LESSONS IN THE DEVELOPMENT OF MARKETS FOR ECOSYSTEM SERVICES IN A WATERSHED CONTEXT: A SURVEY OF DIFFERENT COUNTRY EXPERIENCES

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LESSONS IN THE DEVELOPMENT OF MARKETS FOR ECOSYSTEM SERVICES IN A WATERSHED CONTEXT: A SURVEY OF DIFFERENT COUNTRY EXPERIENCES

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INTRODUCTION

This paper draws lessons from the experience of some countries in the development of market-like arrangements in the delivery of water-related forest ecosystem services. It specifically identifies the various ecosystem services, watershed projects and activities that interested parties have either directly contracted with potential suppliers or have promoted through various financial mechanisms. It also highlights the role of national and local governments, private industries, individual landholders, associations of resource users, local and international non-governmental organizations, and local communities in the establishment of a new watershed institution. A review of this experience provides an understanding of the constraints and the necessary and sufficient conditions in the establishment and sustainability of such arrangements. It also draws the strategic actions to be taken in new areas. The following conditions are critically important in the development of ecosystem services: the willingness to pay of service users, the incentive and payment schemes for the delivery of such services, and the activities and transaction costs in mediating between potential suppliers and consumers of such services, and sustaining their arrangement.

Watershed arrangements for the provision and delivery of ecosystem services have grown in number in different parts of the world. Landell-Mills, N., J. Bishop, I. Porras (2002) identifies about 280 cases of actual and proposed arrangements for ecosystem services in different countries, ranging from watershed protection, biodiversity conservation, preservation of landscape beauty, and carbon sequestration. Twelve cases on watershed protection arrangements are presented in this paper.

In general, watershed arrangements emerged in response to the dangers and costs of forest degradation or loss, such as water shortage and quality deterioration, and the unmet demand of particular sectors for particular forest environmental services. The limited capacity of local and national governments to finance and enforce policies on watershed rehabilitation and protection has also stimulated local private initiative. While the object of these arrangements is to address common environmental problems, there is no single standard arrangement. Instead, a variety of arrangements have been established, differing in the number and type of participants, the degree of private industry involvement, the extent of central and local government intervention, and the sources of finance and forms of payment mechanism.

SURVEY OF WATERSHED ARRANGEMENTS FOR ECOSYSTEM SERVICES

Table 1 presents the 12 watershed arrangements in different countries. They illustrate the particular ecosystem services that are in demand, the various users who are directly linked with identified service suppliers or project implementers, and the role of government or non-governmental mediators. An essential feature of the arrangement is the form and source of the payment for the maintenance or restoration of water-related services. These cases hence provide prototype models for the promotion of market-like arrangements for forest ecosystem or watershed services.

In the establishment of ecosystem service arrangements, a number of questions and issues were addressed. The following key questions are important in evaluating the market potential of such services, setting in place the necessary conditions for the establishment of the arrangement, and fulfilling the sufficient conditions for their sustainable operation. These questions are further detailed in Appendix 2, and are discussed below.

- What are the water-related ecosystem services in a forested watershed that are needed?
- What is the production function of such ecosystem services? Can these services be measured and monitored in order to provide a basis for payment? What commodities or project activities can be designed and may serve as proxy of a watershed service?
- What is the value of the service? Is there a willingness to pay on the part of users? Why does it have a zero or low value relative to its proper service value?
- What are the legal and institutional aspects and incentive structure that constrain potential suppliers and hinder the establishment of ecosystem service arrangements? What are the sufficient conditions?
- What are the transactions costs in the establishment of such arrangements? Who will bear these costs? How can it be reduced?
- What are the payment mechanisms for ecosystem services?

QUESTIONS TO BE ADDRESSED: STEPS FOR MARKET PROMOTION

1. ON THE VARIOUS WATER-RELATED ECOSYSTEM SERVICES IN FORESTED WATERSHEDS

A healthy and stable forest ecosystem or watershed performs numerous significant services that maintain conditions for all life on earth. It provides the following ecosystem services:

- Forests the flow of both surface and groundwater, specifically slowing the rate of runoff in a watershed and determining the recharge of the water table.
- Forests protect the soil, reduce the incidence of soil erosion and landslides, and control the sedimentation of waterways.
- Forest soils filter contaminants, control nutrient and chemical load, and maintain water quality.
- Forests contribute to both farm and fishery production. It maintains aquatic habitats.
- Forests provide a habitat for endangered species. As a biodiversity-rich ecosystem, it provides resilience to the environment, livelihood to indigenous communities, and spiritual, cultural and health benefits.
- Forests are involved in carbon storage and sequestration.

The above services are directly useful to resident and downstream farmers, proximate water-dependent enterprises, neighboring towns or city, if not indirectly beneficial to the larger regional, national or global community. Because these ecosystem services provide direct and demonstrable benefits, there is an implicit demand or an economic value for these services. In other words, a market potential exists for these services. Forest ecosystem services are further discussed in Appendix 2.

In a watershed area, particular ecosystem services are more important than others to specific groups of people because their economic activities, livelihood needs, water requirements, and values of the people are dependent on these services. For instance, the regularity of water flows and stability of soil conditions are deemed important in the heavily eroded sites presented in Table 1 while an assured supply of clean surface water or the proper functioning of the aquifer are crucial in the excessively polluted areas. Because of these services, it was necessary to

respectively protect the watershed from soil erosion and from surface and groundwater pollution. These examples suggest that as populated areas are threatened by service supply shortages and become vulnerable to economic losses, droughts, or environmental damages, the demand for a particular ecosystem service becomes more apparent.

A set of activities is required to help maintain, restore or improve the service that has a local demand. This set of activities implicitly defines the watershed service-commodity that would have to be contracted out and compensated. In the Colombia case, for instance, reforestation activities must be implemented on steep slopes in order to reduce erosion and help extend the life of irrigation canals in the downstream farms. Similarly, the protection of existing groundwater sources of the French mineral water company requires the restoration of the natural forest in northeastern France and the extensive promotion of organic farming practices in the Rhine-Meuse watershed in order to prevent pollution of the aquifer's vital infiltration zones. In the Murray-Darling Basin of Australia, the protection of the forest cover is also necessary to keep water table levels under control and prevent dissolved mineral salts from rising to the surface and degrading freshwater supplies. These human interventions are thus necessary to restore and improve the delivery of ecosystem services.

2. ON THE PRODUCTION AND MEASUREMENT OF ECOSYSTEM SERVICES, AND THEIR PAYMENT

There are a number of information and analytical requirements needed in order to define the watershed service-commodity or the set of required activities that would maintain, restore, or improve the ecosystem services. The lack of information on these services represents a critical limitation to institutional development. If there is initially little or no credible data on basic hydrological functions in most watersheds, it is possible to start with extrapolated measurements and relationships from similar watersheds where data is available. The following data requirements are needed:

Table 1. Different Country Experiences in the Establishment of Institutions for the Provision of Environmental Services

Case	Ecosystem Services	Project
New York City: Watershed Management Program	• Purify water supply	• Best farm and forest management practices • Land development rights distribution • Land purchase • Non-timber production
Australia: Water Transportation Credits	• Reduction of water salinity	• Tree planting • Reforestation
United States: Nutrient Trading	• Improve water quality	• Ecologically sound farm practice • Nutrient reduction credits trading

Case	Demander	Supplier
Sao Paolo, Brazil	• Private water utility company	• Municipal Environmental Council
State of Parana, Brazil: Public Sector Redistribution	• State of Parana	• Municipal governments • Landowners
Costa Rica	• Hydropower producer	• NGO in the upper catchment
Costa Rica: Hydroelectric Utilities' Financing of Upstream Reforestation	• Hydroelectric company	• Private forest landowners
Colombia: Environmental Services Tax (Eco-tax) for Watershed Management	• Municipalities Water utilities Hydroelectric companies • Other industrial users	• Municipal government • Private landowners
Cauca River, Colombia: Associations of Irrigators' Payment for Improvement of	• Irrigation Association • Water management foundations	• Upstream farmers

Case	Demander	Supplier
Stream Flow	• River corporations	
Qujiang County, Guandong Province, China	• Hydroelectricity companies • Domestic water suppliers	• Farmers
Quito, Ecuador	• Farms, livestock, irrigation, hydropower projects, tourist resorts	• Water Conservation Fund
France: Perrier Vittel's Payment for Water Quality	• Natural mineral water bottler	• Upstream dairy farmers • Forest owners
New York City: Watershed Management Program	• Federal-State-Town government • City residents	• New York City government • Upstream forst landowners • Farmers • Timber companies
Australia: Water Transpiration Credits	• Irrigation farmers	• State forests • Tree planing land users
United States: Nutrient Trading	• Industrial polluters with excess discharges	• Nonpoint farmers • Point source polluters discharging below allowable level

Case	Payment/Source	Mediator-Organizer
Sao Paolo, Brazil	• 1% of revenue of the water utility company is paid to the Council	• Self-initiated
State of Parana, Brazil: Public Sector Redistribution	• 2.5% of ICMS (indirect tax on consumption of goods and services) is given to municipalities with protected areas • Another 2.5% is given to municipalities with watersheds supplying water to neighboring municipalities	• State-initiated
Costa Rica	• Payment to NGO from the hydropower company + other voluntary supplemental funds	• Self-initiated
Costa Rica: Hydroelectric Utilities' Financing of Upstream Reforestation	• Hyrdoelectric company pays $18/ha to upstream forest land owners • Government provides a counterpart of $30/ha	• National Forest Office • National Fund for Forest Financing
Colombia: Environmental Services Tax (Eco-tax) for Watershed Management	• Eco-tax comes from: 1% of town's and departments' budget; 3% of hydroelectric companies sales; and 1% of investment of industrial users of water for the Ecosystem Fund • Hydrocompanies provide another 3% to municipalities with hydrologcial basins and reservoirs	• State-initiated • Regional Autonomous Corporation manage the Ecosystem Fund
Cauca River, Colombia: Associations of Irrigators' Payment for Improvement of Stream Flow	• Regional Environmental Authority • Water users in the association volutarily agreed to pay $1.50 to $2.00/liter/second in addition to the existing $0.50 every trimester	• Regional Environmental Authority collects payments, supports water user associations and contracts upland communities
Qujiang County, Guandong Province, China	• Domestic water suppliers give 0.01 Yuan per ton of water to	•

Case	Payment/Source	Mediator-Organizer
	farmers • Hydroelectric companies contribute 0.0005 Yuan/ kilowatt of electricity generated	
Quito, Ecuador	• Trust fund: Various user fees (fee on monthly water bill) + 1% of water district sales + funds from national and international sources (e.g., Nature Conservancy, USAID)	• Nature Conservancy • Fundacion Artisana • USAID
France: Perrier Vittel's Payment for Water Quality	• US$24.5M from mineral water company • The French National Agronomic Institute finances 20% of research • Water agencies pay 30% of the building cost of barns	• Self-initiated
New York City: Watershed Management Program	• 9% increase in waterbill rates over a 5-year period • Sale of NY bonds • Trust fund • Subsidies to farmers and forest landholders	• Federal state government provide financial and technial assistance + USDA assistance and financial incentives
Australia: Water Transpiration Credits	• Irrigation association purchases salinity credits from State Forests • $AUD 17.0/million liter transpired or $AUD 85/ha/yr compensation	• Public sector mediates between irrigation association and State Forests
United States: Nutrient Trading	• Point-nonpoint credit exchange • Point-point credit exchange	• Public sector covers the cost of design and operation of trading system

One, there must be a mapping of the flow of ecosystem services. The location of the services within the watershed landscape must be determined, as well as the ownership or management of these areas. Two, the scientific and empirical relationship between the land use that generates the service and the service itself must be established. The variables across different locations, if not over time must be operationalized and measured. Specifically, the positive or negative effects of different forestry activities on ecosystem services must also be determined.

What species, forest management regimes, and combination with non-forest land uses are optimal? Are forest plantations as effective as natural forests? How badly, for instance, are water supplies affected by the conversion of a hectare of forest to agriculture in the watershed? Apart from changes in forest cover, are there other relevant measurable factors that affect water flow and quality? Three, it is necessary to know what interventions in watershed management can improve the quantity and the quality of existing services, as well as provide other services.

Given these data on the flow of ecosystem services, it is possible to intervene strategically and determine the protection areas, specifically for soil erosion control, aquifer recharge, or salinity prevention, as well as identify the critical stakeholders in the delivery of ecosystem services. Available information would also help substantively determine the terms and conditions of land use and management agreements with landholders, or whether to purchase lands for protection purposes. The planned protection activities and the packaged land use and management practices in the agreements represent the proxy for commodity-service. With measurable activity inputs, the commodity project stipulated in the agreement provides a basis for monitoring supply and determining payments. Moreover, the agreement is an assurance to both purchasers and

suppliers that they are respectively getting something for their money and receiving compensation for their inputs.

Table 1 provides information on the proxy commodities or activities required for ecosystem service delivery. Apart from watershed management or forest conservation, these include reforestation, protection of springs and streams, promotion of best agricultural practices, organic farming, provision of alternative livelihood and non-timber production projects, and direct purchases of land for protection purposes or purchases of development rights to land. Table 2 also provides a list of the various agreements, contracts or proxy commodity associated with the desired ecosystem service. It may be noted that some activities require the direct involvement of private forest or farm landholders or the initiative and action of an external agent. Most activities under the water quality and regulation service are related to private goods, like bottled water, hydroelectric power, and agricultural products.

Table 2. Watershed services and commodities covered by a local arrangement

Service	***Proxy Commodity***
Regulation of runoff and water table and water quality	Water protection contracts – nurseries and reforestation of riverbanks, land management
	Protected area, organic farming, salinity-friendly products
	Land acquisition
	Protection agreements for springs, stream buffers
	Livelihood projects
	Water rights
	Watershed lease
Control of pollution and soil contaminant	Revegetation (ecolotree plantings) and reforestation of sensitive infiltration zones
Water quality improvement	Watershed protection/ best management practice contracts
	Water quality credits (Trading of nutrient reduction credits)
	Land acquisitions
	Conservation easements
	Compensation to landowners, property tax reduction
	Development of non-timber markets
	Soil stabilization, vegetation, enclosure project
Aquatic habitat protection	Best management practice contracts
	Land leases
	Fish specie habitat restoration contract
	Land acquisition

3. ON THE VALUE OF AN ECOSYSTEM SERVICE AND THE WILLINGNESS TO PAY OF BENEFICIARIES

By definition, ecosystem services have some level of economic value because they directly benefit people. There are at least three estimating techniques that were used in the case materials, namely replacement cost, productivity loss, and contingent valuation. For instance, replacement cost was used in some case studies to measure the change in farm practices, the shift from timber to non-timber production, or forest re-growth through reforestation. On the other hand, productivity losses from forest loss and sedimentation were estimated in terms of the decline in hydroelectric power generation and the consequent effect on farm and non-farm production. Illustrating the economic importance of ecosystem services, these estimates are strategically useful in generating financial support for these services.

The so-called contingent valuation method or the estimation of the willingness-to-pay (WTP) for ecosystem services simply entails a field survey of service users and beneficiaries. This may merely be an academic exercise if there are no willing buyers who would make an offer to buy a service. If there are such individuals, their WTP as a sum must at least be sufficient to finance the replacement cost or recapture the income or productivity losses.

There are various reasons, however, why willingness to pay may be low, if not equal to zero. One, if citizens know they have the right to high quality water and are able to access it, they will most likely not have a willingness to pay for it. Two, if users are accustomed to receiving watershed protection services for free, they would tend to view water-related ecosystem services as public goods and would be reluctant to pay for them. Three, there is either no explicit policy or law on the question of environmental service payments, or existing legislation has ruled out any form of watershed charges (Gawamadzi, 1999). Four, some service users, like small subsistence farmers, are either too weak or lacking in income to pay a partial cost of the service while others, like power entities, may be quite strong to resist efforts to make them pay the full costs of water provision.

Willingness to pay, however, is present under different conditions. One, downstream beneficiaries are likely to express their WTP if their water supplies are threatened. Two, even if present supply is adequate, beneficiaries may still have a WTP if future supplies are uncertain, and they wish to guarantee their future needs. Three, an explicit policy that requires users to pay, together with government's capacity to enforce rules would send the message that free-riding is not permitted. Four, beneficiaries will also willingly pay if they clearly perceive the utility of the service to their economic activities, and they are confident that their payments will not be misused, but will redound to their own benefit.

Willingness to pay on the part of some private consumers of ecosystem services may result in more direct action, such as negotiations with potential suppliers and the formulation of agreements on payment mechanisms for watershed protection, even with little or no government involvement. Table 1 provides examples of self-organized initiatives. The large agricultural producers of Cauca Valley, Colombia, for instance, have agreed through their water users' association to assess themselves additional fees that would be used to finance watershed management practices in the upland areas, such as reforestation, erosion control on steep slopes, land purchases and protection agreements for springs and stream buffers, and livelihood projects for upland communities. These watershed practices have been recommended to improve base flows and reduce sedimentation in the irrigation canals.

Another example of private initiative is that of Perrier-Vittel, the world's largest bottler of natural mineral water, which has invested millions of dollars to prevent nitrate and pesticide pollution of their ground and spring water sources, and restore the natural water purification capacity of the forest. The French bottler has specifically undertaken reforestation of sensitive infiltration zones, the purchase of hydrologic sensitive lands, long term contracts with landholders surrounding the springs, and support for the shift to organic farming in the community.

Given their great demand or willingness to pay for ecosystem services, private groups have organized these initiatives on the basis of their production needs and cost conditions. It is in the interest of producers to invest in the maintenance of such services and protect their investments because water services are critical to the production of private goods (bottled water, electricity, agricultural products). Private producers, moreover, have initiated negotiations with other watershed users to address the externalities of their land use practices on production and investments. Perrier, for instance, negotiated with other watershed users and spent money reforesting sensitive infiltration zones and financing the switch to organic farming practices. These ecosystem-based measures were deemed to be cheaper than conventional investments in filtration plants.

Given a policy-enforcement environment where regulatory standards do not provide the desired water quality and flow, it may also be in the self-interest of watershed service users to form private agreements. Under such conditions, private producers who are dependent on ecosystem services must establish and monitor their required standards. Without police powers, they can only enforce them through incentives. These actions are pursued especially if the costs of monitoring and transaction can either be covered by the market price or can partly be subsidized by government.

4. SUFFICIENT CONDITIONS FOR ECOSYSTEM SERVICE ARRANGEMENTS

WTP alone on the part of watershed users is not sufficient to guarantee the establishment of arrangements that will effect the restoration, protection and delivery of ecosystem services. In order to realize their market potential, at least two conditions must be in place, namely a comprehensive policy-regulatory framework and a mechanism for handling various transactions costs.

A comprehensive policy-regulatory framework is necessary to address some of the constraints on the supply side, namely: the absence of secure tenure, lack of incentives, low awareness of market opportunities, and the absence of insurance to reduce risk for buyers. As the most commonly cited reason for market failure, the lack of clear property rights for watershed services goes together with other limitations. Apart from secure tenure rights, upstream landholders must also be aware of their responsibilities to maintain and protect ecosystem services and the market opportunities for these services. As potential suppliers, they may either receive incentives for their involvement in productive activities or direct compensation for the services they have delivered.

Payments from downstream users, however, will only be forthcoming if upstream holders can ensure at reduced risks the delivery of services to downstream users. The delivery of such services may partly require the organization of upstream landholders over a far larger area of watershed and the capacity to invest with or without government support. There are also other constraints that must be addressed.

Apart from the required watershed area, there are other conditions that constrain the formation of self-initiated arrangements between upstream service providers and downstream demanders. Specifically, the varying imputed values for watershed resources among numerous watershed service users, as well as the absence of local mechanisms not only to set one common value for a service but also to resolve differing interests and competing resource uses have prevented the voluntary formation of watershed arrangements. Given the absence of a market for ecosystem services, there is a need for a third party to bring potential investors, sellers and trading partners together to initially debate the ecosystem cost of degraded watersheds. They can then negotiate and mediate between ecosystem service users and potential suppliers, specifically to bring the user's willingness to pay closer to the supplier's willingness to accept, if not the latter's opportunity costs, as well as address the various transactions costs.

Because opportunity costs vary from location to location and even among adjacent holdings, the price that would bring suppliers into the market is likely to be a trial and error exercise. This should be based on political calculation, business negotiations, and continued experimentation. Unless there are potential suppliers or investors who find personal satisfaction or psychic gains in contributing to a healthy environment, a low price offer will result in the participation of only a few suppliers.

Involving stakeholders, particularly in the design of the payment mechanism and service delivery arrangement is one important role of the third party. Stakeholder participation in this area is crucial in order to win the support of beneficiaries and ensure against "free-riding". Similarly, consultations with potential suppliers and landholders would enable the payment system to respond and meet their needs and thereby provide watershed protection. Broad participation is thus essential in order to avoid "free-riding" in consumption and convince beneficiaries to pay.

Apart from promoting stakeholder participation, the third party must also nurture the nascent arrangement. Various functions are involved in the process of institution-building, such as mediating and resolving conflicts, pooling demands and payments for risk sharing, overseeing research on the flow of ecosystem services, establishing systems of fund management, monitoring and enforcement, and proposing necessary changes in the legal and regulatory framework. Since these functions entail costs, the mediator-organizer must identify partners to share the burden, as well as develop strategies to minimize transaction costs. Philanthropic foundations and donor agencies, for instance, have assisted the government's watershed protection program while organizers from the public or private sector have reduced transactions cost by negotiating with established associations of farmers or forest landowners, instead of individually meeting many small owners. These pre-organizational costs have mainly been shouldered by the initiating agency.

5. PAYMENT SOURCES OF THE ESTABLISHED ARRANGEMENTS

Table 1 also shows the sources of payments in the established arrangements. These arrangements are either private initiatives with or without government support or state initiatives in collaboration with other groups. In the self-initiated arrangements, payments to the contracted supplier are either made as a direct expense of the private company or as a given percentage of its revenues. The payments made by Costa Rican hydropower company and the French bottler are reflected in their expense accounts while the payments of the Sao Paulo water utility is a fixed percentage (1%) of its revenue.

Public sector institutions have also provided support to these private initiatives in the form of technical assistance, counterpart funds, or collection of payments. In the Perrier-Vittel case, a government research agency helped finance and conduct research that led to the program while in the Cauca River, Colombia case, a regional public development agency provided technical assistance to local communities and landowners carrying out watershed protection. The agency also helped organize farmer-water user associations, and linked up with upland communities.

In the state–initiated arrangements, new tax measures have either been mandated, like the environmental services tax of Colombia, or existing tax revenues reallocated and distributed to priority areas. A portion of sales taxes in Parana, Brazil, for instance, has been redistributed to municipalities that take action either on their own or in cooperation with private landowners to protect watersheds. Allocated on a competitive basis, a larger portion of tax funds is being given to municipalities that protect more watershed areas.

Some of these generated revenues, moreover, have been used to capitalize a trust fund for watershed management. The Water Conservation Fund in Quito, Ecuador, for instance has been established through user fee collections, water district revenue contribution, and external funds while the Eco System Fund in Colombia has been built through municipal budget allotments and tax collections from hydroelectric companies and industrial users of water. Apart from tax and government budget allotments, funds for watershed management have also been raised through other measures. Together with water rate increases, the New York City government has also sold bonds to establish a trust fund.

The predominant role of governments in protecting water-related ecosystem services is also reflected in the growth of trading systems in pollution credits. This is represented in two cases in Table 1: the trading of water transpiration or salinity credits in Australia and the nutrient trading in the United States. Implemented in countries where environmental standards (e.g., on water quality) can be strictly monitored and enforced, a pollution trading system enables companies or landowners to trade emission credits between those who can achieve the standard cheaply and those who cannot. In the United States case, for example, the highly regulated factories (point sources) with excessive discharges can comply with the standards on nitrogen and other organic pollutants without having to invest in expensive pollution control technologies by merely funding

the unregulated farmers (non-point sources) to adopt ecologically sound agricultural practices. Similarly, irrigation farmers in Australia who contribute to the salinity problem through their high water consumption levels can buy transpiration credits from landowners or the State forests for their tree-planting mitigating activities. Since the non-point sources and mitigating efforts can achieve significant pollution reductions at a fraction of the cost to the polluters, environmental standards can be met at less cost both for themselves and the community as a whole (Faeth 2000).

Among the various sources of watershed financing, public payment schemes have been the most predominant in the world. Relative to self-initiated private arrangements and open trading schemes, the publicly initiated payment systems continue to dominate because of the public goods nature of hydrological services and the public desire for watershed protection. As the most common financial mechanism, publicly financed transfer payments have often been determined by political or budgetary considerations, rather than strict economic evaluation of the environmental benefits. In practice political or budgetary considerations rather than strict economic evaluation of the benefits have usually set the price paid to secure water-related ecosystem services. In other words, state prioritization of watershed protection and management together with collaboration with initiators from the private and nongovernmental sectors have ultimately been the critical factors in allocating resources for the protection of ecosystem services.

IMPLICATIONS AND GENERAL DIRECTIONS: RULES OF THUMB FOR INNOVATORS

There are many opportunities to develop market-like arrangements for hydrological or ecosystem services. Although the approaches employed in the above cases are relatively new, there has been enough experience to suggest several rules of thumb. The literature provides a preliminary set of guidelines on the following areas.

ECONOMIC

- Focus on services that are scarce, declining, and have expensive or no substitutes.
- Focus on services directly linked to downstream investments or beneficiaries.
- Base compensation levels on the estimated value or the economic importance of the service.
- Package hydrological services with other ecosystem services if possible.

SOCIAL

- Seek out and use local knowledge of the watershed.
- Clarify rights and responsibilities under the existing law and customs.
- Identify stakeholder groups and involve key members in early planning.
- Consider equity implications of watershed investments.

BIOPHYSICAL

- Maintain natural forests before investing in reforestation.
- Focus on road-building and soil compaction before reforestation.
- Do not rely on fast growing tree species to slow erosion or extend dry season flows.
- Anticipate differences between species, young versus old forests, natural versus plantation forests.
- Protect or restore wetlands and riparian vegetation first.

OPERATIONAL

- Initiate work at reasonably small scales. Start with tens of thousands of hectares rather than hundreds of thousands of hectares, before scaling up.
- Treat major assumptions as hypotheses, and monitor and test them once implementation begins.
- Do not underestimate transaction costs. Seek government or donor help.
- Assemble an interdisciplinary planning and management team.
- Share experiences and findings early and often, especially with decision-makers and stakeholders.
- Choose financial mechanisms that fit existing institutional conditions. Where public institutions play an important role in land and/or water management, public payment schemes are likely to be important.

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