

Watershed Management and Sustainable Development: Lessons Learned and Future Directions

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Abstract.—A fundamental belief underlying the direction and content of this paper is that the paradigms of land and water management evolving into the 21st century increasingly favor a watershed focused approach. Underlying that approach is an appreciation of the processes of sustainable development and resource use. The increasing recognition that sustainable development and sustainable ecosystem management are processes rather than end states, is coupled with an increasing awareness that these processes are fraught with uncertainty, and that cumulative effects matter. This recognition opens a number of new doors in terms of participatory adaptive management. Practical strategies for dealing with uncertainty and avoiding unsustainable development include more coordinated policies and programs that link distinct political entities; greater flexibility in planning and management; complementing technical appraisals with socioeconomic assessments; using interdisciplinary and participatory planning approaches at all levels; and precautionary monitoring with early warning signs.

Where Are We Going?

General Trends in Watershed Management

A recent USDA Forest Service report stated:

“Throughout their history, conservation science and sustainable-yield management have failed to maintain the productivity of living resources. Repeated overexploitation of economic species, loss of biological diversity, and degradation of regional environments now call into question the economic ideas and values that have formed the foundation of scientific management of natural resources. In particular, management efforts intended to maximize production and ensure efficient use of economic “resources” have consistently degraded the larger support systems upon which these and all other species ultimately depend.” (Bottom et al. 1996).

We learn from our past mistakes and move forward, hopefully, with greater wisdom and experience. A fundamental belief underlying the direction and content of this

paper is that the paradigms of land and water management evolving into the 21st century increasingly favor a watershed focused approach. The logic of using a watershed management approach as the unit of management has been well documented, and encompasses multiple technical and socioeconomic dimensions. Underlying that approach is an appreciation of the processes of sustainable development and resource use. While all is not rosy and nice in the world, we see some fundamental trends that are leading toward a more sustainable management of our natural resources and ecosystems.

Greater emphasis also is being given to decentralized, participatory approaches to land use planning and management, ones that (1) are sensitive to the interests of a wider range of stakeholders, (2) recognize the need to deal in an open way with the tradeoffs that inevitably exist between maximizing production and environmental conservation, (3) introduce novel and more effective conflict management approaches from a sustainability perspective, and (4) recognize the right of future generations to inherit a landscape that is still productive, both in terms of producing goods and in terms of supplying needed environmental services. There is now much greater sensitivity to the positive “externalities” associated with proper natural resources use: clean and adequate water supplies, ecosystem protection from adequate instream water flows, access to biodiversity, carbon sequestration and so forth.

Lant (1999) points out that there are now more than 1,500 locally-led watershed management initiatives in the United States, almost all established since 1990. These types of initiatives focus on (1) a watershed or landscape level rather than small area or plot level planning and management, (2) interactions between resources and their uses and the impacts of such uses, including downstream, and (3) the nonmarket costs and benefits (particularly the environmental services) associated with land use.

These evolving approaches recognize that sustainable land and water management is a process and not an end state that can be defined. This recognition opens a number of new doors in terms of *participatory adaptive management (PAM)*, including those associated with the model forest program introduced in Canada and now spreading to other countries, participatory approaches used in developing countries, various integrated natural resources management programs in the U.S., and the ecoregional

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approaches introduced by a number of groups around the globe. The increasing recognition that sustainable development and sustainable ecosystem management are processes rather than end states, is coupled with an increasing awareness that these processes are fraught with uncertainty, that cumulative effects matter, and that there is need for flexibility in planning and management. The sum of these merging themes leads land and water managers to a fundamental conclusion: "Sustainable development" is a useful term in political and high-level policy discussions, and participatory adaptive management is a useful operational counterpart for management. In the sections that follow we attempt to weave these basic concepts together into a view of where we should be going, based on the lessons from the past.

Principles of Sustainable Development

Sustainable development can be defined as using watersheds and forests to produce goods and environmental services that increase or maintain the welfare of people today, while protecting the environment and natural resource base, on which future production will depend, for future generations (Gregersen et al. 1998). This concept of natural resource sustainability is not new. It has its roots in concerns during the 1800s about perpetuating the forest resource base of countries in Europe, and a growing concern about the dwindling timber supply in this country. In his presidential message of December 2, 1901, Theodore Roosevelt asserted: "The fundamental idea of forestry is the perpetuation of forests by use. Forest protection is not an end in itself; it is a means to increase and sustain the resources of our country and the industries which depend upon them." (Pinchot 1947, p.190). The president also emphasized the importance of protecting water supplies. This early vision recognized the need to sustain natural resources in order to be able to meet the present and future needs of people dependent upon them. Gifford Pinchot, first Chief of the U.S. Forest Service, became an influential advocate of this conservation philosophy: "The conservation of natural resources is the key to the future. It is the key to the safety and prosperity of the American people, and all the people of the world, for all time to come. The very existence of our Nation, and of all the rest, depends on conserving the resources which are the foundations of its life." (Pinchot 1947, p. 324). This conservation philosophy, rooted in concerns about perpetuating natural resources to meet basic needs of people, guided much of the early science and practice of forestry and watershed management. Today it has evolved into the wider concerns of sustainable development.

Our past work has uncovered some basic principles of sustainable development:

An interdisciplinary approach is essential. The sustainable management and use of natural resources involves the interaction of human society with the biophysical environment. A wide range of scientific disciplines is required to understand and address the problems involved in anticipating and solving sustainability problems.

Sustainability is a process, not an end state. Developing sustainable natural resource management and use requires viewing sustainability as a process, not as an end result. Policies and programs designed to promote sustainability are faced with continuing changes in physical, biological and social conditions over time, and must adapt to such changing conditions.

Sustainability has spatial and temporal dimensions. Sustainability policies and programs typically have distinct spatial boundaries within which they are to be applied — a watershed, a village, a state. Yet exchanges and movements of materials, energy, people, goods, and services, take place across any arbitrary boundaries that may be established. Further, although policies and programs have fixed spans of activity, their direct results and indirect or second-order consequences are likely to continue far into the future. Both spatial and temporal externalities and indirect consequences should be anticipated and taken into consideration in designing sustainability policies and programs. In doing so, physical, biological, cultural, and political realities must be recognized.

Distributional consequences must be considered. Changes in natural resource management and use to better address sustainability issues inevitably involve changes in who benefits and who bears costs in society, both now and in the future. Such changes in the distribution of costs and benefits among individuals and groups in society should be anticipated and evaluated before decisions are made about proposed policies and programs.

Consistency and stability of policies and programs are necessary. Some degree of consistency and stability in the external and internal operating environment is necessary. This includes consistency and stability in policies and programs, and in the availability of funding and capital resources, natural resources, and knowledgeable and skilled people. Some change is tolerable, and perhaps beneficial if you can adapt to it, but major unexpected changes may inhibit continued functioning of the existing system, or even lead to its eventual failure. Repeated shifts of missions, goals, and operating environment in response to changes in key managers and policy makers, may make it difficult if not impossible to achieve sustainable development.

Because outcomes of policies and programs are uncertain, *monitoring is essential*. It is difficult to know with any degree of certainty just what will be the outcome of various policies and programs designed to support sustainable development, particularly the farther we get into the

future. Because of this inherent uncertainty, an effective program of monitoring must be established to provide the information needed to guide changes in policies and programs.

Learning and adapting must be continuous. Some form of adaptive management, an integrated system of identifying and responding to change (Holling 1978; Walters 1986), is needed. Attempts are being made to incorporate this new approach into public land management (e.g., Bormann et al. 1994).

Policy and practice must be compatible. Too often policies are designed at a level far removed from those who will carry out the intended practices, disregarding the realities faced by those who must actually carry out the work on the ground.

Coordination among governmental levels and responsible agencies is essential. Policies and programs among governments and agencies with related responsibilities must be coordinated. Jurisdictional and other conflicts must be resolved promptly.

How Do We Get There?

Processes and Practices for Implementation

Moving toward sustainable development requires us to first conceptualize some general principles of sustainability, as we have done above. Then, we need to put into place some practical processes and mechanisms to implement policies and programs that foster sustainable outcomes. In this section, we suggest some strategies, processes and practices for implementation (appendix 1).

All of us are accustomed to dealing with the technical aspects of watershed management, but less so with socioeconomic aspects. In our experience, we have found that the more successful policies and programs in terms of sustainable outcomes are those that consider both the technical and human dimensions of watersheds. First, *identifying stakeholder and natural resource user groups is essential.* We cannot assume that all people living in a watershed will benefit equally from our actions, or that they have the same land use practices, needs and priorities.

It isn't only those living within a watershed that are affected by particular policies and programs. Some who live outside may be affected too, and need to be consulted. Also, some policies, programs and activities outside of the boundaries of the watershed affect people living within the watershed, and may affect their activities as well. In other words, it is well to recognize that when we discuss

watersheds, we are talking about an open system, not a closed one — one that is open to physical, biological and social interchange with the exterior world.

Consequently, *a baseline socioeconomic and technical assessment should be a fundamental step in the planning process*, so that we can identify various stakeholder groups, understand the overall policy context, estimate possible distributional effects, and ultimately compare outcomes with pre-existing conditions for various watershed users. Such baseline studies do not need to be costly or complicated. Many newer rapid socioeconomic assessment techniques now exist that integrate both quantitative and qualitative data, and that can complement other technical and economic assessments for more informed decision making.

Second, *forward-thinking and creative planning enables us to visualize what a sustainable outcome would look like.* We can use adaptive, participatory planning techniques to think in an integrated, multidisciplinary way about outcomes. Ideally, how should this watershed look in another generation or two? What are unacceptable outcomes for agencies, watershed users and residents? Local communities can help us to set broad goals and objectives, and to understand local issues and conditions that outside planners and experts may not anticipate. New approaches to joint planning of natural resources projects have been developed and tested, and can be applied to watershed management. Once we have a future vision and broad goals and objectives that are defined jointly by agency planners and communities, we can work backwards through time to set a work plan and timetable.

Third, we tend to think of decision making and management at discrete levels of responsibility. However, *watershed management can most effectively play a role if there are effective measures and decisions being taken at all levels in an integrated fashion.* Policies and institutional arrangements are needed at the highest levels of government, yet local governmental levels and citizen participation are also essential. Both ends of the spectrum are necessary, but coordination and mechanisms for joint decision-making and management are often the critical missing links. A watershed perspective that overarches individual land uses and landscapes has long been needed to deal with watershed dimensions that extend beyond local communities, such as cumulative watershed effects, externalities, and inequities between upstream and downstream users.

Fourth, while managing for sustainable development provides a proactive and positive policy perspective in watershed management and natural resources programs, in fact, from an operational perspective, *the focus should be on managing to avoid unsustainable development as we move along the path of development.* We can avoid unsustainable development by thinking about what might go wrong, and anticipating unplanned consequences. Sometimes problems and issues arise that the project planners did not anticipate years after a watershed project is implemented.

Fifth, to minimize possible externalities, *consider the law of unexpected consequences*: any human action will result in unexpected consequences (Lundgren 1976). Given that unexpected impacts will almost certainly be felt, have a process with clear procedures in place to deal with problems (Lundgren 1983). *Establish a precautionary monitoring system for both technical and socioeconomic aspects*, that looks for changes in both positive and negative directions (Eckman 1994). We can identify early warning signs and indicators of unsustainability that will inform us if project impacts and outcomes are moving in an unacceptable direction (Eckman 1994). Finally, *conduct an ex post evaluation* when the project is terminated so that we can benefit from accumulated professional and technical knowledge and experience.

Who Does It And Why?

An important lesson from past projects and policies is that resource managers now have a far greater appreciation for the socioeconomic and cultural aspects of watershed management. In particular, we now know that the range of stakeholders in a watershed is far from homogeneous, and impacts are felt differently by various stakeholder groups at different locations on the watershed. We also have a greater appreciation for the importance of involving those various stakeholders in planning and management decisions, no matter how difficult or contentious that process may be.

There is a need for civil society to be involved in watershed management to capture a wide array of values, needs and opportunities. In the United States, there has been an explosion of new partnerships between local citizen groups and agencies to manage natural resources. One such approach, participatory adaptive management, stresses monitoring, evaluation and adjustment (Shindler et al. 1999), with citizen groups playing a major role in monitoring various ecosystem and watershed components.

Many watershed projects now emphasize citizen science and participatory monitoring with the involvement of local groups. However, this process needs to be guided by watershed professionals through an educational component. Effective participatory monitoring means that people understand what they are measuring and why, how to correctly monitor for different purposes (e.g., compliance, cause and effect relationships, background monitoring, etc.), and how to analyze, use, and apply the monitoring information. When properly done, participatory monitoring can greatly assist watershed professionals, and serve to educate the public about watershed

management and water quality issues. Citizen science can never replace professional watershed monitoring, but can complement and reinforce the work of watershed professionals if done under expert guidance.

In Minnesota, for example, such partnerships between public agencies, scientists, and communities have resulted in successful watershed and wetland projects at Lake Phalen in St. Paul, and Cedar Lake in Minneapolis. Volunteer groups monitor water quality at Bassett Creek and Kasota Pond under the guidance of scientists, and are compiling a quaternary history of Bridal Veil Creek. In Canada, innovative model forests integrate agency and private expertise.

These partnering arrangements bring educational, recreational and aesthetic benefits to local communities. They enable public agencies to reduce some human resources costs, while gaining additional information including rigorous quantitative data. Informed and active public citizens lobby legislatures and other policymaking bodies for funds to conserve and protect water resources. At least 768 volunteer monitoring programs exist in the United States, and data from these efforts are used for research, watershed planning, land use decisions, enforcement, education, and other purposes (Volunteer Monitor 1998). New publications such as *The Volunteer Monitor* and the *Conservation Volunteer* have evolved to meet the joint information needs of local groups conducting citizen science, and of technical experts wanting to partner with community members.

In developing countries, there is increased recognition that significant numbers of the rural poor continue to live in poverty, and that the impacts of natural resource and watershed management programs have not been beneficial or sustainable in many cases. In addition, there is increased realization of the negative impacts of conflict on watersheds, and that such conflict leads to unsustainable land use and degradation. In response, donors and non-governmental organizations (NGOs) have evolved new participatory strategies to improve the positive impacts and sustainability of policies and programs. There has been a clear trend toward decentralization of natural resources planning and management in many countries for at least two decades. Such methods are at least in theory more democratic than conventional top-down, logical framework planning methods. Partnering arrangements between NGOs and local community groups are now very common, with the NGOs playing a major facilitative role at the program level, and a strong intermediary role at the international and national policy levels.

There is an array of facilitative approaches and methods that have been developed and tested by NGOs in the tropics. For example, participatory assessment, monitoring and evaluation (PAME) developed by the United Nations Food and Agriculture Organization has been widely tested and successfully used (see, for example,

FAO 1989 and 1990). There is much that western scientists and public agencies can learn from the experience of our colleagues in the tropics about participatory approaches to watershed and natural resources management.

Creating a Policy Environment

Political boundaries and operational decisions seldom respect watersheds, yet good watershed management focuses on the whole system, not just part of it. Thus, management decisions to ensure sustainable development (or avoidance of unsustainable development, in an operational sense) need to be framed within institutional and policy arrangements that link watersheds with distinct political units. In practice, arrangements that have been used successfully in the past include user associations, river basin commissions, and farmers' irrigation associations.

It goes without saying that the integrated watershed management approaches discussed at this conference need to function in a policy environment that support their effective implementation. Participatory adaptive management approaches, ones that involve greater decentralized input from a broader segment of civil society, require some changes in the public policy environments that frame what can and cannot be done and what kinds of incentives exist to encourage participation.

Governments have three basic sets of policy instruments or mechanisms that they can use. They can: (1) introduce regulations and laws that specify what can and cannot be done and what has to be done by citizens and private organizations, (2) introduce financial and fiscal incentive mechanisms that motivate private action (subsidies and taxes are common examples); and (3) invest in public management and facilities (provision of information, e.g., through research and education, management of public lands, investment in infrastructure, and protection of citizens and their property). These three types of instruments commonly are used throughout the market economies of the world.

So what needs to change? How does the policy environment have to adjust if the new participatory adaptive watershed management approaches to sustainable development are to succeed? The following bullets just touch the surface of the complex interwoven policy changes that are needed:

- Encouraging effective participation of citizens in resources management requires good, relevant information that is accessible equitably to a wide variety of stakeholders. Investment in public research and information dissemination are key public policy elements.

- Innovative public financing mechanisms are needed for some key activities within the broader context of integrated watershed management, particularly those that involve public goods and common property management. Governments have bonding authority, and the ability to divert tax revenues into key sustainable development activities and watershed management programs. There are many other ways in which financial and fiscal policies can be used to ensure effectively funded PAM.
- PAM involves a lot of different people with different views. Public sector policies can contribute to improving facilitation of consensus building among the participants by providing incentives for groups to reach consensus on key issues.¹
- Because sustainable development has both temporal and spatial implications, public policies have to be sensitive to both dimensions. Further, public policies should be designed to ensure safeguarding of resources for future generations. The use of best management practices (BMPs) in timber harvesting accomplish this objective, as do a number of other possible policy instruments.
- Means are needed to pay landowners and others for the positive environmental services they provide through various forms of resource management. (Note that this is a different concept than providing "subsidies" for private landowners who contribute to the social good through improved management). Tax rebates and low interest loans are merely two ways in which the public sector can transfer some of the costs of management from private to public sectors.
- Finally, and related to several of the points above, public policies need to provide appropriate regulation and guidance for activities involving common property resources and production of public goods. Such policies, including ones that involve co-management between public and private sectors, should attempt to turn open access resources into common property resources or lead to privatization where such makes sense from a public good perspective.

¹ The Consultative Group on International Agricultural Research (CGIAR) with its 16 centers worldwide operates entirely on the basis of consensus. Dr. Ismail Serageldin, Vice President of the World Bank and chair of the CGIAR, likes to point out to the members of the Group that consensus means "I can live with the decision," not necessarily that "I like the decision."

Summing Up

There are often many positive aspects and complementarities between socioeconomic and environmental goals and actions. The United States with its strong, growing economy has actually improved its natural resource base and the sustainability of its resources. This has been achieved through a mix of policies, incentives, and the organized and innovative efforts of water users at the local, state and national levels.

Traditional watershed management depended upon top-down planning methods by technical experts. We now know that technical expertise is necessary but not sufficient; we also need citizen participation in planning, decision-making and implementation. We now know that sound decision-making needs input at multiple levels: from policymakers, technical experts, *and* local users. To move towards sustainable development, watershed management can most effectively play a role if there are effective measures and good communication at all levels.

Finally, we have observed that sustainable development is a process, not an end state. As such, policies and programs must be flexible, and adjust to changing conditions. We also recognize a need to shift our goals and objectives from *outputs* to *outcomes* in order to achieve sustainable development. A key operational guideline is to avoid unsustainable outcomes, and to monitor closely for both technical and socioeconomic impacts and trends throughout the life of a project and beyond.

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Appendix 1. Dimensions of Sustainable Development in Watershed Management

Nature of the Watershed Policy or Program Impact

- Who/what specific groups are affected (e.g., us/ them, poor/wealthy, etc.)
- How does the impact affect us? (Of what importance are the impacts?) Is the scale of impact beyond our control?
- Trend (What is the general direction of change?) Is there a general negative or positive trend in human well-being, or in the condition of natural resources? Is the impact positive or negative in terms of its contribution to sustainable development or its contribution toward avoiding unsustainability?

Spatial Scale of the Impact

- Level (Are the impacts felt globally, nationally, or locally?)
- Location (Where are the impacts felt, e.g. upstream/downstream?)

- Extent (How widespread are the impacts; do they occur beyond the project domain?)
- Intensity of the impacts (how strong are the impacts per unit area and time?) It is also important to determine whether the impacts are direct or indirect, primary or secondary. It is under this heading that the concept of externalities comes in, or the idea that a project has impacts that are external to the decision framework of the project manager.

Temporal Dimensions

- When are the impacts felt (e.g., right now or next generation)
- Incidence (pace or rate of change) of the impacts (How quickly are they disseminated?)
- Duration of the impacts (How long do they last?)
- Frequency (periodicity) (How often they occur?)

Source: Adapted from Gregersen and Lundgren 1993; and Eckman 1994