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Participatory Natural Resource Management in Watersheds: Concepts, Issues and Challenges for Research

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Abstract: This paper describes a "new watershed approach" characterized by an ecosystems perspective; collaborative and multi-stakeholder decision process; and multi-scale action and analysis. The approach evolved in response to the failures of many past top-down watershed programs based on physical planning for water management. It also reflects changes in the nature of watershed management initiatives and new thinking in the broader field of "watershedology" towards more integrated and multidisciplinary analysis of natural resources. Participatory watershed management is closely related to broader changes in the political economy of natural resource management, as reflected in a growing trend towards devolution or decentralization of authority and responsibility. While there is a growing body of case study evidence to support the effectiveness of new participatory approaches, challenges remain to demonstrate impact and to identify generalizable lessons for watershed organizations. Researchers together with other stakeholders, can contribute to better participatory management by developing better methods and tools for stakeholder identification, organization and facilitation; for participatory research and innovation at the landscape scale; and for assessing impact and scaling up.

Key words: Participatory watershed management, participatory research, stakeholder analysis, scaling up.

Over 40% of the world's population lives in river basins classified as being water-stressed; an estimated 50% of freshwater wetlands have disappeared during the 20th centrury, and pollution and overexploitation have contributed to a 20% loss in freshwater fish species (Wood *et al.*, 2000; Revenga *et al.*, 2000). Forty-two of the world's river basins have lost more than 75% of their forest cover; 15 of these are depleted by over 95% (Revenga *et al.*, 1998). In South and South-east Asia, water erosion accounts for the vast majority of soil degradation (Wood *et al.*, 2000). The Indian sub-continent barely receives more than 2000 m^3 of water per inhabitant per year, the level defined as being water-scarce (FAO, 2002). As systems of dynamic flows, watersheds are particularly capable of widely spreading human- and nature-induced impacts, affecting a large number of humans, animals and plants, though the complexity of watershed dynamics makes causes of degradation especially difficult to trace. Although not all degradation can be attributed to land use practices (Nagle, 2001), agriculture and agriculture-related activities are acknowledged to be primary contributors (Ravenga *et al.*, 2000; Wood *et al.*, 2000).

A growing realization of the magnitude and the distribution of the costs of poor watershed management has contributed to the emergence of participatory natural resource management (PNRM). Increasingly, researchers and practitioners in development are becoming aware of the changes that are possible when outsiders stop deciding unilaterally what is best for the poor and the environment, and allow those who are poor and have a fundamental stake in resource availability to have a voice in defining the problems and needs, as well as taking part in designing solutions. Because watershed communities typically depend on natural resources for their livelihoods, their interest in conserving them can be substantial. Local people also tend to have intimate knowledge of their environment and the dynamics of environmental flows that outsiders lack. So what options are there for capitalizing on community knowledge and incentives for resource protection in the quest for poverty reduction and sustainable watershed systems?

This paper begins to answer that question by assessing the conceptual and empirical evidence on participatory NRM in general and participatory management of watersheds in particular. Section 2 of the paper briefly chronicles the evolution in thinking about watershed management and the emergence of what some are calling "new watershed initiatives" (Born and Genshaw, 2001), one of the main features of which are participatory, multiple stakeholder decision-making processes. Section 3 presents a conceptual framework for understanding users' incentives for participating in different types of natural resource management, and discusses its implications for watersheds. Section 4 discusses six challenges to participatory watershed management where research could make a contribution to better policies, tools and methods. Section 5 summarizes and concludes.

Evolution in Approaches to Watershed Management

Watershed management generally refers to the management of both upland hump-backed "watersheds" and the downstream bowl-shaped "catchments" through which water drains towards a common outlet (Swallow *et al.*, 2001). Since watersheds are defined by water flow, they are a logical unit of analysis for water management. Early watershed management programs in Europe and the USA focused on water management and on direct land-water interactions such as erosion control (Sheng, 2001). Since the watershed was the integrating unit, centralized management of soil and water at the watershed level was expected to lead to optimal resource use. Policies and practices that emerged from watershed-level analysis by hydrologists, geologists and other physical scientists were recommended, often with a combination of carrots and/or sticks, to farmers.

The results of decades of experience with watershed management programs have not always been positive, especially in the developing world (IDB, 1995; Kerr *et al.*, 1996; Pretty and Shah, 1999; Johnson *et al.*, 2001). Large sums of money were spent with little to show for it in terms of water management, let alone welfare of watershed inhabitants. Part of the problem was that technical solutions developed for one place were often implemented in other places where biophysical conditions were very different

(Kerr and Sanghi, 1992; Johnson *et al.*, 2001). More fundamentally, optimal water management may have been the singular goal of central planners in watershed management agencies, but it was not always the main objective of the people living in the watersheds. This is not to say that people did not care about water, but rather that water management technologies had to be cost-effective, given individuals' goals, resources, and constraints. In the language of today, the technologies had to fit into people's livelihood strategies. Past watershed management programs often relied on a narrow range of environmental indicators to judge success (Born and Genshaw, 2001). But inhabitants of watersheds tend to have more diverse sets of interests and criteria by which they judge technological interventions, and many of the technologies recommended by past watershed programs were tried and found wanting.

Over the past decade, the concept of watershed management, in both developed and developing countries, has evolved into what some are calling "the new watershed approach" (Born and Genshaw, 2001; Sheng, 2001; Hinchliffe *et al.*, 1999). The new approach differs from traditional approaches in terms of its objectives, stakeholders, and the scales at which it operates.

New watershed initiatives take an ecosystems approach that integrates analysis of multiple resources such as forests, pastures, or biodiversity along with water and cropland within a systems perspective (Born and Genshaw, 2001). Natural resources are interdependent and water is one of the key links. Since most agencies charged with natural resource management continue to take a sectoral approach, watershed management programs often become an important forum for integration (Swallow *et al.*, 2001).

New watershed initiatives recognize a much wider range of stakeholders than traditional watershed management programs. Past programs often defined a limited number of target users in broad categories such as farmers or beneficiaries of irrigation or municipal water systems. Because new initiatives take an ecosystems approach, they implicitly involve a much greater number of individuals and groups. An individual resource may have multiple users who use it for a variety of purposes. For example, trees along a riverbank can provide environmental benefits in the form of stream protection, and also generate fuelwood, fodder, fruits or even increase tenure security for the person who planted the tree (Swallow *et al.*, 2001; Fortmann *et al.*, 1997). The recipients of the benefits could be downstream water users, the individuals or groups with legal title to the land the tree grows on, or others who have access rights to the tree or its products. Any of these people could be positively or negatively affected by a decision regarding management of the tree.

Understanding and considering all the divergent and often conflicting points of view is beyond the capacity of a single centralized agency. Therefore, new watershed initiatives seek to engage a wide range of stakeholders, governmental and non-governmental, inside and outside the watershed. New watershed initiatives, often called partnerships or multi-stakeholder platforms, are collaborative and decisions are made through negotiation among stakeholders and stakeholder groups. In fact, many recent watershed interventions were

not initiated by government agencies, but rather emerged spontaneously or, more often, through the efforts of local NGOs.

While they continue to view themselves as watershed initiatives and define their formal boundaries using hydrological criteria, many of their activities are not implemented at the watershed or even sub-watershed scale. Since problems are identified and prioritized as part of a negotiated process among stakeholders representing a range of often very local resource interests and objectives, specific activities undertaken in the name of the watershed initiative may not involve all stakeholders or be carried out at a scale defined within the watershed's nested hierarchy. For example, under the umbrella of the watershed initiative, action can be taken to rehabilitate a certain water source, yielding significant local benefits, but with little appreciable impact on the system as a whole. Some even argue for plot-level planning because that is the scale most relevant to farmers (Douglas, in Sheng, 2001).

Actions can also be carried out on a non-biophysical scale. Where collective action among residents is important to achieve objectives, social or administrative scales may be more relevant than hydrological scales for defining the domain of an intervention. For example, a close-knit community whose location crosses hydrological boundaries may have an easier time generating and sustaining collective action than would a group of individuals with few social ties who happen to share a sub-catchment (Johnson *et al.*, 2001). Where governmental incentives or regulations are involved, organizing at the district or county level may be more appropriate. While some evidence suggests that watershed initiatives tend to be more successful if they have a well-defined watershed plan (Huntington and Sommarstrom, 1999), the design and implementation of each activity does not need to involve the whole watershed. Smaller-scale activities may be more relevant and more manageable, and may help build the experience and trust among stakeholders that can allow them to take on larger and larger challenges.

The number of watershed initiatives with these characteristics is growing rapidly, however it should be pointed out that not all watershed programs follow this approach. Many continue to operate in a centralized, top-down mode. In India, where significant resources are directed towards watershed management, the majority of watershed development projects are still based on conventional approaches, emphasizing physical planning with little attention to local conditions (Farrington and Lobo, 1997). Another approach is the "integrated" watershed management project that combines environmental objectives with interventions in the areas such as agriculture, health, infrastructure and education (Sheng, 2001).

Part of the continued dominance of conventional approaches in spite of growing evidence of their lack of impact can be attributed to bureaucracy and resistance to change. However the new approach is not without its methodological challenges. By recognizing multiple resources, multiple stakeholders and multiple scales, new watershed initiatives face challenges similar to those faced by past integrated rural development and integrated watershed development projects of the 1970s and 1980s.

Lack of clear objectives and simple measurable indicators of impact can lead to confusion and unrealistic expectations on the part of stakeholders about what exactly they can expect from the project (Sheng, 2001; Rhoades, 1998). The long time frame involved in natural resource management aggravates the problem. Often few appropriate technological options are readily available, without which management efforts cannot progress. The socio-ecological site specificity can limit the extrapolation of lessons and technologies from one watershed to another or even within the same watershed from one scale to another.

Progress has been made on demonstrating impact, and many successful examples exist. Research by Sinha (1995) identifies the lack of participation in watershed development in India as one of the principal reasons for its disappointing impact in spite of the huge investments made. Also in India, Kerr *et al.* (2000) find that projects with NGO involvement are more effective than those managed by government. Hinchcliffe *et al.* (1999) highlight two requirements for watershed projects to succeed: (i) they adopt an approach centered on local knowledge and skills, and (ii) they elicit participation at all levels.

Nevertheless, systematic analyses over the long term are few and what has been done often fails to identify clear guidelines for how to design a successful project. Born and Genshaw (2001) conclude that "despite expanding empirical research efforts and numerous sets of widely publicized 'lessons learned' for watershed partnerships, ...many uncertainties continue to surround watershed initiatives, particularly regarding cause-effect relationships between partnership characteristics, actions, and accomplishments" (p. 5).

Why participatory natural resource management?

Political-economy of managing natural resources

In most developing countries, formal ownership rights to watershed resources such as forests and water are in government hands. As such, benefits derived from those resources ultimately belong to the state, which can result in a lack of incentives for local users to manage and care for them. Overexploitation and degradation may be avoidable if governments recognize, or even simply tolerate, the use rights of local inhabitants. Problems arise when the state threatens local tenure security, such as appropriating land for forest concessions and dam development, or when the state fails to adequately protect the rights of communities against others extracting or otherwise degrading their resources.

Deficient management of resources in watersheds cannot be simply boiled down to a lack of local control over natural resources. Economic forces and systems also put pressures on poor people to undertake practices that contribute to erosion[1], water

[1] Although landuse practices contribute to erosion in watersheds, storms and flooding (often followed by extreme drought) can be responsible for much larger and more widespread sedimentations flows, though land use practices may exacebate their effect (Kiersch and Tognetti, 2002). Likewise, roads and footpaths have been identified as more significant contributors to erosion as compared to agricultural activities (Swallow *et al.*, 2002).

contamination and resource overextraction. Continued downward pressure on commodity prices, combined with their increasing instability, leave farmers desperately seeking alternative livelihood strategies. They may agree to sell or lease land (where they have rights to it) to private companies for timber extraction because it offers a source of employment. Male migration to urban areas in search of jobs leave women and children to assume the bulk or often the entirety of farming activities. Already overburdened, they cannot afford the added labor needed to undertake conservation practices, and may even apply environmentally damaging practices to reduce their labor load (Verma, 2001; Kaaria and Ashby, 2001). In other areas, population expansion and competition for land result in more intensive farming and non-farming activities and higher use of chemical inputs, contributing to erosion, polluted waterways and contaminated drinking water supplies (CGIAR, 2002). A combination of policy, institutional and technological solutions is needed to address these problems, and though some changes must be sought at national or international levels, local solutions for developing better institutions and practices also exist. Increasingly, development practitioners and policymakers are recognizing the benefits of local organization and joint participation in managing resources that are shared by or link multiple stakeholders.

Security of access to a resource or its products provides users with incentives to invest in and sustain it. Where individuals' actions have consequences for others, coordinated decision-making may improve outcomes. Spatial and temporal dimensions affect how resources are managed. Resources that occupy large spatial areas or accommodate many users require higher levels of collective action to manage effectively, while those that generate benefits over long time horizons demand more secure property rights for users. Figure 1 depicts how incentives for adopting agricultural and natural resource management technologies are affected by temporal and/or spatial considerations.

Technologies such as improved varieties are adopted at the plot level and yield benefits in a relatively short period, which means that neither property rights nor collective action are likely to play a major role in farmers' decisions to adopt them. The benefits of soil management technologies such as barriers or terraces accrue over time, so users need to have tenure security in order to invest in them. To the extent that the benefits are realized via improved productivity on the plot, individuals can adopt these practices on their own. This is not the case with technologies such as integrated pest management, which must be adopted over a large spatial scale in order to have benefits and, therefore, require coordinated action. Resources such as forests require both property rights and collective action because they tend to cover large areas and support many uses and users, and they must be managed with a long term perspective.

Watersheds, like forests or rangelands, require both property rights and collective action. However, watersheds are also combinations of resources, at a minimum land and water, but often incorporating trees, biodiversity or wildlife. Though some of

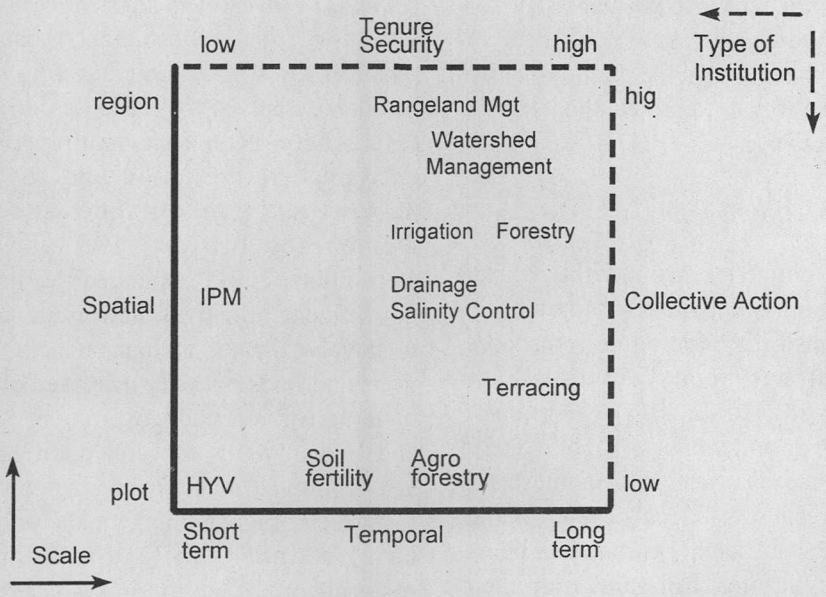

Fig 1 Property rights, collective action, and agriculture/NRM practices (Source: Knox et al., 2002)

the individual resources may not themselves require property rights and/or collective action, looking at them in a watershed context means looking for interactions, externalities and long-term consequences. In a watershed context, the decision of one farmer to adopt high yielding varieties that require high levels of water and purchased inputs may indeed have consequences for his or her neighbors in both the short and long term. If soil erosion on agricultural plots contributes to declines in downstream water quality and quantity, then plot level land use practices may have spatial and temporal dimensions. A watershed approach also allows us to see resources that no one saw before, such as unpaved roads and footpaths between fields that can be important sources of erosion (Swallow *et al.*, 2001). The challenge in watershed management is balancing the incentives associated with managing resources individually versus managing the watershed collectively. Individuals, communities and government have roles to play.

Higher levels of participation and collective action are likely to be important for resources that either span to include many users, or connect many users through spillover effects. Recognizing property rights of users, particularly to resources that generate benefits over time, is critical to providing people a stake in management. Resources that have a large number of multiple users may be more equitably assigned to groups where there is strong capacity for collective action and participation in their management. Where property rights are granted to individuals,

collective action will also be important for developing local rules and collaborative management institutions that temper those rights in such a way as to protect the interests of the collective.

Experiences with devolution

In many countries around the world, governments have undertaken programs in which responsibility for natural resource management has been "devolved" or "decentralized" to local governments, communities or individuals (Ribot, 2002). Where the state has handed over the tasks of caring for resources to local people without providing them sufficient guarantee of being able to count on long-term gains from their investment, people tend not to participate and results are disappointing (Agrawal and Ostrom, 2001; Dupar and Badenoch, 2002; Murombedzi, 1998). On the other hand, many countries witnessed significant improvements in rural livelihoods and ecosystems when they took steps to devolve not only responsibility for natural resource management to local users, but also the *authority* to decide how resources will be managed and assured *control* of the benefits (Meinzen-Dick *et al.*, 2001). Decentralizing control over resources to local government units can be effective when there are robust mechanisms to assure their accountability to local communities. Devolving pilot watershed projects to local government units and the forging of land management agreements with upland farmers in the Barobbob Watershed in the Philippines has resulted in investment in local conservation efforts that have considerably reduced the threat of forest fires brought on by El Niño. Similar initiatives to strengthen security of tenure have been successfully applied to encourage reforestation and sustainable harvesting (Governance and Local Democracy Project, 1998a; 1998b). Vermillion (2001) compares the impact of government initiatives in various countries to devolve irrigation management to local users and finds not only increased efficiency in terms of reduced government subsidies and higher water fee collection rates, but also improved maintenance, responsiveness to farmers, higher grain yields, and in one case, reduced pollution. Increasing recognition of community-based tenure systems in Southeast Asia has contributed to reduced timber harvesting, fewer conflicts, and improved forest cover (Dupar and Badenoch, 2002).

However, handing over rights and responsibilities is unlikely to generate positive outcomes if communities are not prepared to work together – in developing and abiding by rules to govern resource management and in coming together to carry out collective resource management tasks. Devolution may have its greatest successes where local collective action institutions are active and robust, and where there exists a strong sense of community responsibility or social capital[2].

Even where they exist and are strong, however, it would be naïve to assume that

[2] Putnam (2000) describes social capital as a process when individuals form connections that benefit their own and others' interests. Social capaital can emerge from tight groups of members bound by solidarity purposes (bonding), or be more outward-looking and serve networking and outreach objectives (bridging).

local institutions are always representative or democratic. Because local communities or the poorest (particularly women) within communities may lack sufficient power to defend their rights against more powerful stakeholders, it can often be important for the state to protect the rights of the less powerful. Co-management between local governments and communities can also be effective in sanctioning violators of community-established rules where local institutions for doing so are relatively weak. (Lawry, 1990). Ribot (2002) in a study of 60 countries concludes that both national and local governments have complementary roles to play in managing natural resources. National governments can provide frameworks and a limited number of indicators while local governments can, through democratic and participatory processes in which all citizens are represented, decide on the mechanisms by which goals can be achieved.

How can Research Better Support Participatory NRM in Watersheds?

In this section, we discuss six areas where research can contribute to improve user participation in watershed management.

Stakeholder identification and analysis

The objectives and activities of participatory watershed management groups are defined by their stakeholders. Agendas for the same watershed could be very different depending on which stakeholders set them. Therefore, for both equity and efficiency reasons it is important to consider carefully who the stakeholders are and whether and how they can be motivated to participate in a collaborative effort to manage watershed resources.

Ideally, participants would self-select, that is those who recognize that a potential intervention might affect them would voluntarily get involved in negotiating the details. Where communication is good and where people have a good understanding of ecological and economic interactions, public awareness campaigns would likely bring forth relevant stakeholders (National Wildlife Federation, 2002).

Where these conditions do not hold, more purposeful efforts to identify and involve relevant stakeholders will be necessary. Methods for doing this exist (e.g., Ravnborg *et al.*, 1999), though they are generally applied at small scale, and methods for large scale stakeholder identification need to be developed. Identifying relevant stakeholders is especially important because if key stakeholders are left out, not only might they be adversely affected, but they may also be in a position to block implementation of a plan (Ravnborg and Ashby, 1996; Ravnborg and Guerrero, 1999). Yet in a survey of participatory natural resource management research projects, Johnson *et al.* (2001b) found that many projects that targeted women and the poor did little in their participant selection to insure their involvement (Johnson *et al.*, 2001b). Given that participation in any project has opportunity costs, research is needed on the extent to which the poor and marginalized must participate directly in order to benefit.

Organization, facilitation and negotiation

Collective action around natural resource management and innovation does emerge without outside intervention, though very

often this is not the case, particularly in cases where institutions for cooperation may have broken down long ago or never existed. Most of the known and documented cases of PNRM and innovation have been initiated by outsiders, typically NGOs, but also by more progressive research and extension agencies. A study by Kolavalli and Kerr (2000) in the states of Karnataka, Orissa and Rajasthan in India found that NGO commitment to participation resulted in higher levels of collective action being sustained. The experiences of NGOs offer important insights about what factors help sustain collective management and innovation. Lessons emerging from a study by Sinha and Sinha (1996) on the experience of six Indian NGOs involved in community organizing for NRM include:

- The ability of users to realize individual benefits from participation.
- Groups having a clearly defined focus around what they wish to achieve.
- Mechanisms for drawing on past experience and establishing locally relevant monitoring systems to capture new outcomes and experience, as a means of reinforcing a continuous learning and change process.
- Effective and mutually respected forums for conflict resolution. These may be especially important in watershed contexts where stakeholder interests can be highly asymmetrical.
- Recognition of and means to address power differences that marginalize some stakeholders.
- Where external factors (e.g., policy) constrain local objectives, local organization to address those obstacles may be critical.

Technical service agencies staffed with community organizers, or working in conjunction with NGOs who have this capacity, may be well positioned to initiate or facilitate local collective action around innovation – provided they have substantial local experience and credibility (Born and Genshaw, 2001). Such agencies are equipped with technical knowledge that can complement or enrich that of farmers. However, they often need substantial retraining to better appreciate the validity and breadth of indigenous knowledge, and retooling to acquire skills on how to work on an equal partnership basis with farmers. Partnering with trusted NGOs may enable researchers and extension experts to acquire the social organization training they need as well as facilitate their entry into local communities. Evidence from the Andhra Pradesh and Maharashtra states in India reveals that participatory watershed projects carried out jointly by NGOs and government extension agencies or solely by NGOs performed far better than those managed by government agencies alone. This is due largely to the former's attention to social organization (Kerr *et al.*, 2000). Despite the strong evidence to support NGO roles in watershed management in some cases, in general Ribot (2002) cautions against excessive reliance on NGOs since they are non-elected, non-representative groups that have their own interests and agendas.

The way in which outsiders manage social organization can be critical to the

ability of the poor and other disadvantaged stakeholders to benefit from the process. Often the approach is taken to try to simulate level playing fields in which to carry out multi-stakeholder negotiations with the hope of obscuring existing power differences. Instead, power differences need to be explicitly recognized and addressed. Otherwise, the processes and outcomes of such negotiations are likely to be manipulated by dominant or privileged groups and lead to elite capture (Edmunds and Wollenberg, 2002). Even if agreements emerge that do justice to weaker groups, they are unlikely to endure once the parties step away from the controlled negotiating environment and into the real world (Ibid).

Innovation in watershed management

The relation between land use and environmental flows in watersheds has proven to be highly complex and site-specific. Processes can only be confirmed at small scales, which are not conducive to generalization and scaling up (Kiersch and Tognetti, 2002). Furthermore, off-site effects of land-use often take years to materialize and their origins can be difficult to trace (Ibid). In such environments, research is costly and the technologies and other innovations that result from the research process may have limited application beyond the original site. Managing a watershed effectively requires improved technological and institutional options to deal with the problems that are identified, yet in many cases, for reasons described in previous sections, appropriate improved options just aren't available off-the-shelf. Without innovations that lead to real benefits, even the most participatory watershed management associations will likely not be sustainable. If appropriate technologies are to be made available, local people may have to play a significant role in their development and/or adaptation.

Participatory research is fundamentally about involving end users in the development of knowledge and its application. While there are many ways of doing it, perhaps the single common denominator is that it involves to some extent the end-user. In order to be able to add precision to the practice, Biggs (1989) classified participation into four types depending on the degree of end-user decision-making and involvement:

- Contractual, whereby farmers' land is contracted out by researchers and extension agents to undertake experiments.
- Consultative, whereby researchers consult farmers about their preferences and priorities, but researchers ultimately make the decisions and develop the technologies.
- Collaborative, whereby researchers and farmers contribute equally to decision making and technology development.
- Collegial, whereby farmers take the decisions and have control over technology development, but may consult outside researchers and extension agents for input.

Subsequently, Lilja and Ashby (1999) added a fifth category, "farmer experimentation" whereby farmers assume complete control over the innovation process without systematic input from researchers or extension workers. They also divide the innovation process according to what stage

in the research process end-users are first involved, with engagement at the earlier stages of priority setting and technology design signifying a higher likelihood that technologies will reflect farmers' priorities and be adopted (Ibid).

To date, participatory natural resource management research carried out in conjunction with formal research institutions has largely been consultative, though end-user feedback stemming from this type of participation has been seen to push researchers to engage more in collaborative forms and involve end-users at earlier stages in the research process (CGIAR-PRGA, 2003).

In the case of innovations in natural resource technologies and practices, the adage "necessity is the mother of invention" seems to hold true. Small scale farmers are often driven to undertake their own research when their economic means and choices become more limited (Reij and Waters-Bayer, 2001a). This may explain why cases of poor farmers conducting research on natural resource improvements that do not generate short-term solutions to address necessities can be difficult to induce or sustain without the initial use of subsidies or other material incentives to overcome market failures. With technical support from the International Center for Living Aquatic Resource Management (ICLARM), local communities in Bangladesh are engaged in experiments on management of fish culture in deepwater rice fields. Financial support for covering material costs during the project's first two years was critical until the project began generating sufficient revenues to enable community members to cover the costs (CGIAR-PRGA, 2000b). However, subsidies can be easily abused, and have been used as a measure to convince people into adopting technologies that do not conform to their priorities (Kerr *et al.*, 1996), so it is important to apply them selectively, monitor their effects, and eventually phase them out.

Collective action and innovation

Most participatory research for NRM has focused on developing technologies that can be applied at the plot level, such as soil fertility improvement, integrated pest management, and plot level erosion control (see for example, CGIAR-PRGA, 2000b). However, because of environmental flows and the pervasive nature of off-site effects in a watershed context, technologies applied by individuals often will have positive or negative implications for others living in the watershed, such as certain pest control or erosion control practices. Further, little attention has yet been given to resources that have extensive spatial boundaries or are held in common.

Collective action by stakeholders to evaluate the (potential) costs and benefits of technology application is important. It not only acquaints users with the broader implications of their actions, but also can be a means of garnering community pressure to either apply or not apply certain practices. In the case of new or newly adapted technologies, certain individuals may choose or be selected to perform experiments to test their effects, but communities collectively need to agree on reliable indicators for monitoring and evaluating performance, what the procedures will be, and who will carry them out. Though the monitoring may be done by appointed individuals, all stakeholders should be involved in the process

of interpreting results, evaluating the technology, and negotiating and making decisions on its use, and monitoring and enforcing those rules.

Collective action among stakeholders may also be a forum for devising creative mechanisms for redistributing benefits and costs, for example between downstream beneficiaries and the upland residents who adopt technologies and practices that inflict less harm or produce more positive downstream benefits. When users are also organized around innovation, the scope for identifying solutions that satisfy broad interests can be taken a step further – to the level of adapting or developing technologies that take into account the effects on multiple stakeholders.

What is different about landscape level innovations is that collective action is also needed for experimentation and implementation. Watershed technologies that are large scale or undertaken on commonly held resources produce direct benefits for many, such that the cost of testing, installing, and maintaining them needs to be borne by those same beneficiaries. It should be noted that in some cases, experimentation on large-scale technologies may be infeasible or prohibitively expensive such that past experience and indigenous and researcher knowledge may substitute for experimentation (e.g., constructing and maintaining wetlands to control sediment flow and flooding). Table 1 compares the collective action needs for participatory research on technologies or practices applied at a plot versus a landscape level. In both cases, institutional innovations for collective action may need to accompany technical innovations in order for watershed and livelihood improvements to take hold.

Innovation that is not seeded by external agents appears to be largely carried out

Table 1. Steps in participatory research on watershed innovations requiring collective action

Technologies/practices applied at a plot/household level	Technologies/practices applied at a landscape level and/or common property resources
• Assessment of perceived or potential costs and benefits of the technology/practice	• Assessment of perceived or potential costs and benefits of the technology/practice
• Selection of or agreement on individuals to perform experiments on technologies	• Technology experimentation, where feasible
• Monitoring: Agreeing on indicators, procedures and persons to carry out	• Monitoring: Agreeing on indicators, procedures and persons to carry out
• Evaluation: Interpreting results	• Evaluation: Interpreting results
• Decision making on application or adaptation of technology/practice and designing use rules	• Decision making on applicaiton or adaptation of technology/practice and designing joint use and allocation rules
• Designing rules and procedures for monitoring and enforcement of use rules, and managing conflict	• Designing rules and procedures for monitoring and enforcement of use rules, and managing conflict
	• Installation of application of innovation; technology maintenance.

by individuals at plot or household levels (Reij and Waters Bayer, 2001b; Mutunga and Critchely, 2001). Though such innovations often spread through farmer organizations or even informal community channels, there does not seem to be much self-initiated collective action around the innovation process or even joint efforts to coordinate and scale them up in a watershed context (Ibid). Likewise, researchers also tend to think largely in terms of individual adoption of technologies and ignore the potential for more equitable and productive outcomes through coordinated adoption of (sometimes different) technologies within an interlinked system of flows. Nevertheless, this is changing somewhat as participatory approaches involving multiple stakeholders (e.g., resource mapping) enlighten researchers about specific landscape issues and off-site effects. Such was the case in the Ethiopian highlands when the adoption of high-yielding wheat varieties resulted in downstream water-logging, which in turn led farmers and researchers to jointly develop an animal-drawn implement to drain the excess water (CGIAR-PRGA, 2000b). Evidence from this case also showed that when participatory research shifts from farm to watershed scales, farmers participate more in decision-making and collective action.

Evaluating impact

The previous discussion stressed the importance of assessing the impact of watershed management interventions on the basis of a range of economic, social and environmental indicators rather than simply water availability and productivity parameters. A wealth of case study information is available that looks at multiple impacts, however to date few systematic empirical analyses have been done. Better methods and tools are needed.

One of the main methodological challenges in assessing the impact of participatory projects is that when participation is voluntary, the outcomes will depend on unobserved characteristics of participants. For example, a participatory watershed management initiative carried out in a watershed where communities are well organized is likely to have a much better impact than the same program in a watershed that is biophysically identical, but has conflictive social relations. If this initial difference at organization level is not accounted for, the success will be attributed to the watershed intervention rather than to the community's organization. In fact, many communities and watersheds are selected by projects precisely because they have high levels of organization. Therefore, their outcomes cannot be considered representative of impacts that would occur in other areas. Careful attention to site selection and use of both qualitative and quantitative methods are best for assessing impact of participatory watershed projects (Kerr and Chung, 2001).

Many watershed evaluations are done by donors or government agencies seeking to justify their investments. However external evaluators are not the only ones with an interest in outcomes, especially of participatory projects. Since participants in participatory watershed management programs, contribute to the design, implementation and funding of activities, they clearly have an interest in the outcomes

and a need to know that their efforts are making a difference (DFID, 2002). Without observable indicators of progress, it is difficult to maintain enthusiasm and support for the project. Performance indicators, like other aspects of project management, need to be negotiated among stakeholders. However, an important contribution of research would be to identify potential sets of environmental and livelihood indicators that local people could understand, measure, and monitor (Johnson *et al.*, 2001).

In fact, given the site-specificity of watershed outcomes and the labor intensity of monitoring them, it is not likely that external analysis of watershed interventions can be carried out in many locations. Collecting and even analyzing data on changes in outcomes of interest may well fall to local residents themselves. Results can be used internally by the watershed residents, as well as shared with external organizations as part of large-scale resource management initiatives (NWF, 2002; Hearne, 2001).

Scaling up

The term scale is frequently used in conjunction with participatory NRM, especially participatory watershed management, however it often has different meanings that can lead to confusion. One use of the word scale relates to the fact that a key element of the "new watershed approach" is that it is multi-scale. Therefore methods for integrated analysis and action across scales are an important concern for these approaches. Like many NRM projects, participatory watershed management projects are also often asked about their plans to "scale up". In this context, increasing scale is associated with an increase in project coverage and impact. The motivation behind the focus on "scaling up" is to identify ways in which the accomplishments achieved and lessons learned at small pilot sites can be replicated or transferred to a larger scale.

Swallow *et al.* (2001) clarify the issue of scale in watersheds by identifying two main definitions: scale as hierarchy and scale as magnitude. The scale as hierarchy approach is based on the recognition that ecological and social systems are hierarchical and scale nested (Marceau, 1999). Particular questions and problems are best analyzed at specific levels; however, it is important to recognize that the levels are not independent. A key challenge for research on watersheds is to understand how to relate principles and results obtained at one level to other levels (Schreier and Brown, 2001). The challenge introduced by participatory watershed management is to better incorporate appropriate social scales into the analysis. Much work on social scales looks at political or administrative hierarchies; however, these may not always reflect actual communities. Combining social and ecological scales is especially complex. The classic example in the watershed context is that rivers and streams that form the centers of catchments are often the boundaries of social units (Johnson *et al.*, 2001).

Scale as magnitude is essentially related to impact in terms of numbers of people, hectares of land, gallons of water, etc. In this sense, scaling up is defined by its objectives rather than by its specific characteristics or processes. The participants

at a CGIAR-NGO committee at a conference in the Philippines (Silang, the Philippines, April 2000) defined scaling up as:

"Scaling up leads to more quality benefits to more people over a wider geographic area more quickly, more equitably and more lastingly"(Gonsalves, 2001).

A great deal of work has been done on scaling up (e.g., Gonsalves, 2001; Güendel and Hancock, 2001; Gündel *et al.*, 2001), and two general processes of scaling up can be identified. One is essentially replication (scaling out) which means repeating an intervention at the same scale in another place. Scaling up (sometimes called vertical scaling up or institutionalization) implies increasing the scope of an intervention in a given site, for example moving from the sub-catchment to the catchment scale. While scaling up almost certainly involves increasing the geographical area of an intervention, the main driver in scaling up is a change in the social or decision-making scale, e.g., from individual or household to a community scale or from the county to the state level.

Insights from scale as hierarchy can clearly support scaling up processes. Impact assessments that analyze how local characteristics contribute to or hinder project success can be very useful in supporting processes of replication or scaling out. A major challenge for participatory watershed management is how to scale up effectively. While it may not be true that participatory NRM projects are by definition small scale (Johnson *et al.*, 2001b), there certainly are many examples of projects that bring significant benefits locally, but fail to have impact on larger geographical areas or on higher levels of policy making. One option for achieving broader impact is via federation or second order organization. Research can contribute to a better understanding of the emergence and performance of these organizations, especially their implications for the viability of the component organizations.

Discussion

This paper described a "new watershed approach" characterized by an ecosystems perspective; collaborative and multi-stakeholder decision process; and multi-scale action and analysis. The approach evolved in response to the failures of many past top-down watershed programs based on physical planning for water management. It also reflects changes in the nature of watershed management initiatives and new thinking in the broader field of "watershedology" towards more integrated and multidisciplinary analysis (Sommartrom, 1999). Participatory watershed management is closely related to broader changes in the political economy of natural resource management, as reflected in growing trends towards devolution or decentralization of authority and responsibility.

While there is a growing body of case study evidence to support the effectiveness of new participatory approaches, challenges remain to demonstrate impact and to identify generalizable lessons for watershed organizations. Researchers together with other stakeholders, can contribute to better participatory management by developing better methods and tools for stakeholder identification, organization and facilitation; for participatory research and innovation at

the landscape scale; and for assessing impact and scaling up.

One of the key lessons from the literature on participatory watershed management is the importance of local innovation and learning processes. Participatory watershed research and management are intrinsically connected; the line that distinguishes them is blurry at best. Where does local knowledge for managing resources stop and the process of innovation begin? A key function of participatory research in a watershed context should be to strengthen and expand stakeholders' understandings of resource flows and confirmed or hypothetical land-use impacts – in a manner that draws together local and researcher knowledge of these systems. When this knowledge is generated in a forum comprised of different interests, stakeholders stand a better chance of appreciating the human effects of their actions and collectively negotiating improvement options. Hence, participatory research can lead to participatory management.

Sustaining management commitments, however, is likely to require repeated interactions as well as devising workable benefit-cost sharing mechanisms, which can be participatory innovations themselves. With regard to such mechanisms, perhaps more important than their exactitude is their ability to induce the right incentives, and their local relevance and acceptability by concerned stakeholders. Key to maintaining any management scheme is a monitoring system that documents changes and feeds back lessons so as to enable adaptation and spark new innovation in resource management.

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