

SUSTAINABLE DEVELOPMENT / WATER INTERACTIONS

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Summary

Even though it is probably true that in more recent times the water planning and management procedures used in most parts of the appear to have been reasonably adequate, it is now becoming increasingly questionable. A sustainable approach is now required. Yet, it is quite one thing to say “sustainable” in every breath, and another to create a sustainable system when the definition is so vague. A number of questions will certainly have to be answered if water resources experts are to become successful

‘sustainable water resource developers’. Unified concepts for designing, operating and maintaining water resource systems that could assure planners of a sustainable product are still to be developed.

While the notion of sustainability has existed for a long time, the Brundtland report (WCED, 1987) certainly brought the concept into the focus of discussions and arguments throughout the world. It is coming to be realized that if we continue in the old manner it will not be possible to continue to develop and prosper as we have in the past, or to the extent we have the potential to do so in the future. It would seem that everyone is in favor of planning and developing our resources in something called a ‘sustainable manner’. Ignorance about what the future will look like should not, however, be an excuse for inaction by decision-makers.

Because we see the future with imprecision, and since the planners will be required to make guesses about the future, planning and decision-making processes need to be **sequential** and **adaptive**. The assumptions made concerning the future need to be re-evaluated each time planning or decision-making takes place. This must be built-in to a sustainable development process.

Adaptive management (a process of adjusting management actions and directions, as may be appropriate) will be necessary in light of changing future conditions of the total environment and on the progress toward meeting the developing new goals and objectives. It accepts the fact that there will be a continual need to review and revise environmental and other restoration and management approaches because of the changing and uncertain nature of future socio-economic and natural environments.

The inclusion of sustainability criteria along with the more common economic, environmental, ecological and social criteria used to evaluate alternative development and management strategies will almost certainly identify a need to change how we commonly go about developing and using our resources. The concept of change itself is important, because, while there is no doubt that changes will occur over time, exactly what those changes will be is the only thing that is uncertain.

1. Introduction. What Is ‘Sustainable Development’?

While the term ‘sustainable development’ is used today as though it were a completely new concept, the *idea* is not. Planners in earliest times certainly considered the idea, even if they did not use the term. The real question becomes, “What is it that we mean when we say water resources should be developed in a sustainable manner?”

Even though it is probably true that in more recent times the water planning and management procedures used in most parts of the appear to have been reasonably adequate, this is now becoming increasingly questionable. Certainly, there is no need for it to continue. The increasing competition for and the consequences of the development of the various natural resources have undoubtedly made most project-by-project planning methods inappropriate. And while the concept of multiple objective/integrated water planning has certainly been an improvement, if the planners are going to solve the problems that loom on the horizon, problems that are intensified

day by day with all sorts of man-induced factors, then new approaches (new philosophies of planning) will be required.

To begin with, we should agree that there is probably no such thing as *the problems*. For no matter how we view the problems today, they will keep changing over time. As we look into the future, water issues can be illusive target. And so if we have in mind trying to develop our water resources ‘sustainably’, even identifying the problems to be solved becomes very complicated.

There should be little doubt that the ingredients of sustainable development in general are important in establishing a sustainable water resources system in particular. Clearly this has been the case in planning in general, and has always been a factor in the development of society. It will certainly continue to be so, if not even more important in the future as we wrestle with the problems of implementing the concept of sustainability. Yet, it is quite one thing to say “sustainable” in every breath, and another to create a sustainable system when the definition is so vague. A number of questions will certainly have to be answered if water resources experts are to become successful ‘sustainable water resource developers’. These include:

1. Does sustainable development imply resource preservation? What about sources that can only be used once?
2. What is the impact of technology, population growth, and education? Is there something that needs to be done?
3. What can be done today for future generations? In fact, what would future generations want? Is there even total agreement on what today’s generation wants?
4. How much importance should be given to future generations compared to present generations? If we are not sure what they want, should we sacrifice the present?
5. How can sustainability objectives be defined in terms of a multi-objective decision-making framework? Is there a ‘way’ of doing sustainable development planning and management?

While from general discussions it would seem to be of great importance that the challenge of sustainable development be accepted by water engineers, planners and managers, these ‘ideas’ yet remain to be translated into unified concepts for designing, operating and maintaining water resource systems that could assure planners of a sustainable product. Is it necessary? Yes, for the Brundtland Report (WCED, 1987) spoke in generalities about many subjects, it failed completely to mention the critical importance of water as a major factor in social, economic and environmental considerations in decision-making. Is that acceptable? **No**.

In anticipation of the holding of the UNCED (1992), and in particular noting the lack of reference to the importance of water in sustainable development in the Brundtland report, The International Conference on Water and the Environment (ICWE) was held in Dublin, Ireland, in January 1992 (ICWE, 1992). The “Dublin Statement” begins with:

“Scarcity and misuse of fresh water pose a serious and growing threat to sustainable development and protection of the environment ... unless water and land resources are managed more effectively in the present decade and beyond than they have been in the past.”

The participants of ICWE appeared to recognize the need for fundamental new approaches to development and management of a country's water resources which they believed could only be brought about through political commitment and involvement from the highest levels of government to the smallest communities. They urged governments to undertake specific activities, including:

- Integrated water resources development and management,
- Water resources assessment and impacts of climate change on water resources,
- Protection of water resources, water quality and aquatic ecosystems,
- Water and sustainable urban development and drinking water supply and sanitation in the urban context,
- Water and sustainable food production and rural development and drinking water supply and sanitation in the rural context, and
- Mechanisms for implementation and coordination at international, national and local levels.

2. Planning Concepts

It is convenient to use a short-hand method of defining a general planning process:

1. Project identification
2. Project assessment
3. Project screening
4. Project selection and implementation
5. Project monitoring and modification

But the process is almost never so simple and distinct, and in any case there are almost always a number of ‘evolutionary’ processes involved (see Figure 1). But it does hopefully ensure that a basic discipline will be imposed in the decision-making. It is not always the case.

2.1. Single or Multiple Purpose (B/C ratio) Planning

We can start (not at the beginning, but in more recent times) with the simple procedure of determining a benefit/cost ratio that exceeded unity (in fact, political realities never did insist that a B/C ratio exceed unity). More often than not, once a project was identified and had sufficient political power, the process moved very quickly to implementation. If in fact the project was monitored or modified afterwards, it was usually only for technical reasons. The decision-maker in fact was commonly the agency responsible for design and construction, and input from stakeholders was minimal, at best. While the situation today has advanced, it is not uncommon to find projects still being developed in this manner.

But multiple objective planning was a major step up. As noted in UNDTCD/UNEP (1988):

“Multiobjective planning is simply a procedure to increase the awareness of those involved in project planning, selection, and implementation of a wider variety of probable economic, environmental, and social impacts than might otherwise be the case. These impacts will usually include aspects that cannot all be expressed in economic or monetary units, but which may be important to those responsible for planning and making decisions. Decisions based on a broader spectrum of information regarding project impacts can lead to a more efficient use of resources allocated to development and to a higher and more stable rate of sustained social and economic development.

“ ... In effect, multiobjective project assessment involves an iterative interactive approach to planning and problem-solving which seeks to identify numerous objects that together represent an approximation of overall social welfare. It goes beyond conventional benefit/cost analysis to allow for the incorporation of a variety of criteria. These criteria should also include the spatial or distributional extent of any impacts and an estimate of the degree of irreversibility or reduction in future options resulting from the project.”

2.3. Integrated Water Resources Planning and Management

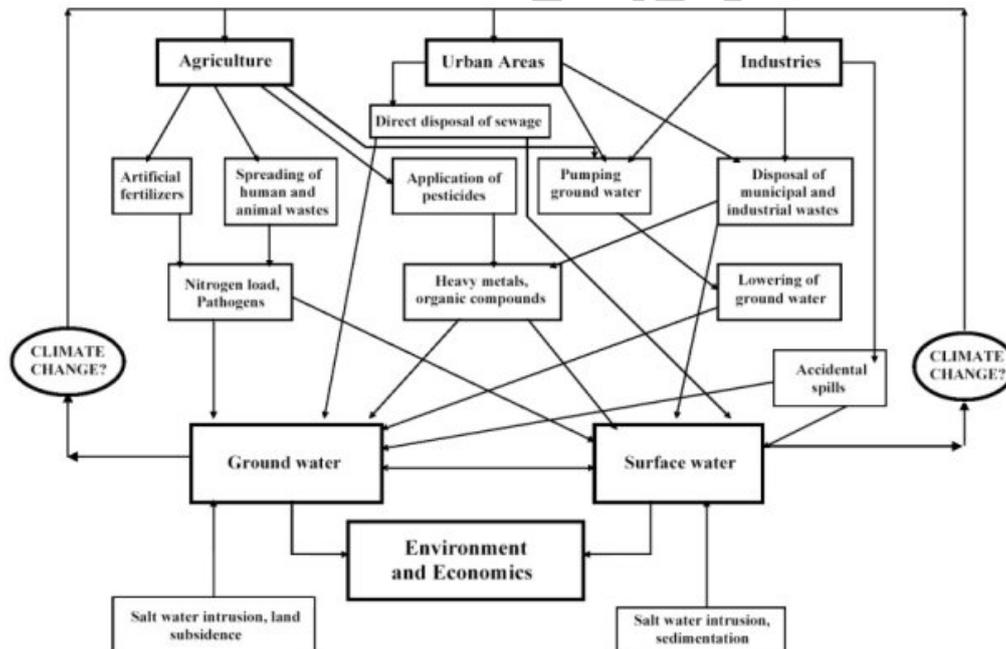


Figure 2. Some interactions between agricultural, urban and industrial land-use and water resources.

In recent years planners began to think seriously in terms of integrated water resources planning and management. A definition was proposed by Hufschmidt & Kindler (1991) as:

“Integrated water resources management is a set of actions that takes appropriate account of the important physical, economic, social and cultural linkages within the water resources system being managed. Examples are the physical linkages between land and water and surface water and groundwater, economic linkages between water uses such as irrigation and hydroelectric power production, and social linkages between water management and people who benefit or are adversely affected.” Figure 2 illustrates only a few of the interactions involved in some water resource planning activities.

The Dublin Conference (ICWE, 1992) established four main principles ‘that need to be applied in taking action to achieve integrated water resources development and management’. Briefly, they are:

1. That since water sustains all life forms, a holistic approach is needed for the development of human societies and economies, and the protection of natural ecosystems on which the survival of humanity ultimately depends,
2. There is a need for a participatory approach in institutions and arrangements for water development and management, and that this has implications for training and education,
There is a need to recognize the central role of women in the provision, management and safeguarding of water, and
3. There is a need to recognize that water has an economic value and, therefore, should be considered as an economic good.

The participants in the Dublin Conference recognized that water resources development and management should be planned in an integrated manner and that it should include the requirements of all users as well as those relating to the prevention and mitigation of water-related hazards, and it should be an integral part of the socio-economic development planning process. The need for sustainability was stated, but not developed.

2.4. Sustainable Development Planning

While the notion of sustainability has existed for a long time, the Brundtland report (WCED, 1987) has brought the concept into the focus of discussions and arguments throughout the world. It is coming to be realized that if we continue in the old manner it will not be possible to continue to develop and prosper as we have in the past, or to the extent we have the potential to do so in the future. It would seem that everyone is in favor of planning and developing our resources in something called a ‘sustainable manner’. And yet definitions of ‘sustainable development’ abound.

In general it is agreed that as a part of total sustainable development our water resource systems should be designed and managed to meet the needs of people who will be living in the future as well as those of us living today. Somehow planners are to take actions now to satisfy present needs and must also consider how those actions will affect future generations as well.

But this can be very difficult for planners, for universally accepted definitions do not exist for many basic concepts used by society, even, as we will note later, for those which concern our well-being. It has often even been argued that this lack of precision is useful for the very reason that they remain contested. And so, probably for that very same reason, sustainable development is acceptable to almost everyone who chooses to participate in environmental discussions. Being in favor of sustainable development as a result offers little or no risk or commitment to a specific set of goals or conditions since it is impossible to find such a set that is agreed upon. Almost any of us can find a personal interest somewhere within the concept, and so it is hard to be against it. As we will see later, however, there are concepts that if adhered to can increase the probability that sustainable development of our water resources can become a reality.

As noted by Loucks & Gladwell (1999), there are a number of important guidelines and criteria that should be included in the planning and management of sustainable water resource systems. They include:

- Developing a shared vision of desired social, economic and environmental goals benefiting present as well as future generations, and identifying ways in which all parties can contribute to achieving that shared vision,
- Developing coordinated approaches among all concerned and interested agencies to accomplish these goals, collaborating with all stakeholders in recognition of mutual concerns,
- Using approaches that restore or maintain economic vitality, environmental quality and natural ecosystem biodiversity and health,
- Supporting actions that incorporate sustained economic, socio-cultural and community goals.
- Respecting and ensuring private property rights while meeting community goals and working cooperatively with private stakeholders to accomplish these common and shared goals,
- Recognizing that economies, ecosystems and institutions are complex, dynamic (changing) and typically heterogeneous over space and time, and developing management approaches that take into account and adapt to these characteristics,
- Establishing baseline conditions for systems functioning and sustainability against which change can be measured, and
- Monitoring and evaluating actions to determine if goals and objectives are being achieved.

While sustainable development is a concept and a philosophy, as a planning method it is distinguished from other planning processes only by the approaches taken. There is no 1, 2, 3, ... progression that distinguish it drastically from Integrated Water Resources Management, for example, except to say that IWRM can be done in a sustainable manner or not. And yet there are a number of concepts within a planning process that must be considered if a sustainable development is to be successfully attained.

3. Sustainable Development Concepts and Procedures

3.1 Introduction

As noted by Loucks & Gladwell (1999):

“Sustainable water resource systems are those designed and managed to meet the needs of people living in the future as well as those of us living today. It is a philosophical concept. It is not a precise state of being. Sustainability criteria force us to consider the long-term future as well as the present. The actions that we as a society take now to satisfy our own needs and desires should not only depend on what those actions will do for us but on how they will affect our descendants as well. This consideration of the long-term impacts of current actions on future generations is the essence of sustainable development.”

But the concept of ‘sustainability’ can mean different things to different cultures and regions. So far it seems to defy a precise definition (As stated in the Brundtland Report (WCED, 1987), *development is sustainable if ... “... it meets the needs of the present without compromising the ability of future generations to meet their own needs.”* In Loucks & Gladwell (1999), *sustainable water resource systems are defined as: “... those designed and managed to fully contribute to the objectives of society, now and in the future, while maintaining their ecological, environmental and hydrologic integrity.”* Many other definitions exist, depending on the perspective of the viewer.).

In general the concept of environmental and ecological sustainability has largely resulted from a growing concern about the long-run health of our planet. We have usually tended to think only in terms of the immediate impact areas. But it is becoming more and more evident that present use and management activities of our resources could in the future have significant effects on the welfare of those living within much larger regions. The management of the resources is being seen as being closely related to much broader societal structures, demands and issues. In that sense, many so-called ‘local’ development and management projects will need to be considered much more from a multi-disciplinary and inter-regional perspective. So must larger ‘regional’ developments. But one must also ask what would future generations like done for them? What might they suggest be done by the planners today that would benefit them in the future? While this will never be known with any precision, assumptions (guesses) can be made. And as uncertain as the assumptions will be, they must be made. They must then be taken into account as the actions are considered to satisfy immediate needs, demands and desires. Tradeoffs, if any, between what present and future generations would like must be identified. It is the job of the professionals to do this. Once identified, or at least estimated, just what tradeoffs should be can be debated and decided openly in the public and political arena. Unfortunately, there is no scientific theory to help in the identification of which tradeoffs, if any, are optimum.

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Bibliography

ECLAC (1989). Guidelines for the analysis of water resource management procedures in Latin America and the Caribbean (Based on Peruvian experiences). United Nations Economic Commission for Latin America and the Caribbean, LC/G.1522, 26 April 1989.

Gladwell, John S. (1972). Water Resources Research - Its Role in the Total R&D Spectrum. *Special Study No. 20a*, National Water Commission, Washington, D.C., January, 1972.

Goodland, Robert, et al. (Eds.) (1991). *Environmentally Sustainable Economic Development: Building on Brundtland*. UNESCO. © 1991 UNESCO, Paris, France. 100 pp.

Hufschmidt, Maynard M. and Janusz Kindler (1991). *Approaches to Integrated Water Resources Management in Humid Tropical and Arid and Semiarid Zones in Developing Countries*. Technical Documents in Hydrology, UNESCO/International Hydrological Programme, Paris, 1991; 161 pp.

ICPR (1999). The International Commission for the Protection of the Rhine - ICPR. Internet web-site: <http://www.iksr.org/icpr/1uk>; 1999.

ICWE (1992). *Proceedings*. International Conference on Water and the Environment, Dublin, Ireland, January 26-31.

Loucks, D.P. (Chair) and J.S. Gladwell (Editor) (1999). *Sustainability Criteria for Water Resource Systems*. ©UNESCO (1999), Cambridge University Press, Cambridge, UK; 139 pp.

Mair, Amy Tyler (1999). Environmental software looks into the future. *Business in Vancouver*, BIV Publications, Vancouver, BC, Canada, September 7-13, 1999; p.7.

Mostert, Erik (1998). A framework for conflict Resolution. *Water International, December 1998, Vol. 23 No. 4, International Water Resources Association*.

Riverwoods (1999). Kissimmee. Riverwoods Field Laboratory, internet web-site: <http://www.eng.fiu.edu/everglades>; 1999.

Samson, Paul (1995). The concept of sustainable development. Green Cross International. Internet publication, 1/4/96.

Seattle Post (1999). Deal clears way to buy Elwha dams. *Seattle Post-Intelligencer*, by Michael Paulson, Washington Correspondent. October 20, 1999.

UNCED (1992). *Proceedings*. United Nations Conference on Environment and Development, Rio de Janeiro, Brazil, 3-14 June.

UNDTCD/UNEP (1988). *Assessment of Multiple Objective Water Resources Projects: Approaches for Developing Countries*. United Nations Department of Technical Co-operation for Development / United Nations Environment Programme, United Nations, New York, 1988. TCD/SEM.88/3 INT/84/R36.

UNEP/Smithsonian Institution (1995). Bright edges of the world, The Earth's evolving drylands; The Aral Sea. Internet Web-site, <http://drylands.nasm.edu:1995>.

UNESCO (1991). *The disappearing tropical forests*. IHP Humid Tropics Programme Series No. 1, Paris, May 1991.

WCED (1987). *Our Common Future*. (The Brundtland Report). Oxford, World Commission on Environment and Development. Oxford University Press. 383 pp.

Biographical Sketch

Dr. John S. Gladwell's first degree, a B.S. in Business Administration (Trinity University, USA, 1953), was followed by B.S. and M.S. in Civil Engineering (Texas A&M University, USA, 1959 and 1961) and finally a Ph.D. in Agricultural Engineering (University of Idaho, USA, 1970). He has served on the Civil Engineering faculties of Washington State University, the University of Maine and the University of Idaho. He also served several years in the Division of Industrial Research of Washington State

University in hydraulic research. Dr. Gladwell is a Registered Professional Engineer (Civil Engineering) in the State of Washington (USA).

Before going with UNESCO in 1980, he had also worked with the US Forest Service, the US National Water Commission, the US Office of Water Resources Research, as the Director of the Idaho Water Resources Research Institute, and as a consultant to the US Water Resources Council. Moving to Paris, France, Headquarters of UNESCO he worked until 1992 in the Science Sector, International Hydrological Programme. In that office he had responsibility for programs in planning, groundwater management, and special problems of the Humid Tropics (which he developed as a major program). For a number of years before retirement he served as Acting Director.

During his years with UNESCO Dr. Gladwell established a publication series dealing with the problems of the humid tropics, and was instrumental in the development and production of a state-of-the-art book on the problems and situations of tropical regions: *Hydrology and Water Management in the Humid Tropics*. He also served as co-editor and contributor to a book on sustainable development: *Sustainability Criteria for Water Resource Systems*. Cambridge University Press published both books. He has also worked with the International Association of Hydrological Sciences (IAHS) in the development of technical conferences.

Moving to Vancouver, BC, Canada in 1992 he established a consulting firm, HYDRO TECH INTERNATIONAL. For several years he was Honorary Consul General for the Republic of Panama for Western Canada. For a number of years he served on the Board of Governors of CATHALAC (a regional humid tropics research center located in Panama), and continues to be involved as a consultant and advisor to organizations in the solution of water related issues and problems of the humid tropics. For three years he was a member of the Canadian National Committee for the International Hydrological Programme.

Dr. Gladwell has maintained an active international lecturing program, which has included sponsorship by the US National Academy of Sciences, the US National Rural Electric Cooperative Association, the Organization of American States, the Canadian Commission for UNESCO, the US National Science Foundation and numerous other professional organizations.