

THE SUSTAINABLE DEVELOPMENT OF WATER RESOURCES

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The sustainability of water is critical to local, regional, national, and global security. It is impossible to think of a resource more essential to the health of human communities or their economy than water. Water runs like a river through our lives, touching everything from our vigor and the fitness of natural ecosystems around us to farmer's fields and the production of goods we consume (Adler, 2002). Inequitable access to resources, like water, cause poverty and environmental degradation that results in human conflict. And with conflict comes regional and national disputes that can best be alleviated by the sustainable use of these resources.

Unfortunately, societies worldwide have not always appreciated the need to protect adequate sources of freshwater. Water consumption has nearly doubled since 1950 (UNESCO, 2003). Thus, much of the world suffers greatly from inadequate access to potable water. According to United Nations statistics, more than 200 million people every year suffer from water-related diseases, and about 2.2 million of them -- mostly the poor -- die. About 20% of the Earth's population of 6.2 billion lacks access to safe drinking water (Hall, 2003).

The human demand for water has been particularly devastating to natural ecosystems, such as wetlands, lakes, and rivers. For example, globally the world has lost half of its wetlands, mostly in the last 50 years. One-fifth of the world's freshwater fish -- 2,000 of the 10,000 species identified so far -- are endangered, vulnerable, or extinct (GreenBiz.com, 2003).

Besides being an integral part of the ecosystem, water is a social and economic good. Demand for water resources of sufficient quantity and quality for human consumption, sanitation, agricultural irrigation, and industry will continue to intensify as populations increase and as global urbanization, industrialization, and commercial development accelerates (Flint and Houser, 2001). The conservation of biodiversity, aquatic habitats, and complete ecosystems will likewise, from an ecological perspective, demand requirements for water resource planning and management, such as the need to maintain minimum in-stream flows and to anticipate the impact of hydrologic modifications on downstream environments (Flint, et al., 1996). Therefore, it is critical that management efforts intended to be sustainable fully consider the health and operation of aquatic ecosystems on which they are based, and that the environmental value of watersheds be recognized when making decisions on water allocation and use.

This presentation provides an overview of how to approach the sustainable use of water resources from a holistic perspective by considering a set of principles that can promote a multi-dimensional way of protecting water resources and achieving their recovery to improve quality of life for everyone. Discussion will focus upon how achieving sustainable development requires groups and organizations to pursue an evolving and ever-changing program of activities, including a continuous process of evaluating current and emerging trends, an ongoing means of encouraging citizen participation and negotiating conflicts, and an updating of plans. And because plans are

intended to reflect substantive policy outcomes, principles of sustainability will be defined to guide future water resources management actions. With these guiding principles a framework will exist for incorporating the concept of sustainability into decision-making at all levels of the public and private sector that finds itself focused on watershed-wide development issues.

New requirements for natural resource assessments, stipulated for example in the 1992 Rio Conference, Agenda 21, include: (a) integrated and timely access to data and information from many different sources and disciplines; (b) analysis of environment-development interactions and policy/management options; (c) identity of cause and effect relationship as well as emerging issues of potential international importance; and (d) assessment of potential impacts and long-term sustainability of alternative development, policy, or management scenarios. To address these needs, we must develop and implement new frameworks for organizing and integrating water resources environmental information, and new tools to assess the information and communicate results to decision-makers. The framework discussed here for achieving sustainability of water resources will include the following elements: (1) articulating a general concept for what sustainable water resources means; (2) identifying the overall goals for developing sustainable water resource strategies; (3) defining the characteristics that identify criteria for sustainability; and (4) delineating the indicators that will tell us how we are doing in achieving sustainability criteria.

The sustainable development of water resources is a multi-dimensional way of thinking about the connections among natural, social, and economic systems equally and simultaneously in the use of water (the three overlapping circles model). For example, consideration of the value of ecosystem services is a method for blending social sciences and environmental science to better understand the economic benefits of watershed protection (Flint, 2003). Integration across sectors will be essential to meet growing challenges of the 21st century. In fact, as population and economic growth place increasingly greater demands on finite aquatic resources, it is doubtful that many activities can afford not to integrate. Likewise, sustainability advocates consideration of space and time scales. It recognizes interactions among different geographical ranges - globally, nationally, regionally, and locally. Acting in a sustainable way also challenges us to look to the future, and to fully assess and understand the implications of the decisions made today on the lives and livelihoods of future generations and the natural ecosystems they will rely upon. This view of sustainable water resources development implies that the conventional economic imperative to maximize production is accountable to an ecological imperative to protect the ecosphere, and a social equity imperative to minimize human suffering.

Goals can be established to begin the in-depth, integrated assessment of watershed resources that lead to sustainability. These goals should be formulated to address a number of fundamental principles that underlay the conservation, protection, remediation, and longevity of water resources. Such goals might include:

- Provide safe, adequate water supplies at times and of the quantity needed for domestic, municipal, industrial, agricultural, and hydropower uses.
- Allocate effectively and fairly freshwater among diverse uses and users.
- Protect freshwater supplies in jeopardy from depletion of groundwater aquifers and/or salt water intrusion.

- Reduce discharges of pollutants into surface waters and eliminate contamination of groundwater.

equivalent, to integrate a watershed approach.

- m) Decisions on water quantity and water quality are considered concurrently, because when evaluated separately these issues pose challenges for water resource management and protection (i.e. in determining whether aggregate pollution from multiple sources exceed standards, both the total amount of pollution reaching the water body and the amount of water present to “dilute” or “assimilate” the wastes affect the determination).
- n) Water conservation strategies are regularly relied upon for reducing waste of water, using water more efficiently, and meeting new demands using existing water supplies.
- o) Holistic, integrated assessment strategies with regards to water allocation and transfers are adapted to limit impact on the economic stability of rural communities.

After a consensus is developed with regards to criteria that describe the future longevity of healthy water resources, indicators to measure sustainability can be defined. Indicators will tell decision-makers and society in general, how we are doing toward the achievement of sustainable use with regards to water resources. Indicators represent standards for measuring characteristic criteria (conditions) of sustainability.

Sustainable development is the centerpiece and key to water resource quantity and quality, as well as to national security, economic health, environmental stability, and societal well-being. Following the guidance of the overlapping circles model (three-legged stool analogy), and incorporating an adaptive management approach to decision-making, allows us to transform the rhetoric of sustainable development into actions that better align economy, environment, and society, by increasing the area of circle overlap. In this way we can test our making of choices and the consequences they represent, to guarantee each act, project, or program implemented will not degrade the environment upon which economic prosperity and social stability rest, by asking the following:

- Does this choice provide an economic benefit? What is it?
- Does this choice provide an environmental benefit? What is it?
- Does this choice offer equal benefits to all sectors of society? What are some?
- Was this choice agreed to through the participation of all stakeholders?

If the answer to any one of these questions is NO, then the project, program, or act should be re-thought to better address the core principles of sustainability.

It is equally important to recognize the fact that sustainability is not strictly a problem of science, engineering, or economics, but is also founded on values, ethics, and the equal contributions of different cultures. Additionally, all members of a community have a shared future; they are dependent on each other in ways that are both complex and profound. Thus, ideals of preservation and protection on the one hand, and of economic vitality and opportunity on the other are not in conflict, but rather in a sustainable future they are linked together. And, we recognize our ability to see the needs of the future are limited; therefore, any attempt to define sustainability should remain as open and flexible as possible, through the guidance of adaptive management.

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