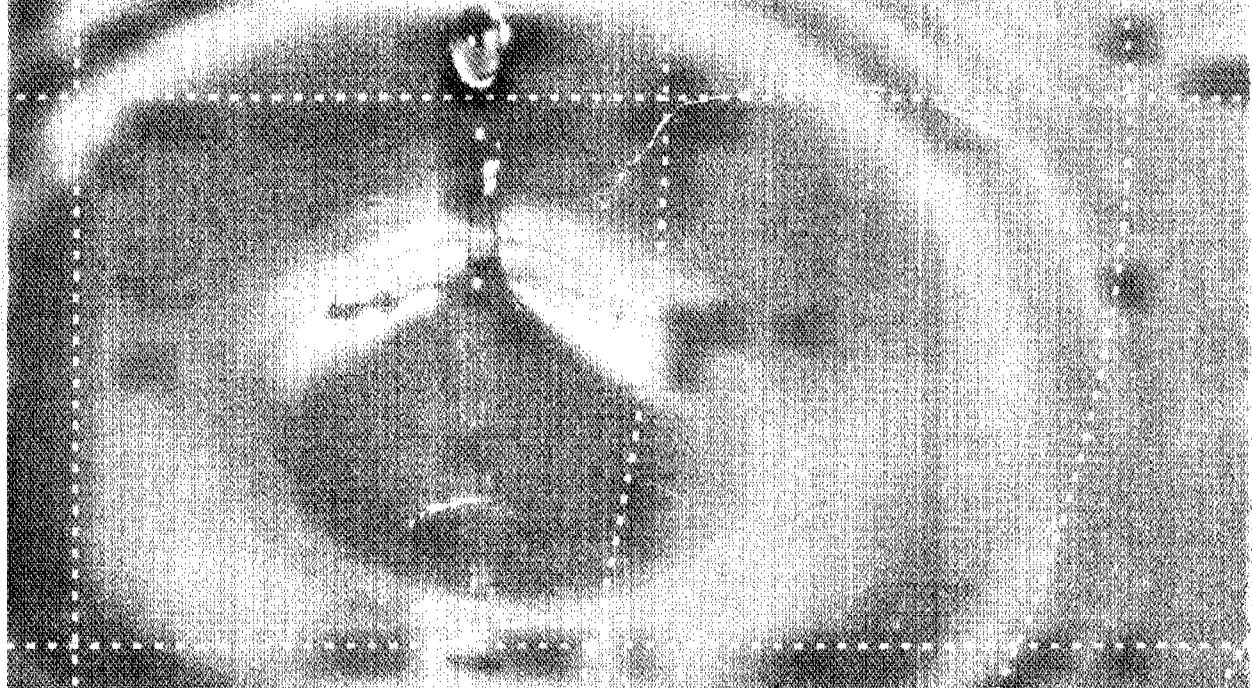
COMPREHENSIVE ASSESSMENT OF THE FRESHWATER RESOURCES OF THE WORLD



SUSTAINING OUR WATERS INTO THE 21ST CENTURY

JAN LUNDQVIST AND PETER GLEICK

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FOREWORD

A rapidly growing demand on freshwater resources, resulting in increased water stress in several parts of the world, increasing pollution of freshwater resources and degraded ecosystems, made the UN Commission for Sustainable Development in 1994 call for a Comprehensive Assessment of the Freshwater Resources of the World. The final report (E/CN.17/1997/9), prepared by a Steering Committee consisting of representatives for UN/DPCSD, FAO, UNEP, WMO, UNESCO, WHO, UNDP, UNIDO, the World Bank, and Stockholm Environment Institute, is presented to the CSD 1997 and to the UN General Assembly Special Session June 1997.

Within the process of the Assessment a number of background documents and commissioned papers were prepared by experts with various professional background. The document *Sustaining Our Waters into the 21st Century* is one of these. As a scientifically based document, any opinion expressed is that of the author(s) and does not necessarily reflect the opinion of the Steering Committee.

Stockholm, June1997

Gunilla Björklund
Executive secretary
Comprehensive Freshwater Assessment

ABSTRACT

This report elaborates on the policy approaches and policy options that would facilitate a long-term sustainable water use, building on other background material for the Assessment and on the outcome of an international workshop.

Water planners, managers and users have to deal with many challenges as we approach the 21st century. Among the multiple functions that water fulfils, the basic human and ecosystems needs are of paramount importance. Water is also indispensable for food production, for industrial development and for a wide range of activities and processes in the landscape as well as in society. Involvement of users and sharing of responsibilities and management tasks is a prerequisite for proper choice of technological and organizational approaches. It is argued that allocation of finite water resources must be agreed upon through political and socio-economic negotiations and that due consideration must be given to the various functions that water fulfils in society and in the landscape. Intersectoral coordination and priorities in allocation are particularly demanding and current sectoral allocations may have to be reviewed. In particular, the issue of national food-sufficiency versus national food self-reliance needs to be addressed in national policies and in international agreements on global food security.

The report urges that more attention be given to the qualitative aspects of water. Threats of water quality degradation will increasingly affect human and ecosystem health, as well as industrial development.

Water is recognized as a vital resource for life, human and societal development and environmental sustainability. Related to this basic view is also a wide acceptance that water should be treated as an economic and social good and that management must aim for the most worthwhile use ensuring equity concerns, efficiency and environmental sustainability.

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EXECUTIVE SUMMARY

Many challenges face water planners, managers, users and, generally, policy makers, as we approach the 21st century. Principal among them are the need to meet the basic water requirements of present and future generations, maintain the integrity of the hydrologic cycle and our renewable freshwater resources, and develop robust public and private institutions capable of managing supply and demand, resolving conflicts, protecting watersheds, and allocating scarce water resources.

This paper, prepared as a background document for the Comprehensive Freshwater Assessment (CFA) for the United Nations General Assembly, presents a framework that explores how planners might begin to define and identify a sustainable water future and sets out specific goals for long-term water planning based on principles of sustainable water resources management and use.

A new consensus is emerging out of nearly 20 years of discussions in the global water community about the nature of today's water problems and the directions that water planning and management should take in the next century. This consensus includes both new ways of thinking about water resources availability and quality as well as new ways of planning and managing human water use. Among the most important elements of this consensus is the understanding that:

- Water is indispensable for human health and well-being and virtually all human activities and for sustaining the ecosystems on which our and future generations depend.
- The availability and quality of water is a major determining factor for socio-economic development.
- There is a difference between basic human and environmental "needs" for water and the much larger set of "wants." Basic human and environmental needs for water must be identified and met as a first priority.
- Water is a finite and vulnerable resource that must be used efficiently, equitably, and in an ecologically sound manner for present and future generations. Increases in the efficiency with which water is used, as well as increases in the efficiency with which water is allocated, should both be pursued. Choices must be made and priorities set for ways in which to allocate scarce water resources.
- The most effective water policies involve the users of water as explicit participants in water management, planning, and decision-making. Acknowledging the role of women in acquiring and managing water in many regions is particularly important.
- Effective water resources management and planning require that better data and information on all aspects of water be collected and made widely available.
- Co-ordination of water and land uses across sectors and spatial units is fundamental. The watershed area is the appropriate unit for such efforts.

Acknowledging these elements will facilitate vital long-term objectives of "sustainable development," including poverty alleviation, economic and social well-being, and safeguarding the sustainability of ecosystem goods and services.

- **Water is indispensable for virtually all human activities and for sustaining the ecosystems on which we all depend.**

Water touches on all aspects of human existence: health, food production, energy, industrial production, ecosystem function, transportation, and so on. It is now imperative that decision-makers in all sectors, and particularly those responsible for socio-economic planning, financial analysis and policy, make development decisions with explicit attention to water resources.

- **The availability and quality of water is a major determining factor for socio-economic development.**

Lack of water is a barrier to sustainable socio-economic development; lack of development is a barrier to solving water problems. Because water integrates so many aspects of life, it must be given prime consideration in the context of development objectives. This includes the day-to-day management of water, decisions about allocations for socio-economic activities, and the preservation of natural resource capital.

- **There is a difference between basic human and environmental "needs" for water and the much larger set of "wants." Basic human and environmental needs for water must be identified and met as a first priority.**

The overall demand for water includes a combination of basic "needs" and a larger set of "wants." 'Need' for water exists independently of economic or political status and, in principle, it cannot be manipulated. It is most evidently illustrated as a 'basic need' in connection with human health. More generally, 'demand' typically refers to the economic and political demand that is expressed in terms of purchasing power and degree of political empowerment and claims. The failure to meet basic needs is the cause of enormous human suffering and meeting these needs should be the top priority of water policy makers.

- **Water is a finite and vulnerable resource that must be used efficiently, equitably, and in an ecologically sound manner for present and future generations. Increases in the efficiency with which water is used, as well as increases in the efficiency with which water is allocated, should both be pursued. Choices must be made and priorities set for ways in which to allocate scarce water resources.**

Inefficient water use and the use of water to produce low-valued, water-intensive products are both fairly widespread. A major focus on the efficiency of the end uses of water can be particularly relevant for those sectors and activities where low efficiency and low-value production prevail and where the benefits (market and non-market) of demand management are greater than the costs of improving the efficiency of water use. Demand management may not only save this finite and vulnerable resource, it should also reduce budgetary pressures in regions where capital for new infrastructure projects is scarce and where pressures on sensitive environmental resources are high. Properly implemented, it would halt the trend of an increasing percentage of GNP being allocated to water infrastructure.

What sectors, activities, or regions should be provided with water on a priority basis? The issue of "allocation efficiency" addresses how water should be

allocated among these sectors, activities, and regions. In countries or areas with insufficient water to satisfy all potential needs and demands, policy makers will increasingly have to make choices and set new priorities for ways in which to allocate water.

- **The most effective water policies and institutions involve the users of water as explicit participants in water management, planning, and decision-making. Acknowledging the role of women in acquiring and managing water in many regions is particularly important.**

Principles of sustainable water use require more than simply maintaining the resource - they require public participation in all aspects of water policy and management. Experience has repeatedly shown that major decisions made without involving local communities and those affected by decisions are considerably more likely to fail. International water conferences and meetings have consistently recommended that water managers and planners be obligated to seek public participation, community discussions about allocations and priorities, to facilitate the user-pay approach, and, generally democratic decision making. The involvement of women at the community and other levels appears to be particularly effective and valuable.

In many regions, greater efforts are needed to build the human capacity necessary for effective water management and institutions. Development of appropriate educational and training programmes is an important part of this capacity building. New approaches are also necessary for preserving the rights and options of future generations. The children of today, who are the grown-ups of tomorrow, must also be actively involved through education programmes and awareness campaigns.

- **Effective water resources management and planning require that more up-to-date data and information on all aspects of water be collected and made widely available.**

Expansion of data collection, free flow of relevant information and the use of hydrological information systems are prerequisites for proper water management. Agenda 21 and the report of the International Conference on Water and the Environment in Dublin recognise that knowledge of the hydrological cycle is an essential basis for efficient water management. The lack of data - prevalent today because of the failure to collect it or the failure to share it - seriously hinders proper planning and management of water systems. In extreme water-scarce regions the development process itself depends on the ability of water managers and planners to provide or receive the right information and knowledge at the right time. Modernising hydrological services will require blending and reinforcing conventional information systems with modern technology and equipment, as well as collecting new information related to the ecological, social, cultural and institutional aspects of sustainable water management and use.

- **Co-ordination of water and land uses across sectors and spatial units is fundamental. The watershed area is the appropriate unit for such efforts.**

Water planning and land use planning should no longer be done in isolation. The close ties between water, food, land and ecosystem management necessitate close

co-ordination. Better institutional mechanisms are needed to address watershed issues that cross political, social, and economic borders. Successful water and sanitation programmes are often based upon partnerships among government, donor, community, and non-governmental organisations.

PRINCIPLES FOR 21ST CENTURY WATER MANAGEMENT AND PLANNING

New principles for water management and planning must be adopted. These principles began to be defined nearly 20 years ago at the groundbreaking conference on water at Mar del Plata, Argentina, and they have been further developed and refined at several important meetings since that time. Significant advances were made at the 1992 Dublin conference in preparation for the Earth Summit in Rio de Janeiro. Below, we summarise and elaborate on four principles, which should be used to guide water decisions into the next century.

Rather than continuing to search for more and more water to meet anticipated demands, it is time that we adopt the idea that water is a finite and vulnerable natural resource and that excessive withdrawal from natural water bodies is exponentially costly and is likely to cause considerable harm to ecosystems' functioning and downstream areas generally (Gleick et al. 1995, Postel 1996, Heyns et al 1997). Rather than thinking in terms of augmenting supply by increasing rate of withdrawal, we — as society, communities and individuals — must decide what we want to do with the amounts that can feasibly be developed.

1. Identify and meet basic human and ecosystem water needs.

Among the concepts raised nearly 20 years ago during the 1977 Mar del Plata conference was that of meeting "basic needs." The 1992 Dublin Conference statement reiterated that principle, which was then strongly reaffirmed during the 1992 UNCED in Rio de Janeiro. International organisations, national and local governments, and water providers should adopt a basic water requirement (BWR) standard to meet basic needs and guarantee access to it. Unless this basic resource need is met, large-scale human misery and suffering will continue and grow in the future, contributing to the risk of social and military conflict. Priority should be given to the unserved and underserved poor who are at greatest risk. The basic needs of natural ecosystems must also be identified and met as a top priority.

2. National food self-sufficiency should give way to the concept of national food self-reliance.

The view that all countries must be responsible for their own food production hinders rational solutions to the problem of true food security. The ultimate goal must be a world that grows sufficient food to meet the world's needs, somewhere, and the institutions and mechanisms to deliver that food where it is needed. Thus "global food security" - where enough food is produced and distributed to feed everyone - is absolutely vital, while the goal of "national food self-sufficiency" - where countries seek to produce all their food needs domestically - is already unattainable for a number of countries. It will be increasingly problematic and costly, in financial and environmental terms, for a growing number of countries. This shift in thinking requires a shift in national water policies, the functioning of global trade, access to agricultural markets, and the design of import-export

policies. The benefits and risks of relying on international trade to ensure food security are at the heart of the debate between those alternative food strategies.

In particular, mechanisms to help shift poor water-short countries away from water-intensive agricultural production must be coupled with the development of robust trade or aid programmes. Over time, changes in diets and new forms for food production like 'urban agriculture' can also play an important role in boosting global food security.

3. Water is an economic good. Its economic values should be given due attention when apportioning scarce water resources among competing uses, without infringing on the basic rights to water services for all people at affordable prices.

Water must no longer be considered a free good. The recognition of water as an economic good, which was one of the cornerstones of the Dublin and Rio statements, implies that planners and users recognise the true value of water in all its competing uses and functions. Recognising the varying ability to pay and with due consideration to social objectives, water users must assume a larger responsibility in recovering the full cost of providing water-related services, including development, provision, maintenance and treatment costs. Mechanisms should also be set up to help water marketing and trading, but such mechanisms must include broad social and environmental values not considered in traditional narrow market approaches. Commercialisation of water systems may be a valuable tool to apportion water to its highest value. But there must also be governmental and social mechanisms for ensuring affordable basic access to water for people and ecosystems and to provide legal and institutional framework for the proper functioning of commercial water systems.

Provision of heavily subsidised water services leads to inefficient water use and inappropriate water allocations. Such subsidies also mean a significant drain on limited public financial and other resources. In order to meet basic human and environmental needs and to stimulate long-term sustainable development, it is imperative that the prevailing notion of water as a free good be changed. Responsible and proper use requires, among other things, that charges and fees reflect the various costs for water with due consideration to the significance of water in all aspects of life and social activity.

4. Water planning and decision-making should be democratic, ensuring representation of all affected parties and fostering direct participation of affected interests.

The principle that water planning and decision-making should involve the fullest participation by affected parties has been enunciated by international organisations and official water conference statements for nearly 20 years, going back to the 1977 Mar del Plata conference. The goal was also one of the prime recommendations from the Dublin meeting.

> *"Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels. The participatory approach .... 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." (ICWE 1992)*

Sustainable water planning and use should ensure comprehensive public representation, open and equitable access to information about the resources, and

direct participation of affected interests in decisions about allocating those resources. The success of policies and programmes for water management, planning, and use now strongly depends on the extent to which the water users and various interest groups become actively involved. This requires new institutional arrangements that are conducive to fostering such involvement and enabling the various stakeholders to play a constructive role. Ways must also be found to incorporate and protect the interests of future generations - a fundamental criteria of sustainability as defined by the United Nations in Agenda 21.

1 TOWARD THE NEW CONSENSUS

Wealth or poverty, health or sickness, food or famine, and war or peace are circumstances that are often related to variations in the availability and quality of fresh water. These variations are a natural part of the hydrological cycle, which distributes water independent of our will. They can also be exacerbated by human interventions. Proper understanding of the natural and human dynamics affecting water resources is a fundamental requirement for truly sustainable development.

The management and protection of our freshwater resources have reached a crucial period. In the last several decades, it has become obvious to many that traditional water policies are not up to the task of meeting the challenges of the 21st century. Yet water institutions and policymakers have so far been unable to develop and implement the new tools and approaches needed to successfully address the nature of these new challenges.

Two trends exemplify the problems now facing the world: the continued inability to meet basic human needs for water; and the omnipresent conflict among urban, agricultural and environmental water interests. Sound water policy for the 21st century will require solid planning, active public participation, and a new vision of sustainable water use, including explicit goals to help resolve water conflicts and to meet basic human and environmental water needs. This paper, prepared as a background document for the Comprehensive Freshwater Assessment to the General Assembly of the United Nations, presents a framework that explores how planners might begin to define and identify a sustainable water future and sets out specific goals for long-term water planning based on principles for sustainable water resources' management and use.

Declarations from a large number of international meetings and organizations during the last several years are converging on a new consensus. In particular, these declarations include the following recognitions:

- Water is indispensable for human health and well-being and virtually all human activities and for sustaining the ecosystems on which our and future generations all depend.
- The availability and quality of water is a major determining factor for socio-economic development.
- There is a difference between basic human and environmental "needs" for water and the much larger set of "wants". Basic human and environmental needs for water must be identified and met as a first priority.
- Water is a finite and vulnerable resource that must be used efficiently, equitably, and in a sound manner for present and future generations. Increases in the efficiency with which water is used, as well as increases in the efficiency with which water is allocated, should both be pursued. Choices must be made and priorities set for how to allocate scarce water resources.
- The most effective water policies involve the users of water as explicit participants in water management, planning and decision-making. Acknowledging the role of women in acquiring and managing water in many regions is particularly important
- Effective water resources' management and planning require that more up-to-date data and information on all aspects of water be collected and made widely available.
- Co-ordination of water and land uses across sectors and spatial units is fundamental. The watershed area is the appropriate unit for such efforts.

Acknowledging these elements will facilitate vital long-term objectives of "sustainable development", including poverty alleviation, economic and social well-being, and safeguarding the sustainability of ecosystem goods and services.

2 LONG-TERM WATER PLANNING: FROM THE PAST TO THE FUTURE

In the past, principal objectives of water development policy were to boost food production and to support increasing levels of economic development. In many countries, significant national and international efforts have focused on building major irrigation projects, large dams and hydro-electric facilities, and water treatment systems for large cities and industries. Another prime objective was to meet specific social goals, for example improving human health or reducing the burden on women responsible for seeking often distant water sources to meet daily needs.

Without a doubt, society has benefited enormously from many of these projects. But in spite of ambitious social and economic programmes, the enduring results have been disappointing. At the beginning of the 1990s, the number of people without access to safe water was more than a billion - nearly 20 per cent of the world population at the time. This illustrates the failure to achieve the objective of providing clean water for all, which was supposed to be achieved during the 1980s, the International Drinking Water Supply and Sanitation Decade. Equally noteworthy has been the neglect and ignorance of basic environmental and ecological water requirements, with consequences evident around the world.

To a large extent, the missing dimension in water development can be interpreted in terms of four circumstances: first, the failure to make a long-term commitment to providing basic human and environmental water needs; second, the lack of active and responsible user participation and a poor understanding of the roles of communities and culture and the wants and needs of future generations; third, a failure to recognize and integrate the many functional roles of water; and fourth, a failure to understand and correct enormous water waste and contamination. Wastage and abuse of finite and valuable fresh water can no longer be accepted when water scarcity and financial scarcity are affecting a growing proportion of the world population. Nevertheless, it continues to be a significant feature around the world, even in areas where access to water is increasingly difficult and expensive to arrange.

The consequences of past water policies include the failure to eliminate widespread human health problems, declining ecosystems, growing political conflicts over water and poor project performance (Falkenmark and Lundqvist, 1995; UNCNR, 1996). These problems are widely recognized by the water community, and efforts to broaden and reshape water policy have been underway for some time.

A new debate has now begun, as reflected by the nature of the statements coming from the 1977 Mar del Plata Water Conference, the 1992 Dublin Statement, Chapter 18 of Agenda 21 from the Earth Summit in Rio de Janeiro, policy papers from the World Bank, the Global Water Partnership, and others (see Chapter 7 and Table 7.1 for a summary). These efforts call for new definitions and concepts in an effort to incorporate characteristics of sustainability and equity in water planning. Developing sustainability goals has become a major policy priority, and requires placing a high value on maintaining the integrity of water resources and the flora, fauna and human societies that have developed around them. Rather than continuously trying to find the water to meet some projection of future desires, it is time to plan for meeting present and future human and ecological needs within the limits of our resources. This is an

essential change, and will require some new thinking at the highest levels - a hydrologic *perestroika.*

Among the approaches receiving the most attention are improving the efficiency of water allocation and use, distributing the costs and benefits of water resource management and development in a fair and prudent manner, and meeting commitments to nature and the diverse social groups of the present and future generations.

Rather than trying to find the water to meet some projection of future desires, it is time to plan for meeting present and future human and ecological need within the limits of our resources. This is an essential change, and will require some new thinking at the highest levels - a hydrologic perestroika.

Water resource planning in a democratic society requires more than simply deciding what project to build next or evaluating which scheme is the most cost-effective. Planning must provide information that helps the public to make judgments about which "needs" and "wants" can and should be satisfied. Water is a common good and community resource, but it is also a private or economic good; it is necessary for life but it is also a recreational resource; it is imbued with cultural values and plays a part in the social and economic life of our communities. The principles of sustainability, equity and efficiency can help bridge the gap between such diverse and competing interests.

Regional and global water planning must now address such questions as: What are the most worthwhile uses of finite and vulnerable water supplies? What are the most basic and indispensable needs for water? How much water is needed to maintain environmental quality and services? How much water should be available and at what quality for the use of current and future generations? What means can be used to improve water-use efficiency and end wastage? The answers to these questions depend on a number of characteristics of water that must increasingly be acknowledged.

3 CRITICAL CHARACTERISTICS OF WATER

3.1 Water is a renewable resource fulfilling multiple functions

Water is a renewable resource that fulfils multiple functions. Yet we often use it non-renewably, and we treat its many functions in isolated and singular fashion. In contrast to the fragmented sectoral and administrative structures and jurisdictions that characterize society, water flows through the landscape where it 'lubricates' both the natural and social components of the Earth. Through this flow, and through the manipulation of it, the basic needs and wants of people are possible to satisfy. Water's vital role for the environment and humans is linked to five main functions (Falkenmark and Lundqvist, 1995):

- *maintaining human health*: clean water is essential for maintaining human health;
- *maintaining environmental health*: the health of aquatic ecosystems is essential for fish/seafood supply, is a major determinant of biodiversity, and provides for many other vital goods and services;
- *supporting two production functions*: a) biomass production, necessary for the supply of food, fuelwood and timber; and b) economic production, since industrial development has traditionally been "lubricated" by easy access to water;

- *supporting two carrier functions*: (a) water plays an active role in diluting and transporting wastes; and (b) in the natural erosion and land processes of the global water cycle;
- *a psychological function*, which makes water bodies, water views, fountains and so on fundamental components of human preferences and desires. Water also plays a role in many religions and cultural activities.

These five functions highlight the twin objectives of societal development and environmental sustainability as discussed in UNCED (1992). At the same time, the list above illustrates that the promotion and safeguarding of these functions make water management a complex issue. This complexity is compounded by the growing need and demand (see distinction below) for water and by the finite availability of the resource. In addition, the poor correlation between spatial and temporal availability of water and patterns of need and demand is already a significant and growing challenge. A large part of the unavoidable population increase during the coming decades will be in areas where water is already scarce and/or erratically available.

3.2 Regional, local and global water imbalances: the issue of scale

There is no such thing as a global water problem - all problems manifest themselves at smaller scales. For example, at the global average level, there is sufficient water to meet the needs and wants of every human being. At the continental level, per capita water availability still seems more than adequate, though large regional disparities appear. In Europe, each million cubic meters of water available per year is "shared" by over 150 people, on average, while in South America only 25 people must share that much water. Comparisons with Asia show even more extreme differences (see Table 3.1). The figures in Table 3.1 are, however, elusive in terms of real problems in various continents. The situation in Africa, for instance, is significantly different from the situation in Europe although availability figures are at the same level.

At the national level, the differences in availability are substantially more marked, with variations of several orders of magnitude. For example, one of the richest countries in Europe, measured by water availability, is Norway, with 10 persons per million cubic meters per year. At the other extreme is Turkey with nearly 1000 persons per million cubic meters per year. Yet Turkey, compared to some of its Middle East neighbours, could be considered water rich (Gleick, 1993; Engelman and LeRoy, 1993; World Resources Institute, 1996; Kelman, 1996; Najlis, 1996 personal communications). And within countries, enormous variations in water availability, water distribution, water quality and water use occur. Similarly, concerns about the hydrologic impacts of global climatic change ultimately come down to how local and regional supplies of and demand for water will be affected (IPCC, 1996).

Growing scarcity at the regional and local levels indicates imbalances between overall availability and growth in need and demand. These imbalances will have implications far outside the areas under stress. An important example is the issue of food production. If more and more countries do not have sufficient amounts of water to grow the food that they need, the deficit must be covered from somewhere else. And there must be arrangements, agreements and institutions capable of (i) creating a surplus large enough to cover the growing regional and local deficits, (ii) providing logistical capacity and procedures for the actual transfer of food and other essentials from surplus to deficit regions, including the poor, and (iii) guaranteeing a political commitment to transfer food to deficit areas and the poor, even if people in these areas do not have the means to provide their own supply. This issue is further discussed in Section 6.2 below.

Table 3.1 Availability of fresh water by continent

Continent	Surface Area (10^3 km^2)	Population (millions)	Runoff (km^3/year)	Availability (people/10^6 m^3/year)	Availability (m^3/person/day)
Europe	10 500	498	3 210	152	18
Asia	43 475	3 108	14 410	211	13
Africa	30 120	648	4 570	144	19
North and Central America	24 200	426	8 200	52	53
South America	17 800	297	11 760	25	108
Oceania	8 950	26	2 388	11	252
TOTAL	135 045	5 003	44 540	114	24

Source: Shiklomanov (1993); da Cunha (1994)

If these three pre-conditions are not at hand or met, the likely result in a growing number of areas is hunger and starvation, political and social instability, tension and conflict, serious ecological disruptions, and mass exodus of people from depressed regions. In any case, the growing dependence on imports of food may soon begin to put upward pressure on market prices of many staples. At the present time there are signs of a reverse of the trend of decreasing staple food prices as compared to other commodities in international trade. Whether or not these trends continue depends in part on how we address regional and local water scarcities.

3.3 The distinction between need and demand

A distinction must be made between basic human and environmental "needs" for water and the much larger set of "wants" for water to provide additional goods and services. The overall demand for water includes a combination of basic "needs" and this larger set of "wants". In truly water short areas, the indiscriminate use of almost unlimited amounts for watering lawns, golf courses and other affluent uses indicate the differences between 'need' and 'wants'. 'Need' for water exists independently of economic or political status and, in principle, it cannot be manipulated. More generally, 'demand' typically refers to the economic and political demand that is expressed in terms of purchasing power and degree of political empowerment and claims.

The goal of providing for basic human needs was officially recognized as early as the 1977 Mar del Plata conference and continues to be an important unmet concern (UN, 1978; Dublin/ICWE, 1992; UNCED, 1992). Gleick (1996) defines basic human needs for water for domestic purposes and quantifies a "basic water requirement" (BWR) to meet these needs (see Table 3.2). Minimum needs have been recognized by policymakers in the form of the "lifeline tariff" as being advocated in parts of the United States, some countries in Europe and Southern Africa, and elsewhere. Minimum needs for natural ecosystems are also beginning to be defined in many places in terms of flow requirements, environmental quality standards and watershed protection. Additional basic needs for water are implicit in food requirements, but these have not been adequately assessed and can be provided indirectly from outside a given region through imports of food (this issue is discussed further below).

Demand for water can be changed and even reduced without necessarily diminishing the overall utility for the individual user of water. If less water is demanded by individual users, for instance through increased price or improved technology, the utility for the user may remain the same. The potential to increase efficiency - i.e., to reduce the volume of water used per unit of output - is quite significant in most productive uses of water, notably irrigated agriculture and industry. If the 'freed' water can be used beneficially by others, this implies improved opportunities and increased utility for society at large.

Table 3.2 Water requirements for basic human needs[a]

Purpose	Recommended Level (litres per person per day)
Drinking water[b]	5
Sanitation services	20
Bathing	15
Food preparation	10
Total recommended BWR for basic human needs	**50 litres per person per day**

Source: Gleick (1996)

[a] Excluding water required to grow food.

[b] This is a true minimum to sustain life in moderate climatic conditions and average activity levels.

3.4 Make water a "first thing" in development strategies

Water resources must now be recognized as a major determining factor for socio-economic development (UNCNR, 1996). During the period when human demands on water were low and when hydrological cycle behaviour and the climate were thought to be fairly predictable, water was the last thing to be considered in the development decision-making process, if it was considered at all. In the past hydrologists and water managers tended to concentrate on gathering scientific knowledge about the hydrological cycle, paying little attention to socio-economic and environmental values, to the point that most development activities naturally assumed that there would always be water available for projects.

Today, due to the increasing pressures on water resources and the recognized variability of the hydrological cycle and the climate, the position of water in the decision-making process has been completely reversed (G. Matthews, personal communication). Now, water must become the one of the first things to be considered in the context of development and security objectives, including the day-to-day management of water allocation for socio-economic activities and the preservation of natural resource capital. It is now imperative that decision-makers in all sectors, and particularly those responsible for socio-economic planning, financial analysis and security, make development decisions with explicit attention to water resources.

> *It is now imperative that decision-makers in all sectors, and particularly those responsible for socio-economic planning, financial analysis and security, make development decisions with explicit attention to water resources.*

Management of the Earth's water and other natural resources, and more generally, the environment, has increasingly been recognized as inextricably linked with possibilities to advance community prosperity and safeguard social and political stability, domestically as well as in an international context. Environmental issues are now high on the diplomatic agenda. New definitions of national security and the notion of sustainability are increasingly based on the view that abuse of the environment, scarcity of resources, and inadequate resource management and planning, in combination with growing populations and economies, can lead to local, regional, and international tensions and conflict. The nexus between development, environment and security is likely to become even more apparent as we move into the 21st century, particularly in the area of water resources (Gleick, 1993; Homer-Dixon, 1993).

As an example of the growing attention to these issues at the highest level, US Secretary of State Warren Christopher recently gave a speech entitled "American Diplomacy and the Global Environmental Challenges of the 21st Century" marking a

strong concern for the possible environmental degradation and the ensuing human sufferings and conflicts. Chrisopher called for a new dimension in US diplomacy and included 'environmentalism' as a top priority, in addition to traditional goals such as preserving peace and promoting prosperity (Christopher, 1996).

Apart from increased concern within the public domain, influential circles in the civil society are showing a new interest in resource and environmental issues. Private and commercial sector interest in water affairs is growing. The handing over of public utilities to private enterprises is increasing in a number of sectors, including the water sector. The new mix of partners concerned about water management and the new consensus about the multifunctional roles of water in development and for security represents an opportunity to approach the complex water challenge in a more flexible and, hopefully, more realistic manner.

4 GOALS FOR GUIDING SUSTAINABLE WATER RESOURCE MANAGEMENT

Understanding these characteristics of water resources has helped water planners to begin rethinking long-term goals and approaches. It is now widely accepted that criteria for sustainable water use and management must include more than simply measuring traditional biological or physical indicators. They must also provide guidance for the individuals and institutions that use and manage water, resolve conflicts over water, and deal with the unavoidable uncertainties and risks in decision-making. Accordingly, sustainability goals for water must apply to the role of public, private, governmental and non-governmental parties. A broad definition of sustainable water use was provided by Gleick (1996):

> "the use of water that supports the ability of human society to endure and flourish into the indefinite future without undermining the integrity of the hydrological cycle or the ecological systems that depend on it".

Explicit criteria and goals for the sustainability of freshwater resources are presented here in Table 3.3. These criteria lay out human and environmental priorities for water use, taking into account not only the needs of the current populations, but also those of future generations. The criteria and goals of Table 3.3 - the result of considerable dialogue and analysis with academic, governmental and non-governmental interests working on regional, national and international water problems - are not, by themselves, recommendations for actions. They are endpoints for policy that lay out specific societal goals that could, or should, be attained. In particular, these criteria can provide the basis for alternative "visions" for future water management and can offer some guidance for legislative and non-governmental actions in the future. While debate on how to attain these goals is unavoidable (and is even desirable), having a set of clear targets will help focus the ultimate policy decisions. In contrast, without specific criteria to guide planning, unsustainable water policies are inevitable.

Table 3.3 Sustainability goals for water planning

1. A basic water requirement will be guaranteed to all humans to maintain human health.
2. A basic water requirement will be guaranteed to restore and maintain the health of ecosystems.
3. Water quality will be maintained to meet certain minimum standards. These standards will vary depending on location and how the water is to be used.
4. Human actions should not be allowed to impair the long-term renewability of freshwater stocks and flows.
5. Data on water resources availability, use and quality will be collected and made accessible to all parties.
6. Institutional mechanisms will be developed to prevent and resolve conflicts over water.
7. Water planning and decision-making will be democratic, ensuring representation of all affected parties and fostering direct participation of affected interests.

Source: Gleick (1996)

Goal 1 Basic human water requirements

The first criterion listed above sets as a primary goal the provision of a basic amount of water for meeting the essential needs of humans. This elementary goal, common to many different interpretations of sustainability over the past few years, was raised in "basic needs" requirements of the 1977 Mar del Plata statement, restated in the United Nations Agenda 21, which explicitly recognized the standing of both humans and ecosystems, and is part of the compact for human development described in the 1994 UNDP Human Development Report (UNDP, 1994). For humans, insufficient access to potable water is the direct cause of millions of unnecessary premature deaths every year (see Box 1: Water Policy for Safeguarding Human Health). The provision - at affordable prices - of a basic amount of fresh water to support human metabolism and to maintain human health should be a guaranteed commitment on the part of governments, international organizations, local water providers and non-governmental organizations.

Goal 2 Basic environmental water requirements

The second of the criterion listed above requires a basic amount of water be guaranteed to meet the essential needs of natural ecosystems. This goal was also supported as part of the "basic needs" requirements of Agenda 21 of the United Nations (UNCED, 1992). Some limited efforts have been made to set minimum requirements for certain threatened or high-priority ecosystems, but few criteria have been set, particularly in the developing world. Societal decisions will have to be made regarding the degree to which these ecosystems should be maintained or restored and the indicators by which to measure their health. Examples of such decisions include the preservation of stretches of undammed rivers, establishment of minimum flow requirements in some river stretches, reallocations of water from major water projects to the environment, and development of standards to protect wetlands.

Goal 3 Water quality standards

Different uses require water of differing qualities. As a result, water quality standards for different purposes must be developed and water quality must be monitored and maintained to meet these standards. Water in most developed countries is protected from contamination by national regulations (WHO, 1984; USEPA, 1992; MNHW, 1992). These water quality standards are supposed to ensure that potable water is reasonably free from contaminants known to affect human health. In many parts of the developing world, however, even minimal water quality standards are not in place, leading to widespread cases of waterborne diseases. At the same time, however, water used for non-human consumption need not be protected to drinking water standards (WHO, 1993). For example, water used for many industrial, commercial, irrigation or landscaping purposes could be protected to a lower standard, with substantial economic savings. Similar water quality criteria need to be developed for environmental water requirements. Substantial effort should go into identifying these differences and developing ways of meeting various demands with water at appropriate levels of quality (see further under Section 5.2).

Box 1

Water Policy for Safeguarding Human Health

by Dennis B. Warner, WHO

Human health must be considered an integral aspect of freshwater development. The World Health Organization reports that every eight seconds a child dies of a water-related disease and that more than five million human beings die annually from illnesses linked to unsafe drinking water, unclean domestic environments and improper excreta disposal. At any given time perhaps half of all peoples in the developing world are suffering from one or more of the six main diseases associated with water supply and sanitation (diarrhoea, ascaris, dracunculiasis, hookworm, schistosomiasis and trachoma). The health burden of poor water includes the annual expenditure of over 10 million person-years of time and effort by women and children carrying water from distant, often polluted, sources.

Significant health benefits can be attained in water development projects through proper consideration of health objectives in the planning and design of water projects. At the same time, the lack of such considerations will generally result in unanticipated adverse health consequences. It is necessary, therefore, to establish a balance between human health, environmental economics and financial viability in the development of our water resources.

Towards this end, some key principles are worth bringing to the attention of organizations responsible for the development of water projects:

- The protection and enhancement of human health should be one of the fundamental objectives of all water resources development.
- The intended health consequences of all water developments need to be more fully identified and described in the planning phase, incorporated into the implementation phase, and monitored and evaluated in the operational phases.
- As water is a basic human need, water development should be based on the principles of equity of access, equity of responsibility, and broad-based participation of project beneficiaries.
- Priority should be given to the unserved and underserved poor, who are at greatest risk, particularly those in the urban fringes of large cities and the neglected rural areas of developing countries.
- Financing mechanisms, such as tariff structures, willingness-to-pay studies and cost recovery schemes, should be viewed as tools to support project sustainability.
- The environmental, social health and economic consequences of projects are the true benefits of water development and should be anticipated in the planning phases and incorporated into project justification (Enderlein, 1996; Warner, 1995). See also WHO: *Community Water Supply and Sanitation*, Report by the Director-General, Forty-eight World Health Assembly (A48/Inf.doc/2, 28 April 1995).

Key lessons learned over the past 15 years must be considered, including:

- Successful water and sanitation programmes are often based upon partnerships between governments, external support agencies, NGOs and communities.
- There is too much reliance on external support and insufficient effort to identify in-country funding mechanisms, such as the private sector.
- Operation and maintenance services cannot be sustained by governments. Mechanisms for cost recovery and financing of O & M must be developed at the local level for long-term sustainability.
- Sustainable sanitation coverage is dependent upon hygiene awareness within the community.
- There is need for more community involvement, especially that of women, in the planning, operation and maintenance of water and sanitation facilities (unpublished material: UNICEF).
- Project beneficiaries should be given choices of technologies and level of services matching their needs and willingness to support them in the long term.

Goal 4 Renewability of Water Resources

Freshwater resources are typically considered renewable: they can be used in a manner that does not affect the long-term availability of the same resource. There are, however, some ways in which renewable freshwater resources can be made non-renewable, including mismanagement of watersheds, groundwater overpumping, land subsidence and aquifer contamination. Any actions that make renewable water resources non-renewable are stealing those resources from future generations, which violates the most fundamental requirement of sustainability. Co-ordinated land-use and water policies should explicitly protect against these irreversible activities.

Goal 5 Data collection and availability

If water planning and management are to be democratic and effective, data on all aspects of the water cycle must be collected and made available in an unrestricted manner. At present, data on many aspects of regional and national water supply and use are not collected and, when they are, are not widely available. At the extreme, some national governments continue to classify basic water data for so-called security reasons. This is unjustified and greatly inhibits effective and equitable water planning and management. Recent advances in electronic communications make sharing resource information easy and inexpensive. In particular, Internet resources related to water are growing at a phenomenal rate, and many sources of information are already freely available. This trend should be encouraged and expanded (see further under Section 5.3). New approaches to collecting data and new requirements for the kinds of data collected are needed, given the broader needs for integrated water planning and management.

Goals 6 and 7 Institutions, management and conflict resolution

Criteria for sustainability are not only about measuring appropriate biological or physical indicators; they must also provide guidance for the institutions that are to resolve conflicts over water and deal with the unavoidable uncertainties and risks in decision-making. The greatest debates over water in the past several decades have focused on how to reach particular goals. The water debate must now be broadened to address the means by which these goals are set. Accordingly, sustainability goals must also apply to water resources' management, particularly to ensure democratic representation of all affected parties in decision-making, open and equitable access to information on the resources, and the options for allocating those resources.

> *Sustainability goals must also apply to water resources' management, particularly to ensure democratic representation of all affected parties in decision-making, open and equitable access to information on the resources, and the options for allocating those resources.*

Water planning and decision-making in many regions are limited to a narrow range of professionals trained in engineering, agriculture and the hydrological sciences. The power of these groups remains significantly greater than that of rural interests, religious or ethnic minority groups, environmental groups and other users. Mechanisms to broaden their participation are needed. Ways must also be found to incorporate and protect the interests of future generations - a fundamental criteria of sustainability as defined by the United Nations in Agenda 21 (UNCED, 1992).

In addition to mechanisms to broaden participation, institutional mechanisms need to be set up to prevent and resolve conflicts over water. A wide range of institutional mechanisms for resolving water disputes already exist in many developed nations,

though their effectiveness varies greatly depending on the issue and the extent of political manipulation and interference. The institutions of the future must not only be more open and democratic, but must resolve conflicts over water in an equitable, prudent and fair manner.

5 IMPORTANT PRECONDITIONS IN POLICY APPROACHES

5.1 The new water world: constraints and opportunities

To achieve these sustainability goals and the broader development objectives of poverty alleviation, promotion of economic and social well-being and stability, and safeguarding of ecosystem sustainability, it is necessary to consider the tremendous variability in water availability that exists between and within countries (cf. Section 3.2). These variations could be seen as indices of variations in environmental preconditions for development. A harsh water environment implies that considerable human effort must be devoted to securing a living, including huge investments in water infrastructure. The combination of problematic environmental preconditions and rapidly growing populations represents a significant challenge.

Measures and activities in water planning and management must therefore vary from country to country in response to the particular circumstances at hand. Some preconditions are, however, quite widespread and some have been forged with important societal structures, creating a complex set of challenges that have to be coped with in water resources' management. In various meetings and discussions in recent years (see Section 7), the following significant features have been documented:

- In some parts of the world water is simply not available in adequate quantities to satisfy all human and environmental demands. Limited overall availability implies that it may not be possible to satisfy all the needs and wants of a rapidly growing population entirely with indigenous natural resources. In such circumstances, allocations to inefficient or low-valued uses may have to be reconsidered - this often suggests taking water from agriculture (see Sections 5.3 and 5.4 below). It also means that upstream-downstream co-ordination with land use and planning will have to be much better.
- Comparatively little concern has been devoted to the impact on water quality and the wider environmental degradation that is part and parcel of intensified use. The Global Freshwater Quality report to GEMS/WATER (Meybeck, Chapman, and Helmer, 1989) provides a good overview and analysis of the state of the challenge. It also illustrates that lack of data and incomplete interpretation of the available data are common features in water management, even in developed countries. A recent compilation about Europe's environmental conditions (Stanners and Bordeau, 1995) clearly illustrates that there are considerable water scarcity and environmental degradation problems in many European regions. Far less work of a comparable nature has been done in developing countries.
- Financial analysis and management, including water pricing and charging for services, are necessary pieces of viable and efficient water management policies. While expenditures for water infrastructure are soaring, the financial autonomy of the water sector is significantly lower than that of other comparable sectors (Serageldin, 1995). The completion of ongoing projects and the planning of new ones are being slowed down partly because of budgetary constraints (see, for instance, Reddy (1992), who analyses the situation in India). In addition, operation and maintenance of many systems are impaired for lack of funds. In

particular, the proper handling and treatment of wastewater is seriously lagging behind.

These three points are related to each other in several ways. The scarcer water is, the more expensive will it be to identify and obtain safe supplies. Similarly, with less water, the easier it is to contaminate the existing supply and the harder it is to dispose of pollutants. Efforts to handle these problems must increase as populations increase and as expectations for improved standards of living rise. A delicate task for water utilities is determining how to recover expenses for new water systems - which are much more expensive in real terms, as compared to 'old' schemes - from water users or taxpayers. Furthermore, the cost to treat wastewater or arrange for its re-use are often not included in current water charges. A formula is urgently needed whereby current and future expenditures are covered or safeguarded for all parts of the water cycle.

The points mentioned above have special relevance with respect to how to meet basic water needs. Certain water uses are indispensable and should be given priority attention. Specific, quantitative measures are needed on how much water is actually needed for such purposes. The notion of a Basic Water Requirement (BWR) as elaborated by Gleick (1996) gives us a tool to understand and decide what quantities of water are required to satisfy basic domestic needs. Similar tools are needed for other human demands and for ecosystems.

The policy implication of the BWR approach is to provide a benchmark and a guideline for deciding what functions should be given priority treatment and what amounts of water should be provided for these purposes. These amounts should satisfy fundamental social and environmental objectives. Water provided and used in excess of these basic needs should be treated differently in terms of charges and user responsibilities. This distinction links up with the notion of 'need' versus 'demand'.

5.2 The complexity of water quality management[1]

During recent decades, water management has focused on water quantity and augmenting supply. The way that water was used and the way in which it was disposed after use have been given much less attention. Most industrial enterprises and urban areas in the South and in Eastern Europe do not treat their wastewater adequately, if at all, and the toll on human and ecosystem health is significant and increasing. Safeguarding water quality is thus an integral component in the new consensus on water.

Management for water quality can be organized according to two approaches. One approach includes the establishment of criteria, objectives and standards for water quality. An alternative approach is to apply (uniform) emission limits. The basis for any approach will vary with regional goals, available finan resources and institutional capabilities.

A Establishment of criteria, objectives, and standards for water quality

Water quality criteria (wqc) refer to the particular concer ations of a substance where it starts to change or adversely affect the chemical/biological balance of the ecosystem or where it starts limiting or excluding the envisaged use of the water body.

The establishment of wqc is - especially for hazardous substances - a time consuming and expensive process (e.g. in Canada costs are about CAN $50,000; in

[1] This section is based on material prepared by Dr. Ute Enderlein, UEH/EOS, WHO and Dr. Dennis Warner, WHO.

Germany some 200,000 DM for developing one water-quality criterion for a hazardous substance). To apply wqc elaborated in other countries needs at least some local toxicity studies in relevant water bodies of the "borrowing country" (Enderlein *et al.*, 1996).

Water quality objectives (wqo) are threshold values with regard to water quality to be maintained or achieved over a certain time period. In some countries, wqo play the role of a regulatory instrument or even become legally binding. The political process which leads to wqo requires a critical assessment of national priorities, which should be based on economic considerations, present and future water uses, forecasts regarding industrialization and development of agriculture, and other relevant socio-economic factors (ECE, 1993; 1995).

It is of utmost importance that these wqo are understandable to all parties involved in pollution control and convertible into operational and cost-effective measures. They should also be possible to monitor with the existing network and equipment compliance with such objectives.

Water-quality standards are goals which are recognized in environmental laws or regulations. They represent concentrations of substances which must not be exceeded if the specified uses of the aquatic environment are to be maintained. In the European Union, for example, numerical standards occur in the annexes to a number of directives, for instance, directives about bathing water quality, quality of fresh waters needing protection or improvement to support fish population, and quality required of surface water intended for the abstraction of drinking water in the member states (EC Water Policy, 1996).

There are many substances for which no standards are available. In this case, individual countries have to decide upon what basic control is required. The OECD and UK, for example, have developed risk assessment methodologies for determining appropriate standards. The basic premise is that there is a certain acceptable concentration of each pollutant which does not produce unacceptable effects on the environment and its uses. This requires an examination of toxicity data, the fate, behaviour and risk of accumulation in organisms and sediments, and existing levels in the water environment (Chave, 1996).

The main reason for not promoting the adaption of international standards (i.e. for drinking water quality) is that they may be too stringent in some countries. In such areas they would limit the availability of water supplies - a significant consideration in regions of water shortage (WHO, 1993).

B Emission limit value approach

An alternative is the "limit value or uniform emission approach" which aims at controlling pollution from point sources. Details vary from country to country, but the basic principle has been to require industries or activities, which are known to contribute to water pollution, to be licensed and to make pollution control a condition of that licence. This is normally expressed in terms of "emission controls" setting limits on how much pollutant may be discharged into the water body. The underlying principle is that industries of the same type must achieve the same minimum effluent standards which are laid down in regulations. Emissions are usually regulated to a best-available-technology specification for the industry concerned.

An advantage of this approach is that the dischargers are exposed to the same regulation which is supposed to remove barriers to trade. Disadvantages are unnecessary levels of treatment will be required at many sites, leading to expenditures which could be better spent elsewhere.

In practice, neither of the two approaches offers an ideal solution in isolation. Environmental quality objectives alone are often insufficient to tackle serious pollution problems and can be abused as a "licence to pollute" up to a defined level. Likewise, a strict emission limit values approach based on "best available technology" can, in some circumstances, lead to unnecessary investment without significant benefits to the environment

In practical terms, the existence of eqo allows authorities to judge the effectiveness or otherwise of the emission limit values adopted and whether they need to be tightened. Conversely, controls on emissions (usually based on BAT) are the key element of any strategy to ensure compliance with eqo (see examples on water quality management in Box 2).

Box 2

Examples on Water Quality Management

by Ute Enderlein UEA/EOS, WHO

Nigeria: The Federal Environmental Protection Agency issued in 1988 a specific degree to protect, restore and preserve the ecosystem of the Nigerian environment. The decree also empowered the agency to set wq standards to protect public health and enhance the quality of water. In the absence of national comprehensive scientific data, FEPA has approached this task by reviewing water quality guidelines and standards from developed and developing countries and international organizations and, subsequently, by comparing them with data available on Nigeria's water quality. The outcome was the "Interim National Water Quality Guidelines and Standards", which will be reviewed from time to time by a Technical Committee.

Papua New Guinea: The Water Resources Act outlines a set of water quality requirements for fisheries and recreational use of water, both fresh and marine. The Public Health Drinking Water Quality Regulations specify water quality requirements and standards relating to raw water and drinking water. The standards were established in accordance with WHO guidelines and data from other tropical countries.

Canada and the United States: Water quality objectives for water courses may also take into account quality requirements of downstream lakes and reservoirs. For example, wqo for nutrient concentration in tributaries of the Great Lakes consider the quality requirements both of the given watercourses as well as of the lake system. Similarly, requirements for the protection of the marine environment, in particular of relatively small enclosed seas, need to be taken into account in setting water quality objectives for water courses. This is the case, for instance, of water quality objectives set for the Canadian rivers flowing into the sea.

Germany: A methodology was developed to establish wqo for aquatic communities, fishery, suspended particulate matter/sediment, drinking water supply, irrigation and recreation. Once wqo are established, they will be used by authorities as a basis for water resources' planning, but they will not be considered as generally binding limit values. Authorities have to decide case by case which water uses are to be protected in a given water body and which wqo are to be applied. Binding limit values on wq will only be established in the course of the implementation of water management plans by competent water management authorities.

River Rhine: The wqo include four major elements of the Rhine Action Programme:

- improving the ecosystem of the river in such a way that sensitive species which were once indigenous in the Rhine will return;
- guaranteeing the future production of drinking water from the river;
- reducing the pollution of the water by hazardous substances to such a level that sediment can be used on land or dumped at sea without causing harm.
- protecting the North Sea against negative effects of the Rhine water.

At present, wqo for the river Rhine cover some 50 priority substances, which were established on the basis of catchment inventories of point and diffuse sources of discharge into the Rhine. The established wqo should be complied with by the year 2000.

India: Water quality classification has been designated on the basis of wqr for particular use. These classes have been used to set wqo for stretches of the Yamuna and Ganges rivers. A pollution Action Plan was framed for the Ganga in 1984 and the Ganga Project Directorate in 1985. Considerable improvements during the Plans could be achieved. Following a comparison of ambient water quality with the designated wqo, any deficiency will warrant appropriate pollution control on the discharges including discharges in upstream. No industries are permitted to discharge any effluent in stretches of rivers classified in class A, which is the best class (Box refers to Enderlein *et al.*. 1996).

The two approaches are therefore complementary and not contradictory. The European Community policy of water pollution control has elements of both approaches derived from an assessment of what is technologically possible. The 1992 Convention on the Protection and Use of Transboundary Waters and International Lakes (ECE, 1992) also stimulates both the use of BAT and wqo for water pollution control. This is the case with a number of new bilateral and multilateral agreements to protected transboundary waters in Europe (Enderlein, 1995).

5.3 Expand data collection and the use of hydrological information systems[2]

Chapter 18 on fresh water in Agenda 21 (UNCED, 1992) and the report of the International Conference on Water and the Environment in Dublin (ICWE, 1992) recognize that knowledge of the hydrological cycle (water cycle) is an essential basis for efficient water management. Water assessment, monitoring and management are dependent on the existence of reliable water resources information systems both at national and regional levels, covering not only the collection and analysis of data but also the exchange and dissemination of these data and related information to the users, ranging from the general public to decision-makers. Moreover, Chapter 18, the ICWE Report, and the WMO/UNESCO Report on Water Resources Assessment (1991) stress that, in many regions of the world, these information systems are not functioning adequately or do not exist at all.

In extremely water scarce regions the development process itself already depends on the ability of its hydrological services to provide the right information and knowledge at the right time. The need to develop mechanisms to provide better hydrological data, information and knowledge also provides countries with four very important opportunities. The first is the opportunity to modernize hydrological networks and databases so that their service capacity can match the demand for information. Second, it provides the country with a unique opportunity to begin creating a modern electronic information infrastructure with the capacity to serve other sectors. Third, because the network has a goal of disseminating information about water resources, availability, use and services, countries will be able to practise comprehensive water resources' management, with a high degree of participation from stakeholders. Finally, it will provide the opportunity to participate in regional and international data sharing for improving collaborative management of shared water resources and climate risk assessment.

Modernizing hydrological services on the basis of the World Hydrological Cycle Observing System (HYCOS) concept as recommended by the WB/UNDP Sub-Saharan Hydrological Assessment programme (SSAHA) is one approach for modernizing hydrological services. HYCOS is not a substitute for the traditional hydrological services. It is the blending and reinforcing of conventional systems with modern technology and equipment that would enable hydrological services to work in ôreal or near real timeö using telemetry and satellites (see Box 3).

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[2] This section includes material provided by Dr. Geoffrey Matthews, IBRD, and Dr. John Miller, WMO.

Box 3

Global Freshwater Assessment and the World Hydrological Cycle Observing System (WHYCOS)

by Geoffrey Matthews, IBRD

The World Meteorological Organization (WMO), in association with the World Bank, started in 1993 to promote a World Hydrological Cycle Observing System (WHYCOS), based on a global network of reference stations with real-time satellite-based data transmission to enable the development of high quality and constantly updated distributed national, regional and international data bases on river flow, water quality and certain climate variables. The objective of WHYCOS is to provide a scientific basis for water resources' monitoring, assessment, and integrated water resources' development and management at community, river basin, national, regional, continental and global levels.

The first HYCOS system in Sub-Saharan Africa (SSA) is being implemented in the SADC Region with the assistance of the WMO. Upgrading the communication capacity and modernizing the data bases of the hydrological services also provide the opportunity to integrate GEMS and FRIEND into the information infrastructure. Considering that West Africa has FRIEND and GEMS, plus years of experience with real-time hydrological monitoring in the Onchocerchiasis programme, and the ORSTOM hydrological information network on the internet, one could imagine that the implementation of the HYCOS concept in some of the river basins in West Africa would provide the catalyst for creating a Regional West African Information Infrastructure, which could assist governments to synergize their economies on the basis of shared information and knowledge about the totality of their water resources, including the monitoring of riparian agreements. All sectors would benefit, including agriculture, health and education. It would also provide the private sector with the means to gather and disseminate market information. In addition, the country would be able to contribute to and benefit from the WMO's World Hydrological Cycle Observing System (WHYCOS).

5.4 The importance and limitations of demand management

The increasing absolute shortages of water in some regions, escalating expenditures required to maintain and expand water infrastructure, and the poor financial autonomy of the water sector have stimulated a new perspective on the conditions under which water is being provided to the users. The focus has shifted from development and management of supply to improved management of demand. In particular, it is now apparent that it will be cheaper, easier and more equitable to improve the efficiency of current uses than to try to continually increase supplies to meet inefficient demands. The distinction between 'need' and 'demand' (discussed earlier in Section 3.3) is relevant in relation to the current debate about 'demand management'. A great deal of hope is vested in demand management but its relevance and potential are often not made clear or fully understood. A focus on the efficiency of the end use of water has particular merit in areas where new or better technology or changes in behaviour can reduce water use without reducing overall utility or benefits offered by that use.

Inefficient water use and the use of water to produce low-valued, water-intensive products are fairly widespread and are often related to subsidies or inadequate cost recovery. Inefficient use is often associated with irrigated agriculture since the total amount of water used in that single sector accounts for some 75 per cent of overall consumptive water use. In areas or countries where water is primarily allocated to such consumptive uses, the per-capita use of water may be quite high but the benefits that are generated are low. Paradoxically, these activities may still be crucial if they produce subsistence food or provide other life-sustaining services. The debate on this issue illustrates the failure of putting conventional economic values on goods and services which may be traded on the market, and also on those which are non-market goods and services.

Demand management should be practised and emphasized particularly in those sectors and activities where low efficiency and low-value production prevails, and

where the benefits (market and non-market) of demand management are greater than the costs of improving the efficiency of water use. It is important to note that demand management not only is supposed to save water, it might also reduce budgetary pressures in regions where capital for large new infrastructure projects is scarce and where environmental conditions are particularly sensitive. Equally important, it could delay and reduce the need for the development of additional sources of supply.

Mechanisms for demand management include developing and disseminating new technology, education about water policies and practices, and a wide range of economic approaches that may partly include charges and fees to improve financial autonomy, foster responsible water use and to meet social objectives. By improving the financial autonomy of the water sector or the overall development budget, the possibilities for cross-subsidies from the relatively wealthy to the poor and disadvantaged segments of society increase (see Figure 5.1). It is thus important to distinguish between the relevance of demand management, which refers to the entire society, and its applicability which refers to certain sectors and social strata.

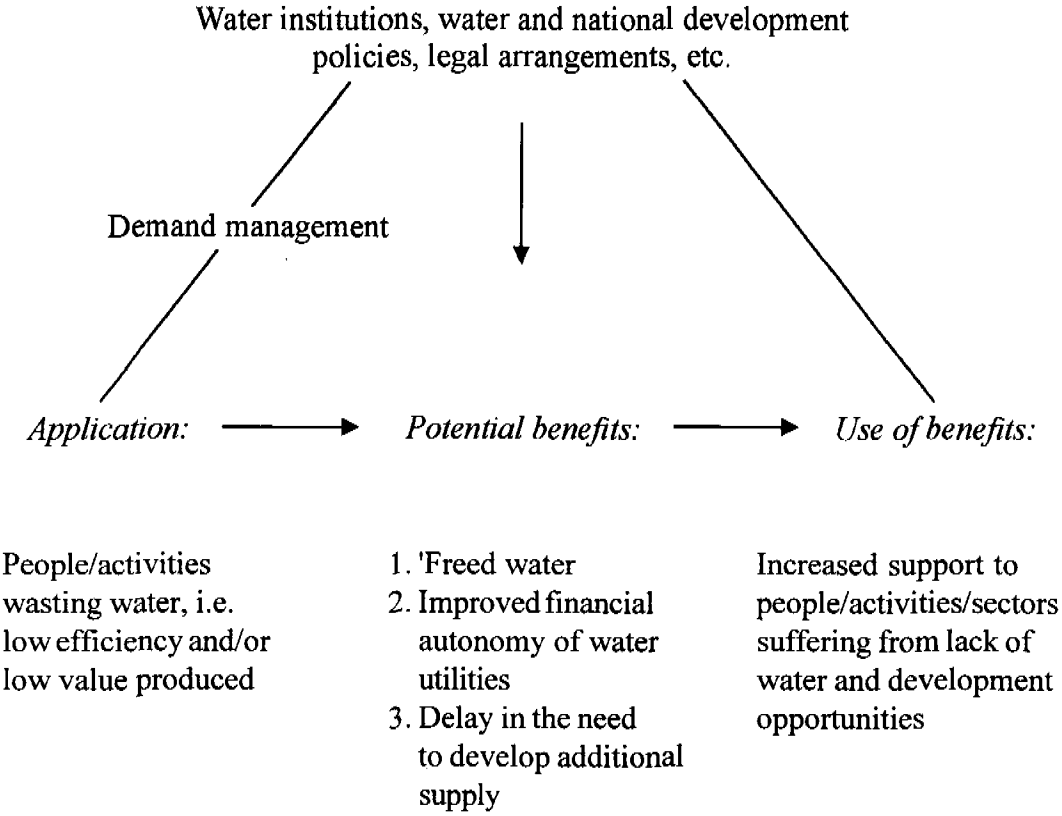

Figure 5.1 Schematic presentation of the application and the relevance of demand management

The issue of cross-subsidies is crucial in developing countries. Since basic human "needs" are not being met for large groups in the South, demand management must have the double aim of improving efficiency in water use and improving the financial autonomy of public and private water providers. The 'freed water' and the improved budget conditions must then be linked with efforts to meet basic human and environmental needs (Falkenmark and Lundqvist, 1996).

"Demand" is too narrow a concept to encapsulate the various dimensions of water requirements. For example, for the one billion people who currently lack access to safe water, it is misleading to speak about demand management. They will not be able to maintain the same level of utility by reducing consumption. Similarly, for the 800 million who are food insecure, according to a recent report from IFPRI (1994), demand management alone is not directly relevant. Rather it must be part of a broader strategy designed to meet basic water needs or 'basic water requirements' (see Boxes 4 and 5). In the words of farmers in Sri Lanka:"We cannot postpone our needs".

Box 4

Recognizing and Meeting Basic Human Needs for Water

Recent efforts to integrate environmental issues and concerns with sustainable economic and social development have returned to the concept of meeting basic human needs first proposed nearly two decades ago. One of the most fundamental of those needs is access to clean water. Efforts to identify basic human needs for water have been made by UN agencies and international organizations in the past. More recently, a comprehensive definition of the "basic water requirement" (BWR) for domestic activities was put forth by Gleick (1996). This work discusses the concept of a basic water requirement, defines and quantifies such a requirement for domestic needs, describes the international legal thinking on basic water rights, and roughly assesses the total population without access to a BWR. Gleick recommends that 50 litres per person per day be provided to meet basic domestic water needs for drinking, sanitation, bathing and food preparation. Gleick further suggests that international organizations, national and local governments, and water providers adopt a basic water requirement standard for human needs of 50 litres per person per day (l/p/d) and guarantee access to it independently of an individual's economic, social or political status.

Hundreds of millions of people, especially in developing countries, currently lack access to this BWR. Furthermore, rapid population growth and inadequate efforts to improve access to water ensure that this problem will grow worse before it grows better. A first step toward sustainable water use would be to guarantee all humans the water needed to satisfy their basic needs.

Box 5

Recognizing Ecosystem Water Needs
(from Gleick, 1996)

Aquatic ecosystems throughout the world are under severe stress and threat of destruction. Globally, more than 700 species of fish alone are considered threatened with extinction. Basic water requirements to protect these species and, more broadly, whole ecosystems, must be identified and provided (UNCED, 1992). In traditional water planning and management, the water needs of the natural environment are rarely considered or guaranteed. In the United States and Europe, some minimum flow requirements have been set for rivers and some minimum quality or temperature standards have been promulgated to protect environmental assets. In some countries, legislation has protected stretches of certain pristine rivers from development, and some water has been reallocated from major water projects and users to the environment. But these examples are the exceptions, not the rule. In 1994, the International Law Commission (ILC) produced a set of articles setting forth principles to guide the behaviour of states. Article 20 explicitly requires "watercourse States" to "protect and preserve the ecosystems of international watercourses".

Ultimately, society will have to make decisions about which ecosystems should be maintained or restored and the indicators by which to measure their health. Then, basic allocations of environmental water will have to be made accounting for climatic variability, seasonal fluctuations and other factors. Such allocations will have to be flexible, with decisions reviewed frequently based on the latest information.

5.5 Distinction between water use efficiency and allocation efficiency

The need to use water efficiently, equitably and soundly raises two fundamental issues. One refers to the performance in water use within a sector or activity and how to accomplish a specific goal with a "reasonable" and "basic" amount of water. Increasing water use efficiency means meeting a given goal using less water. The other concerns

the allocation of water between competing needs and demands. What sectors, activities or regions should be provided with water on a priority basis? The issue of "allocation efficiency" addresses how water should be allocated among these sectors, activities and regions. In countries or areas with insufficient water to satisfy all potential needs and demands, choices must be made and priorities set. Unless these hard choices are made, allocation of limited water will be decided by the 'law' of the most powerful groups, which rarely results in equitable decision-making. Policy and planning should be used to avoid such a disgraceful path of 'development'.

Water management is thus becoming one of the most strategic and challenging tasks in society, increasingly involving choices and priorities and the resolution of conflicts. Water planning is no longer confined only to technical and administrative tasks. Water managers and planners are now obligated to seek public participation, community discussions about allocations and priorities, and more democratic decision-making. As discussed earlier, these obligations should be at the centre of strategies for development. All of this requires political guidance and support.

Water management is becoming one of the most strategic and challenging tasks in society, increasingly involving choices and priorities and the resolution of conflicts. It is no longer confined only to technical and administrative tasks. Water managers and planners are now obligated to seek public participation, community discussions about allocations and priorities. All of this requires political guidance and support.

Efficiency is a key issue in the context sketched above. Low efficiency implies that the overall utility is low and that the total amount of value generated is low and tends to be dictated and captured by self-interest of powerful strata of society. This, in turn, implies that equity will be difficult to achieve since the poor and disadvantaged groups always seem to have difficulties to compete for a fair share of the produce and services available in a society. Poor efficiency is connected to waste and can, for instance, result in water logging in some localities and a lack of water in other parts of a landscape. Low efficiency is therefore also often related to inherently unsound resource management practices.

The two types of efficiency are, to some extent, interlinked as shown in Figure 5.2. But they pose completely different management challenges. It is quite conceivable to improve efficiency within a single sector or activity, such as agriculture, without achieving a high overall efficiency or utility. If large volumes of water are allocated to low-value production, the total amount of value generated will be low, even if water-use efficiency is high - in other words it is possible to produce low-valued items very efficiently. This indicates that "if allocative efficiency is not achieved, it is possible, and even common, to be doing the wrong thing extremely efficiently. It would be much more useful to be doing the right thing, that is with efficiently allocated water, a little badly" (Allan, 1995).

For example, the California agricultural community has made significant efforts to increase irrigation efficiency, using new irrigation technology, precision levelling of agricultural fields, and better monitoring. Overall on-farm efficiency is thus quite high, compared to many other areas around the world. Yet millions of hectares of low-valued, highly water-intensive crops continue to be grown because the subsidized price of water encourages low allocation efficiency (Gleick *et al.*, 1995).

The worst situation combines low water-use efficiency and low allocation efficiency, as characterised in the lower left part of the graph in Figure 5.2. This situation is typically a result of heavy subsidies, privileged treatment of certain sectors, and

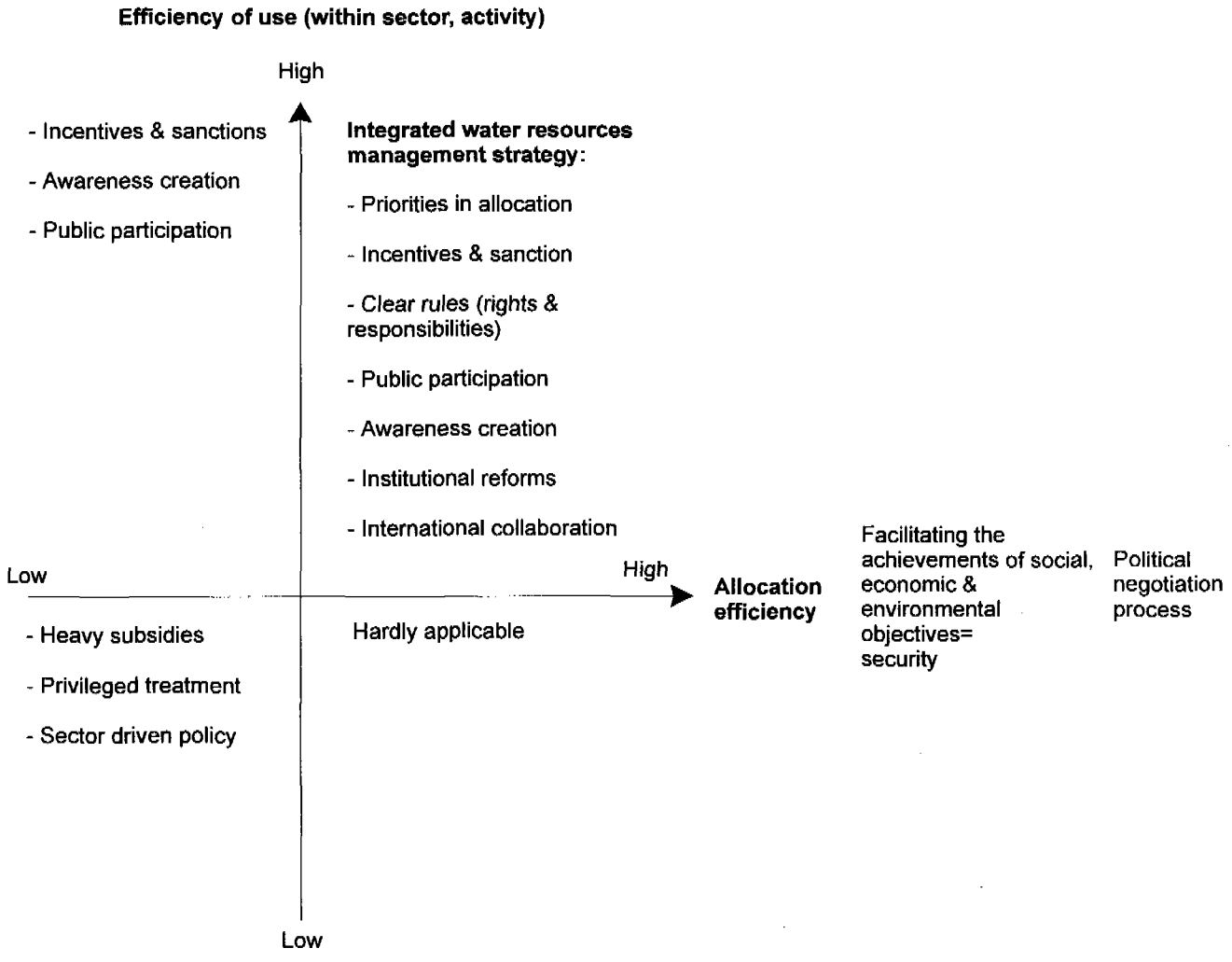

Figure 5.2 A schematic presentation of within-sector efficiency and allocation efficiency and the policy elements associated with degree of efficiency

compartmentalized policy and planning. Many countries who have decided to allocate a large share of their overall water supply to irrigated agriculture now find themselves in that corner.

Achieving allocative efficiency is difficult and should involve more than purely economic considerations. If the highest valued uses are allowed to purchase all water in a purely free market, some groups, typically farmers and farm workers, are going to lose water and their economic base of support. This requires that the economy and the political system be able to provide alternative livelihoods, compensate third parties affected by market transactions, and judge between diverse claims for allocations. This problem is indicative of the overall challenges imposed by poverty - a lack of socio-economic and political development is a barrier to solving water problems.

Allocation efficiency is not likely or possible to achieve unless there is open political negotiation and discussion and institutions that are conducive to the changes needed. Based on experiences of current water management reforms in the north-eastern part of Brazil, Kemper (1996) illuminates the need for the development of arenas where the various stakeholders could meet and negotiate and also the need for proper institutional arrangements that guarantee and facilitate the representation and say also of disadvantaged groups of society (see also Section 8.2. on Brazil). Such discussions and negotiations will have to deal with inter-sectoral allocations, including sensitive reallocations which are particularly important in the most water short areas (cf. Section 8.5 on Israel; Shuval, 1996).

The new management strategy must be integrative and based on physical, institutional and socio-economic realities. Its implementation requires, among other things, the use of incentives and sanctions, and clearly defined roles and responsibilities. Water policy and management must be open to, and involve, stakeholders at local, national, regional and international levels and there must also be an appropriate division of management tasks between the public and private sectors (cf. UN (CNR), 1996).

6 NEW PRINCIPLES FOR WATER MANAGEMENT AND PLANNING

Beginning nearly 20 years ago at the groundbreaking Conference on Water Development and Management at Mar del Plata, Argentina, new principles for water management and planning began to be described and defined. These principles have been evolving as the nature and magnitude of the world's water problems have become evident. Significant advances were made at the 1992 Dublin conference in preparation for the Earth Summit in Rio de Janeiro. Below, we summarize, elaborate and expand on these principles, which should be used to guide water decisions into the next century.

6.1 Identify and meet basic human and ecosystem water needs

Among the concepts raised nearly 20 years ago during the 1977 Mar del Plata conference - one of the earliest international efforts to address global water problems - was that of "basic needs":

> "...all peoples, whatever their stage of development and their social and economic conditions, have the right to have access to drinking water in quantities and of a quality equal to their basic needs" (United Nations, 1978).

The Dublin Conference statement included the principle that:

> "...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" (ICWE, 1992).

This concept was strongly reaffirmed during the 1992 UNCED in Rio de Janeiro and expanded to include ecological water needs:

> "In developing and using water resources, priority has to be given to the satisfaction of basic needs and the safeguarding of ecosystems" (United Nations, 1992).

Implicit in this phrase is the idea of basic resource requirements for certain human and ecological functions, and the allocation of sufficient resources to meet those needs by national and local governments, private water providers, international organizations and non-governmental organizations.

International organizations, national and local governments, and water providers should adopt a basic water requirement (BWR) standard to meet basic needs and guarantee access to it. Unless this basic resource need is met, large-scale human misery

and suffering will continue and grow in the future, contributing to the risk of social and military conflict. Ultimately, decisions about defining and applying the concept of this basic water requirement will depend on political and institutional factors, but the concept may prove useful in meeting basic water needs for the next century. A similar effort should be made to identify and meet the basic water requirements of natural ecosystems, so that the goods and services provided to humanity by the natural environment, such as air and water purification, biodiversity and other values can be maintained indefinitely into the future.

6.2 National food self-sufficiency should give way to the concept of national food self-reliance

The water "crisis", as described in the recent summary of the Committee on Natural Resources of the United Nations Economic and Social Council (UN (CNR), 1996), includes several factors that directly threaten global and regional food security and sufficiency. In particular, finite water supplies and escalating demands, together with degradation of soil conditions and water quality are contributing to concerns that society is beginning to fall further behind in the race to feed the Earth's growing populations.

The 1992 Dublin Conference acknowledged the importance of food security concerns and suggested alternative approaches to ensure future food goals are met:

> "Achieving food security is a high priority in many countries, and agriculture must not only provide food for rising populations, but also save water for other uses. The challenge is to develop and apply water-saving technology and management methods, and, through capacity building, enable communities to introduce institutions and incentives for the rural population to adopt new approaches, for both rainfed and irrigated agriculture" (ICWE, 1992).

The ultimate goal must be to grow sufficient food to meet the world's needs, somewhere, and to deliver that food where it is needed. Thus "global food security" - where enough food for all is grown somewhere - is absolutely vital, while the goal of "national food self-sufficiency" - where countries seek to produce all their food needs domestically - is increasingly unattainable for many countries. The view that countries must be responsible for their own food production hinders rational solutions to the problem of true food security. In addition to global food security, however, countries and families must have access to food. This requires that there be safe and stable international markets for food, that trade embargoes on food be avoided, and that countries work to improve their economic ability to participate in international food markets. This shift in thinking requires a shift in the functioning of global trade, agricultural markets, and import-export policies. The prime objective must be food self-reliance, where nations can meet their food needs through a combination of their own production and an open, reliable and stable international trading environment. The advantages and risks of relying on international trade to ensure food security are the key issues in discussions concerning alternative food strategies (Wolf Kluhn, personal communication).

Truly water-short regions cannot reliably depend on internal water resources to produce sufficient food to meet all their domestic needs. Water and agricultural experts in the Middle East, the western U.S., parts of southern Africa, and elsewhere have already acknowledged that increasing urban and industrial demands will continue to take water from the agricultural sector. Israel, for example, is beginning to assume that the only reliable long-term source of irrigation water may be water reclaimed from

urban and industrial uses. The countries of the Persian Gulf that today depend on non-renewable fossil fuels to pump non-renewable fossil groundwater will eventually be unable to maintain large-scale grain production and be forced to shift more heavily to dependence on world grain markets.

Because many regions experience water scarcity, it is important that the impact of such scarcity on food production be evaluated at the regional and national level. Such evaluation can help countries to formulate sound water policy to ensure adequate access to food security through a combination of internal food production and access to international food markets. Unfortunately, despite the importance of abandoning nationalistic food policies, several problems face developing countries wanting to meet significant food needs on the world market. First, availability of funds for use in purchasing food on the world market is often limited because of the economic structure of developing countries, debt burdens and lack of infrastructure. Second, growing pressure on global food markets has been predicted by some analysts, which may in turn raise market prices and increase competition for limited surpluses (see, for example, Brown and Kane, 1994; Carruthers, 1993; Kendall and Pimentel, 1994; Postel, 1993). These problems, in turn, force countries back toward national food self-sufficiency, at a high cost in both water and financial investment resources.

At the same time, others believe that there is substantial room to do better than we are doing today, and that continuing to provide all necessary food needs can be done with appropriate and achievable efforts (Mitchell and Ingco, 1993; FAO, 1993; IFPRI, 1994). Concerns about the risks of relying on foreign trading partners who may impose conditions on trade or food embargoes for political reasons must first be satisfactorily resolved.

Apart from the insecurity of access discussed above, the growing distance from source to consumer will add considerable transport cost, require new storage facilities, and will entail other negative environmental and resource impacts. Sudden crop failures will add considerable pressure on the logistical system. It is therefore increasingly important to make use of the potential to produce at least some food close to growing population concentrations. One example in this regard is "urban agriculture" where synergy between urban potential and human ingenuity is exploited (see Boxes 6 and 7).

National food supplies will, however, be insufficient to feed the growing population in a number of countries. As a result, we will continue to see a growing trade in water embodied in the purchase of foods and products produced elsewhere. This embodied water - also called "virtual water" (Allan, 1995) - represents the large-scale transfer of water from regions of water surplus to regions of water scarcity.

Another fundamental shift in the global food situation is likely to be necessary from the point of view of water availability - a shift in diet away from water-intensive meat consumption in the more affluent nations. Diets that depend on meat for a significant proportion of protein and calories are far more water-intensive than diets higher in vegetable proteins. At present, nearly 40 per cent of all grain grown worldwide is used to feed animals. Reductions in livestock grain consumption in regions where irrigation is necessary would permit a shift in grain - and the water used to grow it - to direct human use. Current trends, however, are in the other direction, with more and more grain going to provide meat, at a high cost in water.

Box 6

Food Security and Food Sufficiency under Extreme Water Scarcity Conditions

Based on Shuval (1996)

The concept of food security is used by many countries aiming for self-sufficiency in food products as a matter of national security. This is based on the rationale that if food imports are restricted by an embargo or blockade, the country has to be able to feed its own population. If these countries are located in an arid or semi-arid region, the costs involved to implement such a policy are huge, and the water needed to accomplish the goal may not be available. These costs include building massive water infrastructure to convey water from remote well-fields or distant rivers, high environmental costs in terms of groundwater mining, soil salinization, surface water contamination and disturbed ecosystems, and sometimes huge financial investment required to build and operate desalination plants. As a result, the local cost of agricultural production may be as much as five times the world market price for the same crops. The policy of "food security" is thus highly questionable, hardly benefiting human well-being at all.

A benchmark level of 1000 cubic meter per capita per year (m^3/p/yr) has often been used as an indicator of water scarcity (Falkenmark and Lindh, 1974; Engelman and LeRoy, 1993). This level includes the water needed to provide a person with food, and hence implicitly includes the concept of food security. This level is valid in humid temperate regions, where water is abundant but, in water scarce arid and semi-arid countries, meeting this level of water need may be inappropriate - the water required to provide for food security is just not available. In such regions the concept of food "sufficiency" is more appropriate, i.e., that somewhere in the World water must be available to grow enough food, fodder and industrial crops for all of the populations of the World, and that these agricultural products can then be distributed. This approach, in turn, implies that countries unable to achieve food security have to earn enough foreign currency from industrial exports, tourism, etc., in order to purchase food produced somewhere else in the world, and that the political situation is such that food cannot be withheld for political purposes.

A case is the Middle East. Water is scarce, and a number of countries in the region have well below 500 m^3/p/yr, a measure of severe water stress. As populations grow rapidly, many are fast approaching a level of 100-200 m^3/p/yr. This implies that after basic needs and high-valued economic demands are satisfied, such countries will have little, if any, water left for agricultural use.

Under such extreme conditions, a discussion of identifying a minimum water requirement for urban use is relevant (that is, excluding agricultural requirements, but including residential, municipal and industrial uses). In Israel in 1993, three per cent of the nation's GNP was generated by the agricultural sector, and this sector consumes approximately 70 per cent of the available water resources. Outside of the agricultural sector, urban use averaged some 100 m^3/p/yr, with an additional 25 m^3/c/yr for industrial use. Experience in Israel indicates that a high standard of living can be maintained from a combined use of about 100 m^3/p/yr - a level achieved by water metering, charging users for the costs of water supply and wastewater collection and treatment, progressive water charges, and public education on water conservation. Shuval (1996) has proposed that a minimum water requirement of this amount be defined and allocated for domestic, industrial and commercial needs. In addition to this minimum supply, Shuval recommends a further 25 m^3/p/yr be allocated for domestic production of fresh vegetables. By using modern irrigation technology, this is enough to grow some vegetables and salad crops for local consumption. Furthermore, in Israel 65 per cent of urban water use is captured, treated, and made available for re-use in the agricultural sector.

In an arid country like Israel, a total amount of 190 m^3/p/d (100 m^3/p/d plus 65 per cent re-use, plus 25 m^3/p/d for urban gardens) is enough to meet domestic, urban and industrial requirements, and to produce vegetables for local consumption, while still requiring large imports of staple food products in exchange for industrial products being exported. As populations in the region grow, it is expected that Israel's total renewable water supply will eventually have to be dedicated to meeting just this minimum non-agricultural need, with no additional water availability (other than recycled wastewater) for irrigated agriculture. This suggests that over the long term, substantial irrigated agriculture in Israel and other arid regions will be unjustifiable due to both water availability and economic considerations (cf. Section 8.5 on Israel and Section 8.9 on Yemen).

Box 7

Cities that feed themselves - the potential of urban agriculture

by Klas Sandström, Linköping

Conventional agriculture is rural, horizontal and extensive in space and often uses water and nutrients very inefficiently. Furthermore, it tends to be distantly removed from where large masses of people will live in the near future, in the cities, and it implies long and costly transfers of food to urban consumers. An alternative, or rather a supplement, is urban agriculture, i.e. an intensive production of food and fuel in response to the daily demands of consumers within a town or urban using and re-using natural resources and urban waste, to yield a diversity of crops, livestock and biomass. Considering that by the year 2000, 57 per cent of the poor in the developing world will be living in urban areas, and that food purchases in large Third World cities can represent over 60 per cent of total family earnings, the importance of urban agriculture is apparent.

Urban agriculture is nothing new. It already feeds tens of millions of people throughout the world, with far reaching economic, environmental and health implications. To mention a few examples: in Kampala in Uganda, 70 per cent of the poultry needs (eggs and meat) are produced inside the city; in Lusaka, Zambia, food produced within the city accounts for 33 per cent of the total consumption by squatters; in Dar-es-Salaam in Tanzania the proportion of city residents engaged in farming rose from 18 per cent to 67 per cent between 1967 and 1981; and in Calcutta in India, one-fifth of the city's demand of fish is raised in large sewage-fed lagoons.

Food can be grown around the house, on walls, on rooftops and on balconies, along roads, on both public and private land, and on marginal land. There is seldom a lack of land, space or water to farm in urban areas; the problem often lies in gaining a legal access and secure tenure to the land. Studies from the Philippines show that a family can feed itself from an 80-square meter plot in a tropical climate using intensive horticulture techniques.

Urban agriculture can make a major and perhaps sometimes a crucial contribution to the provision of food and fodder to large Third World cities. Urban agriculture is suitable for irrigation by wastewater and other nutrient-rich waste, thus closing nutrient loops at a significant environmental advantage over providing new water resources or finding new sources of nutrients. The use of wastewater also represents a more reliable source of water.

If human waste, and in particular urine, could be part of a closed circuit of nutrients, urban agriculture would benefit. Urine - a cheap source - is a most appropriate fertilizer. Wherever humans live, the nutrients are available in the desired amount and composition. Urine contains all elements required for successful farming, in balanced ratios and free (in principle) from virus and bacteria.

Urban agriculture is often driven by the continued growth of large metropolitan areas. It should, however, not be seen as the undesired consequence of an uncontrolled migration, but as an opportunity to produce more food, in a land and water efficient manner and close to where the consumers actually live. Intensive vegetable production may use only 5 to 20 per cent as much water and one-sixth to one-twelfth of the land, as compared to rural, tractor-cultivated crops. In Botswana, for instance, a high technology variety of container horticulture is found; it is extremely water- and nutrient-efficient, is able to produce up to 20 tons of maize on a per hectare basis, and is highly suitable for congested urban areas. (The text is largely based on UNDP, 1996.)

6.3 Water must be treated as an economic good

The prevailing notion that the provision of water should be free and that the use of water in a particular activity or sector could be pursued without concern about the growing need and demand for water in alternative uses is no longer acceptable. As long as natural water availability is plentiful in relation to overall need and demand, there is no reason to focus on allocation or on financial problems. Under such circumstances, the infrastructure needed to provide water may be comparatively simple and infrastructure expenditures modest. When the ratio of use to overall availability increases, the challenge to allocate water among and between incompatible and competing uses increases. Similarly, the effort in terms of human ingenuity and financial outlays will increase.

Today, the construction of new water infrastructure in many areas requires greater and greater investment for every additional unit of water supply. This is partly due to

the fact that the ratio of use to availability is high in most regions of the World (CSD, 1997) and also because the least expensive sites for dams and storage facilities have already been used. New sites and unused resources are increasingly available only at high economic and environmental costs (Postel, 1996). Responsible and proper pricing of water is therefore a prerequisite for efficiently meeting the various needs for water. Many users of water must not continue to expect that individual interests for liberal supplies of heavily subsidized water will be met as they used to be.

There are many unresolved issues that need clarification and further scrutiny in order for the concept of water as an economic good to be more generally accepted and operationalized. One concerns the tendency to mix and confuse the economics of arranging supply and other water services and the principles for fixing charges, fees and other cost recovery programmes. While rain water does not incur any expenditure for use, the provision of water through dam construction, the laying out of pipes, the treatment of water, etc. is an increasingly costly service. More and more of the water used in the World, including water for food production, is provided through some kind of physical and institutional infrastructure. Somebody must bear the costs incurred for water provision and treatment, either the water user directly or the taxpayer, which is another name for the public sector. There is no one else to do it. But the charges must not be the same for every user. Political guidance and support will have to deal with the question of subsidies, including cross-subsidies between various use(r)s and, of course, level of service.

Another unresolved issue refers to allocation priority. If overall availability is less than overall requirements, some choices must be made. While water is indispensable for most activities in society and processes in nature, some use(r)s and functions are more important than others. Water for health is universally recognized as more important than water for another car or for a range of consumer goods. Policies in most, if not all, countries also put provision of water for health purposes or for basic human needs as the highest priority. The fact that this policy is not fully implemented is a matter for continued grave concern (see Section 6. 1). A more problematic and increasingly pertinent issue is how water shall be allocated between food production and industrial and urban requirements. With rapid rates of urbanization and calls for industrial development, the privileged status of the agricultural sector is under stress (see Boxes 6 and 7 and Chapter 6.2).

Various economic tools for water resources' management also need to be better explored, including the possibility of water trading among sectors, regions or users. While water trading has recently been discussed as a way of meeting constraints on water availability, there are still unanswered questions about definitions of water rights, institutional requirements, the third party impacts of transferring water from one region to another, and the difficulty of valuing the resource to be traded and transferred.

There is thus a need to better define the different kinds of value - economic, health, environmental, social, etc. - that water use may generate and also identify the various kinds of cost associated with water development, distribution, use and treatment: direct cost, opportunity cost and environmental cost. Clarification on these issues is needed in order to better understand and apply the concept. It is also important that the lack of proper data on water and knowledge about water use is rectified since it hinders proper valuation of water resources (see Section 5.3).

6.4 Water planning and decision-making should be democratic, ensuring representation of all affected parties and fostering direct participation of affected interests

The principle that water planning and decision-making should involve the fullest participation by affected parties has been enunciated by international organizations and official water conference statements for nearly 20 years, going back to the 1977 Mar del Plata conference.

> "Countries should make necessary efforts to adopt measures for obtaining effective participation in the planning and decision-making process involving users and public authorities...If necessary, legislation should provide for such participation as an integral part of the planning, programming, implementation and evaluation process" (United Nations, 1978 - p. 295).

Prior to the 1992 Earth Summit in Rio de Janeiro, the water conference in Dublin, Ireland, released a major statement laying out four major principles for water and sustainable development, including one reiterating the vital importance of full public participation:

> "Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels. The participatory approach...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 2 - ICWE, 1992).

At the Earth Summit in Rio (the UN Conference on Environment and Development (UNCED)), integrated water resources' management was proposed, with a fundamental objective being:

> "To design, implement and evaluate projects and programmes...based on an approach of full public participation, including that of women, youth, indigenous people and local communities in water management policy-making and decision-making" (UNCED, 1992 - Chapter18, para. 18.9).

In the past, water management and planning have focused on how to reach particular goals. The water debate must now be broadened to address the means by which these goals are set. At the least, sustainable water planning and use should ensure comprehensive public representation, open and equitable access to information about the resources, and direct participation of affected interests in decisions about allocating those resources. The success of policies and programmes for water management, planning and use now strongly depends on the extent to which the public becomes actively involved.

Water planning and decision-making today sometimes include a far wider range of individuals and interests than before. Nevertheless, such participation is still far from complete, and the power of central planners, urban users and powerful economic interests is often significantly greater than that of smaller rural interests, family farmers, women, poor or minority groups, and other users. Mechanisms to broaden their participation are needed. Ways must also be found to incorporate and protect the interests of future generations - a fundamental criteria of sustainability as defined by the United Nations in Agenda 21 (UNCED, 1992).

Sustainable water planning and use should ensure comprehensive public representation, open and equitable access to information about the resources, and direct participation of affected interests in decisions about allocating those resources.

7 WATER POLICY HISTORY AND MILESTONES

7.1 Milestones toward the new consensus

Awareness about the significance of water for human and ecosystem well-being or for virtually any aspect of economic development has come only gradually. At the Stockholm Conference on the Environment in 1972, most attention was given to water pollution in industrialized nations. Five years later, in 1977, the first UN Conference on water in Mar del Plata, Argentina marked a specific concern for water issues with particular attention on drinking water and sanitation services and made important recommendations and suggestions for water planning. The impact of that initial effort has been meagre. In the Brundtland Commission Report from 1987 *Our Common Future*, for instance, the role of fresh water was largely ignored. The initial agenda for the 1992 UNCED conference also excluded water as a specific item, and it was added only after the strong efforts of a number of governmental and non-governmental organizations.

Fresh water is dealt with in one of the chapters of Agenda 21, the main outcome of the UNCED conference. Agenda 21 was the result of lengthy international negotiations during a series of preparatory meetings prior to Rio. Consequently, this document is quite voluminous and lacks clear priorities for water planners. A series of guiding principles, however, were described in preparatory meetings leading up to Rio, in particular at the Dublin Conference in 1992 and Copenhagen in 1991 (see below). Following UNCED, the concern for water has begun to grow rapidly and is mirrored by a new World Bank policy document (1993), a Development Assistance Committee meeting of the OECD (May 1994), and a statement by the Committee for Sustainable Development (May 1994) leading to the current Comprehensive Freshwater Assessment. Water has thus become an issue in the international policy formulation.

A summary of the major policy statements and declarations vis-à-vis water are presented in Table 7.1. There has been a remarkable degree of consensus about these declarations (Lundqvist and Jönch-Clausen, 1994). Below we describe their common features. Implementation of many of these principles is being tried in different countries, states and regions by governments, local groups and non-governmental organizations (*ibid*). Some examples are given below (see Chapter 8: Examples and lessons of national water policy reviews). But many unresolved issues remain. One is the assignment of roles and responsibilities to the various actors; the public sector, the private sector, the international, regional and national political units. It is also significant that the very basis for water management is weak in terms of lack of adequate information on hydroclimotological circumstances, free exchange of such information and its incorporation in societal planning and decision-making.

7.2 Current initiatives

The Comprehensive Freshwater Assessment is one of the current activities in efforts to promote improved water management. The Global Water Partnership (GWP) and the World Water Council (WWC) represent two other initiatives that have recently been presented by the World's water communities. The activities of these two initiatives relate to a common framework that builds on the principles and visions

highlighted at the International Conference on Water and the Environment in Dublin 1992 and incorporated in Agenda 21. These principles have been widely endorsed and the major task is now to go from words to deeds. This is an enormous task which calls for activities of various kinds. The GWP and WWC set out to accomplish the joint task by fulfilling complementary roles.

After intensive consultations and planning of the design of the *modus operandi*, both organizations were officially launched in 1996.

The GWP is an international network and mechanism committed to the translation of the new consensus on water resources' management into responsive and coherent services to communities in need for such services. GWP is being financed by aid agencies, and at the outset its emphasis is on sustainable water management in developing countries. Its initiators are the World Bank, UNDP and Sida. With an emphasis on facilitation of the implementation of projects and activities close to the water users, the GWP attempts to promote integrated programmes that emanate from locally felt needs. It will co-ordinate activities and provide leadership rather than run projects and it will be particularly attentive to the issue of equality and demand-driven water requirements. Social concern must, however, be tandem with a concern for the ecosystems which form the basis for livelihood security and health, directly for many of the poor and indirectly for communities at large. The GWP may be seen as a contribution to the renewal of multilateralism. An important challenge is to foster co-operation and co-ordination across sectors and geographical and man-made boundaries. Concerted effort and leadership is required to counteract fragmentation and piecemeal approaches that characterize water development and management, internationally as well as at national and sub-national levels.

The World Water Council is aimed at promoting awareness of critical water issues and facilitating long-term efficiency in planning and management of water resources. It will act as a forward-looking think tank. It seeks to promote awareness about critical water issues at all level including the highest decision-making level. An example of this is the preparation of a "2020 vision for water"..

An analytical approach is a key dimension in the work. The WWC will identify critical water issues of local, regional and global importance on the basis of ongoing assessments of the state of water in all its dimensions. It will also provide the forum to arrive at a common strategic vision. It will facilitate arrangements for providing advice and relevant information to institutions and decision-makers who are assigned the task to ensure the sustainability of global, regional and national water resources.

8 EXAMPLES AND LESSONS OF WATER POLICY REVIEWS

8.1 The Central Asian Aral Sea Basin Programme[3]

Water is a strategic resource playing a vital role in the economic and social life of arid Central Asia. Over the last 35 years, intensive cotton farming and one-sided agricultural development have diverted so much water from the two rivers fed by the Aral Sea that its shoreline has in some places retreated by more than 120 km. A vision of abandoned and derelict fishing boats in a landscape of salt encrusted sand first drew the World's attention to the human and ecological crisis facing the Aral Sea and its shore region.

But degradation due to the non-sustainable use of water and related land resources extends far beyond the Sea. Over the last few decades, the upper Basin has lost about

[3] Prepared by Professor Janusz Kindler, Institute of Environmental Engineering Systems, Warsaw University of Technology, Warsaw, and Dr. Geoffrey Matthews, World Bank.

Table 7.1 Summary of major policy statements and declarations vis-à-vis water

Stockholm Conference on the environment (1972)	**Mar del Plata (1977)**	**Nordic Fresh Water Initiative (1991)**	**International Conference on Water and Environment in Dublin (1992)**	**UN Conference on Environment & Development in Rio de Janeiro (1992)**	**World Bank Policy Paper on Water Resources Management (1993)**	**Commission for Sustainable Development (1994)**	**OECD's Development Assistant Committee (1994)**
Water was not a prominent issue at this meeting. The document from the conference calls, however, for abatement of pollution, primarily in developed countries.	This was an 'historic conference' and the first, and so far the only, UN Conference entirely focusing on water. In the **Mar del Plata action plan**, eight recommendations are discussed in detail. In retrospect the implementation of the action plan has been far	The initiative resulted in the **Copenhagen Informal Consultations** with a broad representation from governments and international organizations and in the **Copenhagen Statement** which emphasises two key principles for future strategies for sustainable development and management of water resources for rural communities: (1) Water and land resources	500 participants, including government-designated experts and representatives of eighty international organizations endorsed four guiding principles for actions in the **Dublin Statement**: (1) Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment. (2) Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels. (3) Women play a central role in the provision, management and safeguarding of water.	Links between the environment and development recognized at the highest political level. **Agenda 21** consists of 40 chapters. Freshwater resources is dealt with in Chapter 18. Chapter 18 systematically deals with seven programme areas. Most of the seven programmes cover the same issues as the eight recommendations in Mar del Plata, with the exception of urban issues and climate change.	Based on lessons of experience, the Bank aims at the adoption of a comprehensive policy framework and treating water as an economic good combined with a decentralized management and delivery structure. The policy framework is consistent with the Dublin Statement as well as with Agenda 21.	The CSD in 1994 urged UNEP, FAO UNIDO, WHO, WMO, UNESCO, UNDP, the World Bank and other relevant UN bodies to strengthen their efforts towards a comprehensive Assessment of the Freshwater Resources of the World to be presented at the CSD in 1997 and at the UN General Assembly Special Session. CSD also invited Governments to co-operate actively thereby specifically identifying the Swedish Government. The Stockholm Environment Institute was commissioned by the	Largely endorses the Dublin principles.

Table 7.1 (continued)

Stockholm Conference on the environment (1972)	Mar del Plata (1977)	Nordic Fresh Water Initiative (1991)	International Conference on Water and Environment in Dublin (1992)	UN Conference on Environment & Development in Rio de Janeiro (1992)	World Bank Policy Paper on Water Resources Management (1993)	Commission for Sustainable Development (1994)	OECD's Development Assistant Committee (1994)
	from satisfactory. It did, however, urge for the launching of the *International Drinking Water and Sanitation Decade.*	should be managed at the *lowest appropriate levels.* (2) Water should be considered as *an economic good* with a value reflecting its most valuable potential use.	(4) Water has an economic value in all its competing uses and should be recognized as an economic good.			Swedish Government to actively work in the project.	

50 per cent of its forest cover. Soil erosion has intensified, not only reducing agricultural activity but also leading to silting of storage reservoirs. The massive discharges of drainage water from irrigated land into rivers have resulted in a drastic increase of water salinity. Soil salinization and water-logging are serious problems throughout the Basin. This is all directly linked to a decline in human health and agricultural productivity in the region.

Taking into account the new political, economic and social realities, and recognizing the severity of environmental concerns, the Heads of State of Kazakhstan, Kyrgyz Republic, Tadjikistan, Turkmenistan and Uzbekistan met in January 1994 and approved an Action Plan for the improvement of the environmental situation in the Basin and for its social and economic development over the next three to five years. The regional water management strategy is a centerpiece of the Action Plan.

The principal objective of the regional water management strategy in the Aral Sea Basin is to identify the means and mechanisms combining the development goals and interests of each Basin state with long-term water resources and environmental management objectives. In this context, there are two predominant issues. The first is population growth. By 2010, the population of the Basin is expected to be close to 50 million, compared with about 37 million in 1994. Secondly, about 92 per cent of total water use in the Basin serves an irrigated area of about 7.9 million hectares. Given this large infrastructure and the Basin's economic dependence on agriculture, a fundamental goal is to determine a way to achieve sustainable agricultural development while alleviating the area's substantial environmental challenge.

8.2 Building a water resources' management system in Brazil - a status report[4]

Brazil has about 13 per cent of the fresh water available in the World. However, there are large variations in the per capita availability. An astonishing low figure of only 2 persons/$10^6 m^3$/year in the north is due to the huge Amazon River, which flows through a barely inhabited territory. The worst case is the North-east region, with 228 persons/ $10^6 m^3$/year. There, per capita availability is comparable to what can be found in, for instance, Greece or Spain.

Drought spells that occur on average once in five years in the region bring much more suffering than in any of these European countries. Lack of hydraulic structures, lack of human resources and lack of proper institutions contribute to transform a natural phenomena into a human disaster. Drinking water is truck-transported and Federal Government has to come to the support of millions of people who otherwise would starve to death. There are several reasons for this fact. Examples are: (i) many shallow reservoirs should never have been built because they "steal" water from the downstream deep reservoirs to the atmosphere (annual potential evapotranspiration of 2,500 mm); (ii) gates of several reservoirs have either been inoperative, due to lack of maintenance, or have been operated with short sight; (iii) farmers often grow water-intensive crops and/or use inefficient irrigation procedures because they do not pay for water; (iv) few water users, including urban supply companies, actually have the required permits issued by Government.

Brazilian South and South-east regions are heavily industrialized. Wastewater discharges are rarely monitored and untreated urban and industrial sewage (>90 per cent) is commonly released directly into rivers and lakes. As a result, water quality has

[4] Prepared by Professor Jerson Kelman, Department of Water Resources, Rio de Janeiro State Agency for Rivers and Lakes (SERLA), Brazil.

deteriorated notably around most major industrial and agricultural centres. The Brazilian urban population has grown at a high annual rate (3.4 per cent in the 1980s). This imposes a tremendous demand for urban services and shelter, as well as for water supply.

The Constitution of 1988 calls for the building of a "water management system" to be applied to the nation's rivers. A river basin may contain state and federal rivers, as a state river may be tributary to a federal river. Since 1988, several versions of the federal law necessary for the implementation of the system were drafted, but none has yet been approved by the Federal Congress. The latest proposal, presently under discussion in Congress, is sufficiently flexible to be applied to different water problems. All versions of water laws in Brazil, approved (only at the state level) or still under discussion (at the federal and state levels), share the following general principles.

- planning and management of water resources should be done at the scale of the river basin, with the participation of all water uses;
- bulk water is an economic good and should be charged for in order to: (i) achieve rational allocation; (ii) create the financial resources necessary for the improvement of the river basin;
- controlled issuance of water permits, for intakes or for dilution of effluents, is an essential tool for planning and for investments by the users;
- supply for humans is the top priority among competitive uses.

The first principle is still controversial in Brazil. Large reservoirs, belonging to different river basins, are presently operated in a co-ordinated way by the power utilities. The objective is to minimize the risk of energy shortages. The adoption of a different objective would give more weight to the other water uses, such as pollution control and irrigation, and would mean either an increase of the risk of energy shortage or an increase of electricity production cost.

Water markets have been contemplated in discussions about setting up a legal system for bulk water allocation. In this approach, private parties negotiate water, with due attention to third parties. This approach seems quite attractive for its simplicity. However, it has not been adopted because law makers have not been receptive to the idea that water permits could be negotiable. They argue that water permits should be issued by Government only and, if not used properly, these permits should return to Government. Perhaps this outcome is for the best, given the low efficiency of markets in developing countries, as a mechanism to provide rational allocation of scarce natural resources.

Some states have adopted a legal framework inspired by the so-called "French model" (Chéret, 1994). Allocation in dry periods, pricing and investments will be decided collectively through a political negotiation that will take place in a River Basin Committee. Agencies should act as executive offices of the River Basin Committees. Committees and corresponding Agencies will be created in basins faced with quantity or quality problems. Data collection, development of plans, water "tariff" collection, and investments financing will be the responsibility of the Agency. The financial resources raised by pricing bulk water should be preferably applied in the river basin, in order to assure the legitimacy of the new management system. In other words, pricing bulk water should not be a new way of increasing general Government revenues.

Because political and river basin boundaries in general do not coincide, there is some controversy regarding the possible legal status of the Basin Agencies. They could

possibly be a branch of government, public company or they could be a private company. The first alternative, branch of government, is probably the worst choice, given the lack of continuity of public administration in most developing countries, Brazil being no exception.

Even though the federal law has not yet been approved, some progress regarding river basin organization can already be seen. One of the most stressed river basins is the Paraiba do Sul, which is shared by three different states, Rio de Janeiro, Sao Paulo and Minas Gerais. A large number of industries are located in the basin, as well as large cities, all dumping wastes practically without any treatment. Paraiba do Sul is the source of water for more than 10 million people. Problems are so urgent that a Presidential decree issued in May 1996 created a river basin committee for the Paraiba do Sul basin, composed of 39. Another example is the State of Ceará, located in the "dry" Brazilian North-east. COGERH, which is a bulk water utility created in 1994, has been organizing seminars attended by hundreds of water user representatives (see Kemper, 1996). During these seminars, the participants become more aware of what water management is all about through the discussion of different alternatives for reservoir operation and water allocation. These alternatives are simulated by mathematical models that are run in computers, as a decision support tool for the discussions. Several disputes have been settled with this simple procedure.

8.3 Planning for sustainable water use in California

California water planning and management follows the traditional style of most national or regional water ministries. Every several years, the California Department of Water Resources (DWR) issues an official "California Water Plan", which describes the water supply system in the state and projects future demands from the agricultural and urban sectors using estimates of population and economic growth, and current trends in water management. The most recent Plan, officially released in late 1994, predicts that California water policies and problems in 2020 will be little changed from today (CDWR, 1994). The state will grow the same crops, on about the same amount of land, with about the same irrigation efficiency. The urban population, which used an average of 530 litres per person per day for domestic uses in 1990, will still be using 527 litres per person per day in 2020, with large amounts of water still going for household and outdoor lawns. Many groundwater aquifers will still be pumped faster than they are replenished. Billions of gallons of treated wastewater will be dumped into the oceans, rather than recycled and re-used where appropriate. Water needed to maintain threatened California ecosystems and aquatic species will come and go with the rains and with human demands. And projections of total water demands still exceed available supplies by several billion cubic meters - a shortfall projected in every report since 1957.

An alternative approach to long-term planning has recently been presented in California, offering a positive vision of the future, an analysis about whether such a vision is attainable, and suggestions for policies and programmes to move in that direction (Gleick *et al.*, 1995). In this vision, explicit sustainability goals are set that eliminate groundwater overdraft, increase the health and well-being of the agricultural community by shifting to low-water usage, higher-valued crops, improve urban water-use efficiency using existing technologies and policies, and expand the use of reclaimed water. This analyses suggests that the traditional view of the future is avoidable and undesirable, and that alternative views can be defined, explored and reached.

8.4 India's national water policy. A review[5]

India's National Water Policy was adopted in September 1987. Following this, a few of the States in the Federal Republic drafted their own policies and the State of Tamil Nadu in the southern most part of India adopted its Water Policy in July 1994.

After explaining the need for such a policy at the national level, the national policy paper deals with:

a) developing a standardised national information system;
b) maximising the availability adopting the drainage basin as a hydrological unit for water planning, irrespective of political boundaries;
c) setting up multi-disciplinary units for water management;
d) transferring water from surplus river basins to water short areas;
e) recycling and re-use of water;
f) preserving ecological balance while planning new projects;
g) modernising and maintaining life existing projects to increase their functional efficiency;
h) developing ground water and its conjunctive use with surface water;
i) monitoring regularly for quality;
j) prioritising the allocation for use, giving drinking water its primary place;
k) encouraging farmer participation;
l) flood and drought management;
m) intensifying research and training, and so on.

The National Water Resources Council chaired by the Prime Minister assisted by the National Water Board chaired by the Union Minister in charge, brought in a few suggestions to build up a national data bank, optimisation in water use, drafting dam safety procedures, seeking legislative backing for ensuring equity and so on. Certain revisions in policy and provisions for implementation of the policy guidelines like passing Bills in Parliament for water information, prescribing guidelines for irrigation management, pricing of water, organisational and procedural changes and for allocation of water among the States, were keenly debated in the latest Council meeting held on 6 February, 1996. There was stout opposition from several of the Chief Ministers of the States for many of the items brought out for discussion.

The main barrier for arriving at a consensus is the scheduling of 'water' in the State list in the Constitution of India giving the union only an advisory role in the regulation of inter state rivers. In the political units in the States being governed by different parties with their own agenda and commitments, consensus is becoming difficult. Even proceeding with a perspective plan of interlinking surplus and deficit river basins drawn as early as 1978 for the overall development of the country's water resources has not been possible. A small group of States mostly at the tail end of the river systems favour nationalising the river systems which others resist.

The other barriers are, the concept of the riparian right among the individuals, the fear of the loss of benefit enjoyed by the existing users who toiled long for the creation of the systems and their development, the lack of comprehensive understanding among the users on the availability and demand for water, the frequent failure of supplies due to vagaries of the monsoon experienced by the users who prefer to insist on traditional use and guarantee, and the general slender economic status among the farmers who are mostly small and marginal farmers owning less than a hectare.

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[5] Prepared by Professor A. Mohanakrishnan, Chairman, Cauvery Technical Cell, Madras, India.

India is a vast country with mighty rivers like Ganga, Brahmaputra and Godavari along with many medium and minor non-perennial river systems. Policy options are therefore varied. Creation of more and more storage either large or small after due socio-economic analysis with an eye on environmental impact is the policy option for water harvesting. The next policy option may relate to evolving a suitable land-use pattern, maintaining desirable levels of crop land, tree cover, forest wealth and so on to combat soil erosion and sedimentation of reservoirs. The farmer is his own master in deciding on the cropping pattern, amenable for advice on the best crop that suits his soil and environment. The farming organisations that already exist in most irrigated areas may have to be strengthened with financial assistance, technical guidance, and helped to understand production economics and the value of water used for irrigation. They may be enthused not only to participate but also offer to manage the irrigation system at the local level by themselves which will make them appreciate the need for conservation and efficient use of water. Non-government organisations interested in the service in the water sector particularly in the socio-economic surveys, analysis and action programmes may have to be encouraged to quicken the process of water saving and water management activities. Similarly, the constitution clearly gives room for imposing duties on individuals to protect and improve the natural environment (GoI, 1976).

Successful implementation of policies and strategies in water management depends entirely on the evolution of a national consensus and commitment of the people at large, who are all water users in some sense or other, for optimising its use and maximising the benefits to reach the largest number of people possible.

Allocation priorities confirm the policy which has been practised and socially accepted among the public. The priorities should thus broadly be as follows:

- Drinking water
- Irrigation
- Hydro-power
- Navigation
- Industrial and other uses

The order of priority is not to be used as a blueprint but could be "modified if necessary in particular regions with reference to specific considerations" (*ibid*). It is suggested that the States should develop their water policies and frame them in relation to the National Policy. In Tamil Nadu, for instance, the preparation of the State Water policy was started in 1989 and, after a series of drafts, the Water Policy of Tamil Nadu was approved by the Honourable Chief Minister in 1994. During the final stages of preparation, the formulation of the State Water Policy was influenced by the work on the Tamil Nadu Water Resources Consolidation Project in which negotiations with the World Bank played a considerable role.

The Water Policy of Tamil Nadu is, to a large extent, a reflection of the national policy. The order of allocation priority is the same and a similar cautious attitude is taken in regard of the sensitive issue of water rates. It is important to note that water rates are linked to assured and timely supplies. Recognition of the poor systems management including uncertainty of irrigation schedules and duration and amount of water being issued continues to be one of the essential disincentives for the farmers to commit themselves to contribute to payment. Nobody is prepared to pay for bad services while most people probably would be agreeable to pay for reliable and adequate services.

8.5 Israel: national water resources conservation planning and policies for rapid economic development and conditions of severe scarcity[6]

Israel is a small, semi-arid country which, by 1996, had almost fully developed its limited sustainable fresh water resources under a highly centralized governmental planning and management system for water resources' conservation and development. Despite its severe limitations in water and almost all other natural resources, Israel has a strong, rapidly developing economy, based mainly on high-tech industry, commerce and tourism which has achieved a GDP/capita of $16.000/person in 1996. Israel's Water Law of 1956 has established that all water resources, including brackish water and wastewater, are the property of the Nation, to be managed and conserved as a scarce national resource.

Rainfall, which is seasonal and limited to the six winter months, ranges from a maximum of 700 mm/year in the mountainous northern areas to 100 mm/year at Beersheba in the middle of the country and to essentially zero in the southern most tip of the Negev Desert at Elath. With a 1996 population of 5.5 million and a total renewable mean safe yield of fresh water from all surface and ground water sources of some 1600 million m^3/year (MCM/year) the annual per capita renewable availability of fresh water is a mean of about 290 m^3/year. This is less than one-third of the so-called water bench-mark of 1000 m^3/person/year misguidedly considered by some authorities as a critical minimum amount of water for the survival of a modern society. Land settlement and agriculture have always played a central role in the Israel national value system with the major portion of the water resources allocated to meeting that goal. The central government still heavily subsidizes water for agriculture and sells it to farmers at about 25-50 per cent of its true production cost. While 70 per cent of the nation's water resources are devoted to agriculture only 3-5 per cent of the GDP is generated by farming.

On the other hand, water for domestic/urban/commercial and industrial use is charged at the full price, including the charges for wastewater collection, treatment and disposal. This results in an effective high cost of water for urban purposes of about $1.00/$m^3$. Water metering and an increasing sliding scale of water prices with increased consumption to discourage high water use, in addition to consumer education on water saving devices and water conservation have, despite the warm summer climate, achieved a mean total domestic/urban/commercial water consumption rate of about 250-300l/p/day with a mean annual consumption of about 100 m^3/p/year. An additional amount of 25 m^3/p/year goes for industrial use, with the result that the total urban/industrial non-agricultural use of water in Israel is 125 m^3/p/year. With an active policy of water metering, realistic pricing and increased plans for urban and industrial water conservation, it is hoped by the water planners that this level of urban water supply can be maintained into the future despite the continual rise in the standard of living.

It is the declared policy of Israel's Office of the Water Commissioner and the Government's water planning and management authorities that, as urban populations grow, first priority in water allocation will always be for domestic/urban uses and then industrial needs followed finally by agriculture. It is estimated by the water planners that the population of Israel may reach about 10 million by the year 2030 and that the domestic/urban/industrial per capita water consumption will remain at its current level of 125m^3/p/year. Assuming no increase or reduction in available fresh water resources and based on these assumptions, then by 2030 about 80 per cent of the sustainable safe

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[6] Prepared by Professor Hille Shuval, Lunenfeld-Kunin, Professor of Environmental Sciences, The Hebrew University of Jerusalem, Israel.

yield of fresh water resources will have to be allocated for domestic/urban and industrial use and the remaining 20 per cent of fresh water will be left over for agriculture. There is the possibility that this estimate is overly optimistic for three reasons: (1) per capita urban water consumption may actually increase; (2) the availability of fresh water resources may actually decrease in time due to ongoing known groundwater pollution processes; and (3) due to the possible allocations of some portion of Israel's current water resources to neighbours in achieving final peace agreements and resolving current water disputes. In any event to one degree or the other this would mean a gradual phasing out of the large-scale agriculture development of the past unless alternative low-cost water sources can be developed. It is recognized that, for Israel, food security means developing the earning power to import all of the staple food supplies and some of the fresh produce. By importing low-cost "virtual water" in the form of food, Israel will be able to utilize its limited high quality natural fresh water resources to meet human needs and for economic activities which can provide a very high return for the water they use.

Thirty years ago some visionary agricultural sector officials dreamed that sea water desalination would in time become a realistic alternative water source for agriculture. This belief was so strong and backed with such political pressure that the agricultural lobby succeeded in pressing the water authorities to over-pump the ground water resources for many years in the belief that eventually those sources would be replenished during the era of desalination. However, today it is clear that at current costs of $\$1.00/m^3$, or more, and little hope that it will go much lower than $\$0.8/m^3$ in the foreseeable future, the desalination option for agriculture has been dropped by all realistic water and agricultural planners. The dangerous policy of over-pumping the aquifers has meanwhile been stopped as a result of public pressure.

However, Israeli water and agricultural planners have meanwhile opted for an intensive national programme for the development of recycling and re-use of urban wastewater as a major non-conventional source of water for agriculture. By 1996 about 70 per cent of the urban wastewater flow was treated and recycled for agriculture. It can be estimated that by the year 2030 when the domestic/urban/ industrial water usage reaches some 1250 MCM/year and the goal of 80 per cent recycling is achieved, then about 1000 MCM/year of treated wastewater will become available for agriculture. This innovative policy of developing recycled wastewater as a major source of water supply can provide Israeli agriculture, on a sustainable basis with essentially the same level of water supply it has today, before the reallocation of most of the fresh water resources to the urban sector. Wastewater irrigation, however, can become a serious cause of groundwater pollution unless the areas for such irrigation are carefully selected to avoid highly permeable soils underlain by pollution prone groundwater aquifers. For this reason Israel is transferring much of its recycled wastewater through a major pipeline system to arid areas in the south and the Negev not prone to groundwater pollution.

While some of the agricultural interests still press for the early introduction of sea water desalination, the more enlightened water planners in Israel recognize that it will be economical for major seawater desalination plants to come on line only at some stage in the distant future - when most or all of the sweet water reserves are totally utilized for domestic and urban uses. At that time desalination for urban water supply will be economically feasible and can supply the country with unlimited amounts of water required for any future population growth and economic and industrial development. Israel can be viewed as the case of a semi-arid country that has developed

a strategy for rapid economic development and mass immigrant absorption despite severely limited water resources. This approach is based on sound principles of water resources' management, under conditions of scarcity which will enable the transfer of the limited freshwater resources from the agricultural sector to the domestic/urban/ industrial sector with the recycling of wastewater back to agriculture sector, as part of a conscious policy of careful national water resource conservation.

8.6 Resources' management in Poland[7]

Poland is one of the most water-scarce countries in Europe. Average runoff is at the same level as from the three-times smaller Rhone River Basin in France. The average freshwater availability is only 1,730 m^3 per capita and population density is in the order of 120 inhabitants per km^2 with about 62 per cent of the population living in cities and towns. The country is divided into only two major basins: the Vistula (about two-third of the country's area) and the Odra draining into the Baltic Sea. The combination of scarce water resources, their extensive use, and insufficient wastewater treatment capacities cause water pollution in Poland to be of critical proportions.

Since early 1990, dramatic political, economic and institutional changes in Poland have affected every aspect of life, including water resources' management. Central planning by the state has been almost completely abandoned, and there is a strong movement toward decentralization and privatization. The institutional system is undergoing significant change, leading to a strongly increased role for local self-governing authorities. Responsibility for municipal water supply, wastewater treatment, and ownership of the infrastructure is being transferred to municipalities. Administratively the country is divided into 49 *voivodships*, whose role is comparable to that of French departments - regional representation of national government. Each *voivodship* is divided into municipalities (*gminas*), which are locally elected self-governing bodies.

Poland's state subsidies for water resources' management and protection have practically ended being replaced by subsidies or loans from environmental and water funds. Varied approaches to project financing are promoted, including enhanced local sources of revenue from taxes and user charges, user taxes on potentially polluting substances, and private investments that supplement traditional public-sector and budgetary resources. In spite of these efforts, local resources remain limited, at least in the short term. Drafting new legislation (including a new Water Law) as well as enforcement of new regulatory arrangements is difficult in this period of political, economic and social transition.

According to the 1974 Water Law, the Ministry of Environmental Protection, Natural Resources and Forestry (MEPNRF) is responsible for water policy throughout Poland. This responsibility includes long-term strategic planning, water quality and effluent standard setting, and pricing policy. At the regional level, water resources are managed by the *voivodship* agencies of the Ministry. These offices issue water withdrawal and wastewater discharge permits; they also collect all water and wastewater fees and charges. These funds partially remain at the disposal of the *voivodship*, a portion is, however, transferred to the National Fund for Environmental Protection and Water Management.

Regional agencies of MEPNRF operate within the administrative boundaries of individual *voivodships*. However, as a result, even relatively small river basins are often

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[7] Prepared by Professor Janusz Kindler, Institute of Environmental Engineering Systems, Warsaw University of Technology, Warsaw.

under the authority of several *voivodships*. Frequent conflicts of interest have been observed between water users and administrative bodies, often leading to complex and difficult situations, especially in the frequently recurring dry years. The need for a change towards river basin management was gradually acknowledged. By the end of the 1980s, establishment of river basin authorities and introduction of the "polluter pays principle" were officially endorsed by all concerned.

In 1991 a new Water Law was drafted providing for the establishment of Regional Water Authorities (RWA) and Regional Water Councils (RWC). They are named "regional" to reflect the fact that their boundaries follow hydrographic regions (sub-basins) of the only two major basins, i.e. the Vistula and Odra rivers. Under the proposed new Water Law, the RWAs would be responsible for collection of water withdrawal and wastewater disposal charges. Thus, the current practice of collecting these charges will be modified; this function is to be transferred from the *voivodship* agencies of MEPNFR to the new RWAs. In addition, the RWA would monitor use of both surface and groundwater resources in the region, develop and operate water management information systems, prepare multi-annual action programmes, initiate research and exploratory work, and develop guidelines, such as water allocation principles and limits on wastewater disposal for integrated water use in their regions. The guidelines will have to be co-ordinated among the Regional Authorities for the entire Vistula and Odra basins. The guidelines also are to be used in issuing water withdrawal and wastewater discharge permits, which process remains in the hands of the MEPNRF *voivodship* agencies. Since each of these agencies operates in some part of the river basin only, the water use guidelines will be the main instrument for integrating and co-ordinating effort across each basin.

The Regional Water Committees, composed of the representatives of state government (national and *voivodship*), local self-governing authorities and water users, are charged with water policy-making in their regions. Each Committee is responsible for the approval of action programmes developed by the Board; development of investment priorities and region-wide financial policy (distribution of funds collected by the RWAs and setting up pricing policy for water withdrawal and wastewater disposal); and the overall supervision of the activities of RWAs.

Although the legislative process concerning the new Water Law has not been completed, in 1991 seven Regional Water Authorities were established. Their boundaries follow the hydrography of the country but, until the passage of a new Water Law, they cannot perform their main function of collecting water and wastewater charges. In 1993, without waiting for the new Water Law, Poland initiated the process of setting up Regional Water Councils. Most of the Councils are now established, and it is already obvious that these region-wide "water parliaments" are playing an important role in the country. They provide unique fora for discussion of a number of difficult issues, and, importantly, they give all parties concerned a sense of ownership and participation.

At present, the adoption of a new Water Law is the most pressing issue. Regional Water Authorities are working well, but they cannot play their proper role until the new Water Law gives them power to collect water and wastewater fees and charges. Unfortunately, the legislative process is progressing quite slowly. However, it is hoped that by early 1996 the new Water Law will be operational and the new WRAs will quickly prove their full value to the country and the society at large.

The shift to basin management and planning is recognized throughout Poland as a logical and necessary step. However, development of full working relationships between the administrative structure of *voivodships* and the new Regional Water

Authorities and Councils is an intricate process that has just begun. While supporting the concept of basin management, the *voivodships* are losing part of their authority over water finances to pay for local operations (although *voivodships* are represented on the Regional Water Councils). The principles are correct but there seem to be unsurmountable difficulties with regard to the details that must be agreed upon between those responsible for the former and new water management arrangements.

8.7 SADC Protocol and shared watercourse systems[8]

Eight Heads of State of Member Governments of the Southern African Development Community (SADC) signed a Protocol on regionally shared watercourse systems in Johannesburg, South Africa in August 1995. The signing of the Protocol is a commendable milestone in the recognition of the crucial importance of joint management in the development of shared water resources in the SADC Region in order to achieve economic integration.

The main objectives of the SADC Protocol is to promote the equitable utilization of shared watercourse systems, to formulate strategies for development and to monitor the execution of integrated water resource development plans. The establishment of the required institutional framework where it does not already exist is now required to implement the articles of the Protocol which call upon the Signatories to create appropriate institutions like water commission or river basin authorities to ensure the effective execution of their functions in terms of the Protocol and to develop shared drainage basins on a sustainable basis.

Throughout the SADC Region water is not only unevenly distributed by Nature, but unfairly allocated by Man. Many countries already experience water stress and water scarcity conditions which are aggravated by droughts. The SADC member States recognized the extent to which the lack of sustainable water resource development may adversely affect economic productivity and social upliftment in the region and it became clear that a new assessment of water resource management strategies and water master planning is required.

In August 1995 the Council of Ministers decided to create a Water Resource Technical Committee because the holistic management of fresh water as a finite and vulnerable resource and the integration of regional water plans within the framework of national social and economic policies are of paramount importance for equity-led development strategies in the next century.

In November 1995 the SADC Ministers responsible for water affairs in their respective countries met in Pretoria, South Africa to discuss the possibility to establish a formal Water Sector within the SADC framework. It was agreed that the management of water-related matters needs to be strengthened and that there is a priority for the assessment of water issues. The SADC Secretariat was therefore instructed to initiate the establishment of a new Sector to deal with integrated water planning and development with a special focus on shared river basins.

In April 1996 the UNDP and its Resident Representatives, as well as the SADC Secretariat, supported by the Environment and Land Management Sector and the Water Resources Technical Committee, did preparatory work for a SADC Round Table Discussion on Water Matters, which is scheduled to take place later in 1996.

A number of initiatives have been taken by SADC member States to improve the joint management of a shared watercourse system.

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[8] Prepared by Mr. Piet Heyns, Director, Department of Water Affairs, Windhoek, Namibia.

- In September 1994 Angola, Botswana and Namibia established a Commission for the development of the Okavango River Basin. In 1995 the Okavango River Basin Commission (OKACOM) agreed on the execution of a basin wide environmental assessment with the aim of developing an integrated management plan. The OKACOM also appointed a trinational Steering Committee to liaise with the Department of Development Support and Management Services of the United Nations to obtain funding support from the Global Environmental Facility (GEF) for the study on the Okavango. The GEE decided to make an initial Project Development Fund (PDF Block B) grant available for the work.
- Proposals have been made in November 1994 for the establishment of a Commission on the Zambezi River Basin and this is presently under investigation under the auspices of the Water Resources Technical Committee of SADC.
- South Africa and Botswana have reached a new agreement on the use of water in the Limpopo Basin while Zimbabwe and Mozambique are also having discussions about the future utilization of the water of the Pungue River.
- The South African Department of Water Affairs is at present executing a replanning study on the Orange River, and basin states, for example Lesotho and Namibia, are participating in this study which is of critical importance for the interests of downstream Namibia.
- In May 1996 the Permanent Joint Technical Commission between Angola and Namibia on the Cunene River appointed a Committee to assess the appropriateness of the existing bi-national agreements between the two countries on the use of water from the Cunene River.

The recovery of costs for water services is receiving serious attention in southern Africa and various models, ranging between utilities, parastatals, privatization and commercialization are under consideration. There are already a number of strong water supply entities in operation, for example the Rand Water Board and Mgeni Water in South Africa and the Water Utilities Corporation in Botswana.

The Namibian, South African and Zambian authorities are all in various stages of assessing the restructuring of water services and in Namibia the Government approved the establishment of a State-owned limited liability water utility company.

In the most arid countries in southern Africa, for example Botswana and Namibia, a more pragmatic approach is followed with regard to the policy of food security or food sufficiency. In Botswana, the policy is that there would be no attempt at national food security, but appropriate measures will be taken to ensure food security by negotiating with the suppliers of cereals.

In Namibia, the approach is to encourage the rural dryland crop farming community to be self sufficient in cereal production at household level and to try and produce some surplus food if climatic conditions are favourable enough. However, it remains the responsibility of the Government to ensure food security by assessing the need for cereals and then to secure adequate quantities of staple food from external suppliers.

8.8 Water sector reforms in Uganda[9]

Uganda is relatively well endowed with water, but large tracts of the country especially in the north and south-west experience semi-arid conditions. Increasing population density, deforestation, poor agricultural practices and drainage of wetlands have an

[9] Prepared by Mr. P.O. Kahangire, Director, Directorate of Water Development, Uganda.

increasing impact on both the water quantity and quality. The emerging major surface water quality issues are the deterioration in the quality and ecology of Lake Victoria. Aquifers are limited in yield, extent and hydraulic characteristic and recharge is extremely low which implies that groundwater abstraction for irrigation is not feasible.

The demands/requirements on the water resources are predominantly for water supply (domestic and livestock) and limited irrigation. However, the distribution of the surface water resources means that on a local scale there may be competition for the water. The irrigation water demands may increase to substantial amounts which would be drawn from surface water. Only 36 per cent of the rural population and less than 50 per cent of the urban population have access to safe water supply within reasonable walking distance. Coverage of hygienic sanitation is only 45 per cent in the rural areas and about 60 per cent in the urban areas. Water-related diseases account for 50 per cent of the morbidity in children.

At the international level, the whole of Uganda's water resources is part of the Nile basin shared by ten countries. Approximately 48 per cent of the flow is from upstream countries vulnerable to land-use practices in the upstream countries.

Effective collection, processing and distribution of information about the quantity and quality aspects of the surface water resources is a prerequisite which presently does not exist.

The previous structure of the Ugandan Government, including the water sector, was a centralised system remote from the people with poor communications between the centre and local operating units and a heavy bureaucracy. Some of the government departments also had dual roles for both development of the resources and regulation of its use. However, it had some advantages, for instance, the utilisation of scarce qualified professional personnel and provided an easy channel through which to direct funds to the districts, particularly funding from foreign donors.

The planning, implementation and operation of water supply schemes are presently under the control of two agencies, National Water and Sewerage Corporation (NWSC) and Directorate of Water Development (DWD). Urban schemes are transferred to NWSC, once they are self-sustaining. However, conventional schemes in the smaller towns have not been self-financing units and have been subsidised by the large industrialised towns. The approach now adopted will allow small towns and rural communities to choose a scheme to meet its needs within the limits of its affordability. Therefore, people in such places may have to accept higher charges for a lower level of water service than in a similar town operated by NWSC. It is clearly desirable that there should be a common policy at the interface.

Uganda has taken vigorous steps towards rationalising water resources' management and development. From a virtual breakdown of both physical and institutional structures in the 1980s major efforts have been made to revitalise the water supply sector and then to establish a new framework for management of the country's water resources. This has gone hand-in-hand with overall developments in Uganda towards redefinition of the role of government, with the central government creating the enabling environment for action by local governments, communities and the private sector, and towards serious concern for the environment and sustainable management of natural resources.

The Constitution of the Republic of Uganda, 1995, confirms the framework for decentralisation, which was already enacted in more detail through the Local Government Statute of 1993. The Local Government Statute designated "water resources" as being one of the functions exclusively reserved for the central government. Central government

will continue to have overall responsibility for water resources, including the setting of policies, standards and management regulations; while lower levels of government can have responsibility for local decision making and management within the framework of national policies.

Parallel to the formulation of the National Environment Action Plan and Management Policy, the Uganda Water Action Plan (WAP) was formulated in 1993 94. The WAP identified the water resources' management functions that were considered to be necessary in Uganda. The key water resources' management functions identified are:

- international policy-making;
- policy-making, planning and co-ordination;
- water extraction regulation;
- wastewater discharge regulation;
- water resources monitoring;
- enforcement;
- mediation;
- training and information;
- rural and urban water supply.

The Water Action Plan and Water Statute proposed a management structure that is flexible and coherent with the management functions required to be performed both in the short term and long term. The WAP has subsequently been endorsed in the Water Statute as a legally binding document. As the last in the chain of reform measures described above, the policies which constituted important guiding principles during the process of preparing the Water Action Plan and the Water Statute have been refined and synthesized explicitly as a draft National Water Policy (DWD, 1996). The National Water Policy adopts the guiding principles for water resources' management emanating from the UNCED Agenda 21's Chapter 18, as they were operationalized by the WAP. The overall policy objective of the Ugandan Government is:

> "to manage and develop the water resources of Uganda in an integrated and sustainable manner, so as to secure and provide water of adequate quantity and quality for all social and economic needs, with the full participation of all stakeholders, and so as not to leave the future generations any worse off than ourselves".

The DWD has been restructured to assume the role of planning, supervision and regulation of the water sector rather than implementation of water supply and sanitation services, which has been devolved to the districts, urban authorities and the user communities. However, most of the districts suffer from serious lack of staff, money, implementation experience and logistics, calling for institutional strengthening at all levels.

In the rural areas and small urban centres there has been a major shift in Government strategy towards a decentralised community-based approach whereby the communities are fully involved in the planning and implementation of the facilities and contribute part of the cost of the investment (in kind) and take full responsibility for O & M and recovery of the recurrent costs. With the above reforms considerable progress has been made. Water supply coverage increased from 18 per cent in 1990 to the present 36 per cent and the sanitation has steadily increased from 20 per cent in the 1980s to the present 45 per cent.

The strategy adopted for the major urban centres was to place overall responsibility for water supply and sanitation services under an autonomous organization (NWSC) that would ensure full cost recovery in order to guarantee long-term sustainability of investment benefits. NWSC has evolved into a strong commercially oriented management system.

8.9 Yemen: a low-income, food-deficit, rural based economy with a fast growing population under extreme water stress[10]

Yemen is an arid country, where extraordinary policy measures are urgently required to avert immediate threats to societal and social stability caused by extreme water stress. The institutional and socio-economic conditions and options for sustainable water management are, however, quite limited. Yemen's population, 16.2 million in 1995, is doubling in less than twenty years and the 6.5 million people sharing each cubic km of the renewable water today, will grow to 14.5 million in 2025. With this development, and even with no allocation for agriculture, only half the minimum water requirements (MWR) of 125 cubic meter/person/year as suggested as a norm for Israel (Shuval, 1996; see Section 8.5) for domestic uses will be available.

Seventy per cent of the population in Yemen is rural, and agriculture is based on rainfed production of food crops. With low cropping productivity, frequent droughts and crop losses and a rapidly growing population and food demands, Yemen is fully dependent on grain imports, a major cause for a growing national trade deficit, eroding the national economy and the capacity to establish sustainable systems to secure livelihood. Therefore, Yemen has neither water security nor food security.

The only permanent supply is groundwater where present abstractions, about 2.1 cubic km, amount to about 1.4 times the recharge. The situation is aggravating since water requirements will double in 15 years. Rainfed cropping can no longer support rural populations and as a result irrigation is expanding, putting further pressure on the groundwater resources. People move to urban areas creating population pockets and adding to local water scarcity. Agricultural wells are drying up and major cities, such as Ta'iz and Sana'a, are in outright water crisis.

The options for management interventions remain constrained by political and structural realities and the need to provide sustainable income and employment in the dominant rural sector is not met. Regulation of water uses is required and need to be based on decentralized and community-based systems. Improved rainfed cropping and irrigation efficiency, watershed management and groundwater recharge will be important but not sufficient. Viable urbanization should be based on a structural change in agriculture, including a reduced dependence on this sector. It is necessary to enhance the economy and the institutions and ease the pressure on the water resources. The focus must be on small, local urban centres and not major cities, as they would add to the water scarcity problem and the dimension of social collapse.

Concepts such as water stress index, benchmark and minimum water might therefore be misleading and even frustrating for countries such as Yemen (cf. discussion on the situation in Israel, Section 8.5). A concept reflecting the water stress, together with the institutional and economic constraints, indicating the level of urgency for management measures, is required. The concept, that could be expressed as the number of persons/cubic km/year divided with the GNP per kaput and an institutional capacity index, ranging from 1-5, would serve to underline the need for policy action in the most water-stressed and poor countries. Rough calculations

[10] Prepared by Mr. Bo Appelgren, FAO, Rome.

suggest that the index for Yemen would be about 100 times higher than for a high income, well managed, industrialized Middle East country operating at the level of minimum water requirement of 125 cubic meters/person/year.

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APPENDIX

Workshop on Suggested Strategies and Policy Options for CFWA New York, 18-19 May, 1996

The material prepared for the workshop by the participants as well as the discussions held during the workshop provided very useful background material for this paper, for which the authors are grateful.

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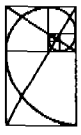

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