

**IWRM: for sustainable use of water
50 years of international experience with the concept of
integrated water management**

**Background document to the FAO/Netherlands Conference
on Water for Food and Ecosystems**

W.B. Snellen (Alterra, Wageningen UR)

A. Schrevel (Alterra, Wageningen UR)

Wageningen, October 2004

Ministry of Agriculture, Nature and Food Quality, The Netherlands

Table of contents

1. Introduction	3
2. Evolution of the concept of Integrated Water Resources Management (IWRM)	4
2.1. Integration in the broader development context	4
2.2. Integrated water development related to sustainable development ...	5
2.3. ... And the Dublin Guiding Principles	8
3. Definition of Integrated Water Resources Management	10
4. Water management and ecosystems	11
5. Recent developments in the concept of IWRM	12
6. IWRM: water management for development and ecosystems	14
References	14

1. Introduction

The objective of this background document is to provide a brief overview of the development of the concept of Integrated Water Resources Management (IWRM). Because integrated water management can be interpreted in a number of ways, it is always possible to find examples of perhaps centuries ago that correspond with a particular interpretation. This overview starts with an example from the USA in 1933. The first example involving the United Nations is from 1957. The UN and other international organisations have played a significant role in the development of the IWRM concept. For that reason, this document does refer to quite a number of international conferences, but only when they have had a significant impact on the conceptual development of IWRM. A focus on the evolution of the concept of IWRM in the international water policy sector, rather than on the scientific discourse on the subject, is also believed to be more appropriate because this is a background document intended for the participants of the International Conference on Water, Food and Ecosystems. A complete overview of international conferences on water is presented in another background document to the conference (Schrevel & Terwisscha van Scheltinga 2004).

This document is comprised of six chapters; Chapter 1 is the introduction and Chapter 6 the conclusion. Chapter 2 covers the larger part of the document and gives a brief account of the historical development of the concept of IWRM. It is divided into three sections, each dealing with an important development in thinking about the concept. Chapter 3 is an important one because it contains the first, and thus far the last, authoritative definition of IWRM. In Chapter 4 the relation between water management and ecosystems is discussed. The focus here is on an FAO publication from 2000, which explains the evolution in water management issues as water becomes scarcer (the water screw turns as the situation tightens). Chapter 5 is the last chapter before the conclusions and in it is described the more recent developments in the concept of IWRM, including the World Bank's view as expressed in their important Water Resources Sector Strategy.

Quotes are frequently used in the text. This enables the reader to take note of the wording that the original authors of the time found appropriate, without the interpretation of the present author. Words in bold in the quotes imply emphasis; invariably the emphasis is given by the present author. Words that need emphasis in the text are italicised.

One can generally recognise the different types of integration in the development of the concept of integrated water resources management:

integration of water resources development in a development context, sectoral

Box 1. Different types of integration in the historical development of the concept of IWRM

- Integration of WRM in the broader **development** context
- Sectoral integration – integrating different **use** of water / different water using sectors
- Integration of the (biophysical) **resource** base
- **Spatial** integration (upstream / downstream interlinkages)

integration, integration of the biophysical resource base, and spatial integration (see also Box 1). It is largely possible to attach these types of integration as labels to specific periods. Distinguishing between them may also help to better understand the evolution of the concept. As the reader will see, these different types of integration constitute a connecting thread in this document.

2. Evolution of the concept of Integrated Water Resources Management (IWRM)

2.1. Integration in the broader development context

An often cited early example of IWRM is the establishment of the Tennessee Valley Authority (TVA) in 1933, which integrated the functions of navigation, flood control and power production, while addressing the issues of erosion control, recreation, public health and welfare (Creighton 1999, Mitchell 1990). Similar to the subsidised expansion of irrigated agriculture in the Western part of the USA through the US Bureau of Reclamation, TVA was part of President Franklin D. Roosevelt's New Deal, aimed at rescuing the US economy from the Great Depression through the construction of large public works (Muckleston 1990). The TVA effort contained many elements of today's perception of IWRM: comprehensive planning of natural resource utilisation combined with economic, social and even environmental objectives.

A report on Integrated River Basin Development to the Secretary-General of the UN in November 1957:

“Describes the challenge that is presented by the orderly development of the rivers in the world, and the lines along which we believe the United Nations and its specialized agencies might suitably move in dealing with it.”

The next quote indicates the authors' perception of integration: water infrastructure by itself does not bring development; supporting services are needed as well:

“Engineering measures are not likely to bring the desired improvements in level of living unless they are accompanied by secondary measures affecting other aspects of resource use. For example, the essential storage and canal facilities of an irrigation project must be supplemented by alterations in credit, marketing, transport, fertiliser, seed supply and similar services if they are to bring genuine gains in farm production.”

Here, integration did not yet refer to coordination of different water-related functions. The same interpretation of integration as in this early UN example is reflected in the title of many internationally-funded **integrated irrigation development projects** well into the 1980s, where **integrated** referred to the supporting services needed to develop irrigated agriculture and not to the coordination between irrigation and other water uses.

Twenty years later, the International Water Conference in Mar del Plata (1977) explicitly addressed the need for co-ordination within the water sector:

*“Institutional arrangements adopted by each country should ensure that the **development and management of water resources take place in the context of national planning** and that there is **real coordination among all bodies responsible for the investigation, development and management of water resources**”* (Mar del Plata Action Plan: Recommendation No.2 on Policy, Planning and Management).

The Mar del Plata Conference recommended expansion of irrigated agriculture: *“If future famines are to be avoided, more land will have to be placed under irrigation.”* Apparently, high water demand and negative environmental impacts of irrigated agriculture were not yet recognised or not considered as sufficiently important. Other major concerns expressed in Mar del Plata, however, still seem valid today:

- Community water supply: *“When it has been possible to send a man to outer space, it is surely paradoxical that here on earth people should be denied a fundamental right – a readily available supply of clean water for healthy survival and betterment.”*
- Pollution: *“Many rivers and lakes are being increasingly polluted as a result of uncontrolled discharge of untreated effluents, both from industry and from agriculture.”*
- Shared water resources: *“No significant progress can be achieved without a more effective framework within which the differing national positions and interests can be harmonised so as to facilitate co-operation.”*

The coordination within the water sector, as advocated in Mar del Plata, was largely seen as a task for the national governments. National governments, at times receiving technical as well as financial assistance from bilateral or multilateral donors for the purpose, started to formulate master plans for water resources development. It was not until much later that one realised the importance of building institutional capacity by involving national experts and institutions in developing such master plans.

At the 1992 Earth Summit in Rio de Janeiro, the need for coordination in the water sector was again given due attention:

*“The holistic management of freshwater as a finite and vulnerable resource, and the integration of sectoral water plans and programmes within the framework of national economic and social policy, are of paramount importance for action in the 1990s and beyond. **The fragmentation of responsibilities for water resources development among sectoral agencies is, however, proving to be an even greater impediment to promoting integrated water management than had been anticipated**,”* (par. 18.6, Ch.18, Agenda 21).

It would seem worth noting that the frustration expressed in the second part (in bold) of the above statement relates to the coordination within the water sector (as had been recommended at Mar del Plata) that is far less ambitious than the fundamental changes needed to achieve the **holistic management** – which may indeed be read as **integrated water resources management** – as advocated in the first part.

2.2. Integrated water development related to sustainable development

...

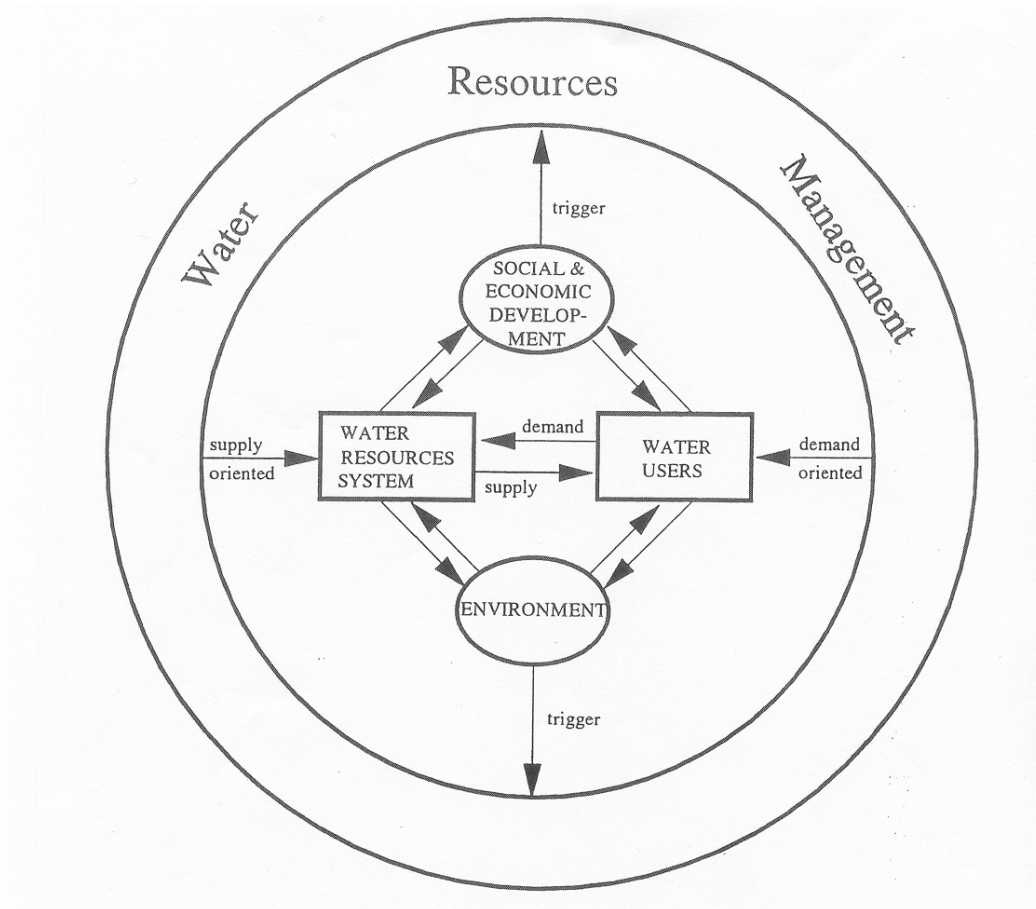
Advocating integrated water resources management, while at the same time reporting the lack of progress of the less ambitious goal of improving co-ordination within the water sector, suggests that an acutely-felt problem must have developed between 1977 and 1992. This was an issue addressed in the Brundtland Commission report of 1987 entitled *Our Common Future*, which concluded that the world was threatened by extraordinarily serious environmental problems, largely caused by development patterns that were leaving increasing numbers of people poor. The report launched the concept of: “*Sustainable development, which seeks to meet the needs and aspirations of the present without compromising the ability to meet those of the future.*” (Brundtland 1987). In December 1989, the General Assembly of the United Nations called a meeting of all nations to confront the twin problems of environmental destruction and the necessity for sustainable development: The United Nations Conference on Environment and Development (UNCED) was set for June 1992 in Rio de Janeiro.

To prepare for the UNCED, the water sector organised the International Conference on Water and the Environment, held in Dublin, Ireland, 26-31 January 1992. The conference attracted 500 water experts from a hundred countries and 80 international, intergovernmental and non-governmental organisations. In a keynote paper entitled *Water and Sustainable Development* by Koudstaal, Rijsberman & Savanije (1991), the authors state: “*The real value of the concept of sustainable development is that it emphasises that the potential – or carrying capacity – of resources should be examined first, rather than just planning [for socio-economic development] and minimising the adverse environmental impacts later.*” They produced a **working model for sustainable development** that was presented in their keynote paper as figure 1 entitled: Schematic representation of integrated water resources management (see Figure 1, this paper). The introduction to figure 1 in the author’s own words reads as follows: .

“An approach as set out in Figure 1 could be a good model for sustainable development. In this approach, the management of water resources is stimulated through triggers stemming from the environment and society’s socio-economic well-being, acting through both supply and demand-oriented actions directed at a system that has found a balance between impacts and carrying capacity. The danger of imbalance, however, remains ever present. In periods of economic recession, people and politicians are inclined to attribute more weight to socio-economic development and accept that future generations pay the bill. The scheme of Figure 1 needs constant support of organisations that are not influenced by political and economic instabilities.”

They advocated a new approach of integrated water management, in which: “*The connotation of the word **integrated** should go beyond traditional concepts such as the coordination among water management agencies, the interaction between groundwater and surface water, or a planning approach which considers all possible strategies and impacts.*”

Figure 1. Schematic representation of integrated water resources management



The main features of the new approach were:

1. The **carrying capacity of the natural environment** is the logical starting point, rather than the traditional approach in which deterioration of environmental quality is seen as an unavoidable cost of economic development;
2. **Demand management**, entailing the formulation and application of incentives aimed at limiting the demand for water by increasing efficiency and reducing waste, should be considered as one of the most important components of IWRM;
3. **Integrated management** in the new sense refers to the fact that water resources should be managed as an integral part of a nation's social and economic development.

The keynote paper entitled: Water and Sustainable Development by Koudstaal, Rijsberman & Savenije, prepared for the Dublin Conference of 1992, contains almost all of the characteristics of IWRM as it is seen today. One aspect that did not get sufficient attention is the importance of the management of the **land resources** for the quantity and quality of the water resources. This issue was the focus of another Dublin keynote paper entitled: Coping with multi-cause environmental challenges – a water perspective on development (Falkenmark & Lundqvist 1992).

2.3. ... And the Dublin Guiding Principles

In the executive summary of Water and Sustainable Development, integrated management was said to mean **management of water resources as an integral part of a nation's social and economic development**. While this is perfectly true, it is perhaps unfortunate that the authors singled out this characteristic of IWRM, at the expense of the **carrying capacity of the natural environment** that they themselves had declared the logical starting point for IWRM. If they would have put this upfront, it might have helped to get something like **maintaining healthy water ecosystems is the first priority for sustainable water management** into the first Dublin Guiding Principle. As it happened, the text of the first Dublin principle is less clear on this issue and, therefore – as we shall see further below - open to re-interpretation. Fortunately, the essential message is conveyed in the accompanying text of the first principle (see Box 2 below).

Box 2. The Dublin Guiding Principles

Principle No. 1 – Freshwater is a finite and vulnerable resource, essential to sustain life, development and the environment

Since water sustains life, effective management of water resources demands a holistic approach, linking social and economic development with protection of natural ecosystems. Effective management links land and water uses across the whole of a catchment area or groundwater aquifer.

Principle No. 2 - Water development and management should be based on a participatory approach, involving users, planners and policymakers at all levels

The participatory approach involves raising awareness of the importance of water among policymakers and the general public. It means that decisions are taken at the lowest appropriate level, with full public consultation and involvement of users in the planning and implementation of water projects.

Principle No. 3 - Women play a central part in the provision, management and

safeguarding of water

This pivotal role of women as providers and users of water and guardians of the living environment has seldom been reflected in institutional arrangements for the development and management of water resources. Acceptance and implementation of this principle requires positive policies to address women's specific needs and to equip and empower women to participate at all levels in water resources programmes, including decision-making and implementation, in ways defined by them.

Principle No. 4 - Water has an economic value in all its competing uses and should be recognised as an economic good

Within this principle, it is vital to first recognise the basic right of all human beings to have access to clean water and sanitation at an affordable price. Past failure to recognise the economic value of water has led to wasteful and environmentally damaging uses of the resource. Managing water as an economic good is an important way of achieving efficient and equitable use, and of encouraging conservation and protection of water resources.

Source: The Dublin Statement. International Conference on Water and the Environment: Development issues for the 21st century. 26-31 January 1992, Dublin, Ireland.

The Dublin Statement – including the four Guiding Principles – was commended at the Rio Summit. The main substantive outcome of the Rio Summit was Agenda 21, a comprehensive blueprint for global action into the 21st century aimed at solving the twin problem of environmental destruction and the necessity for sustainable development. Chapter 18 of Agenda 21 is on Protection of the quality and supply of freshwater resources: Application of integrated approaches to the development, management and use of water resources. The sections concerning IWRM are given below (Box 3).

Box 3. Relevant sections of Chapter 18, Agenda 21: Application of integrated approaches to the development, management and use of water resources.

18.8. Integrated water resources management is based on the perception of water as an integral part of the ecosystem, a natural resource, and a social and economic good, whose quantity and quality determine the nature of its utilisation. To this end, water resources have to be protected, taking into account the functioning of aquatic ecosystems and the perennality of the resource, in order to satisfy and reconcile needs for water in human activities. In developing and using water resources, priority has to be given to the satisfaction of basic needs and the safeguarding of ecosystems. Beyond these requirements, however, water users should be charged appropriately.

18.9. Integrated water resources management, including the integration of land and water-related aspects, should be carried out at the level of the catchment basin or sub-basin. Four principal objectives should be pursued, as follows:

- (a) To promote a dynamic, interactive, iterative and multisectoral approach to water resources management, including the identification and protection of potential sources of freshwater supply, that integrates technological, socio-economic, environmental and human health considerations.
- (b) To plan for the sustainable and rational utilisation, protection, conservation and management of water resources based on community needs, and priorities within the framework of national economic development policy.
- (c) To design, implement and evaluate projects and programmes that are both economically efficient and socially appropriate within clearly defined strategies, based on an approach of full public participation, including that of women, youth, indigenous people,

local communities, in water management policymaking and decision-making.
(d) To identify and strengthen or develop, as required, in particular in developing countries, the appropriate institutional, legal and financial mechanisms to ensure that water policy and its implementation are a catalyst for sustainable social progress and economic growth.

Source: Chapter 18. *Protection of the quality and supply of freshwater resources: Application of integrated approaches to the development, management and use of water resources*. Agenda 21: Programme of Action for Sustainable Development. Rio Declaration on Environment and Development. UNCED, Rio de Janeiro, 1992.

After the Dublin and Rio de Janeiro Conferences in 1992, many international and national agencies adapted their water policies. An example is the World Bank policy paper of 1993 entitled: Water Resources Management. Surprisingly, the term **integrated water resources management** is not used – let alone defined - in this document (except in a textbox presenting the main outcomes of the Dublin and Rio Conferences, including the four Dublin guiding principles).

3. Definition of Integrated Water Resources Management

In 2000, the international water sector convened in The Hague on the occasion of the Second World Water Forum. The World Water Vision was formulated in preparation of this event. The World Water Vision exercise of 2000 was: “*not just to speed up the implementation of the Dublin principles, but also to propose a comprehensive set of practical principles for implementation.*” (Cosgrove & Rijsberman 2000). Notwithstanding the desire to be practical, the glossary of the Vision document describes IWRM as:

“A philosophy that holds that water must be viewed from a holistic perspective, both in its natural state and in balancing competing demands on it – agricultural, industrial and environmental. Management of water resources and services need to reflect the interaction between these different demands, and so must be coordinated within and across sectors. If the many crosscutting requirements are met, and if there can be horizontal and vertical integration within the management framework for water resources and services, a more equitable, efficient, and sustainable regime will emerge.”

The Global Water Partnership – after having observed that “*an unambiguous definition of IWRM does not currently exist*” – presented in 2000 a definition of IWRM in a publication consisting of two parts: 1. What is IWRM? and 2. How to implement IWRM. Here, reference is made to the GWP brochure **IWRM at a glance** that provides a shortened version of the document¹. It explains in a few words why water management is critical; what the main challenges are; how we are all dependent on good water management; what the Dublin principles are and how they translate into action; what an enabling environment constitutes; what the appropriate institutional roles and what the practical management instruments are; and that financing in water management gives attractive returns.

The Global Water Partnership (2000) defined IWRM as:

¹ See: <http://www.gwpforum.org/gwp/library/IWRM%20at%20a%20glance.pdf>

“IWRM is a process which promotes the coordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.”

This definition is the first authoritative definition on IWRM. It should be noted that the management of water resources is defined as a process. It is also a learning process.

4. Water management and ecosystems

The Global Water Partnership produced another technical background paper, on water management and ecosystems (GWP 2003). The author, Malin Falkenmark, had earlier co-authored the publication entitled *New Dimensions in Water Security: water, society and ecosystems services in the 21st century* (FAO 2000). These two documents provide an excellent account of how land use will affect the quantity and quality of renewable freshwater resources that will be available for use by people, nature and the environment, thereby adding significant meaning to the inclusion of the management of **land resources** in the definition of IWRM.

FAO 2000 provides a re-appreciation of the first Dublin principle: *“The story behind these four [Dublin] principles is much richer than it might seem at first glance. The first point contains not only the basic understanding of the limits imposed by the hydrological cycle; implicitly it also conveys a criticism of large-scale engineering optimism (while not denying the necessity from a basic human-needs point-of-view to appropriate larger amounts of the hydrological cycle): the amount of freshwater available is finite; humans need more of it to support desirable welfare increases, yet all of it cannot be appropriated since ecosystems depend on it. ...The picture thus painted is one of a dilemma, the resolution of which can only be achieved by improved management of the resource.”*

Box4, below, explains the increasing need for improved management as water becomes scarcer.

Box 4. Management issues at increasing levels of water scarcity

The turn of the water screw

The crucial scarcity in dealing with water may not be the scarcity of the natural resource – water – but the scarcity of social resources needed to adapt to water scarcity (FAO, 2000). The significance of this message is made clear by considering how water managers can deal with increasing water scarcity over time:

1. At the first turn of the water screw, the remedy is to get more water. This goal is predominantly accomplished by water storage and transfer in time and space;
2. At the second turn the effort is redirected towards efficiency measures, predominantly end-use efficiency. The goal is to get **more benefit per drop**;
3. The last turn of the water screw is reallocation of water rights. This requires profound changes in national policies, since achieving allocative efficiency could mean withdrawal of water rights of irrigation schemes that generate a low value per unit of water. The food needed by growing populations will then need to be imported and paid for by industry and services sector. This

will require large-scale social restructuring and entails risks of tension and conflicts, within countries and between sectors and population groups with different stakes in the new socio-economic environment.

Based on FAO 2000 and Yevjevich 1995

In view of the above, integrated water resources management may be broadened into integrated land/water/ecosystem management. This requires:

- An understanding of water-related needs for the ecosystems within a specific catchment
- Identification of human activities that have important water-implications for these ecosystems
- Exploring possibilities of redirecting human activities in ways that provides a more desirable overall mix of human and ecosystems needs

Pursuing human development goals requires modifications of the landscape. These modifications will lead to changes in the aquatic ecosystems, for example wetlands. Organisms living in those ecosystems have over time developed a capacity to cope with some level of disturbance; this buffer against disturbance is what ecologists call **resilience**. The buffer is provided by **biological diversity**: loss of biodiversity reduces the ecosystems resilience to change.

Similarly, the term social resilience is used to indicate the capacity of society and institutions to cope with change without losing functions and basic properties under stress and to recover from damage through adaptation and renewal.

The implication of the above is that change is inevitable; care should be taken, however, not to introduce changes that exceed the elasticity or resilience of both the social and the ecological systems. The more scarce water becomes, the more pressure is exerted on the social and ecological systems.

5. Recent developments in the concept of IWRM

In a critical assessment of the GWP definition of IWRM, Biswas (2004) comes to the conclusion that the definition as provided by the GWP cannot be implemented, because of a whole series of unresolved operational questions and related problems of establishing measurable criteria. In his comment on the above paper, Mitchell states that Biswas considers only operational management (“*what will be*”) and disregards normative management (“*what ought to be*”) and strategic management (“*what can be*”). Mitchell suggests that the value of IWRM may be greater at the normative and strategic level, thereby providing a framework for different types of approaches at the operational level.

Mitchell’s suggestion appears to correspond well with the approach given in Chapter 3 of the 1993 World Bank Policy Paper entitled Improving Water Resources Management:

“Investments, policies and regulations in one part of the river basin or in one sector affect activities throughout the basin. Thus, these decisions need to be formulated in the context of a broad strategy that takes the long-term view, incorporates assumptions about the actions and reactions of all participants in water management, and fully considers the ecosystems and socio-economic structures that exist in a river

basin...Once a suitable overall framework has been formulated, individual projects can be more easily designed to fit the country's objectives without adding unnecessary complexities."

As we shall see below, by 2004 the World Bank was no longer keen on defining the broad strategy before starting individual projects.

In the World Bank's Water Resources Sector Strategy of 2004, it is explicitly stated that the new "Strategy does not aspire to rewrite the 1993 Policy Paper", of which the main thrusts "are consistent with the global consensus embodied in the Dublin principles" and that "the goals of the 1993 Policy Paper remain relevant and appropriate, but that progress has been slow in getting actions on the ground." (World Bank, 2004). The new Sector Strategy refers to a review by the Organisation for Economic Cooperation and Development, which "...shows that even the most advanced countries are far from full implementation of the Dublin principles in practice." (OECD, 1998). With respect to IWRM, the executive summary provides the message: "**The main management challenge is not a vision of integrated water resources management but a 'pragmatic but principled' approach.**" With this the World Bank appears to say that we know what integrated water resources management is and that we now have to bring it into practice.

As was done in New Dimensions in Water Security (FAO 2000), the new World Bank Water Resources Sector Strategy gives a new interpretation of the Dublin Principles:

*"The 1993 [Water Resources Management] Policy Paper reflected the broad global consensus that was forged during the Rio Earth Summit of 1992. This consensus stated that modern water resources management should be based on three fundamental principles (known as 'the Dublin Principles'). First is the **ecological principle**, which argues that independent management of water by different water-using sectors is not appropriate, that the river basin should be the unit of analysis, that land and water need to be managed together and that much greater attention needs to be paid to the environment. Second is the **institutional principle**, which argues that water resources management is best done when all stakeholders participate, including the state, the private sector and civil society; that women need to be included; and that resource management should respect the principle of subsidiarity, with actions taken at the lowest appropriate level. Third is the **instrument principle**, which argues that water is a scarce resource and that greater use needs to be made of incentives and economic principles in improving allocation and enhancing quality."*

The above description of the **ecological principle** does not specifically mention:

- The perception of water as an integral part of the ecosystem
- The need to protect the functioning of aquatic ecosystems
- The need to reconcile the water needs for human activities with the needs of the aquatic ecosystems
- The priority that needs to be given to satisfying basic human water needs and the needs for safeguarding the ecosystems

Managing water resources – according to the new Strategy – "involves a dialectic between integration (Dublin Principle 1) and subsidiarity (Dublin Principle 2)." The principle of subsidiarity is then used to justify that the business strategies for specific water-using sectors (water and sanitation, irrigation and drainage, hydropower) are determined primarily by these sectors themselves². The new Strategy then "focuses on how to improve the

² Text in document: "Within the World Bank, business strategies for specific water-using sectors (such as water and sanitation, irrigation and drainage, and hydropower) are, in accordance with the

development and management of water resources, while providing the principles that link resource management to the specific water-using sectors.” The linking principles described in the new World Bank Strategy largely come from the GWP document on IWRM (GWP 2000).

6. IWRM: water management for development and ecosystems

The modern concept of IWRM was primarily conceived for the purpose of promoting sustainable water resources management. Its roots can be traced to the International Conference in Mar del Plata, where the need for coordination in the water sector was stressed, and the Brundtland Commission report, which was the first call for development that would not compromise the needs of future generations. Its basic principles were largely established by 1992, the year in which the Dublin Guiding Principles were formulated and the United Nations Conference on Environment and Development was held in Rio de Janeiro.

Today, integrated water resource development is seen as: “*A process which promotes the coordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems*” (definition of IWRM, GWP 2000). This is a concise, yet precise definition of IWRM expressing the need for water development for socio-economic development, while keeping ecosystems healthy. Land, water and ecosystems need to be managed as integrated biophysical complexes, for the sake of human development. To do this, one needs to understand the water-related needs of ecosystems and the water-implications of human activities for ecosystems.

Managing water resources implies redirecting human activities in ways that satisfy both human and ecosystem needs. From the very start, it was clear that IWRM required fundamental changes in terms of values, beliefs, perceptions and political positions, not only of the institutions involved in water management and in the way they deal with their stakeholders, but also of the stakeholders themselves. It has also become clear, from the very start, that progress is difficult and slow. Indeed the operational questions are complex. However, it is generally accepted that to manage water resources there is no alternative to IWRM.

References

- Biswas, A.K. 2004. Integrated Water Resources Management: A Re-assessment. *Water International* 29 (2), June 2004:248-256
- Brundtland, G., 1987. *Our common future*. The World Commission on Environment and Development, Oxford University Press.
- Cosgrove, W.J. and F.R. Rijsberman (for the World Water Council). 2000. *World Water Vision: Making Water Everybody's Business*. Earthscan Publications Ltd, London, UK.

subsidiarity principle, determined primarily as part of the strategies for these sectors. “(World Bank, 2004, p.1-2)

Creighton, S.C. 1999. *Learning to plan for IWRM in British Columbia*. The University of British Columbia.

FAO 2000. *New Dimensions in Water Security: Water, society and ecosystem services in the 21st century*. FAO, Land and Water Development Division, Rome

Global Water Partnership. 2000. *Integrated Water Resources Management*. Technical Advisory Committee (TAC) Background Paper no.4. Stockholm, Sweden

Global Water Partnership. 2003. *Water Management and Ecosystems: Living with Change*. Technical Committee (TEC) Background Paper no.9.. Stockholm, Sweden

Koudstaal, R., F.R. Rijsberman and H. Savenije. *Water and Sustainable Development*. International Conference on Water and the Environment (ICWE). In: Keynote Papers by ICWE Secretariat, c/o World Meteorological Organisation, Geneva, Switzerland.

Mitchell, B. 1990. *Integrated Water Management: International Experiences and Perspectives*. Belhaven Press, London, U.K.

Mucleston, K.W. *Integrated Water Management in the US*. Chapter 2 in: Mitchell, B. 1990. *Integrated Water Management: International Experiences and Perspectives*. Belhaven Press, London, U.K.

Organisation for Economic Co-operation and Development. 1998. *Water Management: Performance and Challenges in OECD Countries*. Paris.

Mitchell, B. 2004. Comments by Bruce Mitchell on Water Forum contribution “Integrated Water Resources Management: A Re-assessment by Asit.K. Biswas.” *Water International* 29(3), September 2004:398-399

Schrevel, A and C. Terwisscha van Scheltinga, 2004, *International Conferences on Water, food, and ecosystems*. Background document to the FAO/The Netherlands Conference on Water for Food and Ecosystems, Ministry of Agriculture, Nature and Food Quality, The Hague.

World Bank, 2004. *Water Resources Strategy: Strategic Directions for World Bank Engagement*. The World Bank, Washington, DC20433, USA.

Yevjevich, V. Effects of area and time horizons in comprehensive and integrated water resources management. *Water. Sci. Tech.* Vol. 31 (8): 19-25, 1995.

