The Watershed Commons: Lessons Learned

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Abstract (200 words): Watershed development is an important component of rural development and natural resource management strategies in many countries. This paper introduces numerous challenges to successful watershed management, traces how projects have tried to overcome them, and discusses lessons from research on common property. Key challenges include uneven distribution of benefits and costs of technical interventions, multiple and conflicting uses of natural resources within watersheds, multiple and overlapping property rights regimes in watersheds, and the difficulty of encouraging social groups to organize around a spatial unit defined by hydrology. To address these challenges, watershed development approaches have evolved from more technocratic to a greater focus on social organization. However, it is not clear how easily the latter can be replicated widely. In addition, participatory approaches have worked better at a small scale, but hydrological relationships cover a larger scale and some projects have faced tradeoffs in choosing between the two. Optimal approaches for future watershed development are not clear, and theories arising from common property research do not support the idea that it can succeed everywhere. The best approach may be to pursue watershed development where conditions are favorable and work on other things elsewhere, including expanding organizational capacity for watershed management.

1. Introduction

Watershed development is an important component of many countries' rural development and natural resource management strategies. A watershed is an area that drains to a common point, and watershed development seeks to manage hydrological relationships within a watershed to optimize the use of natural resources for productivity, poverty alleviation, and natural resource conservation. Watersheds may contain forests, pastures, agricultural land, surface water and groundwater, all linked through hydrology, so by their nature they are an excellent setting for the study of common property.

Many watershed resources are characterized by high exclusion cost and subtractability, which are the two main attributes of common pool resources. Even where land in a watershed is held privately, collective action among all watershed users is essential for watershed management due to hydrological linkages, which do not respect property boundaries (Ravnborg and Guerrero 1999). The fact that water flows downhill – either on the surface or underground – means that natural resources decisions upstream can have strong implications for resource use opportunities downstream. Benefits accrued upstream may result in downstream costs, or costs incurred upstream may bring benefits downstream. Watersheds are complex, multiple use commons, which are characterized by the need to balance interests both within and across diverse interest groups to generate agreement on regulations about resource access, allocation and control (Steins and Edwards 1999a). This means that watershed development requires mechanisms to promote collective action and share costs and benefits. Typically laws are not specified or not enforceable in such matters and thus do not offer much help.

This paper introduces critical socioeconomic challenges to making watershed development work, traces how approaches have evolved to address these challenges, and discusses lessons from research on watersheds and theories about common property management. Most of the examples come from India but the experiences described also are found in many other countries. Before addressing these topics a brief section is devoted discussions of terminology.

1.1. Terminology

As is common in research on common pool resources and common property management, terminology is not clear when it comes to watershed management.

As widely used in discussions of natural resource management, a *watershed* is synonymous with a *catchment* and both refer to an area that drains to a common point.[1] This immediately suggests that a watershed can cover areas of any size, because small watersheds are subsections of large watersheds, and ultimately watersheds can be scaled up to entire river basins. Typically watershed refers to an operational area that is much smaller than a river basin, but beyond that one has to take care to pay attention to what is being described in any given setting. Often *microwatershed* refers to small areas about the size of a village, while *macrowatershed* refers to something much larger. A casual review of the literature found discussions of watershed management covering from two hectares (White and Runge 1994) to 30,000 hectares (World Bank 1990). In that context the term *scale* also becomes important. In the landscape ecology literature it refers to the level of the watershed in question in hierarchy of subwatersheds that are nested in larger watersheds (Swallow et al. 2001). On the other hand, when watershed agencies talk of "scaling up" their operations often they refer to replicating their microwatershed projects over many locations.

Watershed development and *watershed management* also are often used interchangeably. In this paper, watershed *development* explicitly refers to programs that involve technical interventions (planting trees, building check dams, etc.) to raise the productivity of certain resources. Watershed *management* is used to refer to management of hydrological relationships in a watershed, which may involve protecting certain resources from degradation rather than making physical investments in their productivity. Clearly these two things are not mutually exclusive and technical interventions are likely to be fruitless without subsequent management.

[1] Dictionaries define a watershed as either the area draining to a common river system or as the dividing line between two such areas. The latter definition is the source for a third definition of a watershed as a critical point in time that separates one era from another. Swallow et al. (2002) referred to a watershed as a "hump-backed area" within a catchment, which appears to mean the same thing as a dividing line between two subcatchments. In any case, in the natural resource literature watershed is overwhelmingly used synonymously with catchment so that is the practice followed here.

A more important consideration is the different objectives that watershed projects may have. In the United States, watershed management is mainly about protecting water quality. In many areas it is about flood control. In hilly, semi-arid areas of India, the focus is on water harvesting, or trapping runoff during the rainy season for later use when water is scarce. In flatter areas of India with less opportunity for water harvesting, it is more about concentrating moisture in the soil to help make rainfed agriculture more productive. In virtually all watershed projects, soil erosion control is either a specific objective or a means of achieving another objective. This list is certainly not exhaustive and obviously the focus in any given area is defined by the perceived natural resource management problem. In this paper the focus is primarily on projects that aim to harvest water and concentrate moisture, which are widespread in India but also in semi-arid areas elsewhere.

2. What Watershed Projects Aim to Achieve

Watershed projects that focus on water harvesting and soil conservation typically state three objectives: 1) conserve and strengthen the natural resource base, 2) make agriculture and other natural resource-based activities more productive, and 3) support rural livelihoods to alleviate poverty. The first objective builds the foundation for the second, which in turn supports the third.

In India, the natural resource base in question typically includes soil, water, agricultural land, pasture and forest. Surface water bodies may also support small scale fisheries. Steps to strengthen one of these resources inevitably affect both other natural resources and livelihood approaches that depend on them. Watershed projects typically begin by implementing soil and water conservation technology in the upper watershed. The resulting decline in erosion reduces the amount of silt in runoff water. Upper watersheds often are hilly, with pasture or forest land use rather than agriculture. In that case, soil conservation efforts typically involve increasing vegetative cover since bare ground is more prone to erosion. The most effective way to do this is to plant new vegetation and make the area off limits to grazing animals. Water harvesting involves building small dams to capture runoff from upper watershed areas after heavy rains. Reducing erosion lowers the silt load of runoff water, thus lengthening the life span of water harvesting structures by avoiding siltation. Water harvesting in turn benefits farms further down the slope by providing irrigation, either via surface water or by recharging groundwater that can be drawn from wells.

Projects that aim to support rainfed agriculture may focus more on soil conservation on farmers' fields. On flatter lands this typically involves placing small barriers or filters across the slope made of earth, stone, or vegetation, and using agronomic practices to reduce runoff such as planting across the slope to or using a cover crop to minimize bare soil. On steeper slopes terraces may be built to create flat surfaces for cultivation. Stone and vegetative barriers may eventually lead to creation of terraces when soil moves down the slope and builds up behind the barrier.

All of these interventions are designed to eventually raise the productivity of all natural resources in the watershed. Soil becomes more productive for agriculture, water is captured for irrigation, and pastures and forests yield more biomass. All livelihood activities that depend on these resources may be enhanced, and employment may increase as agriculture becomes more productive and more labor is needed for harvesting and other operations. One point to note is that improvements in different parts of the natural resource base come in different durations; water harvesting for example can begin almost immediately but forests and pastures take time to yield increased biomass, and they are off limits to grazing and harvesting in the initial stages while regeneration takes place.

Spectacular benefits have been documented in well-known successful watershed projects in India. In Sukhomajri in the northern state of Haryana, the entire village ecosystem and economy were transformed through protection of common lands and irrigation. The common areas became a lush, valuable forest, stall-fed buffaloes and cross-bred cows almost entirely replaced sheep, turning the village into a major seller of milk, and incomes rose sharply with all households gaining (Kerr 2002). In Ralegaon Siddhi in Maharashtra, irrigated area rose from zero to 70% through water harvesting and transformed the village economy. In nearby areas under the Indo-German Watershed Development Project (IGWDP), irrigation raised labor demand such that within four years of one project's initiation, laborers indicated that they could find eight months of employment compared to only three before the project (WOTR 1999).

3. Challenges to Successful Watershed Development

A number of challenges to watershed management make them more complicated than would be apparent from the glossy statistics from successful projects. In fact, those success stories have unrealistically raised expectations of what can be achieved widely. Many of the success stories, for example, are found in hilly, bowl-shaped microwatersheds with very favorable conditions for water harvesting (Farrington and Lobo 1997). In more typical cases, benefits are incremental and gradual, with less visible connection between investments made and benefits realized. In such cases various organizational challenges to watershed management become more apparent.

As introduced above, one of the biggest challenges to watershed development is that its costs and benefits are distributed unevenly, yet cooperation is required to make it work. The reasons for uneven impacts are not only spatial variation but also the multiple, conflicting uses of natural resources within watersheds. For example, during vegetative regeneration, uncultivated pasture and scrub forest lands in upper watersheds face tradeoffs between being off-limits to promote regeneration, and providing an immediate source of livelihood for landless people. Regeneration supports irrigation by reducing erosion and thus siltation of water harvesting structures, and irrigation mainly benefits the wealthiest community members. If the benefits are large and quickly maturing, those who lose in the short term may be willing to wait for indirect gains, and devising mechanisms to diffuse costs may be manageable. But this is more difficult in the majority of cases where benefits are gradual and incremental. In most of India vegetative regeneration takes about three years, but in drier areas it can take as much as seven years. In either case it is a very long time to ask poor people to refrain from using resources on which they rely.

These problems suggest that a key challenge for watershed projects is to create mechanisms to encourage natural resource users to account for the off-site effects of their decisions, i.e. to internalize externalities.[2] This is a typical environmental policy problem and many approaches are possible. Efforts to encourage better environmental management often are based on moral suasion, laws and regulations, property rights, financial incentives or disincentives, and conflict resolution (Kerr et al. 2006). Some specific approaches that watershed projects have taken are discussed in the next section, but the key point here is that enforceability of any given mechanism is the biggest challenge. Not only are laws often unclear with regard to watershed hydrology, but even if they were clearly specified they would be extremely difficult to enforce because watershed users are dispersed and their actions can't easily be monitored. The invisibility of many hydrological linkages makes this even more difficult.

Accordingly, there is no universal approach to internalizing watershed externalities and much of the solution comes down to local-level community organizing and negotiation to

[2] Externalities can be defined as unreimbursed costs or uncharged benefits accruing to people resulting from someone else's actions. Internalizing them means that people pay for the costs they impose on others and are compensated for the benefits they give to others.

share costs and benefits. Undoubtedly community organizing is most manageable at a small scale, but even then there are challenges. The most important is that property and administrative boundaries do not match hydrological boundaries. A watershed may be an attractive hydrological unit but it does not lend itself very well to human organization (Rhoades 2000, Swallow et al. 2001). For example, a given watershed may contain parts of multiple human settlements (with their separate administrative arrangements), and each of those settlements may lie partly in other watersheds. Under these circumstances the logical organizational unit is not clear.

Another problem is the coexistence of multiple, overlapping formal and customary tenure regimes for a given natural resource. In many countries, for example, land tenure rights change between seasons. In the rainy season when crops are in the ground, individual rights may be very strong and others must keep out. After the harvest, the lands may be open to grazing by mobile herders.[3] Similarly, water rights are different for water on the surface and underground. In India, for example, water in an irrigation tank is jointly owned by the community of people who receive surface irrigation from it. As water seeps into the ground it becomes open to extraction by anyone who owns a well, and once pumped it becomes private property. Changes in technology have muddied once-clear delineations.

A problem hinted at by the previous examples is that gradual changes in local and regional economies can destabilize traditional systems for collective action (Baland and Platteau 1996). As economies diversify, people become more mobile and their economic interests spread beyond the confines of a local community, either by selling their products to nearby markets, working in a nearby town, or migrating seasonally. These economic changes can bring an influx of much-needed funds for investment (Clay et al. 1997), but they can raise challenges for collective action systems for two reasons. First, people may not be physically

[3] In India the spread of well irrigation has created challenges to this system since grazing animals must stay away from crops in the field, and seasonal changes no longer clearly delineate when crops are present or not.

present for management systems that require face-to-face interaction and negotiation, and second, people may have a decreasing economic stake in such systems and thus may simply lose interest in contributing to them (personal communication with various Indian project managers over the years).

On top of all these socioeconomic challenges to successful watershed development, recent literature has stressed various problems related to inaccurate understanding of technical relationships. One topic that has gained substantial recent attention is the faulty assumptions about the role of trees in watershed hydrology. All over India and elsewhere, trees are planted in watershed projects with the stated objective of promoting groundwater recharge. A motto of the Tamil Nadu Forest Department is “Save Trees to Save Water.” Recent literature points out, however, that most trees have precisely the opposite function because they are net consumers of water (Calder 2002). Similarly, literature on soil erosion has long based landscape-wide erosion estimates on extrapolating upward from experimental erosion plots, as if every hectare of land in a watershed suffered the same rate of erosion and all eroding soil disappeared entirely from the watershed. However, more recent evidence shows that the presence of filters in the landscape means that most eroding soil simply moves from one part of a watershed to another (e.g. Swallow et al. 2001, Verbist et al. 2005). Some farmers actually benefit from soil erosion through silt deposition on their land and even actively encourage soil erosions to move to where it can be put to more productive use (Chambers 1990).

Faulty understanding of forest hydrology has led to some spectacular failures in watershed management, sometimes with very harsh implications for local people. For example, in the mid-1990s in the Sumberjaya watershed in southern Sumatra, Indonesia, the government evicted hundreds (thousands?) of coffee farmers who had encroached on state forest lands (Verbist et al. 2005). This action was motivated by plans to build a hydroelectric dam on the river at the bottom of the watershed. Recent research by ICRAF, however, shows that mature coffee farms cause very little erosion (Verbist et al. 2005), and draws much less water than natural forests, leaving higher water volumes for the hydroelectric dam. Additional ICRAF research from Sumberjaya shows that even the relatively small amount of soil that does erode from coffee farms has little effect on silt in the river because it is intercepted by various filters in the landscape.

In India, recent research on hydrology suggests that watershed projects may be exacerbating precisely the water shortages they are intended to help overcome. At the macrowatershed level (covering many villages as opposed to a single village microwatershed), Batchelor et al. (2003) document cases where water harvesting in upper watershed areas has reduced water availability downstream. Calder (2006) refers to the problem of 'catchment closure,' in which water harvesting upstream concentrates groundwater locally and then intensive pumping dries out the shallow aquifer. In this case watershed development prevents both surface runoff and groundwater from moving naturally from upstream areas to downstream areas. In effect, this suggests two perverse outcomes of watershed projects: first, that what is good for one small watershed can be bad for other small watershed lying downstream, and second, what is good for a watershed in the short term can be bad in the long term.[4]

4. How Watershed Projects Have Evolved to Address these Challenges

Watershed project designs have changed over the years in response to lessons learned about the problems described in the previous section. In India, early large-scale projects in the 1980s were purely technocratic as it was assumed that the benefits of watershed

[4]This problem can arise in India in part due to the complete absence of measures to manage groundwater demand. Electricity to run pumps to draw groundwater is free in some states and subject to a low, flat fee in others. As a result, pump owners can draw as much water as they like without any impact on their costs. In addition, as mentioned above there are no property rights restricting access to pumped water (Singh 1992). Whoever pumps it first owns it and this further encourages overpumping.

development were self-evident and uncontroversial. The World Bank-supported Pilot Project on Watershed Development covered 30,000-hectare watersheds in four states and paid relatively little attention to issues of social organization. A set of 47 small model microwatersheds around the country established by the Indian Council of Agricultural Research followed a similar approach.

The previous section listed numerous problems that watersheds needed to address: sharing benefits and internalizing externalities, coping with the long time horizon over which incremental benefits could be realized, the mismatch of hydrological and human boundaries, the unclear tenure rights over many natural resources, the diverse economic interests among watershed inhabitants, and faulty understanding of natural resource processes. After watershed projects in the 1980s encountered such problems, several new project approaches emerged to address them.

In particular, various NGOs were embarking on watershed development focusing much more on social organization and less on technology. From their perspective, watershed technology was fairly straightforward and the real challenge was to organize communities to work collectively for successful watershed development. The apparent success of some of these small projects run by NGOs such as MYRADA, Social Centre, and the Aga Khan Rural Support Programme in the late 1980s and early 1990s (Hinchcliffe et al. 1999, Farrington and Lobo 1997) coincided with the Elinor Ostrom's publication of *Governing the Commons* in 1990 and the planning of the new World Bank-supported Integrated Watershed Development Project (IWDP). Project experts who reviewed the earlier World Bank project and helped plan the new one had obviously read Ostrom's work and were familiar with her design principles of long-lived common property resource management systems.

Despite Ostrom's point that the design principles should not be taken as a blueprint, the IWDP appears to have been one of the first efforts to actually do so. Large watersheds under the IWDP were broken down into smaller subwatersheds with more distinguishable boundaries; user committees were established to represent different interest groups in the watersheds and were given certain powers to make rules; systems of graduated sanctions were established based on traditional institutions; monitoring systems were established; etc. The new institutions were not established on a very solid footing, however, and among the challenges were that committees sometimes existed in name only, monitoring systems were propped up by project funds, and people agreed to things apparently just to gain project funds (Kerr and Pender 1996). Of course these are typical problems facing heavily funded development projects. One problem that was corrected in the mid-course of the IWDP was to modify the unit of implementation from microwatersheds a hybrid of microwatersheds and villages. Watershed committees were drawn from each village rather than from throughout a microwatershed, since it was not feasible to organize people around watershed boundaries (personal communication with project officials in 1994).

The steps taken to improve the project were not sufficient to generate successful collective action under the project. One project component aimed to strengthen traditional institutions for managing common pastures, but it only worked in about five percent of project villages according to project officials. When asked his views on what characterized the small percentage of project villages that were able to develop successful CPR management institutions as envisioned, he said, “I think it worked in the places where it would have worked anyway.”

Meanwhile various other projects continued to develop new approaches. In 1994 the Ministry of Rural Development developed new guidelines to radically redesign its watershed projects (Government of India 1994). These projects became the centerpiece of the government’s rural development efforts in semi-arid, unirrigated areas of India. Among the new features of the 1994 Guidelines was a move to village-based watershed planning, with the new unit of implementation being a sub-village microwatershed. More decision-making power was given to local users and more emphasis was given to indigenous technologies and management systems.

Many projects around the world have designed and implemented approaches to organize watershed communities to overcome the various problems described above. Among them are the following:

CIAT, Colombia: in the mid-1990s, CIAT (the International Center for Tropical Agriculture) initiated watershed work in El Cabuyal, a small watershed area, with a focus on organizing communities, collectively learning about biophysical watershed linkages, developing technical interventions, and facilitating negotiations to develop land management plans (Ravnborg and Guerrero 1999). The watershed covered about 7000 hectares with a population of about 1100 people scattered in 23 villages. There was not much tradition of democratic governance and little scope for people to voice their concerns. Based on previous experience and the literature on collective action, the CIAT team chose to work with small groups of 30-40 families covering about 200 ha subwatersheds[5] to address natural resource management problems requiring collective action. Through a long process, the subwatershed groups gradually developed platforms, or forums in which diverse stakeholders jointly analyze and negotiate diverse interests and develop action plans to solve natural resource management problems. In CIAT's experience, such platforms required the active representation of every interest group and the presence of a third party facilitator (in this case CIAT) to foster negotiation and protect everyone's interests.

[5]200 hectares would be a subwatershed of a microwatershed by Indian standards. It is very small.

MYRADA, India: The Indian NGO MYRADA's experience is quite similar to that of CIAT. Working since the late 1980s, MYRADA aimed to deal explicitly with the fact that village-level microwatersheds contained different interest groups with conflicting ideas about how to use natural resource management (Fernandez 1999). Given heterogeneous communities and the lack of organizational capacity in the southern Indian areas where MYRADA worked, it took the approach of building the capacity of separate interest groups within the watershed – low caste people, women, landless, farmers with irrigation, etc. To help these groups build organizational skills, MYRADA first helped them build savings and credit groups, which addressed people's high priority financial needs while also helping them become numerate and develop much needed organizational skills. Only after the separate groups built skills and gained confidence, MYRADA introduced watershed development and brought the different groups together to discuss possible approaches that could meet everyone's interests. MYRADA's role as facilitator remained essential.

An interesting aspect of MYRADA's approach was to avoid working in areas with very many landless people, since it was very difficult to reconcile landless peoples' interests with the need to make uncultivated areas off-limits to help them regenerate (Fernandez 1994).

The Indo-German Watershed Development Programme (IGWDP), India: IGWDP aimed explicitly to replicate the successful community watershed approach of the NGO Social Centre in Maharashtra, western India (Farrington and Lobo 1997). Among IGWDP's innovations were that its projects were village-based; they included an 18-month community organizing period prior to making any watershed investments; they operated only in communities that could demonstrate the capacity for collective action around natural resources, and they worked only in villages with topography favorable for water harvesting. Villagers also had to promise to refrain from planting water intensive crops like sugarcane, which become much more attractive with successful watershed development but can allow benefits to be captured by a small minority of well-off farmers. These approaches were based on the clear recognition of conditions that had facilitated successful watershed development in Social Centre's earlier work.

Latin American payment for environmental services approaches: In recognition of the need to create incentives to provide off-site benefits and the failure of approaches relying on laws or threats, many Latin American programs offer payments to landowners for managing their land in a way that protects water quality downstream. The most famous example is Costa Rica's Payment for Environmental Services Program, which offers payment not only for watershed protection but carbon sequestration and biodiversity protection (Zbinden and Lee 2005). Echevarria (2004) describes cases in Ecuador in which small municipalities pay upstream landowners to protect upper watersheds. In many of these cases, population is extremely sparse and this reduces the number of people who are party to the agreement, increasing the payment per person (if not per hectare) and lowering transaction costs.

United States watershed programs: In the U.S., watershed management focuses primarily on reducing nonpoint pollution that drains in streams and rivers, damaging the water quality downstream. In many places the stimulus for watershed development is to protect water sources used for recreation or as fish habitat. The Federal government, through the Environmental Protection Agency and the US Forest Service, makes grants to cross-jurisdictional watershed committee groups that focus on spreading awareness and mobilizing community groups to promote reduction of polluting activities. An evaluation by Doppelt et al. (2002) of the USFS program found very similar challenges to those facing watershed projects in developing countries. For example, Forest Service employees often were not accustomed to working in community-based partnerships in which the main challenges were socioeconomic rather than technical. Working across jurisdictional boundaries was a major challenge, and success of individual projects correlated closely to local civic capacity. The evaluation recommended focusing the watershed projects in areas where such capacity is high while investing in such capacity elsewhere.

These cases are not intended to represent all watershed projects worldwide, but they do reflect commonly cited cases of successful approaches. They share a number of common themes and reflect the trend of moving from a technocratic approach to a more participatory one, moving from large to small, from organizing around watersheds to communities, and in the evolution of thinking about how to share net benefits.

While these projects and many others have adapted to the challenges of managing watersheds, the shortcoming they all face is that their scope and coverage is limited as a result of their adaptation. Two kinds of problem emerge. First, projects with high investment in an effective social design may not be replicable beyond a few cases. Second, moving back toward a workable social unit (a village-based microwatershed rather than a large macrowatershed that crosses administrative boundaries) may trade one set of problems for another.

Regarding the first of these problems, there is little or no evidence that very successful projects have replicated beyond a handful of villages. Even those that have expanded their operations successfully reveal the major limitations. For example, the IGWDP undertook a systematic approach to scaling up (replication) and its successful village level projects number in the hundreds, but the area in which it works contains tens of thousands of villages. The IGWDP’s deliberate approach has yielded strong performance, in sharp contrast to government projects that operate in thousands of villages (Kerr 2002).

Regarding the second problem, hydrologic relationships in watersheds certainly do not respect administrative boundaries, and they operate independently of whether or not a community has high social capital and administrative capacity. The big question concerns the severity of tradeoffs that arise when watershed projects move away optimal biophysical unit of operation, and when they move from large macrowatersheds to small microwatersheds, to overcome socioeconomic constraints. The problem of catchment closure described above shows that these tradeoffs potentially can be quite large.

These concerns raise questions about what really can be expected of watershed development as a strategy for transforming the natural resource base and rural livelihoods. Rhoades (1999) raised this question regarding participatory watershed approaches and discussed many of the challenges listed here. He suggested the need for more empirical analysis of whether participatory approaches can really be scaled up, and he argued that project workers need better science, better methods, and better organizational skills along with donor money and patience. To date, there have been more evaluations (e.g. Kerr 2002, add others) but most of the participatory approaches still operate on a tiny scale, both in terms of geographic coverage and number of project. Most literature on them still covers the small success stories (e.g. Hinchcliffe et al. 1999). Some projects listed above certainly have aimed for the improved approach that Rhoades recommended, but it is not clear how widely his suggestions have been heeded or how widely they could be applied.

5. Lessons from Common Property Theories

Can watershed management be effective as a means to achieve the triple objectives of improved natural resource management, higher agricultural productivity, and poverty alleviation? We know that this is certainly so in some cases, but can it succeed widely?

Theories about common property resource management can help provide insights into this question.

5.1 Design principles and enabling conditions for successful commons management

There is a long line of literature in common property resource management on conditions that encourage successful management of the commons. In the late 1980s Ostrom (1990) and Wade (1988) offered sets of favorable conditions, and Baland and Platteau (1996) updated them. Agrawal (2001) synthesized and revised these factors and his updated set of enabling conditions is presented in Table 1. The list of conditions combines characteristics of the resource, the group, the relationship between the resource and group characteristics, institutional arrangements, and the external environment.

A cursory look at table 1 is enough to see that watersheds do not fit the list very well, and it provides many clues about why a project might find it attractive to work in a village-based microwatershed than a macrowatershed that spans a much larger area. To begin with resource characteristics, Agrawal lists five favorable attributes: small size, well-defined boundaries, low levels of mobility, possible storage of benefits, and predictability. All of these characteristics point to the advantages of working in microwatersheds rather than macrowatersheds. Mobility, storage and predictability all present problems in watersheds regardless of the scale but they are mitigated somewhat in smaller projects.

Characteristics of the group that Agrawal cites are small size, clearly defined boundaries, shared norms, past successful experiences, appropriate leadership, interdependence among group members, heterogeneity of endowments but homogeneity of interests, and low levels of poverty. All of these attributes except poverty levels point to the advantages of working in a subvillage microwatershed. Poverty is not necessarily relevant to questions of scale, but it does support MYRADA's approach of not working in areas with large groups of landless people (Fernandez 1994). The question of shared norms and interdependence among users may cause large problems for watershed users. Dependence really flows in one direction in watersheds in the sense that upstream resource use influences downstream opportunity. However, watershed resources have multiple, conflicting uses and there are clearly not shared norms about how to use them.

Agrawal's next set of conditions are the relationship between the characteristics of the resource system and those of the users, including overlap in location of the users and the resource, high level of dependence by users on the resource, fairness in allocation of resource benefits, low levels of user demand, and gradual as opposed to rapid change in resource demand. Again watersheds face problems with these characteristics, especially the overlap in location between the resource and the users. The fact that upstream uses determine downstream outcomes sharply undermines this condition, although less so in smaller microwatersheds where at least the relationship between upstream and downstream may be perceptible and the inhabitants may know each other. Fairness in allocation of resource benefits is clearly on a case-by-case basis, and many of the success stories described above aimed to achieve that. In very large scale watersheds with limited communication among inhabitants this may be very difficult to achieve and payment for environmental services is in part a way to address this problem. High levels of dependence but low levels of demand appear as though they would be in conflict in most cases and Agrawal (2001) does not explain the apparent contradiction.[6] Even so, one way to interpret this that helps explain the problems of watershed management is that in watersheds, protection of upstream vegetation prevents siltation of water harvesting ponds and thus increases water resource access below the water harvesting structure. If there is low demand for upstream vegetation and high dependence on water the watershed management system will be easier to manage. This again

[6]I need to ask him about this.

supports MYRADA's approach of trying to avoid working in places with large numbers of landless people with high demand for biomass from the common lands in upper watershed areas.

Agrawal's enabling institutional arrangements include simple rules, locally devised access and management rules, ease of enforcing rules, graduated sanctions, availability of low-cost adjudication, and accountability of monitors and other officials to users. These conditions yet again show the advantages of working in small rather than large watersheds, because rules can be neither simple, enforceable, locally devised or easily adjudicated if they cover multiple villages that have poor communication with each other. Accountability of monitors is always a problem, especially where the resources have multiple, conflicting user. Monitors may be more easily accountable to one group of users than another, for example.

Agrawal combines characteristics of the resource, the group and the institutions with following enabling condition: matching restrictions on harvest to regenerative capacity of the resource. This calls to mind Calder's observation of catchment closure, whereby trapping water resources upstream and pumping it heavily prevents its regeneration in downstream areas. The challenge here is that where the microwatershed is the management unit, what makes sense locally may not make sense at a larger scale.

The final set of enabling conditions that Agrawal presents concern the external environment: characteristics of technology, access to market, supportive government, and others. There are many examples of all of these factors both favorable and detrimental to successful watershed management and they will not be discussed here, apart from the clear point that governance of watersheds is very difficult.[7]

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[7] Ostrom (1999) outlines a similar list of enabling conditions focusing specifically on the emergence of self-organization to manage common resources as opposed to sustainability of existing management arrangements. They include attributes of the resource (feasibility of improvement, easy indicators of resource conditions, predictability of resource availability and conditions, and small size with well-defined boundaries). They also include characteristics of the group: dependence on the resource, a common understanding of the resource and effects of how it is managed, a low discount rate, an interest in management by those who are economically and

The Common Property Resource Digest (2000) devoted an issue to discussions of Ostrom's design principles as a part of CPR theory. Most of the comments were critical and pointed to the limitations of the approach. Ravnborg (2000) commented that had she paid attention to the design principles she never would have undertaken the work in El Cabuyal watershed described above, because watersheds did not meet the design principles. This would have meant one less success story that papers such as this one could cite. On the other hand, Ravnborg's success story may simply be one more exception that proves the rule, because it operated on a very small scale with intensive external assistance that cannot be replicated widely.

5.2. Platforms for managing the commons

As mentioned above, 'platforms' for resource use analysis and negotiation have been discussed in the literature as a means to promote collective action on the commons. Steins and Edwards (1999a, 1999b) drew on this idea in an effort to move away from theoretical discussions about people's propensity to work collectively and toward discussions of approaches to help them do so. In this context they examined the use of such platforms for the management of complex, multiple-use common pool resources such as watersheds. They edited a special journal issue to examine the role of platforms for several multiple use common pool resources and concluded that platforms have great potential to help manage complex common pool resources. They listed several factors that help such platforms work and Table 2 cites them verbatim. These enabling conditions are quite complex and subtle, and it is easy to imagine difficulty in making them work widely. One important facilitating factor in Table 2 is the presence of a third party facilitator to smooth negotiation processes

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politically powerful, trust among users, autonomy for management with respect to outside authorities, and prior organizational experience. These factors overlap to a degree with Agrawal's list and do not affect the implications for watershed management discussed above.

and protect the interests of the weak. This was particularly stressed by Ravnborg and Guerrero (1999) in their study of the role of platforms in watershed management. This appears to further reinforce the argument that successful watershed management needs to take place at small scales where such facilitation is actually feasible.

5.3. Is replication a realistic goal?

Replicating widely or 'scaling up' success stories seems to be the Holy Grail for the management of all kinds of human experiments and certainly for common pool resource management. This makes sense given the objective of widespread social change. There are several reasons, however, why scaling up may be an unrealistic goal more often than not. Manski (1995) helps clarify why this is so in his examination of "the conditional predictions that can and cannot be made given specified assumptions and empirical evidence." Although his book focuses on social science research and the challenges of drawing conclusions based on limited data, many of his lessons are applicable to practitioners. For example, the conditions of an experimental project site or a pilot project are not likely to be replicated exactly in other sites. In watersheds, differences in physical, economic and social factors are inevitable and may lead to changes in program outcomes. Small variations in one factor or another may only bring small changes, but small variations in several factors may bring large changes, especially given the complexity of how such factors may be related.

Second, a pilot project is likely to be carried out differently than the scaled up version that follows, even if the design is identical. For example, a small pilot project may not affect the market wage or strain the supply of competent program administrators, which would influence the program's effectiveness. The CIAT program in Columbia is a good example: it worked beautifully thanks to the active participation of CIAT researchers who can contribute in a very small number of places (Ravnborg and Guerrero 1999). Rhoades (1999) mentions the problems that arise when participatory methods are implemented poorly, with emphasis on the method rather than the process. Such an outcome is almost inevitable when participatory methods are institutionalized in large government programs.

Similar problems can arise with project outputs. For example, a project that teaches local people to make and sell crafts can only do so in a limited number of places before the market for the crafts becomes saturated and prices fall. Analogous problems can be imagined for watershed projects.

While Manski's insights are particularly relevant where the issue is replicating project successes beyond a small number of locations, similar problems arise where the aim is to scale up from a microwatershed intervention to a macrowatershed intervention. As Swallow et al. (2001) point out, the appropriate intervention varies with different scales: secrure land tenure helps an individual farmer take better care of an individual plot, community-based collective action will help address problems at the small-scale microwatershed, and larger types of comanagement arrangements might be needed at larger watershed scales. The problems are not the same and neither are the solutions.

6. What can be done?

The discussion so far raises various possibilities regarding what to do about watershed development and this section discusses some options. The best approach certainly depends on the situation and objectives. Some possible approaches are: 1) stay small and give up on complex, large scale watershed management; 2) try to simplify the watershed management approach at the higher scale and aim for a less ambitious outcome, and 3) build capacity for larger scale watershed management through improved institutional mechanisms and improved technologies.

6.1. Give up scaling attempts and accept a smaller impact

Several examples from section 4 – CIAT, MYRADA, and IGWDP – operated complex programs heavy on social organization, and all of them suggested that building organizational capacity at the local level is critical for making watershed management succeed. In MYRADA's experience, not only were watershed management investments without prior capacity-building wasteful, but an initial investment in capacity building led to a wide assortment of other economic opportunities that people could pursue (Fernandez 1994). The US Forest Service program was less complex but made the same point about the need to build organizational capacity.

The IGWDP approach is based on an understanding of the limited potential for replication, so it seeks to work only where it perceives a high probability of success. It is important to recognize that narrowing the pool of priority areas for watershed development in no way discriminates against those villages deemed poor candidates for a watershed project. For one thing, being bypassed by a project that would not work anyway is no great loss, and for another, rural areas of developing countries have many other needs aside from watershed development. For example, Table 3 shows the development priorities expressed by respondents in a survey in Andhra Pradesh and Maharashtra states in India. Clearly there are many other ways besides watershed development to invest development funds. In an era of decentralization it seems logical that people should also be able to choose between watershed and other investments like infrastructure and government services.

The drawback of the IGWDP approach is that without certain precautions, negative effects could occur in downstream areas as discussed above (Calder 2006).

6.2. Make larger scale projects more manageable by simplifying them

Part of the reason watershed projects are so complex is because they involve many activities intended to compensate for undesirable effects of other activities. In India, for example, various income-generating activities are incorporated into watershed projects to assist landless people who lose access to uncultivated lands while they are regenerating. Revegetation of uncultivated land in turn has the immediate purpose of newly constructed water harvesting structures from siltation (while also being desirable for other reasons). Projects with less complex objectives, like protecting waterways against siltation or pollution (although certainly complicated in their own right) may be able to simplify. As discussed above, erosion in a watershed is subject to natural filters in the landscape, so much of the eroded soil simply moves from one place to another without entering a waterway (Swallow et al. 2001, Verbist et al. 2005). In that case a watershed project can focus its erosion control efforts close to a waterway and eliminate much of its other work.

Whether or not simplification is really an option is an empirical question that will vary by case. But given the immense challenges of complex participatory watershed projects the idea is attractive.

6.3. Build capacity for operating at macrowatershed scales

Building capacity for operating at higher scales involves several possible components. One component is simply continuing to build organizational, administrative, and governance skills at local levels as mentioned above. A second, related component is to build new institutional mechanisms for interaction among disparate groups within large watersheds. In a sense this would involve developing something like the 'platforms' approach at a macrowatershed scale. It could involve specific mechanisms to assist in the interaction such as new legislation or new arrangements for sharing costs and benefits of upstream-downstream watershed relationships. Some market-based approaches may be possible and this is discussed below. A third component would be improved technology to facilitate better understanding and tracking of upstream-downstream relationships and that is also discussed.

Strengthening organizational, administrative, and governance skills: When reading about MYRADA's approach to watershed development it is striking how little of it seems to be about watersheds. MYRADA's conviction that watershed development cannot succeed without a strong investment in organizational and administrative capacity is the reason for this (Fernandez 1994). Organizational and administrative skills are needed to bring together stakeholders with conflicting interests, design workable compromises, and put them to work. Better governance may help in enforcing whatever agreements can be developed.

Improved institutional mechanisms for watershed management: Experience shows that microwatersheds are easier to manage than macrowatersheds, but that ignoring linkages among microwatersheds can create severe management problems. A logical solution would be to focus simultaneously on developing better approaches to manage microwatersheds while also building institutional linkages between microwatersheds. In other words, whereas the early watershed projects tried and failed to start at the very large scale and work down, the alternative would take the opposite approach.

It is not clear how this will be done, but the SCALES project under the CGIAR's Water and Food Challenge Program offers one approach. In Kenya's Nyando River Basin, SCALES includes both efforts to promote intravillage collective action around water management and intervillage, basin level interaction for improved management at this larger scale. As described by Brent Swallow (personal communication December 2004), the latter involves a basin-level 'conversation' among stakeholders.

> The idea is roughly as follows. First, stakeholders throughout the basin are identified and assessed viz their power, knowledge, linkages etc. Second, imbalances in power and knowledge are evened out through engagement with relatively weak stakeholders…who are systematically excluded from decision-making processes. These weak stakeholders are assisted to "ask the right questions" of other stakeholders and power brokers in the system… Third, various stakeholders are brought together in a "conversation." Outcomes from the conversations include commitments on all sides to address key problems.

It is too soon to know how this approach will play out, but clearly this effort represents an effort to overcome many of the problems described in this paper. The third party facilitation apparently critical to the platform approach may be easier to carry out and replicate once at a basin scale rather than many times, once for each microwatershed within the basin.

Payment for environmental services (PES) is another new institutional approach for watershed management that appears to be an improvement in at least some respects in some places. The key point of PES approaches is that they reward upstream land users for managing their natural resources in ways that benefit people downstream, rather than trying to punish them for natural resource management approaches that cause downstream problems. This creates incentives to comply rather than to shirk. It can create goodwill between program officials and watershed inhabitants, and unlike the complex layers of project approaches in some programs as mentioned above, PES is very direct and simple (Pagiola 2006). It is more simple in principle than in practice, however, because operating PES requires being able to identify those who provide the service and verify that they are providing it, and then provide payment as compensation. These things can be difficult and expensive, especially with small holders.

One interesting question regarding PES is whether it has advantages when operating at a larger scale. Rose (2001) suggests that tradable environmental permits, another form of market-based mechanism for natural resource management, has advantages in operating at higher scales compared to common property approaches. Does this also hold for PES? The simplicity and directness of the approach suggests that it could be more feasible at higher scales than other approaches, but the operational challenges make this uncertain. Experience to date suggests that PES systems have a difficult time reaching small holders compared to large properties (e.g. Zbinden and Lee 2005), but how much that affects their effectiveness is not known very well yet.

Improved technology: The idea discussed above of simplifying watershed management by focusing on priority locations and ignoring others would be much more feasible with better technologies for rapidly and cheaply identifying such locations. New technology can also play a role in developing better mechanisms to manage upstream-downstream watershed relationships. As discussed, among the things that make watershed management difficult are the invisibility of the hydrological relationships and the difficulty in tracing the impacts of natural resource use in one location on another. Technologies that could overcome such challenges would open many new possibilities for developing indicators and monitoring systems, which can greatly facilitate better management systems (Johnson et al. 2001). Although such technologies may seem like a fantasy, it is worth considering that remote sensing and GIS have revolutionized research on land use and land cover change, laying the groundwork for various complex institutional arrangements under development such as global markets for carbon sequestration.

On a less futuristic level, some new technologies already exist to facilitate the management of upstream-downstream watershed relationships. Calder (2006) shows how

EXCLAIM, a simulation model with a visual interface, can model hydrological relationships and demonstrate visually the linkages between upstream decisions and downstream opportunities and the effects of management changes. Using this tool makes it possible to anticipate the outcomes of different management changes under different scenarios of land use and climate and this can be used to facilitate land use negotiations. Of course such technology cannot replace such negotiation, only support it.

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Table 1. Agrawal's list of critical enabling factors for sustainability on the commons

1. Resource system characteristics
a. Small size
b. Well-designed boundaries
c. Low levels of mobility
d. Possibilities of storage of benefits from the resource
e. Predictability

2. Group characteristics
a. Small size
b. Clearly defined boundaries
c. Shared norms
d. Past successful experiences - social capital
e. Appropriate leadership - young, familiar with changing external environments, connected to local traditional elite
f. Interdependence among group members
g. Heterogeneity of endowments, homogeneity of identities and interests
h. Low levels of poverty

1. and 2. Relationship between resource system characteristics and group characteristics
a. Overlap between user group residential location and resource location
b. High levels of dependence by group members on resource system
c. Fairness in allocation of benefits from common resources
d. Low levels of user demand
e. Gradual change in levels of demand

3. Institutional arrangements
a. Rules are simple and easy to understand
b. Locally devised access and management rules
c. Ease in enforcement of rules
d. Graduated sanctions
e. Availability of low cost adjudication
f. Accountability of monitors and other officials to users

1. and 3. Relationship between resource system and institutional arrangements
a. Match restrictions on harvests to regeneration of resources

4. External environment
b. Technology:
- Low cost exclusion technology
- Time for adaptation to new technologies related to the commons

b. Low levels of articulation with external markets
c. Gradual change in articulation with external markets
d. State:
- Central governments should not undermine local authority
- Supportive external sanctioning institutions
- Appropriate levels of external aid to compensate local users for conservation activities
- Nested levels of appropriation, provision, enforcement, governance

Source: Agrawal (2001)

Table 2. Factors associated with effectiveness of nested platforms in governing complex common pool resources[1]

1. It is important that nested platforms[2] correspond with the resource system level that is at stake – in ecological, economic, and social terms – and that they are stakeholder-based, rather than user-based.[3]
2. "Back up" by small-scale local platforms can facilitate decision-making and effective representation in larger-scale nested platforms for collective CPR management.
3. The empowerment of platform participants to elicit their views is important to challenge inequalities (in terms of gender, ethnicity, education, and skills) and dominant power relations, and to create a situation in which communication is as open (and voluntary) as possible.
4. Stakeholders' priorities, as well as the resource system, are dynamic and are constantly being reshaped. Consequently, nested platforms are subject to the same dynamics.
5. In collective CPR management, social learning about the ecosystem at stake and the different stakeholders' views and actions is vital to agree on action strategies and to break down existing power structures that may hinder collective actions.
6. Platforms for resource use negotiation are always nested within other decision-making structures. The latter influence the role of the nested platform and create the context within which new platforms for solving certain resource management problem are necessary or redundant.
7. A too strong reliance on the formation of nested platforms as the solution to complex resource management problem may overshoot the mark; sometimes it can be more effective to let platforms evolve from smaller-scale initiatives to tackle the perceived problem.
8. There is good reason to believe that the presence of a third party is beneficial to the performance of nested platforms.

[1]Source: Steins and Edwards (1999b). These factors are quoted verbatim from the original.
[2]"Nested platforms" refers to the fact that decision-making processes take place at multiple levels, including the legislative level that sets the legal framework, the collective choice level whereby broad rules are made that govern interactions among different organizations, and the operational level where specific rules are made regarding day-to-day decisions (Steins and Edwards 1999a).
[3]Stakeholders are broader than users; they include all those who affect and are affected by the resource system.

Table 3: Priorities for developing the village: percentage of respondents cited by[1]

Priority	Maharashtra	Andhra Pradesh
Improved medical facilities	38	64
Roads	37	37
Latrines	10	37
Drinking water	35	15
Irrigation	22	25
Improved bus service	8	26
Better electricity	10	20
Better educational facilities	18	9
Improved housing	4	17
Credit/bank	3	7
Watershed development	9	1
Veterinary service	8	2

Source: Kerr (2002)

[1]Respondents listed multiple priorities. Other priorities (listed in descending order of frequency): employment, dairy or milk collection center, telephone service, including STD, community hall and equipment for it, government shop, ban on alcohol, vocational training, land for landless, fruit trees, horticulture, tree plantation, improved seeds and fertilizer, ban on dowry, community tractor, grain storage facility, weekly market, petrol pump, post office. Large landholders are more interested in irrigation, watershed works and credit; landless are more interested in housing, electricity and latrines. No patterns were observed across project categories.