

## INTEGRATED WATER RESOURCES MANAGEMENT (IWRM), WITH SPECIAL REFERENCE TO SUSTAINABLE URBAN WATER MANAGEMENT

**P E Odendaal**

### 1. INTRODUCTION

The Earth Summit that was held in Rio de Janeiro in 1992, produced *Agenda 21* which focused on the sustainable management of the earth's natural resources. It has forty chapters, and although only Chapter 18 deals specifically with freshwater, the management of freshwater affects issues discussed in most of the remaining thirty-nine chapters.

Water is indeed a horizontal issue. A survey by the Scientific Committee on Problems of the Environment (SCOPE), during 2000 - involving 200 scientists in 50 countries - identified freshwater scarcity and pollution together as the major environmental issue that requires attention during the 21<sup>st</sup> century.

This paper focuses on the water sector, specifically on integrated water resources management (IWRM). Not only does IWRM constitute an essential strategy in the pursuit of sustainable water management, it also facilitates integrated and therefore, sustainable, management of the environment in the broader context.

### 2. INTEGRATED WATER RESOURCES MANAGEMENT

It became abundantly clear over the last two decades of the 20<sup>th</sup> century that problems associated with water management had become so complex that fragmented and short-term approaches, based on single disciplines or sub-sectors, could no longer suffice. These problems related to issues such as increasing water scarcities, burgeoning pollution, environmental degradation and proliferating conflicts in water allocation.

Furthermore, in addition to traditional engineering/scientific considerations, the human factor - i.e. the needs and preferences of society - is becoming increasingly prominent. There is a growing necessity for issues such as institutional considerations, the involvement of key role players (including society at large), and economic principles to be factored into water management. In other words, we saw the emergence of a global recognition of the need for an integrated or holistic approach towards water management. This has been articulated in the concept of integrated water resources management (IWRM).

IWRM is undoubtedly the central guiding principle that emerged from the major policy-related water conferences since the 1990s. It was postulated in the New Delhi Statement (1990) and the Dublin Statement (1992), and forcefully emphasised in Agenda 21.

Since then, IWRM principles have been elaborated upon and refined at several other policy-focused international water meetings, particularly at the *Second World Water Forum* in The Hague, 2000. It is also significant that the Global Water Partnership

(GWP), jointly established by the World Bank and a group of UN Agencies, has the promotion of IWRM as a main objective. Undoubtedly IWRM will again feature strongly in discussions on water issues at the World Summit on Sustainable Development, Johannesburg, August/September 2002.

## 2. THE NATURE OF IWRM

The difference between sustainable water management and integrated water management is not always clear. Essentially sustainability is the goal, and integrated management a strategy for pursuing the goal. Therefore, the challenge for effective IWRM is to find the right balance between protecting the resource itself - ground and surface water - while meeting social and ecological needs and promoting economic development.

The GWP provides the following broad definition of IWRM: "IWRM is a process that 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."

IWRM is truly an evolving process: "IWRM has neither been unambiguously defined nor has the question of how it is to be implemented been fully addressed. What has to be integrated and how is it best done? Can the broad principles of IWRM be operationalized in practice – and, if so, how?" (*United Nations Global Water Partnership, Technical Advisory Committee, 2000.*)

Principles that are generally accepted for effective IWRM are listed in **Box 1**.

## 3. PROGRESS IN THE DEVELOPMENT OF IWRM

The concept of IWRM has now been around for more than a decade. It is widely accepted and even imbedded in the policies and legislation of various countries (Including South African water legislation). Nevertheless, there is a general perception that progress in the implementation of the concept has not met expectations. Statements quoted in the paragraphs below substantiate this perception.

The Global Water Partnership (2000):

*The concept of IWRM has attracted particular attention following the international conferences on water and environmental issues in Dublin and Rio during 1992. However, IWRM has neither been ambiguously defined, nor has the question of how it is to be implemented been fully addressed. What has to be integrated, and how is it to be done? Can the agreed broad principles for IWRM be operationalised in practice - and if so, how?*

The United Nations Economic and Social Council (2001):

*Despite many major international water meetings that have had an impact on the formulation of integrated national water policies and programmes, the implementation of integrated water resources management has not been fully*

*achieved in either developed or developing countries. Water management issues continue to be dealt with on the basis of fragmented sectoral approaches.*

**BOX 1: PRINCIPLES OF IWRM**

1. *IWRM should be applied at catchment level.* It is important to recognise the catchment as a single management unit.
2. *It is critical to integrate water and environmental management.*
3. *A systems approach should be followed.* A true systems approach recognises the individual components as well as the linkages between them, and that a disturbance at one point in the system will be translated to other parts of the system.
4. *Full participation by all stakeholders is necessary, including workers and the community.* This will involve new institutional arrangements.
5. *Attention to the social dimensions.* This requires attention inter alia to the use of social impact assessments, workplace indicators and other tools to ensure that the social dimension of a sustainable water policy is implemented.
6. *Capacity building.* At many levels in the process – even at governmental level – stakeholders lack the necessary knowledge and skills for full application of IWRM
7. *Availability of information and the capacity to use it.*
8. *Full-cost pricing complemented by targeted subsidies*
9. *Central government support through the creation and maintenance of an enabling environment*
10. *Adoption of the best existing technologies and practices*
11. *Reliable and sustained funding*
12. *Equitable allocation of water resources*
13. *The recognition of water as an economic good*
14. *Strengthening the role of women in water management*

#### 4. OBSTACLES TO THE IMPLEMENTATION OF IWRM

A main obstacle to the successful implementation of IWRM is weak funding, particularly in developing countries. There are also other obstacles.

##### 4.1 Fragmentation of institutional responsibilities

For instance, surface and groundwater, drinking water and wastewater are often planned, regulated, and managed separately. In addition, there is insufficient linkage to planning and management in other sectors that impact water management, notably urban planning and industrial development. The most important missing link is probably that between land use and water use. Institutional transformation to support IWRM is essential.

##### 4.2 The potential complexity of the IWRM concept

Chapter 18 of Agenda 21 presented detailed actions that would be necessary for the implementation of IWRM. It is possible that a perceived complexity of IWRM, as projected in Agenda 21, presented a barrier to its rapid implementation. The vision of grand-scale IWRM, without explicitly allowing for strategic planning or a phased approach, is a daunting prospect, especially for poor countries with low installed capacity to carry out even the most basic aspects of the approach.

It would be more appropriate to steer away from urging the immediate launch of comprehensive grand-plan IWRM, and propagate a far more realistic approach based on flexibility, incremental and evolutionary gains, and an initial approach directed at key issues of importance to all stakeholders. This allows for *adaptive management* that responds to changes in information and circumstances, and to gains in experience and understanding.

##### 4.3 A lack of reference projects

In view of regional differences, there can be no universally applicable blueprint for IWRM. However, it is conceivable that successful IWRM implementation in a particular region can provide guidelines for IWRM initiatives in other regions. Such reference projects are not available. In other words, a sufficient knowledge base is lacking and there are few proven strategies and models to move from theory to practice. It is gratifying to know that a number of collaborative international initiatives are ongoing which should serve to establish a valuable body of reference projects. Two important initiatives are:

- **The *ToolBox for Integrated Water Resources Management*.** This is one of the flagship projects of the GWP. The ToolBox brings together global knowledge about and experience with IWRM in an assessable form. Case studies form a central element of the Toolbox and provide a valuable dissemination mechanism for improving practical understanding of IWRM.

- The **HELP initiative** by UNESCO and the WMO. It is aimed at establishing a global network of catchments to improve the links between hydrology and the needs of society.

#### **4.4 Lack of adequate skills, expertise and awareness**

In accepting the premise that IWRM should be implemented at catchment level, the underlying implication is that the necessary expertise, skills and resources will be available to the catchment authorities concerned. Most developing countries at the present time lack sufficiently skilled human resources at local level. Even in the case more developed countries, there is still very little *installed capacity* within government for managing the required reforms implied by IWRM.

A noteworthy development in this context is *the International Network for Capacity Building in IWRM (CAPNET)*. It is an associated programme of the GWP and UNDP, with the Netherlands government as initial sponsor

#### **4.5 Lack of adequate and reliable data**

IWRM can only be rationally and effectively implemented if consistent and reliable data are available on all water-related issues - information gaps have the effect of making important water issues invisible. Informed decision making requires the use of reliable data on local watershed conditions that encompass several topics: hydrology, ecology, water quantity, water quality, climate, stakeholder needs and priorities, as well as cultural values, attitudes and behaviours. Unfortunately, specifically in developing countries, there has been a decline in the quantity and quality of information on the availability and use of water.

Fortunately initiatives to strengthen data generation have been launched by organisations such as the WMO, World Bank, UNEP and UNESCO.

#### **4.6 Gaps in available knowledge and technology**

There is a range of priority areas where research must be increased. Furthermore, knowledge and technology that do exist or become available should be effectively transferred to those that can benefit from them. It is true that globally much relevant research is being done, but in certain key areas this needs to be accelerated and synergy created through collaborative research.

### **5. SUSTAINABLE URBAN WATER MANAGEMENT**

The fundamental premise is that IWRM should be applied at catchment level, recognising the catchment or watershed as the basic hydrological unit of analysis and management. At implementation level, there is now a growing conviction that *integrated urban water management (IUWM)* should be pursued as a vital component of IWRM. It bears repetition here that sustainable management is the objective and integrated management the means.

At the three major international events in Dublin, Rio de Janeiro and The Hague, the urban environment was hardly mentioned as a major component in the overall concept of integrated water management. However, pure logic dictates that **urban environments constitute important operational areas within which to pioneer integrated water management**. Not only is there a great need for IUWM in its own right, but cities are obviously dominant features in the catchments where they occur and many, if not most, of the water-related problems in catchments derive from cities. Therefore, successes in IUWM will make important contributions to the theory and practice of integrated catchment management (ICM) and IWRM in the broader basin context.

Thus, IUWM is not seen as a goal in itself, but as a practical means to facilitate one important sub-system of the hydrological basin. IUWM must *inter alia* endeavour to optimise the interfacing of urban water concerns with relevant activities beyond the urban boundaries, such as rural water supply, down-stream use, and agriculture

### **5.3 Impacts of urbanisation on water management**

Rapid growth of urban populations and the concomitant mounting needs for water services create formidable pressures on water supplies, downstream users, groundwater resources, stresses on receiving waters and their aquatic ecosystems, with an evident linkage to associated social and health issues. (UNESCO, 2001).

The nature and the dynamics of urban water problems in the developing countries are substantially different from those of urban areas in the developed world. For instance the growth of informal settlements poses grave water supply, waste disposal and sanitation problems. On the other hand, cities in developed countries face ageing systems requiring urgent renovation. In both cases, adopting “business as usual” approaches can lead to critical situations. (UNESCO, 2001).

By 2025, the world’s urban population will have doubled to over 4 billion people (more than 60% of world population, compared to the present 45%). The number of big cities with over 1 million people will almost triple to well over 500. By 2015, one person in five will live in a big city, compared to one person in nine now. This rapid urbanisation is causing severe problems relating to water supply, sanitation and water pollution control. The challenge for developing countries, in particular, is daunting. Over the next 25 years 95% of population growth in developing countries will occur in urban areas (Water Supply and Sanitation Collaborative Council, 1999).

In the developing world by far the fastest rate of urban growth is taking place in slums and squatter settlements situated on waste ground, flood planes or unstable hillsides. Such cities are particularly subject to fragmented water management and the associated disadvantages. This is mainly due to the awesome challenges in providing basic water supply and sanitation services. Through force of circumstance, priority is then given to meeting short-term needs. A further contributing factor is that in many instances, services are provided through the intervention of external support agencies that focus on the “needs at hand”, without a mandate to be involved in broader integrated approaches.

The growing severity of urban water management problems can only be dealt with through an integrated approach.

## 5.1 Principles of IUWM

Water-related processes in urban environments include potable water supply; sanitation (ranging from pit latrines to full water-borne sewerage and treatment); water reuse; environmental flows; water demand management; solid waste management; industrial water and waste management; urban drainage; water-based recreation; and environmental protection.

IUWM means that in the planning and operation of urban water management, consideration should be given to the *interaction* and *collective impact* of these processes on issues such as human health, environmental protection, quality of receiving waters, water demand, affordability, land and water-based recreation, and stakeholder satisfaction. Individual processes should then be planned and managed in such a way that the collective impact be optimised as far as possible.

IUWM requires involvement by stakeholders such as those responsible for water supply, sanitation services; storm water and solid waste management; regulating authorities; householders; industrialists; labour unions; environmentalists; downstream users; and recreation groups. While local authorities are well placed to initiate and oversee IUWM programmes, planning and implementation should be driven by a combination of top-down regulatory responsibility and bottom-up user needs/obligations.

Realistically, IUWM cannot be implemented fully-fledged in the short term. On the other hand, the continuation of short-term, fragmented approaches will inexorably compound negative ramifications over time. Therefore, at least a start must be made, looking at incremental gains through the integration of sub-systems.

## 5.4 Progress requirements for IUWM

The IUWM concept is obviously far from new and has featured in various conferences and many publications. It is a formal sub-programme of UNESCO's International Hydrological Programme, and it is strongly supported by the International Water Association (IWA) and the International Council for Local Environmental Initiatives (ICLEI). The *UNESCO Symposium on Frontiers in Urban Water Management: Deadlock or Hope?* Held in Marseilles, June 2001, issued the *Marseilles Statement* which strongly urges the IUWM approach.

However, the fact is that the knowledge base for IUWM is still very limited, as IUWM initiatives thus far tended to be isolated and fragmented, thereby precluding the development of generic and proven strategies and tools. In fact, most of the IUWM activities reported thus far mainly relate to the integrated management of wastewater and urban runoff. They did not deal with the extended range of issues indicated earlier on.

While many cities have already succeeded in integrating the management of some water-related facets, total integration of all conceivable facets is still on the far horizon. Furthermore, the situation facing each individual city is unique, so that there can be no

“blueprint” for IUWM. There is a need to develop a conceptual model for IUWM that can direct integrated planning and management, with the necessary adjustments being made for site-specific considerations. The University of Exeter is already making an initial thrust in this direction with EU support. Such a model will obviously have to be refined progressively over time as experience and new insights are gained.

A model for IUWM, is not the be-all and end-all, however. It is true that from the classical systems perspective the “optimised whole” will be better than the uncoordinated sum of the parts. However, the optimised whole will be better still if, in turn, the constituent parts are optimised as well. This is exactly where there are still huge gaps in our knowledge and where research needs to be accelerated. Some of the crucial gaps are the following:

- (1) Innovative ways for the delivery and financing of water services, including mixes of private and public ownership institutional options for promoting IUWM.
- (2) Strategies for effectively involving civil society in IUWM.
- (3) *Life Cycle Assessment* (LCA) adapted for the water industry. LCA provides a tool to understand, manage and reduce the environmental impacts associated with a product, process or activity, by considering all life-cycle stages, from ‘cradle-to-grave’. LCA has been well researched in the field of industrial manufacture, and is finding increasing application. However in the water field, very little LCA research has been done and needs stimulus.
- (4) Understanding the quantitative and qualitative water requirements of ecosystems.
- (5) The internalisation of environmental costs.
- (6) There is an urgent need for resource economic studies to assess the costs and benefits of natural resource protection, rehabilitation, and wise use. Such information is vital for decision making. For example, the City of Durban in South Africa, through the application of resource economic principles, estimated that the environmental services provided by critical open space amounted to R \$330 million per annum. This excluded the value of tourism to the city.
- (7) More information is needed on insidious micro-pollutants that could have serious health and environmental impacts.
- (8) Strategies for incorporating water reuse into urban planing and IUWM. Water reuse is an obvious and viable option for supplementing conventional water supplies. It also serves to ameliorate water pollution by diverting pollutants from the water environment.
- (9) Product recovery from industrial waste streams, and the recycling and reuse of wastes can reduce treatment costs and result in reduced need for raw materials, including water.
- (10) The perennial problem of municipal sludge management, based on nutrient recovery and recycling. One of the main issues precluding the beneficial use of sludge is the

presence of heavy metals derived from industrial sources. Strategies need to be researched whereby heavy metals can be removed or recovered at source and not allowed to reach treatment plants.

- (11) Educational programmes on IUWM and environmental management.

## 6. CONCLUSION

In promoting the IWRM concept, it is realised that it is an evolving process. There are no complete or grand-plan IWRM strategies available for immediate implementation. It will involve an *adaptive management* approach, based on incremental gains; an initial focus on key issues of importance to participating stakeholders; and responding to changes in information, understanding and circumstances.

The important issue to be recognised is that the human mindset that created the present unsustainable situation in urban water management is based on linear and fragmented approaches. This same mindset cannot be a point of departure in seeking solutions. There must be a paradigm shift towards integrated and synthetic thinking.

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