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Improving Watershed Management Programs

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Abstract: Watersheds have become an integral component of natural resources management. It is an integrated approach to water management. The major issues and challenges involved in watershed management are identified and discussed here. At the higher slopes changes in land use tend to generate downstream effects that impact on other stakeholders in the watershed. Infact, both costs and benefits need to be equally shared amongst both upstream and downstream stakeholders. The watershed management incorporates improving management of (a) natural resources, (b) local development and (c) externalities. Improving management of externalties is crucial in watershed management because improving equity becomes a prerequisite to improving the efficiency and sustainability of watershed investments. Rural poverty and degradation of natural resources are interlinked.

Key words: Watershed, land use, catchments, soil erosion, natural resources, sustainability

This paper focuses on the management and rehabilitation of watersheds. Watersheds have become increasingly important in the World Bank's natural resource management policy. Bank programs, such as the Bank Netherlands Water Partnership Program (BNWPP), that emphasize improving water resource management recognize watersheds as being one of the major aspects of an integrated approach to water management. A recent OED evaluation found that significant improvements in people's livelihoods have been achieved as a result of a number of watershed projects such as the Loess Plateau in China and the Land Management II project in Brazil. This paper identifies and discusses the major issues and challenges involved in watershed management. From the point of view of the WSM Program, the terms watershed and catchments are inter-changeable. They both refer to an area that supplies water by surface or sub-surface flow to a given drainage system, be it a stream, river, or lake.

At the higher slopes common in upper watersheds, changes in land use tend to generate downstream effects that impact

on other stakeholders in the watershed. The magnitude of these impacts depends on many factors, including the spatial scale of the watershed. Although the impacts of changes in land use are most readily felt at smaller spatial scales, it is important to get a clear understanding of the direction and magnitude of these impacts. This is no easy task. There are considerable controversy and misconceptions about the direction and magnitude of the impacts of land use on water resources.

Watersheds are also *water supply and distribution systems* whereby a finite water resource is made available to a range of users (e.g., for primary production, domestic and industrial consumption, transportation, and power generation). Watersheds provide many important water-related functions and services to many stakeholders, who are directly or indirectly affected by changes in the quantity and quality of water available at any point over time.

Why Upper Watersheds?

Watershed management activities necessarily focus on *upper catchments* because the areas with the most dynamic land-water interactions are invariably located on the steeper slopes (commonly located in the headwaters and lateral margins of the typical catchment profile). As a result of the normal pattern of human settlement and infrastructure development in settled catchments both the under-serviced communities of rural poor and the remaining forest resources tend to be located in the marginal uplands and the remote catchment headwaters. Left untendered, at higher population densities these combinations of isolation, poverty, and increasingly scarce (valuable) forest products often results in extensive denudation.

Although soil erosion and forest degradation are frequently most severe in the more fragile upper portions of the catchment, it must be recognized that the resident upland communities offer real opportunities for improving natural resource management and minimize downstream impact if poverty alleviation efforts and local institutional development are effective.

Elements of Watershed Management

Watershed management incorporates three closely related elements:

- *Improving natural resource management* by communities resident in upper catchments
- *improving local development management* by their local governments; and
- *improving management of the externalities* inherent in every catchment as human settlement generates important impacts that increasingly characterize upstream-downstream hydrological relationships.

Improving the sustainable productivity of natural resources in upper catchments through improved *community resource management* is a core strategy for reducing rural poverty and improving watershed management. Better management also requires upper catchment (upland) communities having access to essential economic and social services such as micro-credit, all-weather roads, potable water, basic health, and functional education. Facilitating community resource management and reducing rural poverty therefore requires *improvement in the*

development management capability of rural communities and their local governments, possibly including their ability to extract compensation for the important "environmental services" they can provide.

The inter-relationship of efficiency, equity and sustainability objectives in natural resource management takes special importance in watersheds due to the presence of multiple and diverse users and externalities. *Improving the management of externalities* is critical to watershed management because improving equity becomes a prerequisite to improving the efficiency and sustainability of watershed investments.

Externalities in Watershed Management

In a watershed the classic example of externalities is erosion from hill farming that deposits sediment behind dams and in canals, reducing their life expectancy and efficiency at a high cost to downstream users and the national budget.

Externalities may be pervasive in a wide variety of additional watershed contexts because upstream and downstream land and water users are interlinked by hydrological relationships. This is true at every catchment scale within the watershed hierarchy, from the entire river basin to very small "zero-order" micro-catchments.

Environmental services and externalities

"Environmental services" is a generic term for positive externalities or *off-site benefits* that are generated by a particular land use. There are typically no markets for environmental services so land users do not receive compensation for such services or take them into account when making a land use decision.

The basic policy principle is: the polluter pays and the provider gets. Where watershed treatments distribute costs and benefits unevenly, it stands to reason that those who bear the costs of generating *positive* externalities will support the intervention (including beyond the project period) only if they are appropriately compensated for adopting good land management practices. Alternatively, where watershed degradation is not yet serious, it may well be more effective to facilitate agreements and institutions that enforce a system of appropriate disincentives for *negative* externalities in line with the principle of "the polluter-pays".

Failure to address externalities helps explain the persistence of land degrading practices in upper catchments and the failure of many early watershed projects. Early efforts to introduce improved land and water management in upland areas provided inadequate incentives and resulted in low adoption and poor maintenance so that improved practices disappeared when projects ended. Land tenure problems, inappropriate technology and inadequate participation explains some of these problems, but where externalities were at play uplanders also had insufficient incentives to permanently change their patterns of land use. Many opportunities exist to develop markets for environmental services, but they may encounter complex problems.

Examples of environmental services

- *Hydrological services*: denotes services with regard to water availability, water distribution and water quality.

- *Biodiversity services*: includes consideration of the existence value of exotic species, as well as eco-tourism and bio-prospecting values.

- *Carbon sequestration services*: value of carbon removed from the atmosphere by planting or maintaining forest or plant cover that reduces the impact of climate change induced by carbon dioxide emissions

- *Scenic beauty services*: encompass values for the preservation of landscapes for tourism, and recreation

Technological Aspects

Watershed management can be achieved by using a variety of technologies such as vegetative conservation techniques (including hedgerows and grass contours) and physical structures techniques (including terracing and stone bunds). In Bank projects, the former were usually favored. This supports the global trend that favors the choice of technologies that are low cost and more farmer friendly. A successful adaptation of technology in Bank watershed projects was also achieved through farmers involvement in the choice of technologies. This helps in using technologies that are more compatible with existing land uses and surrounding environments and that meet the farmers needs. Most Bank projects have opted for an integrated and multi-disciplinary approach that takes multiple agricultural actions and other activities into account. Such approaches have been very successful in raising agricultural yields and bringing about local environmental improvements such as reduced soil loss, improved flood control, increased vegetation cover, and improved soil fertility.

Economics of Watershed Management: A Downstream Perspective from Madagascar

In the highlands of Madagascar, siltation of canals and reservoirs due to high sediment influx is a major constraint to irrigation development. Does it make sense for irrigators to invest in protection activities, such as slope stabilization and hedges, which would reduce erosion and decrease sediment load and costs of maintenance? To get a rough estimate of the economic feasibility of such activities, investment costs and reductions in rehabilitation and maintenance costs were estimated (Watershed Management scenario, WSM) and compared to the current costs of regular maintenance and periodic rehabilitation of the infrastructure (Maintenance scenario).

The results (Fig. 1) show that the ratio of irrigated area and watershed area is an important factor in determining the economic feasibility of watershed management from a downstream perspective. For typical ratios in Madagascar (1:30 to 1:100) the costs of watershed protection are substantially higher than maintenance costs. For smaller ratios (1:5), costs for watershed protection are comparable or lower than the maintenance scenario.

This estimate has to be treated with caution as other factors must be considered which were not taken into account in this simple calculation. The results suggest, however, that it does not always pay to invest in watershed management solely from the perspective of downstream irrigators.

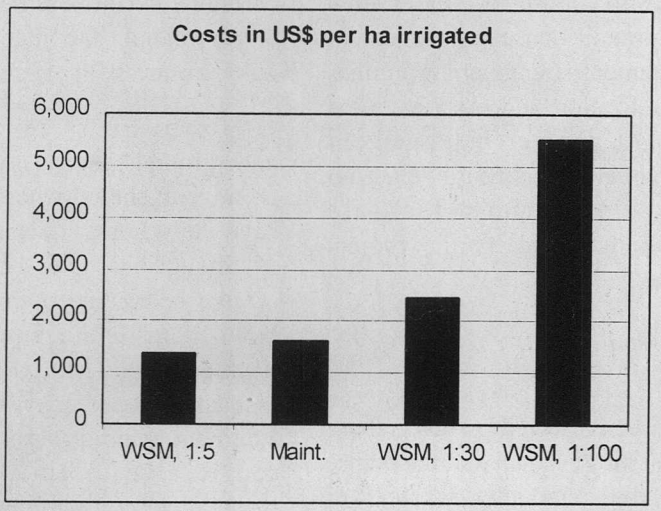

Fig. 1. Comparison of protecting downstream irrigation through watershed management versus regular maintenance and rehabilitation in Madagaskar highlands.

Rather, downstream benefits when complemented by upstream benefits must be large enough to merit the investment.

Institutional Approaches to Watershed Management

Rural poverty and degradation of natural resources are frequently linked in a vicious cycle that is active in the critical headwaters of many watersheds. There is general consensus that poverty alleviation requires that rural poor gain access to not only the means of production but also to basic services and essential social and economic infrastructure. This requires that rural communities be facilitated to become organized and empowered to negotiate adequate access to the land with other interest groups from local and higher levels. Effecting this change in the status quo is proving much more difficult than introducing technical interventions or even basic services that can improve crop yields or primary health.

Community resource management

Interventions are initially required to build the capacity and capability of rural communities and their local governments to sustainably improve natural resource management in critical headwaters and denuded uplands. These interventions must to be community based since natural resource management decisions are typically taken at this level.

Local development management

Concurrently, local governments need to be facilitated to improve their capacity for managing area development including incorporating watershed management considerations into their situation assessment and planning activities. One of the most critical issues in watershed management projects relates to the ownership of the project

by the community and its sustenance thereafter. Community-based management and local government strengthening implies a clear-cut mobilization and empowerment strategy so that project management structures are operated through existing decentralized institutions that are purposefully strengthened by the project process.

Managing externalities

Managing externalities requires agreements between affected parties. Where the number of parties is small and the nature and extent of the externality is clear to all, forging such agreements may be a simple matter of one-on-one negotiation. A complicating factor in managing watershed externalities is that there is no single decision-maker in control of the watershed, but rather a more or less amorphous group of stakeholders, each of whom makes decisions separately so that negotiating solutions to externalities becomes very complex.

Some Issues Emerging from India

Landless poor as a group usually only participate in watershed management through wage employment, preferably relevant to the resource management program.

There is recognition that in upper catchments landless poor (particularly women) could also gain recognized usufruct rights to common property, community lands, forest lands, under conditions commensurate with improved natural resource management.

In arid and semi-arid zones more than 80% of water loss is due to evapotranspiration or runoff, and the best method of conservation is percolation facilitated by trenches and gully controls in the upper catchments.

However, once water is stored underground, equity issues becoming very prominent: should whoever drills a borehole have the water or does the community own it? Should boreholes be used for irrigation or use restricted to drinking water only? How to legislate equitable access and payments for (irrigation) water? How to mandate the transfer payments for the positive externalities produced so that landless poor can receive incentives for improving percolation on community lands?

While each stakeholder's interests and activities may have insignificant impact on others downstream, the aggregate effect can be quite large. Intermediary institutions are needed to bring the parties together to develop and implement mutually acceptable arrangements. Entirely new catchments institutions may be required to manage externalities (including the possible levy and distribution of transfer payments in return for environmental services), but given the ubiquity and diversity of watershed externalities some form of permanent local institutional arrangements are needed.

Payments for environmental services by downstream users is one option for distributing benefits and costs of watershed management between upstream and downstream stakeholders. Payments may take a variety of forms ranging from direct compensation to indirect measures aimed at giving upstream communities a stake in watershed conservation (such as the voting a budget for improved village water supplies and schools that facilitates uplander access

services that reduce uplander poverty and supports the adoption of sustainable land uses). Building the understandings and mechanisms for institutionalizing such mutually supportive interactions is a central challenge of watershed management.

Markets for Environmental Services

Well-publicized watershed projects in India and the Dominican Republic provide good examples of markets for environmental services. These markets play an important role by giving all parties an interest in watershed development and can play the critical role of generating benefits to landless people, who make critical contributions to successful watershed management but enjoy few direct benefits.

In Sukhomajri village, India, a project is aimed to provide irrigation water from a small runoff pond. Landless families utilized the pond's catchment area for grazing, but the resulting lack of vegetative cover caused erosion that threatened the pond with siltation. To make the project favor everyone's interests, villagers proposed that landless families receive rights to valuable irrigation water in exchange for eliminating grazing in the catchment area. These families could then sell their water share or use it on leased farmland in the lower watershed.

In the Dominican Republic, the FIRENA project successfully encouraged farmers to adopt soil conservation without subsidies by tying conservation to access to irrigation.

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