

Resource Integration and Shared Outcomes at the Watershed Scale

Eleanor S. Towns¹

Abstract.— Shared resources are universal resources that are vital for sustaining communities, enhancing our quality of life and preserving ecosystem health. We have a shared responsibility to conserve shared resources and preserve their integrity for future generations. Resource integration is accomplished through ecosystem management, often at a watershed scale. The shared outcome of resource integration is sustainability, which can be measured with the appropriate criteria and indicators. Using a watershed approach to land stewardship, we can identify priority problems, obtain stakeholder involvement, integrate the support and participation of multiple agencies, and measure success through monitoring.

Introduction

What do we mean by the term shared resources? Shared resources can be viewed as common resources that are essential for community economic growth, enhancing the quality of our lives and preserving ecosystem health. Shared resources cross ownership boundaries to reach a variety of users — the public (e.g., ranchers, farmers, industry, urban and rural communities, etc.), states, tribes, local governments and federal agencies. Air, oceans and watersheds are natural resources that are shared among many users who affect their quality. For example, if atmospheric emissions are reduced, many downwind ecosystems and watersheds may benefit. Shared resources can also mean migratory species such as birds or mammals, the variety of life and ecological processes (biodiversity), shared financial resources and shared knowledge among resource specialists.

The Southwestern Region of the United States Department of Agriculture Forest Service maintains an ecological basis for ecosystem management (Kaufmann *et al.*, 1994). By definition, ecosystem management crosses ownership boundaries and is practiced at various scales or hierarchical units, including the watershed level (U.S. Environmental Protection Agency, Environmental Monitoring and Assessment Program, 1997; USDA Forest Service, 1993; United States Department of Defense, Department of Agriculture and Department of the Interior, 1998). It is through ecosystem management that the various

resource areas are integrated and sustainability is ensured.

Shared outcomes are when the benefits of watershed management and watershed health are shared among many resources and sectors. These benefits include improved watershed condition; species and habitat conservation; sustainability of renewable resources; and social, cultural and economic benefits. For example, well-planned activities, as demonstrated by the Verde Watershed Association, can benefit streamflows, riparian species such as cottonwood trees, and landowners within the watershed (Verde Natural Resource Conservation District, 1999). Therefore, the benefits of watershed management are shared among communities, water resources, soils, wildlife, etc. The measure of success for resource integration and shared outcomes is sustainability.

Watersheds are natural ecological units. They provide an appropriate spatial scale for assessments and management activities such as restoration. The Environmental Protection Agency defines a watershed-scale approach to resource management as “a strategy for effectively protecting and restoring aquatic ecosystems and protecting human health” (United States Environmental Protection Agency, 1999a, b). Healthy watersheds are important because they can provide the timing, quality and quantity of water needed for designated uses such as domestic water supply, contact recreation and fisheries. Terrestrial ecosystems and the health of many organisms benefit from well-managed watersheds. Thus, a watershed approach to resource management can be an umbrella that allows many disciplines to focus on identifying priority problems, obtaining stakeholder involvement, integrating support and participation of multiple agencies and measuring success through monitoring.

Focusing on Watersheds

The Forest Service emphasizes watershed management. Existing guidelines include the President’s Clean Water Action Plan (United States Environmental Protection Agency, 1999), the Natural Resource Agenda (United States Department of Agriculture Forest Service, 1998) and the Southwestern Region’s ecology-based approach

¹ *Regional Forester, USDA Forest Service, Southwestern Region, Albuquerque, NM*

to ecosystem management (Kaufmann et al., 1994). The Southwestern Region is also a partner in the Southwest Strategy that is designed to ensure continuing collaboration with other federal agencies and the public (United States Department of Defense, Department of Agriculture and Department of the Interior, 1998). In addition, large-scale watershed restoration projects are being identified nation-wide by the Forest Service.

Clean Water Initiative

In January 1998, President Clinton announced his Clean Water Initiative to meet national clean water goals (United States Environmental Protection Agency, 1999). A key element of the initiative is *community-based watershed protection efforts at high priority areas*. Focusing on whole watersheds is one of four key elements for setting priorities and restoring and protecting the quality of our nation's rivers, lakes and coastal waters.

In order to revitalize the national commitment to shared water resources, nine federal agencies were directed to develop a comprehensive plan for watershed protection i.e., the Clean Water Action Plan). The goal of this document is to accelerate the rate of progress in the improvement of America's water quality. The Action Plan is designed to provide cleaner water, public health protection, watershed protection at high priority areas, and stable water resources for communities. The nine agencies are working with tribal, state, and local partners to implement the Clean Water Action Plan.

Federal land management agencies are also developing a unified federal policy for ensuring a "watershed approach" to federal land and resource management (United States Environmental Protection Agency, 1999a). The proposed national policy is designed to improve water quality and aquatic ecosystems on Federal lands. The Unified Federal Policy emphasizes:

- assessing the function and conditions of watersheds;
- incorporating watershed goals in planning;
- enhancing pollution prevention;
- monitoring and restoring watersheds;
- recognizing waters of exceptional value; and
- expanding collaboration with others.

The draft policy outlines specific federal commitments that can achieve consistent watershed assessments; improve watershed management; comply with water quality requirements; and enhance collaboration with states, tribes and others. It also provides a schedule to meet those

commitments. According to the policy, watershed management priorities will be based on the geographic extent of the watershed under federal management, the magnitude of the existing impairment, vulnerability to degradation, the amount of public interest, and concerns that arise from state and tribal assessments.

Natural Resource Agenda

On March 2, 1998, USDA Forest Service Chief Mike Dombeck announced a Natural Resource Agenda for the 21st Century (United States Department of Agriculture Forest Service, 1998). The first priority of the Natural Resource Agenda is to maintain and restore the health of ecosystems and watersheds. The agenda focuses on four key areas: watershed health and restoration; sustainable forest ecosystem management; forest roads; and recreation. Chief Dombeck challenged the agency to lead by example, saying "We can lead by using the best available scientific information based on principles of ecosystem management that the Forest Service pioneered. And we can use the laws that guide our management to advance a new agenda." This effort echoes the emphasis placed on watershed conservation by other federal policies and mandates.

According to the Natural Resource Agenda (United States Department of Agriculture, Forest Service, 1998) goals for healthy watersheds on the national forests will be achieved when:

- healthy, diverse, and resilient aquatic systems support a variety of conditions and benefits;
- forest and grassland systems support all biological and physical components, functions, and interrelationships and their capability for self-renewal;
- rangeland systems include robust riparian systems and a variety of conditions and benefits;
- populations of threatened, endangered, and sensitive species are abundant and thriving;
- watersheds provide the timing, quality, and quantity of water needed for beneficial uses and to sustain desired conditions; and
- soil is productive enough in the long term to support healthy, diverse, and resilient terrestrial and aquatic ecosystems.

Southwest Strategy

On December 16, 1997, nine federal agencies in Arizona and New Mexico began a cooperative program called the "Southwest Strategy." The strategy encourages close work

with the public to develop a natural resource conservation and community development strategy for management activities under their jurisdiction (United States Department of Defense, Department of Agriculture and Department of the Interior, 1998). The Southwest Strategy recognizes that federal agencies need to be consistent and collaborate to most effectively serve communities and the public. As a federal family, agencies must reshape and strengthen relationships with other governments—tribal, state and local authorities. Only collaboration between researchers and scientists, public land managers and members of the public can lead to public land conservation that meets the needs of the land as well as people.

Large-Scale Assessments

The Forest Service is in a nation-wide process of identifying large-scale watershed restoration projects. Each project is intended to provide significant results over about 80,000 - 200,000 hectares. These restoration projects are being designed to enhance water quality, wetlands, migratory bird habitats, fisheries, riparian areas and watersheds. A key component of these projects is continuing partnerships with conservation organizations, state and tribal governments, other federal agencies, communities, private corporations and others.

Global Efforts Toward Sustainability

The federal government has international commitments to sustainable ecosystems. In 1995, the United States participated in an international agreement for Conservation and Sustainable Management of Temperate and Boreal Forests, known as the *Santiago Declaration* (Congressional Research Service, 1995; United Nations, 1995). Seven criteria (conditions or processes) and corresponding indicators (measures) for conservation and sustainability were identified. The seven criteria are:

- conservation of biological diversity;
- maintenance of productive capacity of forest ecosystems;
- maintenance of forest ecosystem health and vitality;
- conservation and maintenance of soil and water;
- maintenance of forest contribution to global carbon cycles;
- maintenance and enhancement of long-term multiple socioeconomic benefits to meet the needs of societies; and
- legal, institutional and economic framework for forest conservation and sustainable management.

Indicators are provided for each criterion in the *Santiago Declaration*. Examples include:

- ecosystem diversity addresses fragmentation, succession, etc.), species diversity, genetic diversity for *conservation of biological diversity*;
- production and consumption; recreation and tourism; investment in the forest sector; cultural, social and spiritual needs and values; and
- employment and community needs for *socioeconomic benefits*.

The participating countries of Australia, Canada, Chile, China, Japan, the Republic of Korea, Mexico, New Zealand, the Russian Federation and the United States represent about 90 percent of the world's temperate and boreal forests (Congressional Research Service, 1995). Other international efforts are targeting the sustainability of water resources. For example, the Israel Academy of Sciences and Humanities, Palestine Academy for Science and Technology, Royal Scientific Society, Jordan, and the U.S. National Academy of Sciences are collaborating on programs that can provide sustainable water supplies in the Middle East while preserving environmental quality (Committee on Sustainable Water Supplies for the Middle East, 1999).

Grey Towers Protocol

A land conservation strategy known as the Grey Towers Protocol was established in a summit sponsored by the Pinchot Institute for Conservation. Results are contained in a subsequent publication entitled "Land Stewardship in the Next Era of Conservation." The Protocol defined stewardship as "*passing the land and resources — including intact, functioning forest ecosystems — to the next generation in better condition than they were found*" (Sample, 1991). The Protocol also states that "*management activities must be within the physical and biological capabilities of the land, based upon comprehensive up-to-date resource information and a thorough scientific understanding of the ecosystem's functioning and response.*" This implies that Forest planning and land management activities need to allow for climatic extremes, like drought associated with the El Nino Southern Oscillation (ENSO) climatic cycle. Therefore, stewardship means maintaining future options. Like physicians, land managers should strive to "do no harm" to ecosystem integrity.

Further National Efforts Toward Sustainability

Additional assistance in moving the agency toward sustainability may come from the United States Environmental Protection Agency's Environmental Monitoring and Assessment Program (EMAP). The research program will develop new technological tools to monitor and assess the status and trends of national ecological resources (United States Environmental Protection Agency, 1997). The goal of EMAP is "to develop the scientific understanding for translating environmental monitoring data from multiple spatial and temporal scales into assessments of ecological condition and forecasts of the future risks to the sustainability of our natural resources."

The Forest Service maintains strict Standards and Guidelines during project planning and implementation. Forest Plans are constrained by the standards and guidelines to protect and improve soil and water quality. In December 1997 the Secretary of Agriculture appointed a distinguished panel of natural resource scientists and professionals to review and evaluate our current land management planning process. The 13-member committee provided scientific and technical advice for improving the planning process for resource management on National Forest System Land. In their report, the Committee of Scientists said that sustainability — the preservation of plants, animals and habitats— should be the first priority in managing Forest Service natural resources (United States Department of Agriculture Forest Service, 1999). They also recommended more partnerships in making management decisions, including outside groups such as industry, recreation, environmental proponents and other government agencies. The report supports a Forest Service mission of providing multiple benefits to people within the capabilities of ecosystems. The Committee of Scientists recognized that in the past the agency focused more on timber and forage resources, but that today emphasis is placed on water and recreation resources.

Methods for Watershed Management of Shared Resources in the Southwestern Region

Watershed management is directed toward specific geographic areas that cross boundaries of ownership and management responsibility. Although watersheds such as the Rio Grande Basin cross international boundaries, smaller watershed scales are appropriate for local actions.

The Forest Service uses a variety of methods to protect shared resources within watersheds. These include Best Management Practices (BMPs) for water quality protection, soil condition objectives, ecological-unit inventories and monitoring protocols to determine stream health and riparian function. Potential risks to water resources are also assessed through erosion modeling.

Best Management Practices emphasize controlling nonpoint source pollution. For example:

- minimizing impacts of roads at stream crossings;
- maintaining buffer zones of inactivity along riparian areas;
- protecting water quality within developed recreation sites;
- revegetation of disturbed areas; and
- mined-land reclamation.

Best Management Practices used in the Southwestern Region are described in the Region's Soil and Water Conservation Practices Handbook. They are designed to meet federal, state and tribal water quality requirements. The effectiveness of BMPs is determined by monitoring, and adjustments are made if monitoring results indicate that the BMPs do not adequately protect water quality.

The Southwestern Region of the Forest Service has implemented soil condition guidelines as a measure of changes in long-term soil productivity. The ability of the soil to function properly and retain its productivity is categorized as either satisfactory, impaired or unsatisfactory based on a soil condition-rating guide. Three soil functions that are rated to indicate soil condition are hydrologic function, stability against mass movement or erosion, and nutrient cycling. The soil condition-rating system incorporates indicators for each soil function, and the range of conditions is described for each indicator. Examples of soil condition indicators include infiltration, erosion, litter, and vegetative community composition.

The Southwestern Region of the Forest Service has an ecological inventory and classification system, the Terrestrial Ecosystem Survey (TES). The TES delineates ecological units based on climate, soil and vegetation. It contains a description of soil and vegetation type by map unit. A TES map unit is a collection of areas delineated by soil taxonomy; climate class; soil particle size, depth, texture, temperature class, mineralogy class; vegetation association (taxonomic abbreviation) and climax vegetation class (United States Department of Agriculture Forest Service, 1986). Preliminary map units are drawn from aerial photos then surveyed using transects and plots. Final TES map units incorporate the field observations and are recorded and displayed using a Geographic Information System. The results of TES inventory and mapping are

available to all managers. This information is used to identify special use limitations, hazards and improvement opportunities for management units in the Southwestern Region.

The Water Erosion Prediction Project (WEPP) is a computer model that analyses how land use affects soil erosion and sediment delivery. This assessment tool contributes to making knowledgeable predictions prior to enacting a management practice that could influence sediment transport. Since it is not practical to monitor the effect of management practices in all ecosystems under all weather conditions, erosion predictions can be used to rank alternative practices based on potential impacts on erosion rates (Laflen et al., 1991).

The Forest Service also has a protocol to assess stream health called T-Walk for *Thalweg - Watershed Area Link*. (Thalweg is the term for the deepest part of a stream channel.) These assessments evaluate: a 200 meter stream reach for diversity, productivity, stability (factors like pool depth, substrate, habitat, bank stability); and 16 ha of land for land-use effects on erosion, sediment transport and concentration of pollutants (Ohlander, 1998). This information can be used to help develop restoration plans.

Riparian areas can be described as stream-side transition zones between terrestrial and aquatic ecosystems. They are also corridors within landscapes that facilitate the flow of energy and species, and the cycling of materials. Many small birds require or utilize riparian nesting habitats (United States Department of Agriculture Forest Service, Riparian / Terrestrial Research). In the Southwest, a large percentage of birds utilize riparian areas, especially at low and mid elevations (Johnson et al., 1977, 1987; Cartron et al., 1999). One assessment method for riparian areas is called Proper Functioning Condition (PFC), a joint effort by the Bureau of Land Management and the Forest Service. It requires interdisciplinary teams to assess stability and determine whether riparian areas are either functioning properly, functional-at-risk, or nonfunctional (Rosenlieb et al., 1998). Accelerated wetlands losses are also a concern.

Discussion

At the dawn of the new millennium rests the promise and uncertainty of the global future. Exponential population growth, climate change and other global concerns are evident. In response, many efforts are coming together that can lead toward the sustainability of shared resources. These struggles to achieve sustainability are occurring from the global level to local levels. The watershed ap-

proach to resource integration is an important reflection of our agency's long-held commitment to stewardship.

The standards, guidelines, mandates and tools mentioned above are used in the Southwestern Region for watershed management and restoration activities. Watershed improvement projects help restore areas that have been damaged. Improvements are designed to reduce sediment transport to streams, reduce erosion from runoff, or improve soil condition. Watershed improvement treatments include large-scale treatments such as prescribed burning, and forest or woodland thinning and seeding. Other treatments are site-specific measures such as the installation of channel structures, road obliteration or relocation, and abandoned mine restoration. Assessment and prescriptions are also made for natural disasters that affect watershed condition like large wildfires, floods or windstorms. About 4,050 hectares are currently treated each year in the Southwestern Region.

At this time the Forest Service is entering into a new fiscal management and accounting process. The ability of the new system to integrate funding from various resource functions is currently being studied. When in effect, it will facilitate the implementation and monitoring of regional watershed management projects, the storage and retrieval of watershed management data, and data analysis. The results of these analyses will improve our ability to move toward adaptive resource management that utilizes new data as a feedback loop for updating management decisions.

What Lies Ahead?

Financial investors and gamblers can testify that predictions can be both precarious and dangerous! Given this disclaimer, here are some potential futures for watershed-scale management in the Southwest.

- Control of Southwestern water resources will be the biggest management issue during the next several decades.
- Watershed management will be a standard protocol to protect water quality, reduce contamination, and support healthy ecosystems.
- Watershed management partnerships will thrive and provide unique solutions to local problems.
- The role of National Forests in protecting shared resources will be more evident, as mandated through the Organic Act.
- The public will be more aware that preventing contaminants from reaching drinking water sup-

plies reduces the need and costs for treatment and ensures a sustainable water supply.

- Water for wildlife and plant species (vs. water for human needs) will require urban, community, and multi-agency collaborative negotiations.
- Water conservation efforts will accelerate in response to increasing demands on water supplies.
- The Forest Service will be a conservation leader by using the best available scientific information and ecology-based principles of ecosystem management.
- Restoration of Southwestern riparian areas will present a challenge for decades to come.
- There will be increased international coordination to reflect concerns for the global economy and the global environment.

Summary and Conclusions

Shared resources such as soil, water, air and biological diversity demand efficient use, prudent management, and protection from degradation. Everyone shares in the benefits of healthy, communal resources and depends upon them for survival. Watersheds link our shared natural resources and provide large-scale units on which conservation efforts can be focused.

Resource integration and shared outcomes are important at the international, national, regional and local levels. The Santiago Agreement signifies international cooperation for achieving sustainable water resources. The President's Clean Water Action Plan provides the foundation for accomplishing our watershed management goals at the national level. The Natural Resource Agenda provides parallel agency direction to maintain and restore the health of our ecosystems and watersheds. The Southwest Strategy provides the framework for interagency and public collaborations. A watershed emphasis in land stewardship results in sharing knowledge, working together to find and apply solutions to problems, and exploring a wider array of management options.

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