTA ET AL. 2003).

***Poor consumers***

Rural areas can be rather isolated from global food markets, even if the country is integrated in international markets. PWS may then have an impact on food prices, if it diminishes the local supply of main food crops. Higher food prices will hurt all poverty groups that rely on purchased food. ZILBERMAN ET AL. (2006) therefore argue that a sub-national scale of analysis regarding food markets will be necessary if PWS implies changes in the cultivation of food crops.

***Conclusion on the distributional impacts of PWS***

It is important to note that PWS is *not* primarily an instrument for poverty reduction, because it cannot be targeted to areas with high poverty. As it is the very basis of PWS to generate watershed services, the programme must be targeted to areas that deliver these services for downstream beneficiaries. Hence, PWS will only have the potential to contribute to poverty alleviation, if there are high poverty rates in the relevant areas. But even if this is the case, a very careful design of the scheme is required in order to secure that poor people are able to participate as service providers (PAGIOLA/ARCENAS/PLATAIS 2004).

As it was discussed, a PWS system may also have substantial impacts on other poverty groups than service providers. It is therefore important to apply a systematic approach to check possible livelihood effects on all of these groups before implementing a PWS programme. The Sustainable Livelihoods Approach may be one method that can be used in this context (GRIEG-GRAN/PORRAS/WUNDER 2005). In general, PWS has the potential to benefit the poor if

- the areas that provide watershed services have high poverty rates,
- investments are made in the ability of poor service providers to cope with the market,
- activities for watershed protection increase labour demand and
- the downstream poor share the benefits of improved watershed services.

Potential impacts on different poverty groups and strategies to design PWS in a way that favours these groups are summarised in Table 4.

| **Poverty group** | **Potential positive impacts** | **Potential negative impacts** | **Pro-poor strategies** |
|---|---|---|---|
| *Upstream small landholders* | ▪ decreased vulnerability through additional, regular income<br>▪ increase of social capital | ▪ loss of income through unfavourable deals with more powerful downstream beneficiaries<br>▪ loss of land due to higher interest of powerful in marginal lands | ▪ make sure poor landholders have access to the market and are able to cope with it |
| *Upstream landless* | ▪ higher income through more employment opportunities<br>▪ higher income through participation as service providers | ▪ loss of income through loss of employment opportunities<br>▪ loss of income through closure of common lands | ▪ create employment opportunities in watershed protection works<br>▪ promote formalising of usage rights for common lands if landless are potential service providers |
| *Service users* | ▪ income benefits through improved watershed services | ▪ loss of access to water if they cannot pay | ▪ design tariff systems in a way that secures poor people's equal access to the watershed services |
| *Consumers (applies to all groups)* | | ▪ higher food prices | ▪ make sure PWS does not decrease local food crop supply in remote areas |

**Table 4: Potential impacts on poverty groups and pro-poor strategies in PWS (source: compiled by the author)**

## 2.5 Summary

In the following, a summary of the success conditions for PWS is presented in form of a checklist of feasibility criteria. The following questions should be evaluated before the implementation of a PWS-scheme. If all of of them can be answered with "yes", there will be favourable conditions for implementing PWS.

*Biophysical conditions*

- Is there a clear link between the applied activities and the provision of the service?
- Is the service well defined and measurable?

*Institutional conditions*

- Are suppliers and beneficiaries clearly defined?
- Is a PWS mechanism accepted and demanded by all stakeholders?
- Do cooperational institutions on both the supplierss' and the beneficiaries' side exist?
- Is there an effective intermediary organisation for the connection of buyers and sellers?
- Is there a functioning information flow among all stakeholders and public authorities?
- Are all stakeholders represented in the management institutions and do they have decision autonomy about their institutional mechanisms?
- Do external government agencies respect the right of participants to decide about their own mechanisms?
- Are effective mechanisms for monitoring, sanctioning and conflict resolution in place? Are agents who fulfil monitoring and sanctioning fully accountable to participants? Are monitoring mechanisms capable of detecting unintended effects of a PWS system?
- Are the institutional rules flexible enough to being able to adapt to changing conditions?
- Are property/tenure rights on the suppliers' side clearly defined?

*Financial/Economic conditions*

- Can a PWS mechanism be designed without transaction costs surpassing the generated benefits?
- Is there a willingness to pay by downstream beneficiaries that is high enough to exceed forgone opportunity costs of service providers?
- Is it secured that the created funds are used to address the identified problem?

*Social conditions*

- Have power structures taken into account and is it likely that there will be a fair negotiation process between upstream and downstream communities?
- Is it secured that poor landholders are able to participate in the PWS-system?
- Is it secured that the PWS-scheme does not reduce employment opportunities for landless people?
- Are tariff systems on the beneficiaries' side designed in a way that secures poor people's access to the service?
- Is it secured that PWS does not decrease local food crop supply (in remote areas)?

# 3 Overview: Existing PWS-related approaches in India and Asia

For the following chapter, a literature research on existing PWS-related approaches in India and Asia was carried out. The cases presented in the following derive from both studies on particular cases and more general works and guidelines on PWS that referred to certain examples for market-based mechanisms. The presented cases were chosen because of their relevance for introducing the concept of PWS in India and Asia, and they represent a rather broad spectrum of ideas, how market based mechanisms may be used for the allocation of water resources.

## 3.1 India

### 3.1.1 De-linking of land and water rights in Sukhomajri Village, Haryana

The case of the village Sukhomajri in the Indian state of Haryana is often referred to in order to show that market based approaches can affect both the provision of watershed services and the livelihoods of poor upstream communities in a positive way (SENGUPTA ET AL. 2003; LANDELL-MILLS/PORRAS 2002). Furthermore, the case is of special interest as new market based arrangements were generated on two scales: First, on a macro scale, involving the downstream city of Chandigarh and the upstream community of Sukhomajri village, and second, on the local level of Sukhomajri village itself.

In the early 1970s, the city of Chandigarh was confronted with the rapid increase of siltation of Sukhna Lake, an artificial water body that was of high recreational value to the people of Chandigarh. The Central Soil and Water Conservation Research and Training Institute (CSWCRTI), which was assigned by the city administration to solve the problem, found that the heavily degraded mountain land near Sukhomajri village accounted for 80-90% of the silt flowing into the lake. Due to the degradation of their lands, the local villagers themselves were constantly forced to clear more forest for practicing agriculture and grazing of cattle and goats. It was realised that the local families would have to be compensated in some way if they should be motivated to give up free grazing and free tree felling in the hills. Therefore, two earthen dams for water harvesting during the monsoon were built by the Chandigarh Administration and the involved research institute. The villagers were able to obtain enormous irrigation benefits from the dam, and their agricultural production increased fourfold. The water availability for irrigation marked an immediate incentive for them to stop grazing in the hills and initiate watershed protection work: If they wanted the dam to deliver water, they would have to prevent the dams from silting up by protecting the vegetation cover of the surrounding area. The project led to the substantial reduction of siltation rates in Sukhna Lake. The investment made by the city of Chandigarh in the dams can be seen as a payment for the watershed service that it received. It must be noted, though, that for the Sukhomajri people, the local benefits of irrigation water rather than an external payment have been the main incentive for their watershed protection activities.

The crucial factor, which led to the success of the project, was the principle of equitable sharing of the benefits out of the collective protection work at the local level. In the beginning there were problems because costs and benefits of the dam were spread unequally across the community; while some benefited, others had to give up their traditional grazing rights in the hills. To overcome this problem, a market based solution was introduced: All households in the village, including the landless, were assigned an equal share of the water collected in the dam in return for their participation in watershed protection activities. Hence, the landless and those with very small landholdings were able to sell their water rights to larger landowners who needed more water. The de-linking of water rights from land

rights compensated the landless and the small landowners for the loss of access to traditional grazing lands and allowed them to gain an equal share of the watershed benefits.

In this context, the literature also refers to examples of a few other Indian villages, where similar market based mechanisms for equal benefit sharing of watershed protection works have been successfully introduced. However, as discussed in chapter 2.4, not all attempts to transfer the Sukhomajri model to other sites were successful.

### 3.1.2 Traditional irrigation systems (kuhls), Himachal Pradesh

In their study on PWS in India SENGUPTA ET AL. (2003) also highlighten examples of inter-village institutions for natural resource management. The functioning of traditional irrigation systems offers an interesting insight into existing market-like cooperation systems between upstream and downstream communities in India, and thus points of departure for developing other market-oriented forms of inter-village transactions.
One of these examples is the traditional community irrigation system of *kuhls* (channels for water transfer from upstream to downstream) in the State of Himachal Pradesh. Over the years, upstream and downstream communities have developed precise rules and regulations regarding the amount of water that is released to different villages at certain times and of the labour that downstream communities have to provide for maintaining the upstream *kuhls*.
Being established between the villages on the base of negotiations, the *kuhls* system is conceptually closer to a market-like system than to a state-controlled regulatory framework. Traditional institutions for the management of irrigation infrastructure are therefore useful for the development of other upstream-downstream transactions for watershed services.

### 3.1.3 Direct payment agreement for the improvement of water supplies between villages in Himachal Pradesh

Also in the State of Himachal Pradesh, a case of a direct compensational transaction from downstream to upstream communities was found. The two downhill villages of Suan and Ropri were facing a problem of water scarcity due to the degradation of common lands that belonged to the upstream village of Bhodi. Because the Bhodi villagers themselves were not facing any problem regarding their water resources, the villagers of Suan and Ropri agreed to provide free labour for watershed protection works of the Bhodi lands. In addition, they transferred the government payments they received for this work to the village fund of Bhodi. The Bhodi villagers, on the other hand, agreed to diminish the collection of grasses and fuel wood from the common lands. Through the restoration of their lands, the Bhodi villagers were able to increase their income due to the sale of grass that had started regenerating. This provided sufficient incentives for them to continue the protection of their common lands, even without further contributions from Suan and Ropri villages.
This case offers an example of how even one-off payments/labour contributions from downstream beneficiaries to upstream communities can deliver incentives for sustainable watershed management over the long term (GEOGHEGAN, T. 2005; SENGUPTA 2003).

### 3.1.4 Hydropower companies as beneficiaries in Himachal Pradesh

In Himachal Pradesh, downstream hydropower companies are already financially contributing to upstream forest and watershed protection works. The payments are based on the Environment Protection Act (1986) and the Forest Conservation Act (1980) and are compulsory. It is therefore difficult to say, whether the hydropower companies would be willing to pay for the watershed services on a voluntary basis. But the reduction in silt flow is a watershed service of great importance for the companies, as siltation of dams is a major problem and causes heavy costs.
The payments are not made regularly, but on a per project bases. Further, the beneficiaries do not pay the upstream service providers directly, but the money goes to the State first, from where it is

reallocated to the Forest Department. It is therefore not ensured that the total amount of payments made is actually used for watershed protection works, nor that upstream communities benefit from the transactions (SENGUPTA ET AL. 2003).

### 3.1.5 Community-based environmental and financial management in Adibala District, Andhra Pradesh

The recent development in Adilabad District, Andhra Pradesh, demonstrates how payments for watershed services can contribute to poverty alleviation and empowerment of marginalised communities in a substantial way.
Within the Andhra Pradesh Participatory Tribal Development Project, supported by the Government of India, IFAD and the World Bank, a strategy of building up thrift and savings groups (frequently also denoted as Self-help Groups (SHG)) among tribal women was started in 1994 in order to improve the livelihoods of tribal peoples and reduce environmental degradation. In the first years of the project, social mobilisation and savings among the SHGs, which are comprised of 8-14 women, were low. However, the project made an important breakthrough in 2000, when it was decided that funds for watershed protection works should be directly transferred to the SHG. An IFAD Coordinator spent two days in the first village, where the approach was applied, to discuss the objectives of the programme with the women, and to motivate them to implement the watershed protection works. Finally, the SHG was given a contract for watershed protection with the Integrated Tribal Development Agency (ITDA). Then, around 50 villagers carried out a project of building two diversion drains to check soil erosion during the monsoon and improve soil moisture retention in the downstream farmland. The SHG was paid a sum of Rs. 85,000 (around 1,820US$) for the work, and after paying the wages to the participating community members, the SHG was able to save approximately 30% of the funds in the group's thrift account. This approach was applied with great success in over 500 SHG in 300 villages in Adilabad district. The design and location of soil and water conservation works and the maintenance of the management structures was improved by transferring the funds directly to the community institutions, because a greater sense of ownership was built up. Many of the SHG were able to increase their savings several fold by taking over the responsibility for watershed protection works. In addition, the project provided assistance for the SHG to learn how to manage finances, reinvest the money they earn and manage restoration projects over time. The economic success of the SHGs has had immensely positive impacts on social development: Households started spending more money on the education of the children, literacy among women increased, the population growth rate has fallen from 2.42% to 1.39% within 10 years (1991-2001) and poverty levels are decreasing.
The case of Adilabad shows how PWS can achieve ecological goals, while addressing social and poverty issues at the same time (D'SILVA/PINGLE/POFFENBERGER 2004; PFOFFENBERGER).

## 3.2 Indonesia

An example of voluntary contracts for watershed services between downstream beneficiaries and upstream villages comes from Segara River Basin in Indonesia. In the watershed, several financial arrangements have been developed independently. Among the contributors to upstream watershed protection activities are farmers with irrigated land and other downstream residents. The most important contributions are made by two companies, a drinking water company and a tourist rafting company. They both depend on good water quality and quantity and have entered into formal contracts with the upstream village of Bentek. The payments are made on an annual basis in order to support forest guards, infrastructure improvement and the traditional systems of forest protection in the village. This is the only case of ongoing direct payments between downstream beneficiaries and upstream service providers in Asia that was found in the literature review (MUNAWIR ET AL. 2003).

## 3.3 Vietnam

In Vietnam, a number of PWS-related mechanisms have been applied within projects by IFAD, Sida and The World Agroforestry Centre. The PWS scheme as such has not been implemented yet, but the case studies provide examples of how to reward upland farmers for environmental services.
Four applied mechanisms of rewarding upland farmers for their watershed protection works were found by DUNG THE/THANH HA/QUOC CHINH (2004) in their study of PWS-linked activities in Vietnam:

- First, and most important, the assurance of property rights of the cultivated land
- Cash, free planting materials and employment opportunities
- Harvesting of timber and NTFP
- Improved environmental services for the communities themselves

Similar to the case of Adilabad, India, within the existing projects in Vietnam upstream communities are rewarded for their watershed services by the government and not by private service buyers. This implies a sustainability problem as it is questionable whether the government will be able to continue paying the rewards. The challenge of connecting upland farmers as sellers to downstream buyers of watershed services therefore remains.

## 3.4 The Philippines

The best known case of PWS from the Philippines is the development of a Master Plan for Makiling Forest Reserve, 100km south of Manila. The Master Plan was developed by the University of the Philippines in collaboration with UNEP, the Resources, Environment and Economics Center for Studies (REECS) and the Economy and Environment Program for Southeast Asia (EEPSEA) in order to encounter the problems of declining water quality and increasing scarcity of water supplies. However, the challenge was the financing of the watershed protection works foreseen in the plan. In 2000, a proposal for a Watershed Protection and Conservation Fee was presented. It is suggested that a fee for upstream watershed protection should be added to the water bills of downstream users, focussing on the main users like Water Districts responsible for potable water and tourist resorts at the beginning. Downstream users' willingness to pay was estimated to be significantly higher than the estimated costs of the service provision. Unfortunately, the available literature does not provide information on the progress of the plan's implementation (LANDELL-MILLS 2002; ROSALES 2003).

## 3.5 Summary and lessons learned

The identified cases of PWS-related approaches in India and Asia provide only limited guidance on how to implement a PWS-scheme in the region. Mainly, because experiences are basically limited to cases that do not represent PWS-schemes according to the common definition, i.e. ongoing direct payments from downstream beneficiaries to upstream service providers. The case of Segara River Basin, Indonesia, is the only identified case, which can be classified as a 'PWS-system'. Further, the literature about most of these cases does not go very far into detail. For instance, detailed information about the applied payment mechanisms is generally missing.

However, the reviewed cases do provide ideas of how payments and other compensation mechanisms can be used for solving water related conflicts and allocating resources in a sustainable way, and thus they form points of departure for developing PWS-systems in other locations.

Although it can be assumed that it is usually more difficult to assess clear biophysical upstream-downstream linkages the larger the scale is, most of the PWS-related approaches, and the furthest developed at the same time, were surprisingly found on the catchment level (see Table 5). This indicates that further distances between the location of service providers and beneficiaries have not been a major obstacle for implementing payment arrangements. In all cases on the catchment level, erosion/siltation problems made up the basis for developing innovative solutions. In India, no market-based systems exist on this level yet. In the case of Chandighar-Sukhomajri only a one-off contribution was made, and the hydropower companies in Himachal Pradesh make payments only on a compulsory, state-regulated basis. But it is found that compensation mechanisms on the catchment level between poor upstream communities and larger downstream beneficiaries have the greatest potential to develop in India (SENGUPTA ET AL. 2003). The examples of Segara River Basin in Indonesia and Makiling Forest Reserve in the Philippines may provide ideas of how to develop such schemes. However, SENGUPTA ET AL. (2003) warn of generalisations based on certain experiences. Whether a PWS-system works depends on the specific social, political and economic contexts of a watershed, and what works in one place may not be appropriate in another.

The identified cases on the local level in India show how community organisations successfully manage funds they receive for watershed protection works and how this can contribute to poverty reduction. On the meso-level, we found two examples for voluntary cooperation between different villages in the management of their common water resources. A more detailed analysis of existing functioning institutions for irrigation management may offer a valuable basis for the development of PWS.

| **Local level** (intra-village mechanisms) | **Meso-level** (inter-village mechanisms) | **Catchment-level** (compensation mechanisms between small upstream stakeholders and larger downstream beneficiaries) |
|---|---|---|
| ▪ Sukhomajri Village, Haryana (India)<br>▪ Adibala District, Andhra Pradesh (India)<br>▪ RUPES Vietnam | ▪ Kuhls irrigation system, Himachal Pradesh (India)<br>▪ Suan and Ropri Villages – Bhodi Village, Himachal Pradesh (India) | ▪ City of Chandighar – Sukhomajri Village, Haryana (India)<br>▪ Hydropower companies as beneficiaries, Himachal Pradesh (India)<br>▪ Segara River Basin, Indonesia<br>▪ Master Plan for Makiling Forest Reserve, The Philippines |

**Table 5: Geographic levels of PWS-related experiences in India and Asia (source: compiled by the author)**

# 4 Conclusion

It has been shown that a successful PWS-system depends on a significant number of requirements and that there is a broad spectrum of factors which may constrain its implementation. Fulfilling these requirements involves very high transaction costs in many cases. While some costs will arise in every case (e.g. an economic appraisal on supply and demand), the amount of other transaction costs depends on the specific local context, such as the clarity of property rights and the necessary capacity building among stakeholders. The biggest part of transaction costs is expected to arise for both broad participation and institution building, which together mark the key condition for PWS in many cases and the most difficult to achieve at the same time. Institutionalising public participation is a very time-consuming and costly process, and it gets the more difficult, the more stakeholders are involved and the less homogeneous they are. It can be assumed that PWS will be easiest and cheapest to implement in a watershed, where functioning participative water management institutions already exist.
On the other hand, PWS may also have the potential to facilitate cooperation between stakeholders for CPR management. This will be the case, if both potential suppliers and beneficiaries expect to economically benefit from such a mechanism and thus decide to cooperate for this purpose. The distribution of information and the intense dialogue with/among the stakeholders therefore plays a crucial role. Well developed methods of development planning for identifying socio-economic dynamics and stakeholders' perceptions like PRA and RRA, which were refined and adapted to the context of PWS by JEANES ET AL. (2006)[5], are highly relevant in this context (WAAGE ET AL. 2006).

PWS also has the potential to benefit the rural poor – but this will only be the case, if areas of high poverty coincide with areas that provide valuable watershed services. Although PWS cannot primarily be an instrument for poverty reduction, it may contribute to this aim because in many developing countries, it is marginalised groups that live in upstream regions and manage lands which deliver watershed services. If a scheme is designed in a way that considers the livelihood strategies of poor households and assists them to overcome the hurdles for participating in PWS, it will have the potential to have positive livelihood impacts. At the same time it is important, though, to consider possible impacts of a PWS system on other poor groups, too. As it was pointed out, PWS may for example have negative impacts on landless people if they are not taken into account. A systematic approach is needed for being able to calculate, how different groups will be affected by a scheme.

In India, where rural areas are characterised by high population density and uneven land distribution, PWS programmes that increase employment opportunities by stimulating the demand in agricultural labour are likely to have the greatest benefits for the poor (ZILBERMAN ET AL. 2006). The fragmentation of society along lines of caste, class and political affiliations is however a major constraint for implementing PWS on a watershed level in India (IIED/WINROCK INTERNATIONAL; see chapter 2.4).

It can be concluded that the success of a PWS-scheme will basically depend on the presence of certain conditions and on the ability to develop the appropriate design of a programme for a specific context. However, if too many of the constraints that were discussed in this work are present in a watershed, market-like arrangements will not be likely to offer the optimal way of achieving environmental conservation and solving water-related conflicts.

[5] See part II of this report for a description of the 'Rapid Hydrological Appraisal' (RHA) approach.

# 5 Reference list

ALBÁN, M./WUNDER, S. (n.y.): Payment for Environmental Services at the local level: Comparing two cases in Ecuador. Online. URL: http://www.cifor.cgiar.org/pes/publications/pdf_files/Ecuador_paper.pdf (Issue: Feb. 2007).

BOSCH, J.M./HEWLETT, J.D. (1982): A review of catchment experiments to determine the effect of vegetation changes on wateryield and evotranspiration. In: Journal of hydrology 55, 3-23.

BRUIJNZEEL, L.A. (2000): Tropical forests and environmental services: Not seeing the soil for trees? Faculty of Earth and Life sciences, Vrije Universiteit Amsterdam. Online. URL: http://www.asb.cgiar.org/pdfwebdocs/AGEE_special_3.S_Bruijnzeel.pdf (Issue: Feb. 2007).

CALDER, I. R. (2001): Canopy processes: Implications for transpiration, interception and splash induced erosion, ultimately for forest management and water resources. In: Plant ecology 153, 203-214.

CALDER, I. R. (2005): Blue Revolution, Integrated land and water management. London.

CFA = Conservation Finance Alliance (ed.)(n.y.): Conservation Finance Guide. Chapter: Payments for Watershed Services. Online. URL: http://guide.conservationfinance.org/chapter/index.cfm?IndexID=18 (Issue: Jan. 2007).

CHOMITZ, K.M./KUMARI, K. (1998): The domestic benefits of tropical forests. A critical review. In: The world Bank Observer ,13, 1, 13-35.

D'SILVA, E./PINGLE, U./POFFENBERGER, M. (2004): Empowering the poor. Community-based environmental and financial management in Adilabad District, India. Community Forestry International and International Fund for Agricultural Development. Santa Barbara.

DOLŠAK, N./OSTROM, E. (eds.) (2003): The Commons in the New Millennium: Challenges and Adaptation. Cambridge

Dung The, B./Thanh Ha, D./Quoc Chinh, N. (2004): Rewarding upland farmers for environmental services. Experiences, constraints and potential in Vietnam. IFAD, Sida and World Agroforestry Centre. Bogor.

FAO (ed.) (2004): Payment schemes for environmental services in watersheds. Regional forum, 9-12 June 2003, Arequipa, Peru. Online. URL: ftp://ftp.fao.org/docrep/fao/006/y5305b/y5305b00.pdf (Issue: Jan. 2007).

FAO/REDLACH (eds.) (2004): Electronic forum on payment schemes for environmental services in watersheds. Final report. Online. URL: http://www.rlc.fao.org/foro/psa/pdf/report.pdf (Issue: Jan. 2007).

FAO/SARD-M (n.y.): Valorisation of positive externalities within the framework of the SARD-M Project. Online. URL: http://www.fao.org/SARD/common/ecg/2531/en/SARDMexternalities 2006.pdf (Issue: Jan. 2007).

GEOGHEGAN, T. (2005): Challenges to establishing markets for watershed services: learning from country diagnostics. International Institute for Environment and Development. London.

GRIEG-GRAN, M./PORRAS, I./WUNDER, S. (2005): How can market mechanisms for forest environmental services help the poor? Preliminary lessons from Latin America. In: World Development 33, 9, 1511-1527.

GUTMAN, P. (2003): From goodwill to payments for environmental services. A survey of financing options for sustainable natural resource management in developing countries. WWF. Online. http://www.biodiversityeconomics.org/document.rm?id=707 (Issue: Jan. 2007).

HARDIN, G. (1968): The Tragedy of the Commons. In: Science 162, 1243-1248.

HOPE ET AL. (2005): Negotiating watershed services. Centre for Land Use and Water Resources Research, International Institute for Environment and Development, Winrock International India and Centro de Investigacion Politica Economica/Universidad Nacional Costa Rica. Online. URL: http://www.cluwrr.ncl.ac.uk/related_documents/costa_rica/Web-docs/A3.2.6-Negotiation.pdf (Issue: Jan. 2007).

IIED/WINROCK INTERNATIONAL INDIA (eds.) (n.y.): Markets for watershed protection services and improved livelihoods in India. A policy brief. Online. URL: http://www.winrockindia. org/nrm/Final_policy_brief.pdf (Issue: Jan. 2007).

JEANES, K. ET AL. (2006): Rapid Hydrological Appraisal in the context of Environmental Service Awards. ICRAF. Bogor.

KERR, J. (2002): Watershed development, environmental services, and poverty alleviation in India. In: World Development 30, 8, 1387-1400.

LANDELL-MILLS, N./PORRAS, I.T. (2002): Silver bullets or fool's gold? A global review of markets for forest environmental services and their impact on the poor. Instruments for sustainable private sector forestry series. International Institute for Environment and Development. London.

LELE, S. (2006): Payments for Forest Ecosystem Services: Conceptual and empirical issues in the Indian context. South Asia Regional Workshop on Compensating for Ecosystem Services. Institute for Social and Economic Change. Bangalore.

MOSS, A J./GREEN, T.W. (1987): Erosive effects of the large waterdrops that fall from plants. In: Australian Journal of Soil Research 25, 9-20.

MUNAWIR ET AL. (2003): Action-learning to develop and test upstream-downstream transactions for watershed protection services: a diagnostic report from Segara River basin, Indonesia. PSDAL-LP3ES and International Institute for Environment and Development. Jakarta, London.

MUÑOZ, C. ET AL. (2005): Paying for hydrological services of Mexico's forests. Online. URL: http://www.ine.gob.mx/dgipea/download/draft_ecological_economics.pdf (Issue: Feb. 2007).

NAKASONE, H./KURODA, H. (1999): Relationship between water quality in irrigation resoervoirs and the land use of the watershed. In: Lakes and reservoirs: Reserarch and management 4, 135-141.

OSTROM, E. (1990): Governing the commons. The evolution of institutions for collective action. Cambridge.

PAGIOLA, S. (2002): Paying for water services in Central America: Learning from Costa Rica. In: Pagiola, S./Bishop, J./Landell-Mills, N. (eds.): Selling forest environmental services. Market-based mechanisms for conservation and development. London, Sterling.

PAGIOLA, S./ARCENAS, A./PLATAIS, G. (2004): Can Payments for Environmental Services help reduce poverty? An exploration of the issues and the evidence to date from Latin America. In: World Development 33, 2, 237-253.

PAGIOLA, S./BISHOP, J./LANDELL-MILLS, N. (eds.) (2002): Selling forest environmental services. Market-based mechanisms for conservation and development. London, Sterling.

PANDEY, A. ET AL. (2003): Estimation of runoff for agricultural watershed using SCS Curve Number and Geographic Information System. Map India. Online. URL: http://www.gisdevelopment.net/application/agriculture/soil/pdf/48.pdf (Issue: March 2007).

PETER, J.R. (2004): Participatory irrigation management. World Bank Technical Paper 442. Online. URL: http://www.maff.go.jp/inwepf/documents/inaugural/inpim-note.pdf (Issue: Jan. 2007).

PFOFFENBERGER, M. (n.y.): Environmental service payments and the rural poor in Asia. Online. URL: http://ecosystemmarketplace.com/pages/article.news.php?component_id=546&component_version_id=6443&language_id=12 (Issue: Jan. 2007).

RAO, K.P.C.ET AL. (1998): Rainfall infiltration and runoff from an Alfisoil in semi-arid tropical India. No till systems. In: Soil and Tillage Research 48, 51-59.

ROSALES, R.M. (2003): Developing Pro-poor markets for environmental services in the Philippines. International Institute for Environment and Development. London.

SENGUPTA, S. ET AL. (2003): Developing markets for watershed protection services and improved livelihoods in India. Winrock International India and International Institute for Environment and Development. New Delhi, London (unpublished draft).

STÅLGREN, P. (2006): Corruption in the Water Sector. Causes, Consequences and Potential Reform. Swedish Water House Policy Brief Nr. 4. Online. URL: http://www.waterintegritynetwork.net/content/download/251/1938/file/SWH_Policy_Brief%20Water_Sector.pdf (Issue: February 2007).

WAAGE, S. ET AL. (2006): Research Summary: A scoping assessment of current work on payments for ecosystem services in Asia, Latin America and East & Southern Africa. Forest Trends. Online. URL: http://wcln.org/modules.php?name=UpDownload&req=getit&lid=7 (Issue: Jan. 2007).

WUNDER, S./DUNG THE, B./IBARRA, E. (2005): Payment is good, control is better. Why payments for forest environmental services in Vietnam have so far remained incipient. CIFOR. Bogor.

WWF (ed.) (2006): Payments for Environmental Services. An equitable approach for reducing poverty and conserving nature. Online. URL: http://assets.panda.org/downloads/pes_report_2006.pdf (Issue: Jan. 2007).

ZILBERMAN, D./LIPPER, L./MC CARTHY, N. (2006): When are Payments for Environmental Services beneficial to the poor? ESA Working Paper No. 06-04. Agricultural and Development Economics Division, FAO. Online. URL: ftp://ftp.fao.org/docrep/fao/009/ag074e/ag074e00 .pdf (Issue: Jan. 2007).