# 2

# Integrated water resources development and management

## 2.1 Background

The extent to which water resources development contributes to economic productivity and social well-being is not usually appreciated, although all social and economic activities rely heavily on the adequacy of the supply and quality of freshwater. As populations and economic activities grow, many countries are rapidly reaching conditions of water scarcity or facing limits to economic development. Water demands are increasing rapidly, with an estimated 70–80% required for irrigation, less than 20% for industry and a mere 6% for domestic consumption. 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 proving, however, to be an even greater impediment to promoting integrated water management than had been anticipated. Effective implementation and coordination mechanisms are required (UN-DTCD/IBRD/UNDP, 1991; UN-DTCD, 1991b, c, d).

Institutional capacity for implementing integrated water management should be reviewed and developed. Existing administrative structures will often be quite capable of achieving local water resources management, but the need may arise for new institutions based upon the perspective of river catchment areas, district development councils and local community committees. Although water is managed at various levels in the socio-political system, demand-driven management requires the development of water-related institutions at appropriate levels, taking into account the need for integration with land-use management.

In creating the enabling environment for lowest-appropriate-level management, the role of Government includes mobilization of financial and human resources, legislation, standard-setting and other regulatory functions, monitoring and assessment of the use of water and land resources, and the creation of oppor-

tunities for public participation. International agencies and donors have an important role to play in providing support to developing countries in creating the required enabling environment for integrated water resources management. This should include donor support to local levels in developing countries, including community-based institutions, non-governmental organizations and women's groups.

The International Conference on Water and the Environment drew upon the large and diversified experience gained among all countries since the United Nations Water Conference, Mar del Plata, 1977. Some serious errors and unwise biases were identified, while at the same time there was recognition of numerous fruitful advances in understanding and action. There emerged four main principles that need to be applied in taking action to achieve integrated water resources development and management. The principles below are quoted directly from the Dublin Statement, the full text of which appears in Annex 1.

**Principle No. 1 – Fresh water 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 policy-makers at all levels**

The participatory approach involves raising awareness of the importance of water among policy-makers 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 recognized as an economic good**

Within this principle, it is vital to recognize first the basic right of all human beings to have access to clean water and sanitation at an affordable price. Past failure to recognize 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.

## 2.2 Integrated water resources planning

### *Basis for action:*

In all countries, the planning of water resources development is as important an activity as their efficient management. Effective planning is needed to solve the many problems inherent in the control and utilization of water: conflicting demands; too little or too much water; maximizing economic and social benefits; equity considerations; environmental and economic sustainability. The interdisciplinary nature of water problems requires new attitudes towards integrating the technical, economic, environmental, social and legal aspects into a coherent framework and the development and dissemination of planning methodologies, as demonstrated in OAS (1984).

Water resources development and management should be planned in an integrated manner, taking into account long-term planning needs as well as those with narrower horizons, that is to say, they should incorporate environmental, economic and social considerations based on the principle of sustainability; they should include the requirements of all users as well as those relating to the prevention and mitigation of water-related hazards; and they should constitute an integral part of the socio-economic development planning process (see Bamberger and Cheema, 1990). A prerequisite for the sustainable management of water as a scarce vulnerable resource is the obligation to acknowledge in all planning and development its full costs. Planning considerations should reflect on the one hand all types of benefit, both direct and indirect, and on the other all investment, environmental protection and operational costs, as well as the opportunity costs reflecting the most valuable alternative use of water. Actual charging need not necessarily burden all beneficiaries with the consequences of those considerations. Charging mechanisms should, however, reflect as far as possible both the true cost of water when used as an economic good and the ability of the communities to pay.

### *Strategy and programme targets:*

The most effective way to promote the new approach is to apply it to all policy, programmes and project formulation exercises in order to assist governments in selecting appropriate strategies to meet considerations of sustainability, and human development. This is to be supported, in developing countries, by training and technical assistance.

Table 7. *Integrated water resources planning*

| Activities and related means of implementation | Level[1] | Considered by | |
|---|---|---|---|
| | | ICWE[2] | UNCED[3] |
| 1. Diagnostic assessments in the water sector through rapid but comprehensive analyses of the existing status of water resources development, national goals and strategies, problems and priority areas for action. | N | X | X |
| 2. National capacity building through: (a) training of water managers and professionals at all levels; (b) transfer of technology; (c) human resources development including the improvement of career structures; (d) institutional strengthening; (e) rationalization of public and private sector intervention; (f) development and strengthening of cooperation, including mechanisms, at all levels concerned, namely:<br>– delegation of water resources management to the lowest appropriate level, including decentralization of government services to local authorities, private enterprises and communities and supporting water-user groups to optimize local water resources management;<br>– at the national level, integrated water resources planning and management in the framework of the national planning process and establishment of independent regulation and monitoring of freshwater, based on national legislation and economic measures;<br>– at the regional level, consideration of the harmonization of national strategies and action programmes;<br>– at the global level, improved delineation of responsibilities, division of labour and coordination of international organizations and programmes, including facilitating discussions and sharing of experiences in areas related to water resources management. | INPL | X | X |
| 3. Integrated information management through: (a) surveys of existing data; (b) assessment of needs and review of technology; (c) inventories of water resources, in combination with land-use planning, forest resource utilization, protection of mountain slopes and riverbanks and other relevant development and conservation activities; (d) development of interactive databases, forecasting models, economic planning models and methods for water management and planning, including environmental impact assessment methods; (e) formulation of data gathering programmes. | NP | X | X |

| | | | |
|---|---|---|---|
| 4. Formulation of costed and targeted national action plans and investment programmes taking into account the optimization of water resources allocation under physical and socio-economic constraints and the need for the integration of water quantity and quality management. Such plans would include flood and drought management, risk analysis and environmental and social impact assessment. Plans should be monitored and evaluated and updated through the development of interactive and flexible machinery. Plans should be implemented at different scales including: (a) community development programmes and activities; (b) district and province programmes and projects; (c) multipurpose projects (including the special problems of man-made lakes); (d) river basin plans; (e) international watercourses. | NPL | X | X |

[1] Level of implementation: I=International; N=National; P=Provincial or sub-national; L=Local.
[2] Considered in ICWE *Report of the Conference* section 2.
[3] Considered in UNCED Agenda 21 paragraph:18.6–22.

Table 8. *Demand management*

| Activities and related means of implementation | Level[1] | Considered by | |
|---|---|---|---|
| | | ICWE[2] | UNCED[3] |
| 1. Water auditing to promote improvement in efficiency of supply and wastage minimization through: (a) the effective metering and measurement of volumes supplied; (b) leak detection and repair; (c) identification of illegal connections. | NPL | X | X |
| 2. Development of water use policy to include water tariffs and other economic instruments to effect demand management in domestic supply, in agriculture and in industry. | N | X | X |
| 3. Implementation of allocation decisions through demand management, pricing mechanisms and regulatory measures, taking into account: (a)legal and institutional aspects; (b) allocation of public expenditures; (c) accounting and auditing systems; (d) monitoring and evaluation. | NPL | X | X |

[1] Level of implementation: I=International; N=National; P=Provincial or sub-national; L=Local.
[2] Considered in ICWE *Report of the Conference* section 2.
[3] Considered in UNCED Agenda 21 paragraph: 18.6–22.

All countries will be expected to have carried out by the year 2000 a diagnostic phase to develop a strategy and a planning phase aimed at costed and targeted national action plans.

## 2.3 Demand management

### *Basis for action:*

Abundance or scarcity of water can mean prosperity or poverty, life or death. It can even be a cause of conflict. Most countries have serious problems concerning the quantity and quality of their freshwater resources. Constraints on the supply of fresh water are increasingly aggravated by droughts, depletion of aquifers, pollution and land degradation, while demand for water is rising rapidly for food production, industry and domestic consumption. A constraint of a different kind is the absence of detailed knowledge of the volumes of water 'used' by the different customers that would be obtained from the effective metering and measurement of supplies.

Pursuant to the recognition of water as a social and economic good, the various available options for charging water users (including domestic, urban, industrial and agricultural water-user groups) have to be further evaluated and field-tested, (see UN-DTCD, 1991a). Further development work is required for economic instruments that take into account opportunity costs and environmental externalities. Field studies on the willingness to pay should be conducted in rural and urban situations. Options for water conservation and reuse should be vigorously pursued. These ideas have been extensively reviewed by, for example, Borde and Pearce (1991), Pearce and Markandya (1989) and United Nations (1980).

### *Strategy and programme targets:*

Rather than seeking a supply adequate for some set of water 'needs', water management is concerned with finding a balance between the benefits of water use and the costs of water supply. 'Needs' are no longer measured in consumption per capita per day, but in terms of the health and welfare of human populations. Costs are not linked to financial outlays for engineering and construction, but include all adverse effects on the economy, or activities which compete for the basic resources and on the environment.

Demand management should be introduced into all national action plans and implemented by the year 2000 (UN-DTCD, 1992a). The necessary training and transfer of technology should have taken place and at least half the developing countries should have carried out evaluation of the effectiveness of demand management.

Table 9. *Institutional arrangements*

| Activities and related means of implementation | Level[1] | Considered by | |
|---|---|---|---|
| | | ICWE[2] | UNCED[3] |
| 1. Implementation of water and land resources management at the lowest appropriate level. | NPL | X | X |
| 2. Creation of appropriate water authorities and coordination arrangements. | NP | X | X |
| 3. Integration of water management at basin level. | INP | X | X |
| 4. Inception of efficient and effective organizational alternatives for the provision of water-related public services and for operation and maintenance of projects. | NPL | X | X |
| 5. Creation of international arrangements and organizations for planning, developing and protecting international waters. | IN | X | X |

[1] Level of implementation: I=International; N=National; P=Provincial or sub-national; L=Local.
[2] Considered in ICWE *Report of the Conference* section 2.
[3] Considered in UNCED Agenda 21 paragraph: 18.6–22.

## 2.4 Institutional arrangements

### *Basis for action:*

Sustainable water development is contingent on appropriate institutional arrangements. Such arrangements should ensure an unbiased and independent approach in policy making, planning, allocation, development, conservation, protection and in the monitoring and assessment of the water resources on which the other activities depend. They should also bring about optimum technical efficiency, and ensure effectiveness in the provision of water-related services.

### *Strategy and programme targets:*

Centralized and sectoral approaches to water resources development and management have often proved inadequate in addressing local water management problems. Recognizing the need for a central mechanism capable of securing national economic and social interests, the role of government needs to change to enable the delegation of responsibility for water resources development and management to the most appropriate and efficient levels, including both the informal and formal private sectors.

Governments should have assessed their institutional arrangements and taken steps to establish more appropriate mechanisms as part of national action programmes by 1995.

## 2.5 Legal frameworks

### *Basis for action:*

Policy decisions cannot be implemented successfully unless there is adequate water legislation. Based upon the agreed strategy to develop water resources, water legislation provides part of the enabling environment, ensuring as far as possible the most equitable, economic and sustainable use of available water resources. Such legislation is a complex endeavour since it has to take account of several simultaneous, and sometimes conflicting objectives: development objectives, including related public and private investments; environmental and conservation goals, requiring effective public control, but also demanding private sector cooperation and involvement; and social objectives, consisting mainly of water-related services and the social impact of development components.

At the international level effective treaties or joint or concurrent legislation are essential to deal with increasing instances of transboundary water pollution and conflicting demands on shared watercourse systems.

Table 10. *Legal frameworks*

| Activities and related means of implementation | Level[1] | Considered by | |
|---|---|---|---|
| | | ICWE[2] | UNCED[3] |
| 1. Review and analysis of customary and existing water legislation. | NPL | X | X |
| 2. Enactment of appropriate water resources legislation including regulations and by-laws. | NPL | X | X |
| 3. Enactment of legally compulsory rules for the assessment of water projects and programmes. | NP | X | X |
| 4. Enactment of legislation for the provision of water-related public services. | NPL | X | X |
| 5. Bilateral, multi-lateral, regional and global international agreements on the use, environmentally-sustainable development, protection, and allocation of the resources of international water resources systems, with particular regard to transboundary water bodies. | IN | X | X |

[1] Level of implementation: I=International; N=National; P=Provincial or sub-national; L=Local.
[2] Considered in ICWE *Report of the Conference* section 2.
[3] Considered in UNCED Agenda 21 paragraph: 18.6–22.

***Strategy and programme targets:***

Enactment of appropriate, enforceable and applicable legislation, both for water and for activities having an identified impact on water resources. Such legislation should at the same time encourage and enhance private sector participation and cooperation, and provide tools for expedient public intervention, when and as needed (all countries by the year 2000).

Global acceptance and effective application of rules of cooperation in good faith, environmentally sustainable management, equitable apportionment and prohibition of causing appreciable harm when developing and using the resources of international watercourse systems (acceptance of rules by 1995, application to large international watercourses by the year 2000).

## 2.6 Public participation

***Basis for action:***

No matter how efficiently the water resources planning and implementation process is carried out, its long-term impact and sustainability will depend on the effectiveness of public participation. This applies particularly to the full implementation of demand management, the establishment of a legal framework for water resources management and cost-recovery. In developing countries, the role of women in water resources management must be enhanced since they and their families are the prime users and beneficiaries of water development programmes and since they are often more concerned than men with the protection of the quality of surface- and groundwater (cf. Rodda, 1991).

The delegation of water resources management to the lowest appropriate level necessitates educating and training water management staff at all levels and ensuring that women participate equally in the education and training programmes. Particular emphasis has to be placed on the introduction of public participatory techniques, including enhancement of the role of women, youth, indigenous people and local communities. Skills related to various water management functions have to be developed by municipal government and water authorities, as well as in the private sector, local/national non-governmental organizations, cooperatives, corporations and other water-user groups. Education of the public regarding the importance of water and its proper management is also needed.

***Strategy and programme targets:***

A clear exposition to policy makers should be made of what is to be accomplished by involving the public in planning and management and how it can be achieved.

Table 11. *Public participation*

| Activities and related means of implementation | Level[1] | Considered by | |
|---|---|---|---|
| | | ICWE[2] | UNCED[3] |
| 1.Promote public participation through: (a) development of extension courses; (b) public relations exercises including sharing of knowledge and technology; (c) dissemination of information to the public; (d) training in conflict resolution; (e) social impact assessments; (f) awareness-raising and educational programmes. | NPL | X | X |
| 2. Promote community participation in planning, implementation, operation and maintenance, evaluation, monitoring. | PL | X | X |
| 3. Enhance the role of women through: (a) participation in the decision-making process; (b) participation in projects and programmes; (c) development of training materials; (d) training of various target groups; (e) dissemination of results. | NPL | X | X |

[1] Level of implementation: I=International; N=National; P=Provincial or sub-national; L=Local.
[2] Considered in ICWE *Report of the Conference* section 2.
[3] Considered in UNCED Agenda 21 paragraph: 18.6–22.

A major part of the strategy should be using the public information, education and training process to develop an iterative (i.e. top-down, bottom-up) open planning process; for example, training professionals in the sector in the use of the participatory techniques and applying the process to individual projects.

Since many of these objectives are difficult to quantify or specify as targets, self-evaluations by countries should be performed in the year 2000 to evaluate, at least qualitatively, the extent to which public participation has been enhanced and to gauge its impact on programme effectiveness.

## 2.7 Effective technologies

***Basis for action:***

To bring about the more effective integration of water resources development and management activities, a wide variety of technological options are available. These range from improved methods of data collection and handling, which enable the water resources planner to review different ways of developing a resource, to so-called 'non-conventional' methods of increasing the resource base, such as desalination and inter-basin transfer. The dissemination of knowledge of these techniques and options and the technology transfer needed to make them operational in developing countries is a priority area for action.

The development of interactive databases, forecasting methods and economic planning models appropriate to the task of managing water resources in an efficient and sustainable manner will require the application of techniques such as geographical information systems and expert systems to gather, assimilate, analyze and display multisectoral information and to optimize decision making. In addition, the development of new and alternative sources of water supply and low-cost water technologies will require innovative applied research. This will involve the transfer, adaptation and diffusion of new techniques and technology among developing countries, as well as the development of indigenous capacity, for the purpose of being able to deal with the added dimension of integrating engineering, economic, environmental and social aspects of water resources management and predicting their effects in terms of the human impact.

The setting afresh of priorities for private and public investment strategies should take into account (a) maximum utilization of existing projects, through maintenance, rehabilitation and optimal operation; (b) new or alternative clean technologies; and (c) environmentally and socially benign hydropower.

Table 12. *Effective technologies*

| Activities and related means of implementation | Level[1] | Considered by | |
|---|---|---|---|
| | | ICWE[2] | UNCED[3] |
| 1. Incorporation of the concept of integrated water resources development and management into relevant university graduate and post-graduate courses. | NP | X | X |
| 2. Giving priority support to technology transfer and national technical capacity building programmes and projects. | IN | X | X |
| 3. Dissemination and diffusion of new and appropriate technologies to developing countries. | I | X | X |
| 4. Promotion of international cooperation in scientific research on freshwater issues. | IN | X | X |
| 5. Development of new and alternative sources of water supply such as sea-water desalination, artificial groundwater recharge, use of marginal-quality water, wastewater reuse and water recycling. | NP | X | X |
| 6. Provision of venture capital for field testing of promising new technologies. | IN | X | X |

[1] Level of implementation: I=International; N=National; P=Provincial or sub-national; L=Local.
[2] Considered in ICWE *Report of the Conference* section 2.
[3] Considered in UNCED Agenda 21 paragraph: 18.6–22.

***Strategy and programme targets:***

Developing countries need to strengthen their technological capabilities with the assistance of bilateral and multilateral organizations with regard to transfer of experience and know-how, technical cooperation and training.

Such technology transfer should be an integral part of the implementation national action plans, with the goal of reduced dependence on imported technologies and the establishment or strengthening of indigenous research and development facilities by the year 2000.

## 2.8 Targets and costs

### *(i) Targets*

(a) All countries should have designed and initiated costed and targeted national action programmes and should have appropriate institutional structures and legal instruments in place by the year 2000;

(b) All countries should have established efficient water-use programmes to attain sustainable resource utilization patterns by the year 2000;

(c) Demand management should be introduced into all national action plans and implemented by the year 2000; the necessary training and transfer of technology should have taken place and at least half the developing countries should have carried out evaluations on the effectiveness of demand management;

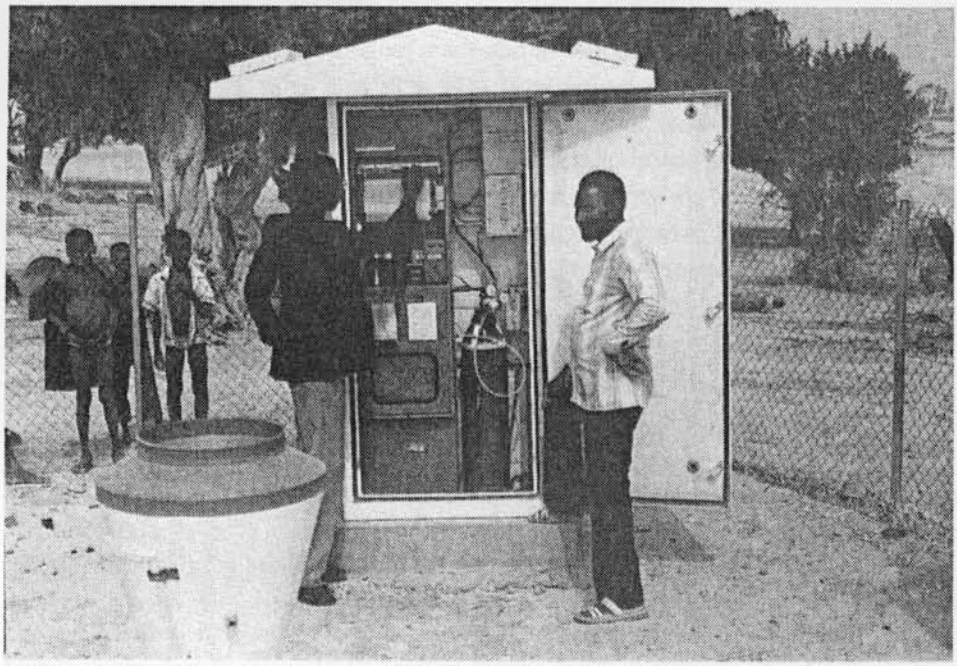
(d) Self-evaluations by countries should be performed in the year 2000 to measure qualitatively the extent to which public participation has been enhanced and its impact on programme effectiveness;

(d) Sub-sectoral targets of all freshwater programme areas should have been achieved by the year 2025.

### *(ii) Cost estimates*

During the period 1993 to 2000, an annual amount of about US$ 100 million of international financing is required to support national development in this programme area. The strengthening of international institutions in support of the planning and initiation phases at the country level requires the allocation of about US$ 10 million per year. Transboundary and global freshwater issues require a financial support in the order of US$ 5 million annually for the executing national, regional and global authorities and organizations. The total annual financing requirements in this programme area amount to about US$ 115 million from the international community on grant or concessional terms*.

* When estimating the financial requirements for integrated water resources management it has to be kept in mind that the bulk of investments and external donor support is covered under the programme areas on protection of water resources, urban water management and rural waste management.



*Assessment of the resource is vital for understanding, planning and management.* A meteorological measuring facility in West Africa. Credit: WMO.