PERSPECTIVES ON WATERSHED MANAGEMENT IN ARIZONA

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Watershed management perspectives at global, national, and regional levels apply equally to Arizona. Issues identified by Brooks and Eckman (2000) at the global level, Adams et al. (2000) at the national level, and Ffolliott et al. (2000) at the regional level—such as water scarcity, water pollution, and a scarcity of land and natural resources—are all relevant in considering past, present, and future perspectives on watershed management in Arizona. Watersheds are effective planning units for ecosystem-based, multiple-use oriented watershed management practices, projects, and programs at all levels. However, as pointed out by Adams et al. (2000), continued use of watersheds in a planning capacity will depend largely on whether watershed management issues are responsively prioritized by decision makers. The ability to adequately balance the competition for consumptive natural resource use, advancement of appropriate technologies, and development of effective land-use policies will also affect the continued planning for watershed use (Ffolliott et al. 2002). These are certainly relevant in Arizona.

PAST PERSPECTIVES

Watershed management from the early 1940s through the beginning of the 1980s was focused largely on increasing water yields through vegetation management on upland watersheds. Water-yield improvement tests were conducted on experimental watersheds throughout the state (Baker 1999; Baker and Ffolliott 2000; Fox et al. 2000). If the experiments proved successful in increasing water yields, they were scheduled to be implemented operationally. Experiments with clearcutting, other silvicultural treatments, and conversions from high-water-consuming vegetation to low-consuming vegetation have demonstrated that water yields originating on the upland watersheds could be increased to varying magnitudes and duration by changing the structure and compositions of the vegetative cover on a watershed. Any additional water yields were attributed largely to decreases in transpiration rates.

The emphasis had shifted by the late 1970s from water-yield improvement to concerns about the quality of the water originating on upland watersheds; this remains a main focus today (Ffolliott et al. 1997). Part of this concern evolved from the increased public awareness of environmental quality issues in natural resources management. This heightened level of concern was exemplified by passage of the National Environmental Policy Act and the Clean Water Act, along with creation of the Environmental Protection Agency in the early 1970s (Ffolliott et al. 2002). Watershed management took on the added dimension of ensuring that whatever practices were implemented also considered the physical, chemical, and biological qualities of water originating in streams from upland watersheds.

PRESENT PERSPECTIVES

Watershed management practices are presently grouped into those that minimize any adverse impacts to the soil and water resources to maintain the status of watersheds in good condition, those that sustain high-quality water flows originating on upland watershed lands, and those that rehabilitate watersheds to increase productivity (Baker 1999; Baker et al. 1995; Lopes and Ffolliott 1992). It is important to protect the watershed lands in Arizona from further deterioration of their fragile soils and limited water resources. Past degradation, often widespread, has been attributed largely to overgrazing, fire suppression, and both high-intensity rains and prolonged droughts. Watershed management practices similar to those used to prevent excessive rates of initial erosion are implemented to reduce further degradation of watershed resources.

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Road construction is prohibited in or near stream channels. When roads are closed to public travel, the roadways are seeded with herbaceous plant species to protect against erosion. Timber harvesting in Arizona and elsewhere in the Southwest has recently been sharply curtailed in response to environmental concerns. Livestock grazing and recreational use is continually monitored to determine if and when remedial actions should be taken to mitigate the impacts of these land uses on stream channels, riparian ecosystems, and water quality. Prescribed burning and mechanical control treatments are used to reduce excessive fuel accumulations on sites prone to wildfire (Edminster et al. 2000). These actions are essential components of integrated watershed management to maintain the lands in a good condition, to accommodate ecosystem-based, multiple-use management programs, and to address the increasing public concern about threatened and endangered plant and animal species.

Sustaining high-quality water flows from upland watersheds is another major focus of present watershed management. Water shortages, always present in Arizona, will likely become even more limited in the future as human populations increase. Although large-scale manipulations of vegetative cover specifically to meet water-yield improvement objectives are not planned, a custodial management strategy to maintain the health of the forests, woodlands, and shrublands in the region is paramount (Baker 1999); such management practices are consistent with sound land stewardship. Best management practices (BMPs) are often selected as the best approach for sustaining high-quality water flows. The BMP approach involves identification and implementation of watershed management practices to reduce or prevent nonpoint pollution (Brown et al. 1993; Ffolliott et al. 2002). Many of these practices are well known for mitigating erosion-sedimentation processes from agricultural, forestry, and road construction activities (Brooks et al. 1997). The BMPs for mitigating some types of chemical pollutants, however, are not currently known.

Concern for the declining health of watershed lands and riparian corridors has led to implementation of management practices to restore the proper hydrologic functioning of degraded watershed and riparian ecosystems (Baker et al. 1999). Management practices implemented to rehabilitate watersheds in poor condition include controlling gullies and mass wasting with properly constructed check dams and other mechanical controls; protecting unstable stream channels from further damage; establishing protective tree, shrub, or herbaceous covers on degraded sites; and further curtailment of timber harvesting, livestock grazing, and other exploitative land-use practices (Baker 1999; Baker et al. 1998).

FUTURE PERSPECTIVES OF WATERSHED MANAGEMENT

Future watershed management perspectives in Arizona, elsewhere in the Southwest, and throughout the nation will likely represent a more holistic approach to managing the biological, physical, and social elements on a landscape delineated by watershed boundaries (Ffolliott et al. 2002). Watershed management practices must be based on the art and science of managing natural resources on a watershed basis to provide goods and services to society without adversely affecting the basic soil and water resources. Watershed management must also broaden its past focus on wildlands to include the urban fringe and urbanized areas to contend with anticipated population needs. More specific perspectives are considered below.

Continuing Emphasis on Watershed Improvement Practices

Future watershed management practices will continue to minimize adverse impacts, sustain high-quality water flows, and rehabilitate watersheds in poor condition. It is likely that these practices will be intensified as monitoring activities identify the need to require remedial actions to restore properly functioning hydrologic processes on the watersheds (Baker et al. 1999). Implementation of BMPs should help achieve these objectives.

BMPs for silvicultural treatments, livestock-grazing practices, road-related disturbances, and agricultural practices to mitigate erosion-sedimentation processes are known (e.g. Chaney et al. 1990; LaFayette et al. 1992; Lynch et al. 1985), but BMPs for chemical pollutants are incomplete. Regardless of the situation, specifying BMPs to attain a designated water-quality standard in a cost-effective manner requires an understanding of the cause-and-effect relationships between land disturbances on upland watersheds and the quality of downstream water, as well as knowing the costs of alternative approaches to mitigation.

Sustaining the Integrity of Riparian Ecosystems

Riparian ecosystems are situated in the interfaces between terrestrial and aquatic ecosystems along the banks of streams and rivers and around the edges of meadows, lakes, and reservoirs. These ecosystems provide the necessary water for humans, livestock, and agricultural crops throughout Arizona. Other resources available in these moist environments include wildlife and fish, livestock and wildlife forage, and shade for recreational activities. Insuring the sustainability of riparian corridors, therefore, will likely be a major thrust for future watershed improvement practices. Obtaining increased knowledge about the fluvial, geomorphological, and ecological functions, processes, and dynamics of these unique landscapes is needed to sustain diverse and healthy riparian ecosystems into the future (Baker et al. 1999). Maintaining the integrity of these systems will also require careful management and, in some cases, protection from overgrazing by livestock and wildlife, excessive tree-cutting activities, and intensive and concentrated recreational use.

A continuing assessment of the condition of riparian ecosystems and efforts to restore the functioning of riparian ecosystems that are at risk because of inappropriate management in the past will undoubtedly be another focus of future management. Although there is often a public perception that riparian ecosystems are fragile, available information indicates that these systems are often quite resilient (Baker and Medina 1997; Baker et al. 1999). Furthermore, current research suggests that the functioning of many degraded riparian areas can be restored when stresses such as overgrazing by livestock and wildlife are relieved through the use of inexpensive materials and equipment and changes in land-use practices.

Increased Emphasis on Demands for Watershed Resources

Much of the watershed-research effort in the past and the present has been focused largely on the supply side of watershed management, for example attempting to increase the flows of high-quality water from watershed lands. Other approaches to increasing water supplies have also been explored, such as water harvesting and spreading, gaining access to deep aquifers, and modifying storage techniques to reduce evaporation rates (Gregersen et al. 2000). These supply-side efforts will probably continue to be a focus of watershed management where realistic opportunities are present. However, watershed management practices must also emphasize the demand side of the resource-availability equation.

Innovative technological approaches to reducing the demand for watershed resources alone might be insufficient in solving future scarcity problems. The unequal distribution of water and other natural resources on watershed lands could be more limiting than a failure to implement improved technologies (Gregersen et al. 2000). A lack of institutional capability and effectiveness in planning and managing for scarcity and a failure to incorporate market forces into future allocation plans can also contribute to this problem.

More Efficient Use of Limited Watershed Resources

The benefits of watershed management will become evident through more efficient use of the limited watershed resources in Arizona. To paraphrase Gregersen et al. (2000), greater efficiency in the use of watershed resources is likely to be attained by changing to technologies that use these resources more efficiently and effectively. Giving people more responsibility for their use of limited watershed resources to encourage conservation is also needed. Increasing the real or imputed prices for water, livestock forage, wildlife habitats, and recreational opportunities to reflect their true scarcity-value and the costs of supplying them is also necessary.

A focus on improving the stewardship of available (existing) supplies of water and other watershed resources will be necessary despite any progress made to increase the supplies or reduce the demands for these resources. To that end, more effective applications of known technologies should be encouraged, watershed-management technologies must be improved, effective technology transfer mechanisms should be developed, and public awareness of the need to balance the economic and environmental values of available watershed resources must be increased.

SUMMARY

Past perspectives on watershed management in Arizona have evolved from a desire to increase the quantity of water available to a desire to protect its quality. Present perspectives are centered on minimizing adverse impacts to soil and water resources, sustaining high-quality water flows, and rehabilitating watersheds in poor condition.

Future watershed management will likely become more holistic than what presently exists; this will occur largely through increased emphasis on reducing the demands for watershed resources, from more efficient use of limited watershed resources, and with better management of available watershed resources. With broad public participation and stakeholder involvement, this integrated vision must be the future focus of watershed management to effectively respond to people's concerns about improved land stewardship.

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