

Defining and Mainstreaming  
**ENVIRONMENTAL  
SUSTAINABILITY**  
in  
**WATER RESOURCES  
MANAGEMENT**  
in Southern Africa



**A SUMMARY**



SADC Technical Report  
to inform and guide water  
resources policy and investments



Summary of a technical report by the Southern African Development Community (SADC) and development partners:

World Bank, Sida, IUCN and SARDC

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# Defining and Mainstreaming ENVIRONMENTAL SUSTAINABILITY in WATER RESOURCES MANAGEMENT in Southern Africa

## A SUMMARY

The technical report on *Defining and Mainstreaming Environmental Sustainability in Water Resources Management in Southern Africa* showcases the threats to our precious water resources, and to the environment that sustains them, and it also offers solutions for long-term protection and appropriate utilization. Water is a limited and essential resource that urban dwellers often take for granted. In the rural areas of the region, however, people are confronted directly by its elusive nature as they are more vulnerable to the ravaging cycles of drought and flood, and the slowly degrading resource base.

Water is a necessary input for many productive activities including agriculture, forestry, industry, mining, commercial and livestock development, energy production, tourism, wildlife conservation, etc. The effective and sustainable utilization and management of water resources is an essential pre-requisite for sustaining all forms of life, improving livelihoods of the people and fostering overall socio-economic development in southern Africa. Our natural environment also needs water, if it is to continue to provide important social, ecological and hydrological functions, although we seldom consider that wider context.

Environmentally sustainable management of water resources is linked to poverty alleviation in many important ways. Strategies to reduce or alleviate poverty should not lead to further degradation of water resources or ecological functions and services. Sustainable water use and improved environmental quality should contribute directly to reducing poverty.

Water availability varies considerably across the region and within countries. Overall, it is a scarce resource, which is vulnerable to global factors such as climate variability and climate change, and to regional constraints imposed by the management of transboundary waters.

Water is also vulnerable to local and national factors such as the growing demands of urban and rural populations, increasing sectoral demands, greater competition and potential for conflict over water, worsening water pollution, land and catchment degradation, destruction and encroachment on aquatic ecosystems, and proliferation of invasive weeds.

Increasingly, environmental degradation from unsustainable land and water use patterns and other anthropogenic factors is undermining and threatening the sustainability of the water resource base itself, and if this remains unchecked then it is likely to further exacerbate water scarcity in a region that has a limited endowment of water.

Although awareness about environment has increased since the Earth Summit in Rio in 1992, the operational integration of environmental quality objectives, economic efficiency principles, and social equity goals in water resources planning and management decision-making remains a major weakness to be addressed in water resources policy and institutional reforms and water resources development.

Since the majority of the people in southern Africa depend on and derive their livelihoods directly from natural resources, the region has placed a high priority on the need "to achieve sustainable utilization of natural resources and effective protection of the environment" and has enshrined this priority as a policy objective in the 1992 Treaty of the Southern African Development Community (SADC).

Compared to most developing regions of the world, SADC is ahead of the curve in the search for environmentally sustainable solutions for managing its limited and fragile water resources. However, much needs to be done to have in place both an operationally effective policy and

Main International River Basins of the SADC Region



SADC Water Sector 2002  
The smallest international river basin in the SADC region, the Umbeluzi, is not shown here.

Map 2.1 in technical report

an institutional framework, and practices that reflect effective integration of sustainable management principles.

The SADC Environment and Land Management Sector (ELMS), with the SADC Water Sector and partners,<sup>1</sup> commissioned the preparation of the technical report on *Defining and Mainstreaming Environmental Sustainability in Water Resources Management in Southern Africa* to contribute to the public policy discourse and to support the development of practical approaches for the integration of environmental quality objectives in the planning and management of the water sector.

The technical report addresses a key SADC objective, “to achieve sustainable utilization of natural resources and effective protection of the environment”, and supports the integration of environmental quality objectives into the implementation of the SADC Protocol on Shared Watercourses and the Regional Strategic Action Plan (RSAP) for Integrated Water Resources Development and Management in the SADC Countries (1999-2004).

The 336-page, full colour report is also a SADC contribution to the United Nation’s World Summit on Sustainable Development (WSSD) in Johannesburg in August 2002 and to the New Partnership for Africa’s Development (NEPAD).

The central messages are that:

- effective development and effective management of water resources are essential for sustainable growth and poverty reduction in the SADC region; and
- sustainable water resources management must balance between the short term needs of the people for their social and economic development and the protection of the natural resource base.

The specific intention of the technical report is to provide a framework for defining tools for sustainable management of water resources and for operationalizing complex concepts related to the impacts on the water environment of changes in the amount, timing and quality of water resulting from direct water development activities, as well as indirect land use and other activities within the river basin. The report is based on an analysis of best practices from the region.

The implementation of the recommendations of this report will contribute towards the mainstreaming of environmental sustainability in water resources management in the SADC region.

The report has been prepared by specialists from the SADC region,<sup>2</sup> and they include environmental planners and managers, natural resources economists, river scientists, freshwater ecologists, civil engineers, biologists, land-use specialists, wetlands specialists, hydrologists, water resources management specialists, political scientists, sociologists, and journalists. The draft chapters were presented for review to the National Technical Committee members of both SADC ELMS and SADC Water Sector at a workshop in Harare from 28-29 October 1999, and to a scientific advisory committee. More than 65 workshop participants at the workshop included regional experts from governments, academia and non-governmental organizations. The final draft was peer reviewed by specialists from the region, the SADC ELMS and SADC Water Sector, and the World Bank.

The target audiences of this report include water resources and environmental policy makers, planners, managers and decision-makers from the public and private sectors, and undergraduate and graduate students interested in various natural resources management disciplines.

The technical report provides policy guidance and practical tools for addressing the specific challenges related to the water, environment and poverty nexus. This is a short summary of its contents and objectives.

### Water, environment and poverty nexus

The technical report is based on two fundamental assumptions that link water and environment to poverty alleviation.

- First, strategies to reduce poverty should not lead to further degradation of water resources or ecological functions and services.
- Second, sustainable water use and improved environmental quality should contribute to reducing poverty.

1 Partners include IUCN-The World Conservation Union Regional Office for Southern Africa (ROSA), the Southern African Research and Documentation Centre (SARDC) India Musokotwane Environment Resource Centre for Southern Africa (IMERCSA), the Africa Water Resources Management Initiative (AWRMI) and the Environment Department of the World Bank, and the Swedish International Development Cooperation Agency (Sida).

2 Specific numerical data on pollution, water use, water scarcity and other related parameters were derived by individual experts on the basis of information that was available and may therefore vary from some of the official sanctioned numbers. The authors and editors have tried to use official data where available and they take full responsibility for other data which cannot be attributed to SADC.

Table 1 summarizes the elements of a basic framework for linking water, environment, and poverty. A broad definition of poverty is adopted, that extends well beyond income and consumption, to include inequality, health, opportunity, livelihoods and vulnerability.

Linkages between Water, Environment and Poverty

Table 1

Dimensions of poverty	Examples of water and environmental linkages
Income and Consumption	Access to water for productive use, access to natural resources, sustainable growth
Inequality and Equity	Secure tenure and access to natural resources, water rights and entitlements
Sustainable Livelihoods	Sustainable land and water use practices
Health	Water quality, safe drinking water and sanitation, protection against water-borne disease
Security and Vulnerability	Improved disaster preparedness and response, water harvesting and conservation
Inclusion and Empowerment	Participation, devolution of ownership, rights and responsibilities to water users, community groups, basin organizations, local governments

Table 1.1 in technical report

Understanding the biophysical, social, and socio-economic linkages is critical to addressing the environment, water, and poverty nexus because in many cases it is the poor, who are most directly or indirectly dependent on terrestrial and aquatic ecosystems livelihoods and wellbeing.

“Because of social and economic disadvantages, the poor often live in fringe areas, where access to potable supplies and adequate sanitation facilities is limited and where higher mortality, morbidity, and disease rates prevail. Or they live in highly vulnerable areas (floodplains and degraded watersheds), where buffering capacity to natural and anthropogenic shocks and disasters is limited. Also, poor downstream communities relying on flood recession agriculture, dry season livestock water supplies, fodder, firewood, or fishing are often left out when major upstream water allocation or urban/industrial development decisions are made without adequate considerations of downstream uses.” (Hirji and Ibrek 2001: 2)

#### Objectives of the technical report

The overall goal of the technical report is to inform the policy and decision makers about the complex biophysical, social and economic dimensions of environmental sustainability in water resources management. The report underscores the fact that sustainable management of

water resources must incorporate at an operational level, the ecological, economic and social considerations into water resources planning and management decision-making. Another goal is to,

- provide policy guidance, practical approaches and operational tools for developing and managing the region’s basic and vital resource – water – in an environmentally sustainable manner,
- share successful lessons and experiences about environmentally sustainable water resources management practices from the region, and
- define in operational terms the elements of “environmentally sustainable water resources management”.

A primary objective of the report is to provide information and guidance for policy makers, decision makers and water resource managers on how best to ensure the sustainable development, use and management of water resources, in ways that provide the most benefits for people, particularly the poor, while still ensuring that the water resources are protected for the benefit of future generations. This can only be achieved by paying adequate attention to the environmental aspects of water resources, and ensuring that environmental issues are brought into the mainstream of all decision-making regarding water resources. It is insufficient to address environmental issues only through Environmental Impact Assessments (EIAs) for projects. Environmental sustainability criteria must be fully incorporated into the operational frameworks of water resources management.

The idea that management of the environment can be separated from water resources management, and that the environment competes with people for the use of water, can no longer be entertained if we are to achieve true sustainability of water resources and address poverty reduction successfully.

The report also attempts to dispel myths about water and dependent ecosystems (Box 1) in order to assist policy makers and water managers to make informed project decisions on how to address significant adverse impacts on important natural systems and livelihoods of downstream communities.

**Misconceptions about water and water-dependent ecosystems** Box 1

There are a number of misconceptions about water and water-dependent ecosystems that are so widespread they are often taken as fact by various sectors and individuals, including in some cases, at high levels of decision-making:

- That water originates from pipes, and not from watersheds, springs and aquifers.
- That wetlands are wastelands with no social or economic value to society.
- That freshwater biodiversity is not important to the region.
- That water flowing into the sea is wasted water.
- That downstream impacts of major water projects are insignificant and therefore should be ignored.
- That environmental management is a concern of outsiders and not of the region's people.
- That environmental management provides few benefits to society, but is costly and poses a huge economic burden.
- That existing Environmental Impact Assessment policies and laws are sufficient for integrating environmental sustainability criteria into water resources planning and management decision-making.

Box 1.1 in technical report

**WATER AND WATER RESOURCES IN THE SADC REGION**

**A system in crisis: A degrading and undervalued resource base**

The water resources system, comprising water and water-dependent ecosystems, is essential for the sustenance and health of all species – human beings, plants, and animals. Water resources in the region are treated as a source of natural capital that provide fundamental input for a whole array of human needs and economic development activities, and as sinks for wastewater discharges from municipal, industrial, mining, urban and agricultural activities. However, the important hydrological and ecological functions of freshwater-dependent ecosystems are less well recognized, and are consequently, poorly addressed in planning and management decision-making.

**Ecosystem goods and services**

Figure 1 on water-based ecosystems highlights the multiple uses, values, services and functions of water and dependent ecosystems. Aquatic ecosystems serve important ecological and hydrological functions on which people, especially the poor, often directly depend. Riverine, riparian and wetlands ecosystems provide many, vital social and economic services and benefits such as fisheries, nutrient removal, water supply, and forest products. Understanding the range of benefits

and services provided by the aquatic ecosystems is essential to addressing equity and distributional considerations when assessing possible changes to flow and quality as a result of upstream actions.

**Water: An essential and limited resource**

The availability of water underpins the social and economic fabric of the society in the SADC region, which is characterized broadly as underdeveloped with widespread poverty. The population is largely rural-based and heavily dependent on agriculture, but is urbanizing rapidly. Low coverage of water supply and sanitation facilities for the

rural and urban poor has a significant impact on public health. The region's wetlands support the livelihoods of 60 percent of rural farmers and pastoralists, as well as wildlife and other biodiversity. The region's energy is

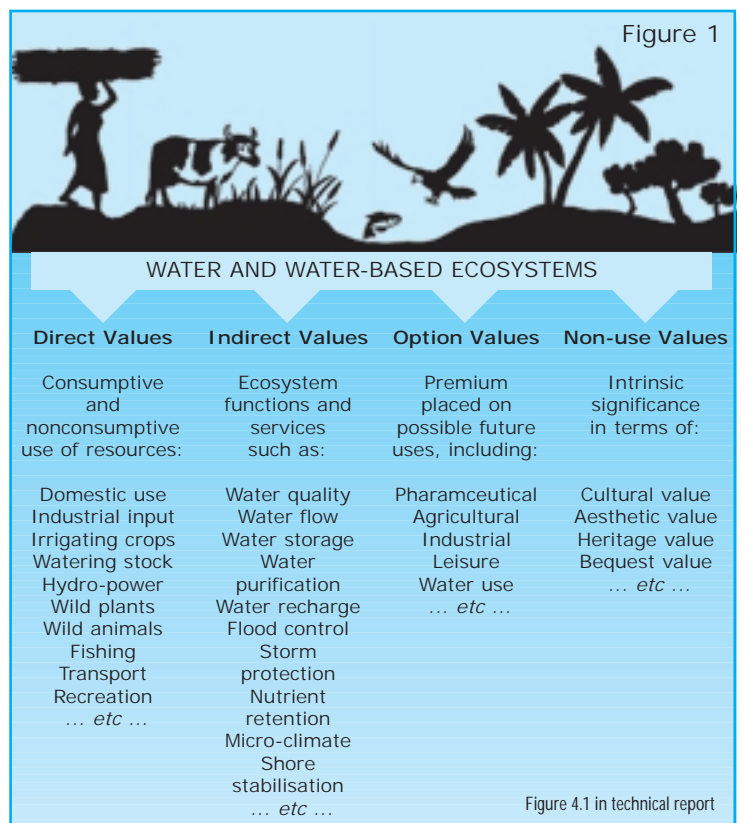
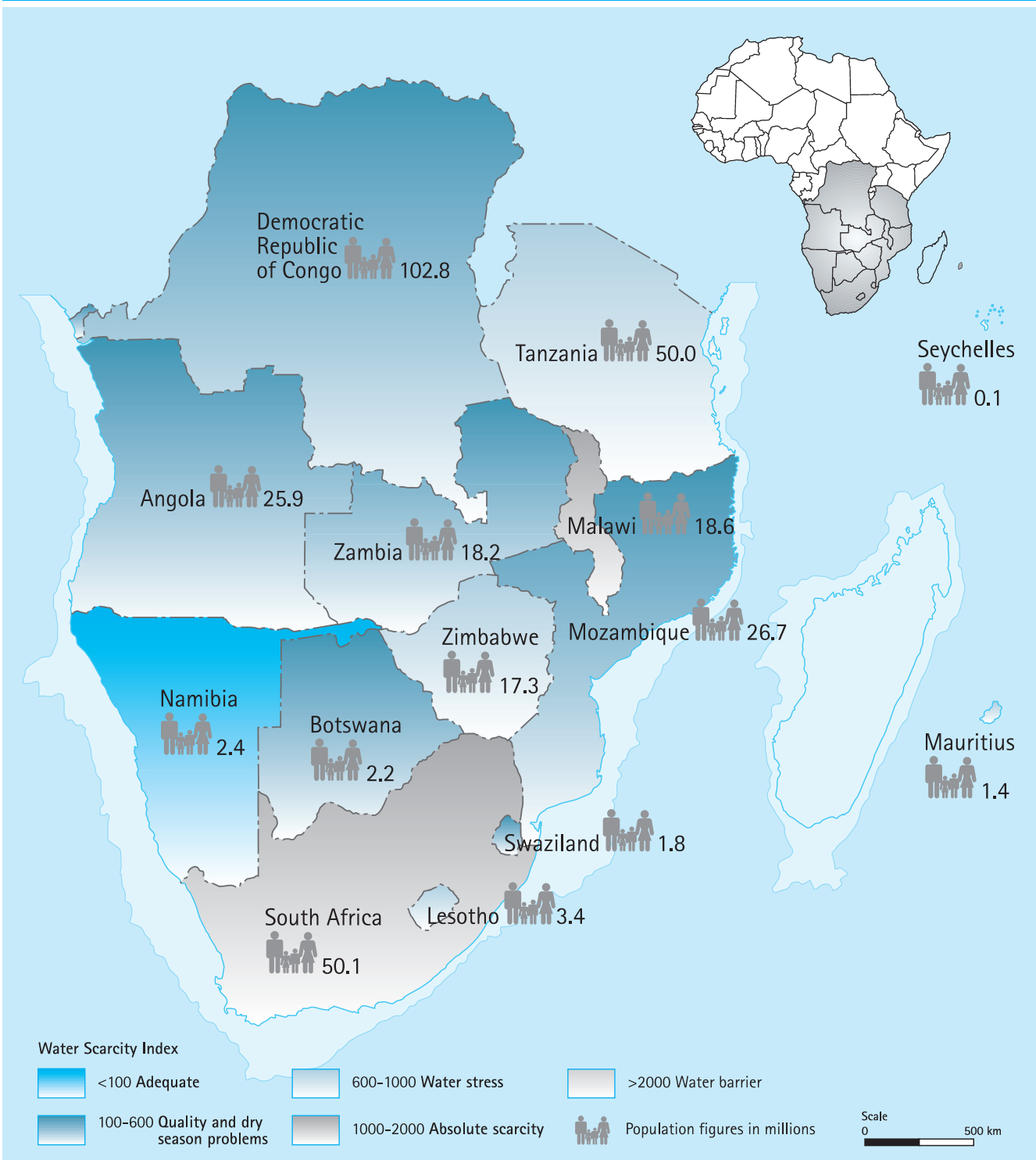


Figure 1

Projected Water Scarcity in Southern Africa: Water and People, 2025



Water Scarcity Index from Falkenmark 1993. Recalculated using water availability data from Gleick 2000. Population figures 1995 from SADC, projected for 2000 using 1999 population and annual growth rates in *SADC Statistics 2000*. Population projections for 2025 based on projections 2000-2025 from UN Population Division 1998, in UNFPA 2000, and recalculated at the same rate using SADC data for 2000 (see Table 2). Comparative data for 2025 are reliant on population projections which are not calculated uniformly for each country, thus showing outdated and unadjusted figures, for example, for Angola and the Democratic Republic of Congo. Geographical variations within countries are also a factor, for example in Malawi and Namibia, where water resources are concentrated mainly in one part of the country while other parts of the same country are already short of water. This map represents the situation based on the most reliable data currently available. Map 1.2 in technical report

generated mostly from hydroelectricity. In short, water is an essential resource for supporting human and other forms of life, maintaining ecological systems and sustaining economic development in all sectors.

Chapter 2 of the technical report describes the importance of water resources to the region's economy and shows how vulnerable the economy is to climate variability.

Water is already scarce in a number of local basins, reaching availability levels of 1000 cu m or less per capita per annum, partly due to the semi-arid climate of a large proportion of the region, and partly due to increasing populations with increasing demands for water. By 2025, on the basis of data on renewable supplies and demographics, it is expected that Malawi and South Africa will face absolute water scarcity, and Lesotho, Mauritius, Tanzania and Zimbabwe will be water stressed; while Angola, Botswana, DRC, Mozambique, Swaziland and Zambia are likely to experience water quality and availability problems in the dry season. There are significant variations within countries such as Malawi and Namibia where water resources are located in one area while other parts of the same country are already short of water.

The alarming decline in water availability predicted for the period 1995-2025 (Table 2 below and Map on facing page) is likely to be a common feature of the water resources future in southern Africa. This makes it all the more urgent that people in the region make every effort to ensure the careful and sustainable management of the water resources that we have, since opportunities for development of new sources of water to meet future shortfalls are, and will remain, limited.

### Challenges to sustainable management of water resources

A central challenge facing the region is that the concept of sustainable water resources management is poorly understood by policy makers as well as by water resources planners and managers. The concept of the "environment" continues to remain elusive in spite of the progress made since the United Nations Conference on the Human Environment in 1972, the African Ministerial Conference on Environment and Natural Resources in 1985, and the United Nations Conference on Environment and Development in 1992. Although the First Dublin

Annual Renewable Freshwater Resources, Population and Water Availability in SADC States, 1995-2025: Water Scarcity Index\*

Table 2

Country	Year of estimate and source	Annual renewable water resources (cu km/yr)	Population (000)			Population pressure on water availability (people/M cu m/year)			Water scarcity index		
			1995	2000	2025	1995	2000	2025	1995	2000	2025
Angola	1987 b	184	11 558	13 302	25 940	63	72	141	1	1	2
Botswana	1992 c	14.7	1 459	1 651	2 270	99	112	154	1	2	2
DRC	1990 c	1 019	43 900	50 730	102 830	43	50	101	1	1	2
Lesotho	1987 b	5.2	1 930	2 140	3 400	371	412	654	2	2	3
Malawi	1994 c	18.7	9 374	10 160	18 695	501	553	1000	2	2	4
Mauritius	1974 c	2.2	1 122	1 205	1 410	510	548	641	2	2	3
Mozambique	1992 c	216	15 400	17 245	26 730	71	80	124	1	1	2
Namibia	1991 c	45.5	1 590	1 817	2 460	35	40	54	1	1	1
Seychelles	-	n/a	75	82	110	-	-	-	-	-	-
South Africa	1990 c	50	39 477	44 000	50 160	790	880	1003	3	3	4
Swaziland	1987 b	4.5	908	1 046	1 800	202	232	400	2	2	2
Tanzania	1994 c	89	28 400	32 422	56 090	319	364	630	2	2	3
Zambia	1994 c	116	9 100	10 755	18 285	78	93	158	1	1	2
Zimbabwe	1987 b	20	11 526	13 485	17 395	576	674	870	2	3	3
SADC		1 784.8	175 820	200 040	327 525	98.5	112	184	1	2	2

\*Water Scarcity Index 1 Adequate 2 Quality and dry season problems 3 Water stress 4 Absolute scarcity 5 Water barrier

Index from Falkenmark, 1993: <100=1; 100-600=2; 600-1000=3; 1000-2000=4; >2000=5

Recalculated using water availability data from Gleick 2000, as indicated above b/Belyaev 1987 and c/UN FAO 1995. Population figures 1995 from SADC, projected for 2000 using 1999 population and annual growth rates in *SADC Statistics 2000*. Population projections for 2025 based on projections 2000-2025 from UN Population Division 1998, in UNFPA 2000, and recalculated at the same rate using SADC data for 2000. Population projections to 2025 rely on the UN calculations which are not uniform by country, and show unadjusted figures for Angola and DRC.

Table 2.1 in technical report

Principle, also known as the ecological principle, has been widely accepted, its implementation is poor. There is a wide disconnect between water managers and environmental managers. Important hydrological and ecological services provided by the aquatic environment are considered to be of marginal value, and wetlands continue to be seen as wastelands and not an integral part of the water resource base. Water flowing into the sea is considered “wasted water”. It is therefore not surprising that the environment continues to be addressed narrowly, its protection is seen by water managers as a “green” issue promoted largely by external interest groups.

Three decades after Stockholm and a decade after Rio, environmental protection is still considered as anti-development. The intrinsic properties of ecosystems are not well understood or appreciated, and consequently, biota are not seen as important indicators of the health of aquatic ecosystems – river, lake or wetland – upon which the livelihoods of millions of people, livestock, and wildlife depend, and which comprise important habitats for biodiversity.

The SADC region faces a number of challenges in its pursuit of environmentally sustainable water resources management. How well the region addresses these challenges will determine how effective we will be in reducing poverty and improving the well-being and livelihoods of the region’s people in the long term.

- Provision of basic water supplies and sanitation is not yet adequate, in rural or urban areas. In rural areas, the challenge is to provide the water infrastructure to reach outlying areas, in a way that is cost-effective and within reach of the rural poor, taking into account the ability to pay as well as the capacity to maintain and operate water infrastructure. In urban areas, the challenge is to keep pace with rapid informal urbanization and demands for larger volumes of water, where existing infrastructure such as storage reservoirs, drainage systems, sewers and treatment works may not be able to meet these demands.

- Overall demands for water are growing rapidly, with the need to promote agricultural, mining and industrial development, as economies in the region develop and diversify away from subsistence agriculture towards more commercial agriculture and manufacturing-based industries. The impacts of such developments on water resources can be severe, both in terms of water demand and pollution potential.
- Water resources in the region, like the climate, are subject to extreme variability. (Box 2) Droughts are endemic to the region, floods are relatively frequent occurrences, and many rivers do not have year-round flow. This makes it difficult and expensive to store water in order to meet shortfalls, and leaves people more vulnerable to natural disasters. Global climate change will only exacerbate these problems.

#### Rainfall trends in southern Africa 1967 – 2000

Box 2

1967-73	This 6-year period was dry across the entire region. Some records show a severe drought in 1967.
1974-80	This period was relatively moist over much of southern Africa. In 1974 the mean annual rainfall was 100 percent above normal throughout the region.
1981-82	Drought in most parts of southern Africa.
1982	Most of sub-tropical Africa experienced drought.
1983	A particularly bad drought year for all parts of the continent.
1984-85	Near normal seasons, but drought strains from the previous three years were still felt in most parts of the region.
1986-87	Drought conditions returned to the region.
1988-90	Near normal seasons.
1991-92	Severe drought in southern Africa, excluding Namibia.
1993-94	Conditions improved.
1994-95	Many SADC countries were hit by the worst drought in memory, surpassing effects of the 1991-92 drought in some parts of the region.
1995-96	Widespread rains in most parts of the SADC region prompted forecasts of a bumper agricultural yield.
1996-97	Normal rainfall for most of the region.
1997-98	Normal rainfall throughout the region including the north-east, although impacts of El Nino were significant.
1999-2000	Cyclone Eline hit the region and widespread floods devastated large parts of the Limpopo basin (southern and central Mozambique, south-eastern Zimbabwe, parts of South Africa and Botswana).

Chenje 2000

Box 2.4 in technical report

- Most of the major river basins in the region are shared between two or more countries. Unless these are jointly managed, the shared watercourses can lead to uncertainties and tensions regarding water allocations; and to lack of coordinated water resources planning, development and management, as well as monitoring and data insufficiencies.
- Fisheries in the region, which are a mainstay of several economies, are declining due to over-exploitation, pollution of water resources, invasive alien species and aquatic weeds, regulation of river flows and encroachment of human settlements onto floodplain areas.

### Threats to sustainability of water resources

In addition to the challenges faced by the SADC region, many water resources are already threatened in various ways:

- Pollution of surface and groundwater resources is a growing problem, making many water resources unfit for use without expensive pre-treatment. Pollution is increasing from point sources, such as municipal discharges of industrial and domestic waste, and from non-point sources, such as solid waste, agro-chemicals, mining (Box 3) and urban runoff.

#### Mining industries pollute the Kafue river in Zambia

Box 3

Copper-mining activities are concentrated in the upper reaches of the Kafue river catchment, in the northwestern region of Zambia. The Kafue is polluted upon entering the mining area; its water quality (suspended solids, hardness and chloride) is altered, and associated with the suspended solids are trace metals.

The national environmental standards for effluents are 100mg/l for suspended solids, yet suspended solids from run-off dumps in the rainy season are as much as 894mg/l. The permissible effluent level for dissolved copper has been set at 1mg/l.

At Hippo-pool, Chingola, copper levels were 120mg/l before declining to 21mg/l at Kitwe, 26mg/l at Ndola and 23mg/l at Mpongwe. Permissible dissolved cobalt levels are 0.5mg/l but at Hippo-pool, the cobalt levels are as high as 6.2mg/l.

The water is rendered hard when it enters the mining area. This arises from calcium and magnesium sulphate from the mines. At Mwambashi, 1426mg/l sulfate has been recorded. High sulphate levels lead to low pH. The mining activities in the Copperbelt have degraded the Kafue river, which is a source of drinking water for a number of urban areas in Zambia. The costs for treating the water for human consumption have escalated as the quality of the raw water deteriorated due to the mining activities.

Chishiba and Nkolonganya 1997

Box 6.6 in technical report

#### The impacts of dams on the lower Zambezi river, with emphasis on Cahora Bassa

Box 4

After the closure of Cahora Bassa dam on the Zambezi river in Mozambique, the water level in the dam was held constant for 19 years, resulting in a near-constant release of 847 m<sup>3</sup> s<sup>-1</sup> over the same period. Observations before and 20 years after the closure of Cahora Bassa dam, revealed the impacts listed below. Some of these may be contributed to by other dams on the system, eg Kariba, and may also be related to the 20-year civil war in that country, but many can be related directly to the over-regulation of a major river system:

- many of the mangroves in the delta dried out and died back;
- the community structure of the floodplain vegetation changed, with a substantial increase in trees;
- meanders and oxbows, once a feature of the floodplain, became clogged with reeds and trees;
- the productive, flood-dependent grasslands were depleted of grasses, the favoured food plants of herbivorous mammals;
- mammals, including the formerly abundant buffalo, practically disappeared from the delta;
- the abundance of waterfowl declined significantly;
- floodplain "recession agriculture" declined significantly;
- vast, vegetated islands, many of which became inhabited by people, appeared in the river channel;
- dense reeds lined the sides of the river channels;
- erosion of the coastal zone was evident, probably as a result of the release of sediment-hungry water from Cahora Bassa dam rather than as a result of changed flow patterns;
- water levels in the lower Shire river, the largest tributary of the Zambezi downstream of the dam, dropped, prohibiting navigation of this river.

Davies and Day 1998, Chenje and Johnson 1996

Box 5.7 in technical report

- Over-abstraction and regulation of surface water resources has caused significant changes in the flow regimes and water quality of many rivers, leading to negative impacts on aquatic biota and subsequent loss of ecological function and health. This has led to losses of sensitive and sometimes commercially important species, or loss of plant and fish resources on which people rely for subsistence purposes (Box 4). Over-exploitation of groundwater resources has in some cases led to permanent damage to aquifers, including aquifer subsidence and seawater intrusion.

- Encroachment of human settlements onto floodplain areas and riparian zones is causing the loss of wetland habitat, which has serious consequences not only for biodiversity conservation, but also for the maintenance of subsistence agricultural and fishing communities. Encroachment in floodplains also increases vulnerability to floods.
- Invasive alien fish species threaten indigenous fisheries in several water bodies, notably Lake Victoria, while the proliferation of invasive aquatic weeds is one of the region's most severe and widespread water resources problems. Many areas of open water have been completely choked by dense mats of aquatic weeds, leading to loss of navigable channels, collapse of ecosystems and fisheries, and water quality problems.
- Degradation of watersheds due to poor land-use practices, which include deforestation, overgrazing, soil erosion due to intensive cultivation, contamination of soil and underground water and removal of

riparian vegetation, is causing serious problems in water resources, such as sedimentation of river channels, lakes and reservoirs, changes in flow regimes that lead to alterations in hydrological and ecological processes, and loss of critical habitats for important aquatic species (Box 5).

#### Water resources management

The review and analysis of the current situation in the region revealed that there have been encouraging policy shifts, but fundamental shortcomings in water resources management still remain. At both the operational and policy levels, these pose constraints to achieving sustainability. The recommendations and action plan set out in the technical report represent an attempt to provide options for overcoming these constraints.

- Water is utilised by many sectors (such as energy, industry, agriculture, domestic supply), but water policies and legislation remain sectorally compartmentalised and fragmented, making implementation and enforcement very difficult. Coordination between different sectors is very weak.
- Although recent policy reforms in the region are indicating a trend towards inclusion of environmental issues in water policy, the integration of environmental sustainability criteria into decision-making processes and policy remains superficial at best, and has generally not penetrated to the operational level (Box 6). Primarily this is due to the lack of a clear definition of environmental sustainability criteria for water resources management.
- Environmental impact assessment is one of the most important regulatory tools available for integrating environmental sustainability criteria into operational water resources management, but in general, the enforcement of EIA regulations in water resources development projects is poor. The implementation of environmental management plans related to water resources projects is not firmly established in regulation, nor is it adequately audited (Box 7).
- Community involvement in water resources management, at the decision-making and the operational levels, is generally still poor due to lack of consultation

#### Measures adopted for watershed management Box 5

- Conservation of natural vegetation cover and ecosystems in headwaters of rivers.
- Implementation of sound soil conservation practices, both structural and non-structural, at farm and community levels through training, extension education and credit support.
- Construction of specific hydraulic structures, such as dams, to store waters and control floods and sedimentation in downstream areas.
- Implementation of water conservation and demand management programmes in order to support the optimal and equitable utilisation of limited water resources.
- Development of appropriate, acceptable and implementable land-use plans using democratic and participatory approaches.
- Enforcement of pollution control regulations.
- Establishment of watershed authorities to regulate water resources development at national and international levels.
- Establishment of pilot catchment protection and/or rehabilitation projects involving local people and promotion of exchanges of knowledge and experiences among projects and countries.

Box 7.5 in technical report

### Key challenges in the integration of environmental sustainability criteria into water resources management Box 6

- The concept of sustainable water resources management is poorly understood.
- Environmental sustainability criteria for the water sector are absent.
- Economic analysis of the environmental and social costs and benefits of water resources development and management is inadequate.
- The environmental impact assessment process is generally ineffective due to weak implementation.
- Consultations and representation in the EIA process and in water resources management decision-making are inadequate.
- Current water policies are not environmentally sustainable.
- Environmental regulations for international waters are inadequate.
- Capacity to carry out complex environmental and socio-economic analyses is limited.
- Representation of water users in water management institutions and participation of water users in water resources planning and management decision-making is inadequate.
- Regulatory frameworks for water resources management are generally weak.
- Capacity to manage lakes and other aquatic ecosystems is limited.
- Public sector water and energy utilities are generally not perceived to be providing people with equitable access to the basic services that are considered to be benefits of sustainable water resource utilization.

Box 11.1 in technical report

### Factors that can undermine the influence of EIAs on project decision-making Box 7

The influence of EIA on project decision-making can be diminished if,

- the scope of the EIA is narrow (for example, if downstream impacts of a dam project located in a sensitive ecological area are not evaluated properly);
- the methods used to predict and forecast the impacts are not adequate;
- the EIA is implemented late in the decision-making process (for example, after the project has been sited or after the major project design decisions have been made);
- there is a conflict of interest involved (between the project proponent and a regulatory agency or between the design firm and the firm that is carrying out the EIA);
- there is no independent body to oversee implementation;
- no analysis of alternatives is carried out;
- the economic value of resource degradation is not incorporated into the project's cost/benefit analysis and decision-making.

Box 1.7 in technical report

by authorities and lack of awareness within communities. Yet, in cases where community involvement in water resources development projects has been strong, the subsequent ownership of the projects by the community, and their willingness to take responsibility, have greatly enhanced the sustainability of the projects in economic as well as environmental terms.

- The full economic costs and benefits of water resources projects, including environmental and social costs and benefits, are not adequately integrated into evaluation of options for water resources development and management. Policy and operational frameworks do not generally require full economic analysis of projects in the broadest sense, with the result that unforeseen long-term costs often accrue to those who can least afford them.
- Institutional capacity within the region is weak, partly due to a lack of human resources capacity and expertise, but also due to lack of coordination by the multiple institutions which have responsibilities or influence over water resources.
- Data insufficiency is a critical weakness in the region. This includes basic hydrological and water quality data, data on present and projected water uses and impacts, and data relating to the water environment and aquatic ecosystems. Monitoring networks are limited in their scope and functionality, and data management infrastructure generally is inadequate, with only a few exceptions.
- Conflicts and tensions in the region, some of which can be related to water issues (Box 8), lead to uncertainty in operational management of water resources, particularly transboundary water resources, and make cooperation at all levels between countries difficult.

## Water-use conflicts in Tanzania

## Box 8

The Pangani and Rufiji River basins cover about 23 percent of Tanzania and contain all of the existing hydroelectric power production and much of the irrigated agriculture in the country. Most of the hydropower production potential and a significant portion of the irrigation potential lies in those basins. The surface and ground waters in the basin are also used for urban, rural, industrial, livestock and wildlife water supply, fisheries, shrimp production and habitat conservation.

The surface waters appear to have been over-apportioned and used inefficiently, with irrigation efficiencies of 15-20 percent. Current demands exceed supply. Low water levels in the 1990s in the Nyumba ya Mungu dam on the Pangani river and Mtera dam on the Rufiji river severely constrained energy production at hydropower facilities on these rivers, resulting in nation-wide power shortages. Both basins are facing significant management challenges due to complex and interrelated factors. These include rapidly increasing water demands from growing population and water use, inefficient use of water, recurring drought, growing scarcity of water and emerging conflicts between sectoral uses of water in the two basins. The water use conflicts are between:

- farmers and hydropower interests,
- groups of farmers,
- farmers and pastoralists,
- farmers and water managers, and
- farmers and environmental interest groups.

Hirji *et al* 2001

Box 3.8 in technical report

- the need to identify and fully value all the goods and services provided by aquatic ecosystems, not just the water, and
- the need to mainstream environmental criteria into water resources policy and operational contexts;
- a framework for operationalizing sustainable water resources management that includes supporting policy and legislation, a suite of appropriate technical management tools, and the development of effective institutional structures and processes for implementation;
- a plan for actions to be taken at regional and national level which should ensure tangible progress towards environmentally sustainable management of water resources.

## OPPORTUNITIES TO BUILD UPON

The current and emerging threats to water resources and the weaknesses in water resources management may seem to paint a bleak picture, especially in terms of ensuring sustainability of resources and reduction of poverty. However, many positive lessons have emerged from the review and analysis of current initiatives and projects at national and local level within the region.

There is something to be learned from every country. These lessons have been consolidated into a framework for action that can be implemented in the region as a whole, and can significantly advance the movement towards truly sustainable water resources management in support of poverty reduction and improvement in people's wellbeing and livelihoods.

The remainder of the technical report draws together and presents, from the lessons learned:

- a conceptual basis for sustainable management of water resources, which rests on three key principles, namely
- recognition of the environment as the resource base from which water is derived,

## CONCEPTUAL BASIS FOR SUSTAINABLE MANAGEMENT OF WATER RESOURCES

## Principle 1

**Recognising the environment as the resource base**

Although there has been and remains a tendency to think of water itself as the only commodity of value which is provided by water resources, in fact aquatic ecosystems provide a number of goods and services that are of value to people. These include:

- supply of water with reasonable assurance and of adequate quality which can be abstracted for offstream use, to meet commercial, agricultural, industrial or basic human needs;
- the ability to dilute and transport wastes, and to purify some biodegradable wastes;
- biological products for harvest, such as fish, reeds, food plants, medicinal plants and shellfish;
- opportunities for transport;
- aesthetic, leisure and tourism opportunities;
- use for cultural and spiritual purposes;
- attenuation of floods (see Box 9);
- maintenance of microclimate;

### The role of wetland ecosystems in flood attenuation and flow regulation

Box 9

Wetland ecosystems may act as flood detention and flow regulation reservoirs.

As a flood enters a wetland, flow becomes attenuated. There is a lag period between the time the peak enters the wetland and when it leaves, and the peak flow leaving the wetland is usually significantly lower than that entering it. This has the effect of offering protection for communities living downstream of the wetland.

The Okavango delta, the Linyanti and the Barotse swamps best illustrate this function.

Wetlands store water that is gradually discharged into river systems throughout the year, helping to maintain base flows during the dry season.

The Barotse floodplain stores 8,600m<sup>3</sup> at low flow and as much as 27,000m<sup>3</sup> during peak flood. This wetland ecosystem stores water that contributes towards maintaining the perennial flows of the Zambezi river. The floodwaters of the Zambezi in the Barotse floodplain play an important role in securing year round freshwater supplies for human and animal populations.

The Kafue basin above Itezitshizi is subject to significant regulation by the Lukanga, Busanga and other swamps.

Box 3.3 in technical report

### The importance of floodplain recession agriculture

Box 10

Wetlands have been used for several centuries for flood recession agriculture. Early civilizations and settlements especially in the Middle East thrived on floodplain agriculture. The variations in inundation levels of wetlands result in very fertile soils that attract human settlement.

In the Kafue flats, the permanent area of inundation is 13,000 sq km and seasonal inundation covers a total area of 28,000 sq km. The variations in flooding create fertile soils used to support intensive agriculture.

The main floodplains in the region, *ie* Barotse floodplain, Wembere plains, East Caprivi wetlands and the Kafue flats have a long history of settlement and this is partly attributed to the fertile soils found in these areas.

The Barotse floodplain supports more than 300,000 people whose livelihood is dependent on the fertile alluvial deposits from the Zambezi.

In Namibia, the fertile floodplains of the East Caprivi support a total of 134,708 cattle and 18,470 goats.

Bethune 1998

Box 3.4 in technical report

- maintenance of agricultural societies (see Box 10);
- maintenance of terrestrial ecosystems, particularly in the case of groundwater.

The common thread running through all of the goods and services listed above is that their availability depends directly on the maintenance of healthy, functioning aquatic ecosystems. For example, if nutrient cycling is affected by loss of key species of insects and bacteria which aid the

natural decomposition process, then aquatic ecosystems will not be able to process and purify wastes efficiently. Thus there is a need to consider, manage and protect aquatic ecosystems as the resource base from which the commodity of water, and other valuable goods and services, are derived, rather than as users of water which compete with people for a limited water supply of water.

Chapter 3 of the technical report deals with the role and importance of aquatic ecosystems in water resources management.

The sustainability of the goods and services which are so valuable to people, and some of which are critical for our life support, require that the structure, function and health of all components (vegetation, fauna, water and physical habitats) of aquatic ecosystems be protected:

- by supplying the aquatic ecosystems with sufficient water, at the right time, in the right quantities and of suitable quality; and,
- by ensuring that riparian and instream habitats are not degraded as a result of poor land-use practices or over-exploitation and that natural biotic communities are not compromised by the introduction of invasive alien species.

In water resources management, a balance must be achieved between protecting the ecological health of aquatic ecosystems at a level such that the water resources remain able to sustain utilisation

in the long term, and utilising the water resources in order to meet short term imperatives for economic development, subsistence lifestyles or provision of basic water and sanitation services.

These two objectives need not be conflicting, and particularly in rural areas they may often be complementary, since great reliance is usually placed on the natural functions and products of aquatic ecosystems in rural areas.

**Principle 2****Recognising the economic values of goods and services provided by water resources**

Policy and decision makers need to be aware that water resources provide a range of goods and services apart from just water. Planners and water users should be aware of the need to identify and quantify the economic values of such goods and services. Traditional economic approaches have had a rather narrow view of the economic issues surrounding the use and management of water resources. In the past, maximising economic efficiency has meant the maximisation of net benefits that contribute directly to standard measures of economic performance, such as Gross Domestic Product (GDP). Sustainability has been perceived in terms of sustaining the benefits from economic activities associated with the direct use of water resources, rather than sustaining a full range of benefits, including ecological goods and services and biodiversity. This limited approach ignores the benefits of environmental management, the economic implications of degraded water resources and aquatic ecosystems, and the opportunity cost of environmentally damaging economic activities and management approaches. Understanding the opportunity cost implications of water supply and allocation is central to making informed decisions about development and allocation trade-offs.

Water-based ecosystems have various direct and indirect values. Although it is not always easy to quantify these in monetary terms, this idea provides a useful framework or starting point from which to examine the economic value of goods and services provided by water resources. As a matter of course, these values should be included in full cost-benefit analyses which address environmental, social and economic costs and benefits of water resources development and management decisions.

Chapter 4 of the technical report provides considerable detail on approaches and tools for determination of the direct and indirect economic values of water resources.

**Principle 3****Mainstreaming environmental sustainability criteria into water resources policy and management**

The concept of sustainable water resources management is poorly understood by policy makers as well as water resources planners and managers. The concept of the "environment" continues to remain elusive and there is a

wide disconnect between water managers and environmental managers. Important hydrological and ecological services provided by the aquatic environment are considered to be of marginal value, and wetlands continue to be seen as wastelands and not an integral part of the water resource base. Water flowing into the sea is considered "wasted water". It is therefore not surprising that the environment continues to be addressed narrowly, its protection seen by water managers as simply a "green" issue promoted largely by external interest groups.

A related challenge is the absence of clear criteria that define environmental quality goals or objectives to guide water resources planners and managers in their decision-making. The absence of clear criteria typically compromises the allocation of water for environmental requirements as a priority in relation to uses of water for sectoral purposes. The lack of specific measures of sustainability (for allocating water and setting water quality objectives) complicates the task of defining acceptable or allowable levels of change in quantity or quality, and this can result in a lack of compliance to stipulated provisions. A set of clear guiding principles defining sustainable use and management of water resources is needed to form the basis for developing specific national, international, and regional priorities (Box 11).

Only when these principles are incorporated into water policy and legislation, designed into the technical and scientific tools used in water resources planning and management, and firmly established in the day-to-day operational management of water resources, will environmental aspects of water resources be adequately addressed in the search for sustainability.

### FRAMEWORK FOR OPERATIONALIZING ENVIRONMENTALLY SUSTAINABLE MANAGEMENT OF WATER RESOURCES

**Supporting policy and legal contexts**

A necessary requirement prior to operationalizing environmentally sustainable management of water resources is to provide strong, clear and supportive policy and legal contexts. A wide range of national and regional environmental management policy and institutional reforms are currently taking place in the SADC region.

At the national level, new water policies, laws, strategies and master plans are being prepared. Environmental management agencies and river basin and catchment

### Environmental sustainability criteria for water management

#### Box 11

- A minimum water requirement to be guaranteed to all people to maintain human health.
- Sufficient water to be guaranteed to restore and maintain the health of ecosystems. Specific amounts will vary depending on climatic and other conditions. Setting and implementing the environmental flow requirements will require flexible and dynamic management.
- Data on water resources availability, use, and quality to be collected and made accessible to all parties.
- Water quality to be maintained to meet certain minimum standards. These standards will vary depending on the location and how the water is to be used.
- Human actions should not impair the long-term renewability of freshwater stocks and flows.
- Institutional mechanisms to be set up to prevent and resolve conflicts over water.

Gleick *et al*/1999

Box 11.4 in technical report

agencies are being established. There is also a fundamental shift in national policy and institutional reforms towards integrated water resources management approaches that emphasise economic efficiency, environmental sustainability and social equity.

The key features of policy and legislation which support environmentally sustainable management of water resources are:

- provision of basic water supplies to all people as a right;
- clear indication of the status of the environment in water resources management, and of the status of water allocations for aquatic ecosystems in relation to water rights or water allocations for other water users;
- use of economic valuation methods which encompass the direct and indirect values of water resources, and which incorporate social and environmental costs and benefits into full economic cost-benefit analyses of policies, projects and decisions;
- increasing use of economic instruments such as incentives, taxes, penalties and cost recovery to promote greater self-regulation, to ease the administrative burden of command-and-control enforcement, and to ensure financial sustainability of water resources projects;
- provisions and incentives for promoting water conservation and demand management, at sectoral level as well as at individual end-user level;

- harmonisation with environmental policy and legislation, including making EIA mandatory in all water resources development projects, and making provision for the auditing and enforcement of post-development environmental management plans;
- mechanisms for ensuring cross-sectoral and inter-institutional co-operation in planning and decision-making which affect or have impacts on water resources, including land use, water use, urban, industrial and agricultural development;
- mechanisms for ensuring meaningful community participation in water resources planning, decision-making

and management, and provisions for devolving water resources management responsibilities to the lowest appropriate level, in order to promote community ownership of projects and an attitude of stewardship with respect to water resources;

- mechanisms for resolving conflict over water resources, particularly in times of water shortage or natural disasters, as well as in transboundary river basins.

Chapter 10 of the technical report describes current and recommended policy, legal and institutional frameworks for environmentally sustainable water resources management.

#### Technical tools for water resources management

Technical tools for water resources management generally fall into two main categories:

- those designed to support supply-side management approaches; and
- those designed to support demand-side management.

Supply-side management is an approach in which increasing demands for water or use of water resources are met by finding or developing new sources of supply, within or outside the watershed. For example, new storage dams might be constructed to meet rising demand for irrigation water, or to make water available for releases to meet environmental flow requirements; inter-basin transfer schemes might be constructed to deliver additional water to a rapidly-growing urban area; higher levels of

potable water treatment might be employed to counteract the effects of pollution from agricultural, urban or industrial sources. While supply-side management options are sometimes necessary and may be the only way to meet short term imperatives for economic development or provision of basic water services, they are almost always expensive in monetary terms, technologically demanding to install and maintain, and do not adequately address protection of the environmental sustainability of water resources. This is especially true as the readily accessible and cheaper sources have become exploited.

Demand-side management entails the management of offstream demands for water and minimization of the impacts of land use and water use on water resources, through a mix of planning, regulatory and economic measures. The purpose of demand-side management is to make more water available, either to meet growing offstream demands or to provide for environmental flow requirements, without necessarily resorting to expensive and unsustainable structural and technological supply-side interventions.

Whether designed to support supply-side or demand-side management, technical tools focus on four main aspects of water resources management:

- water quantity, flow regulation and abstraction;
- water quality;
- invasive species, and
- watershed management, particularly at the land-water interface.

**Management of water abstraction.** Water abstraction should be managed and controlled as far as possible, through the use of permits where appropriate, combined with economic instruments such as pricing.

Environmental flow requirements (EFR) should be determined as a matter of course prior to water resources development projects, and before new water allocations are made to water users. New impoundments should be designed to ensure that the various flows which make up the EFR can be released at the appropriate times, and the operation of existing impoundments should be improved where possible to mitigate some of their effects on downstream ecosystems. Incorporation of EFR into water resources planning will allow estimates to be made of the true amount of water still available for future development, and of the true extent of shortfalls in the case of over-abstraction of water.

Chapter 5 of the technical report deals with the determination and implementation of EFR.

**Management of water quality.** The impacts of discharges of waste on water quality can be controlled through the use of authorisations and permits, the conditions of which should be linked to appropriate instream water quality objectives and effluent discharge standards. Economic instruments such as waste charges, incentives for recycling and penalties for pollution should be used to reinforce the polluter pays principle, and to encourage compliance with permit conditions. Non-point sources can be managed to some extent through regulatory approaches which require the on-site implementation of best management practices for disposal of solid waste and domestic waste, application of agro-chemicals, and collection and management of urban stormwater. However, management of the water quality impacts of informal settlements, small to micro-scale industries and small-scale or subsistence agriculture is much more difficult and probably best addressed through education, awareness campaigns and incentives.

Chapter 6 of the technical report addresses water quality management and pollution control issues in detail and describes regulatory and management approaches to water quality problems.

**Watershed management.** Management, prevention and remediation of the impacts of land use on water resources require that all sectors recognise the biophysical and ecological links between land and water, and that land-use decisions are made with due consideration being given to their potential impacts on water resources. Approaches tend to focus more on the institutional aspects of the problem, since strong cross-sectoral cooperation is needed, as well as the development of harmonised, integrated land and water management strategies that recognise the river basin as the primary geographic unit of management. As with invasive species, preventive management is usually far more cost-effective than remediation, if remediation is even technologically feasible, which is often not the case.

Chapter 7 of the technical report addresses the causes of watershed degradation, the impacts on water resources and water users, and possible management approaches.

**Management of invasive species.** Once released into a system, alien species are very difficult to eradicate (this is particularly true of breeding populations of alien fish species). A combination of vigilance, rapid and early response to infestations, and dedicated preventive management is usually the most cost-effective approach to control of invasive alien species. Long-term commitment to integrated programmes of mechanical, chemical and biological control of aquatic weeds can be highly successful, although it is unlikely that weeds can ever be eradicated completely and cost-effectively once present in a water body.

Chapter 8 of the technical report addresses the control and management of aquatic weeds.

### Institutional structures and processes

Environmentally sustainable water resources management requires participatory, integrated approaches which recognise the linkages between land and water, and which can be applied at the interface between water, environment and poverty. This will require fundamental changes in institutional structures in order to ensure successful implementation. Strongly centralised command-and-control structures which rely on a high level of bureaucracy will be too inflexible, too slow and too distant from the communities which they serve to be effective in the future.

New water management institutions will need to be:

- responsive to changes in the economic, social and ecological contexts around them;
- knowledge-intensive, in order to best utilise data and information to support sound decision-making;
- cooperative, in order to ensure cross-sectoral and transboundary integration of regulatory and management strategies;
- representative, in order to ensure that water resources management is truly participatory and that the primary needs of communities are brought to the forefront of all water resources management planning and decision-making.

The general trend in the region to establish statutory river basin management agencies, at the national and regional level, is directed towards meeting the challenges of sustainable water resources management (Box 12). Development of appropriate institutional structures is dealt with in detail in Chapter 10 of the technical report.

### Institutional arrangements for efficient management of water resources in Zimbabwe

Box 12

- A national water authority (ZINWA) and a statutory corporation will be formed. The authority will be the apex organization for the management of water resources in Zimbabwe operating on a commercial basis. It is expected that the authority will operate and maintain water works and provide services to other government institutions and catchment councils. The authority has been formed by an act of Parliament through a process of stakeholder consultation. Several meetings and workshops were also held to discuss the formation of this institution. The major functions of the authority will be to advise the minister in the formulation of national policies and standards on water resources management and planning, pollution control, water quality management and protection of the environment.
- Central government, through a smaller and streamlined Department of Water Development, will continue to undertake the statutory and regulatory functions in the sector.
- The local authority institutions, *ie* the urban and rural district councils, will provide potable drinking water in their areas of jurisdiction. The role of these authorities would be to treat and distribute water to the consumers. ZINWA will provide bulk raw water to these institutions for supply to consumers.
- Catchment councils and sub-catchment councils formed under the Water Act will also play a very important role in the management of water. These stakeholder institutions will play a more active role in the allocation of permits for water use, the monitoring of water use, pollution control and enforcement of regulations.
- The catchment outline plan will act as an important tool for coordinating the activities of different sectors within the catchment.
- The private sector will be expected to play a greater role in the development of the sector. Through partnerships with government, the local authority, or on their own, the private sector will be given opportunities in various forms to participate in the sector. The form and nature of participation will differ with the activity.
- The role of rural communities in the maintenance of water facilities will be further strengthened. Through cost recovery the communities increasingly contribute towards the operation and maintenance of water points.

Zimbabwe Water Resources Management Strategy draft 1999

Box 10.18 in technical report

Processes of planning, decision-making and management must also be adapted to ensure meaningful community consultation and participation, and to encourage community responsibility for projects in the post-development phase (Box 13). This will help to ensure that the benefits of water resources projects actually reach those for whom they were intended.

Roles and responsibilities for decision-making, implementations, monitoring and enforcement must however be clearly established and lead agencies identified, so that critical gaps are not left.

Chapter 9 of the technical report describes approaches to community-based management of water resources and provides several examples.

### Community management of Ismani Water Supply Scheme

Box 13

Ismani Water Supply Scheme has the following features:

Its one intake is at Mgera stream with a transmission gravity mainline covering 144.45 km, a distribution network whose total distance is 150.9 km, 12 break pressure tanks, 29 storage tanks, 245 public domestic points and about 90 in house private connections, 13 cattle troughs and five cattle dips.

From 1984 to 1996 all villages served by the scheme formed Village Water Committees (VWC), which were charged with the responsibility of managing part of the scheme which falls within the village boundaries. In order to coordinate the activities of these VWCs, an Ismani group scheme was established and entrusted with the duties of carrying out operation and maintenance of the intake and the main transmission lines.

Scheme management under the group scheme committee and VWCs was not satisfactory. The committees were unable to raise enough funds to meet operations and maintenance costs. Formation of the Ismani Water Users Association was aimed at improving the management of the scheme.

With the formation of the association, the communities are now more involved in the management of the scheme than ever before. They carry full responsibility for operation and maintenance. They now decide on the management structure and tariffs, private connections and expansion/extension of the distribution systems. They also have powers to discipline defaulters.

The day-to-day running of the scheme is under the Management Committee of the Association which consists of eight members, four of whom are women.

Revenue is raised through user fees. Each water user who collects water at a public domestic point pays Tshs. 200 (US\$ 0.25) per month while persons with private connections pay Tshs. 1000 (US\$1.20) per month. It has proved difficult to collect revenue from users of public stand pipes compared to users with private connections. Revenue collection is hampered by lack of by-laws which can be used to take appropriate actions against users who fail to pay the water fees.

Gwimile 1998, Ismani Water Supply

Box 9.13 in technical report

## CONCLUSIONS AND RECOMMENDATIONS

### Lessons learned

The technical report shows the severity of present and emerging threats to sustainability of water resources in the SADC region, and highlights the magnitude of the challenges facing the region in moving towards sustainable water resources management and equitable distribution of the costs and benefits of the development and utilization of water resources.

The thematic reviews in each chapter of the current situation in the region and discussions of emerging future options at the policy, regulatory and operational levels provide several important lessons for SADC countries, which are consolidated below and in Chapter 11 of the technical report.

### Sustainable water resources management is underpinned by good information.

The scarcity of reliable quantitative information for water resources management is one of the major weaknesses for most SADC countries. Integration of environmental sustainability issues into water resources planning, development and management requires that cost-effective, long-term monitoring programmes be established to collect information on aspects such as:

- water availability;
- water quality;
- present and future water and land uses;
- projected demands on water resources;
- state of the aquatic environment;
- local knowledge and indigenous knowledge systems;
- macro-economic trends which affect demographics and hence water demand;
- the status of water resources, in terms of both biophysical factors and ecological health; and
- indicators of economic wellbeing which allow assessment of the degree to which environmentally sustainable utilization of water resources is generating socio-economic benefits for communities.

### Awareness should be generated of the need to quantify the value of all goods and services provided by water resources, not just water.

All stakeholders including those who make policy and decisions at all levels need to be sensitive to the range of goods and services provided by water resources apart from just water, and that the maintenance and utilization of these goods and services depend to a large extent on the protection and maintenance of healthy, functional aquatic ecosystems.

Planners and water users should identify and quantify the economic values of such goods and services, and make this information widely accessible. The emphasis on the ecological and biophysical dimensions must be complemented by the socio-economic considerations of impacted people and communities.

As a matter of course, these economic values should be included in full cost-benefit analyses which address environmental, social and economic costs and benefits of water resources development and management decisions in an integrated manner.

**Biodiversity of aquatic ecosystems is critical to ensuring the sustainability of water resources utilization.**

If water resources, and the many goods and services which they provide, are to be managed as renewable resources, then restoration and maintenance of the natural biodiversity of aquatic ecosystems is vitally important in ensuring that water resources retain their resilience and ability to recover from the pressures of utilization. Policy and regulatory frameworks and watershed management strategies must recognize the biodiversity of aquatic ecosystems as a key criterion in sustainable water resources management.

**The water requirements of aquatic ecosystems should be given clear status in law, policy and planning processes.**

The provision of sufficient water of adequate quality, delivered in as close to a natural flow regime as possible, underpins the protection of aquatic ecosystems, which in turn ensures the sustainability of water resources. In order for the water requirements of aquatic ecosystems to be assured, explicit and clear status should be afforded to these water requirements in water policy and law, and there should be clear indications given of how they will be addressed in decisions on water allocations. Environmental policy and law should specify that the water requirements of aquatic ecosystems be addressed in the earliest planning stages of water resources development projects and water resources management and allocation decisions. Determinations of the water requirements of aquatic ecosystems should be based on the principle of maintaining an adequate level of natural ecological processes and functions to sustain the provision of the various goods and services that are valued or relied upon by communities. To support this, a river health classification system needs to be established.

**Sectoral policy, regulatory and planning frameworks related to watershed management should be harmonized and consolidated.**

The links and cause-effect relationships between land-use and water resources should be explicitly recognized in policy and regulatory frameworks. This may require that sectoral policies, such as those addressing agricultural, energy, mining, industrial and livestock development, water resources management, services provision and envi-

ronmental protection and management, be reviewed, harmonized and possibly consolidated in order to promote integrated management of land and water resources at a watershed level. The use of Strategic Environmental Assessment (SEA) approaches should be promoted and followed when planning and setting objectives for land and water resources management. Institutional structures and mechanisms may need to be concurrently reviewed and reformed in order to implement integrated watershed management strategies.

**Meaningful representation of user groups in water management institutions and participation of communities in planning and decision-making is essential.**

Water resources institutions such as river basin authorities must be representative of the multiple water user interests in the basin. Planning and decision making processes related to development, allocation and utilization of water resources must be broadened from a narrow technical exercise to also integrate effective participation of water user groups and communities impacted by such decisions. The processes should be community-driven, and should address the short-term and long-term socio-economic needs of these communities. Community and user participation in the planning and management decision-making processes helps to ensure that the distribution of costs and benefits of water resources development, allocation and management is equitable. If stakeholders perceive the distribution of costs and benefits to be unfair, they are unlikely to change the ways in which they use and impact upon water resources.

**Preventive management is more cost-effective than rehabilitation or remediation.**

The long-term costs of rehabilitation or remediation of degraded water resources, and restoration of the goods and services provided by these resources, usually far outweigh the short-term economic benefits of over-exploitation, whether through over-abstraction, pollution or poor land-use management. The precautionary principle should be applied in decisions regarding development and allocation of water resources, or those regarding control and management of land-based activities which cause degradation of water resources. Preventive management strategies should include and promote demand-side management approaches over supply-side interventions.

**Successful control of invasive and nuisance species requires commitment to holistic, long-term management strategies.**

The control of invasive and nuisance species, particularly aquatic weeds, requires the development and implementation of holistic long-term strategies if it is to be both successful and cost-effective. Preventive management remains the most efficient way of dealing with the problem of invasive species, but once they are present in a water resource, short-term controls such as mechanical and chemical methods must be balanced with longer term approaches such as biological controls and with long-term commitment to integrated control programmes. Collaboration between neighbouring countries and those sharing water resources is essential, and control programmes should be designed and implemented jointly by all countries in shared water resources.

**Environmental sustainability criteria should be incorporated into strengthened regulatory frameworks and effective implementation promoted.**

Regulatory frameworks for water resources management should be strengthened, particularly where related to the assessment and mitigation of environmental impacts on water resources.

Environmental sustainability criteria should be incorporated into regulatory frameworks, utilizing regulatory tools that are:

- flexible, *ie* they can take account of the needs of different socio-economic development situations and different biophysical and ecological characteristics of water resources;
- relatively simple to administer and enforce, so that implementation can be effective even if capacity and expertise is limited at community level;
- appropriate, *ie* tailored to suit southern African aquatic ecosystems rather than being imported from northern temperate countries and applied with no modification;
- based on the use of economic instruments such as charges, incentives and penalties, in order to promote self-regulation and encourage minimization of impacts on water resources.

**Mobilize limited expertise and capacity in the region through establishment and facilitation of effective knowledge-sharing networks.**

Expertise and capacity for sustainable water resources management is severely limited in southern Africa, especially in the public sector. This is a critical weakness, since it is primarily public sector organizations such as government agencies and river and lakes basin authorities which are responsible for the various aspects of water resources management. Communication between the different sectors and even countries is often slow and ineffective, and sharing of knowledge between professionals and water resource managers at the operational level is frequently constrained due to bureaucratic processes. At national and regional level, innovative strategies are needed in order to overcome existing barriers to sharing of knowledge, experience and expertise.

#### A FRAMEWORK FOR ACTION

The technical report outlines some of the important ways in which poverty and economic development are inextricably linked to environmental sustainability, and in particular to water resources sustainability. The primary focus of SADC is to promote economic growth, to alleviate poverty and to foster regional cooperation. In that regard the sustainability and sustainable utilization of the water resource systems are not ends in themselves, but essential components of the welfare and security of people and their livelihoods, especially the poor wherever they may live.

The final section of the report proposes a framework for action for achieving the broad objectives of systematically mainstreaming environmental sustainability objectives in water resources planning, development programmes and investments.

**1 Adopt a clear framework for environmentally sustainable water resources development and management.**

- Action SADC  
Sustainable water use is defined as 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. SADC should develop an accepted framework which incorporates a limited set of out-

comes (with explicit goals and criteria) to express this concept of sustainability, and make it operationally useful in assessing where present policies and plans may lead or are leading or in deciding among alternative strategies.

For successful implementation, any framework for sustainability of water resources needs to include:

- policy and legal instruments which clearly establish the status of aquatic ecosystems;
- tools for setting quantitative objectives for protection of water resources (quantity and quality of water required for aquatic ecosystems);
- a river health classification index;
- regulatory tools for controlling and auditing direct water use such as abstraction and discharge in order to ensure that protection objectives are met (includes environmental flow requirements, effluent standards, water quality objectives, EIA, licensing procedures);
- regulatory tools for controlling and auditing people's behaviour and use of land and water, in order to ensure that protection objectives for aquatic ecosystems are met (land use practices, water conservation and demand management practices);
- appropriately designed monitoring networks and information management systems which provide the necessary information to support sustainable management of water resources.

- Action Member States

Countries should actively engage in the preparation of a SADC framework for environmentally sustainable water resources development and management, which they can adopt and use at national level to critically measure other sectoral policies and plans (*eg* agricultural, economic, environmental and water policies) in terms of their contribution to or impact on the sustainability of water resources.

## 2 Broaden economic evaluation methods at project and programme planning levels.

- Action SADC

An improved understanding of the economic values of all the goods and services provided by aquatic ecosystems, (not just water), should be promoted by SADC, particularly at the levels of policy, planning and decision-making, but also engaging other stakeholders. International water resources projects in shared river basins should, as a matter of course, incorporate full socio-economic analysis of

environmental costs and benefits as part of the options analyses at the planning stage.

- Action Member States

There is a need to broaden the currently used, project economic evaluation methods to incorporate the benefits of environmental management and socio-economic implications of the degradation of water resources and aquatic ecosystems in order to improve and inform project decision-making. This is because of the growing recognition that economic and environmental objectives are compatible rather than conflicting.

Sharing of water for environmental and other uses may seem like a zero sum game, but it is not a win-lose situation. Experience has shown that if downstream fisheries, agricultural productivity and groundwater recharge functions, and the storage nutrient cycling functions and water cleansing functions played by wetlands are not protected, the overall economy suffers.

Countries should incorporate, into regulatory procedures such as EIA and into planning processes for land-use and water-resources development, full socio-economic and cultural analysis of costs and benefits related to all goods and services provided by aquatic ecosystems.

## 3 Strengthen the role of planning tools such as the Environmental Impact Assessment (EIA) and Strategic Environment Assessment (SEA) in project planning and decision-making.

- Action SADC

EIA is a limited planning tool at the basin level. Here, Strategic Environmental Assessments are more useful for assessing options and planning decisions, since EIA is project-focused and reactive instead of proactive. The value of Strategic Environmental Assessments as planning tools related to sustainable resource management should be highlighted more strongly.

- Action Member States

Countries should strengthen their planning tools, particularly the implementation of the EIA process, and encourage and broaden the emerging tools such as SEA; and work towards strengthening the contribution of EIA to project decision-making. Countries without EIA policies and legislation should adopt these, while countries with EIA policies and legislation can improve implementation.

Mainstreaming is consistent with a changing focus and orientation from a “do no harm” to “promote improved development” that should be adopted in EIA policies at a country level. This calls for improving EIA effectiveness in project planning and management decision-making, and addressing factors that undermine the influence of EIAs in project decision-making. In addition, the following elements should be considered:

- Introducing and encouraging the use of Strategic Environmental Assessment as a strategic planning tool for sustainable water resources management.
- Expanding the use of Sectoral Environmental Assessments and Regional Environmental Assessments;
- Increasing the emphasis on basin-wide understanding of the ecosystem’s functions, values and requirements, and how community livelihoods depend on and influence them, before decisions on development options are made;
- Valuing ecosystem, social and health issues as an integral part of project and river basin development, and giving priority to the avoidance of impacts, in accordance with a precautionary approach;
- Selecting project options that avoid significant impacts on threatened and endangered species. When impacts cannot be avoided, appropriate mitigation measures and viable compensation measures must be put in place;
- Ensuring that project affected stakeholders are consulted in a timely manner and that their views are incorporated in the final project design.

#### 4 Accord clear status, determine and give effect to water requirements for aquatic ecosystems and basic human needs.

- Action SADC

Effective environmental and water resources management requires that water property rights are clearly defined to protect the interests of various stakeholders. Changing water property rights has relevance to poverty and social stratification and affects the efficiency of water use and its allocation. It is important to protect the services provided by water resources, which depend on the quantity, quality, and assurance of water, and which are needed to protect basic human needs and the structure and functions of ecosystems so as to secure ecologically sustainable devel-

opment and use. SADC WSCU and SADC ELMS should support countries to develop the legal frameworks at national level for environmental management of water resources. This is important for both national and international water allocation systems. SADC should review the Protocol on Shared Watercourses to ensure that it makes adequate provision for the status and determination of water requirements of aquatic ecosystems and basic human needs. SADC should also support the efforts of member states to undertake studies to determine the quantity and quality of water required for aquatic ecosystems and basic human needs.

- Action Member States

Countries should review, reform and harmonize water and environmental policy and legal frameworks to clearly establish the status of water quantity and water quality allocations for aquatic ecosystems and basic human needs. Countries should establish locally driven, inclusive processes to determine water requirements for aquatic ecosystems and basic human needs; and should ensure that environmental flow assessments are integral components of impact assessment, including provision for monitoring to allow potential revisions of flow requirements at specific intervals.

For example, environmental flows can and should be released from major dams and hydraulic structures, but equal attention needs to be given to the issue of controlling run-of-river abstraction. The provision of environmental flows and the control and auditing of water abstraction are much more difficult in unregulated rivers, but must be addressed if aquatic ecosystems are to be fully protected.

#### 5 Mainstream environmental issues in water resources planning, development and management.

- Action SADC

SADC should support countries’ efforts to build national and local government agencies responsible for environmental protection of water resources, to develop EIA policies, procedures, and regulations. There is a reliance in the region on sector-oriented water policies, which rely on the command-and-control approach, are difficult to implement and coordinate, and do not properly integrate environmental quality objectives. Instead of building a

unity of purpose, these have the opposite effect, creating scattered and competing interests.

SADC should support water policy reforms that integrate all water-related sub-sectors, including environmental uses of water and should espouse the use of the following appropriate instruments:

- economic (*eg* pricing, tariffs, demand management, and subsidies, etc.);
- regulatory (*eg* laws and regulations) and participatory (*eg* user representation, and transparency);
- participatory planning and decision-making, education, awareness, consultations, etc.; and
- social and cultural engagement (*eg* recognizing and respecting local and indigenous knowledge, attracting local expertise, and working in partnership with community leadership in locally driven processes).

#### ● Action Member States

Countries should mainstream (*ie* ensure the systematic and timely integration of) environmental quality objectives in water resources investments, planning, development and management decision-making in water resources infrastructure projects and policy reforms. For most water development projects it would be possible to balance development objectives with the objectives of conservation of aquatic ecosystem functions and services if they are addressed in the early stages of planning, provided that there is a commitment by the member states and project proponents to these objectives. To achieve this, new policy provisions and procedures will be needed; and in addition, rigorous attention to the implementation of existing policies and procedures will be needed.

The water supply and sanitation, rural and energy sub-sector boards should be encouraged to develop explicit procedures for addressing the sector-specific environmental issues in a structured manner. Specific training and capacity-building programmes should also be encouraged, to focus on the establishment of an environmental regulatory framework to complement and support the reforms related to privatization.

## 6 Move from restorative to preventive management.

#### ● Action SADC

Given that freshwater is a vital but diminishing resource, it is essential that SADC assists governments and the private

sector to undertake planning and management for the development and protection of water resources and the conservation of the associated freshwater ecosystems and habitats. The costs of preventing resource degradation are small compared to remediation and rehabilitation. A major challenge for freshwater resources is to increase the level of effort for preventive measures, while maintaining support for remedial interventions in degraded areas. SADC can promote operations for preventive and restorative measures that enhance the environmental management of water resources, in particular lakes and reservoirs, either as freestanding projects or as components of projects.

#### ● Action Member States

Governments should in a similar manner, assist the other stakeholders at a national level, such as in private sectors and communities, to undertake the protection of water resources and the conservation of the associated freshwater ecosystems and habitats, and strengthen understanding that the costs of preventing resource degradation are small compared to remediation and rehabilitation.

A major challenge for freshwater resources management at national levels is to increase the local efforts for preventive measures while maintaining support for remedial interventions in degraded areas.

There will be a need to consider the design of monitoring networks based on the “pressure-state-response” approach, which measures:

- the pressures on the aquatic environment, including driving forces such as climate, flow, water quality, water and land use;
- the resulting state of the aquatic environment, in terms of ecosystem health, quality and flow of ecosystem goods and services, and
- the response of the people who directly and indirectly utilise and rely on water resources, in terms of their social and economic well-being.

## 7 Move to integrated water quality management, set clear water quality objectives and implement programmes for achieving these objectives.

#### ● Action SADC

Integrated water quality management is the planning, organization, direction and monitoring of all aspects that

have an effect on the quality (physical, chemical, biological, bacteriological, etc.) of the water resources, incorporating and balancing the different requirements of relevant water users and water functions in order to enhance efficient and sustainable use of the resource.

To assure a consolidated and coordinated approach to water quality management, SADC should promote a Water Quality Management Strategy. The Strategy would support a region-wide exchange of knowledge and experience in water quality management that would be reflected in policies, best practices, programmes and individual operations.

SADC should promote a step-by-step approach to attain clearly defined water quality objectives, taking into account the current water quality, current and potential new water uses in the catchment area, available technical and financial means for pollution prevention, control and reduction, as well as the urgency of control measures. These objectives, which represent the result of a balance between what is desirable from an environmental point of view and what is feasible from a technical and economic point of view, should be regarded as a policy goal for client countries to be attained within a certain period of time.

- **Action Member States**

Member states should develop and implement integrated water quality management strategies, which incorporate the setting of policy goals and measurable objectives for water quality and pollution control, and which recognise the need to mobilise all levels of society to ensure that land and water use is managed so as to minimise the impacts on the quality of water resources.

## **8 Strengthen environmental management capacity related to water resources management.**

- **Action SADC**

The need for skilled and experienced staff in the region is fundamental. While the SADC region has some highly experienced water-resources professionals with the relevant environmental management training and skills, there is still a lack of some key professionals (such as freshwater ecologists, limnologists, environmental economists, experts in water law, EIA practitioners, environmental information systems experts, water institutional

issues specialists and groundwater specialists). Also, the depth of operationally relevant experience is limited. There is a need to encourage greater interaction among regional staff, improve sharing of experiences, establish regional advisory services, provide specific training, mentor young staff members, improve the peer review systems, and more effectively draw upon region-wide experience.

SADC should undertake a careful review of the human resources needs and skills mix needed to address the environmental management challenges related to water resources management in the region. This should complement the ongoing restructuring and capacity-building initiatives of SADC to address the traditional areas of water resources management.

- **Action Member States**

Countries should take cognizance of the proposed SADC review of the skills needed to support environmentally sustainable water resources management. At a national level, there is a need to increase both the numbers of environmental staff who understand and can communicate the aquatic ecosystem issues and the numbers of water resources specialists who understand the real substance of the environmental concerns as well as staff who can quantify the value of potential or actual losses associated with resource and ecosystem degradation.

## **9 Work in structured partnerships to address and eliminate the causes of watershed degradation.**

Over the years most governments in southern Africa have realised the need to eliminate the causes of watershed degradation. This is reflected by the various national conservation strategies and national environmental action plans that have been formulated by most countries. In some cases these policies have not been genuinely implemented. Most of the approaches adopted for watershed management have been driven by one or a few government ministries, *eg* Ministry of Agriculture or Natural Resources. Other government agencies that are responsible for other natural resources such as water, vegetation and roads have often been treated as interested observers. In addition, users of natural resources within a watershed such as peasant farmers tend to be told what is best for them in terms of watershed manage-

ment without any meaningful input into the identification of the problems and formulation of solutions. This approach is ineffective with regard to watershed management. Therefore a sound water policy should integrate horizontally and vertically the efforts of various government agencies and those of local communities in order to combat watershed degradation.

There is a need to establish structured partnerships at all levels and involve representation of all stakeholders. This integrated approach is applicable at the regional, national, watershed, and local levels.

- Action SADC

SADC sectors should ensure that their initiatives take cognisance of the linkages between elements of a watershed in order to combat degradation. For example, initiatives aimed at improving food security at the regional level should incorporate the need to manage soil loss, vegetation clearance for the purpose of increasing cultivated lands, and use of inorganic fertilizers; all of which have the potential to cause watershed degradation.

#### 10 Facilitate and support knowledge-sharing.

- Action SADC

SADC should take a strong lead in facilitating the sharing of knowledge and experiences. SADC is accumulating significant information and knowledge on the issues of environmental sustainability. Efforts to consolidate and share this knowledge should be reinforced. SADC and its partners should play an instrumental role in facilitating knowledge-sharing, through the development and implementation of innovative strategies and partnerships which ensure that knowledge is disseminated at appropriate levels to the people who most need it in support of their everyday work.

- Action Member States

Countries should support SADC efforts to facilitate knowledge-sharing, and remove bureaucratic and organizational barriers that prevent easy, rapid access to relevant knowledge. A structured programme of knowledge-sharing should have clear objectives and use innovative knowledge products to get knowledge and information to people at various levels, from government ministers, to technical professionals, to water users and the public. Seminars are probably one of the least effec-

tive ways to transfer knowledge since they usually involve small groups of like-minded professionals who seldom communicate further than their immediate circle. Transfer of expertise at the technical or professional level can be facilitated for example through exchange visits, joint projects, electronic access, and active involvement in professional societies.

#### 11 Develop and implement a broad awareness and communication strategy.

- Action SADC (and Member States)

The communications strategy should be a long-term programme of SADC, its partners and member states promoting a regional and national forum with the objective of developing an informed group of policy-makers and public/private user groups.

A communications strategy should be developed and implemented with the objective of informing, educating and engaging public and private users and communities in a dialogue to improve understanding and share perspectives about the important water resources management issues in the region and about the roles, responsibilities and obligations of both water users – individual, collective, and commercial – as well as regulatory authorities – catchment boards, water apportionment boards, river basin development authorities, lake management authorities, and specific water-using departments or ministries – in specific aspects of water-resources management. This strategy will also translate and interpret into common language, differing aspects of the ongoing water sector reforms in the region.

The communications strategy should be developed at the regional level by SADC and its partners and at the national level by member states, and should be based on developing specific messages for targeted audiences such as policy-makers, decision-makers and technical specialists, users from all sectors, community groups and the general public. This can engage different media (print, radio, TV, newsletters, workshops, policy briefs, factsheets, posters, and other fora) to inform and engage the public in a dialogue and debate about the management of an important, but increasingly scarce resource that is under severe stress. It should also disseminate information on alternative options for utilizing water more efficiently in the various sectors, highlighting the different activities and costs associated with the management of water. The communications

strategy should address a wide range of water management issues, challenges and options, guided by the SADC ELMS and SADC WSCU national focal points and their representatives, and developed with a team of regional experts working actively on water resources management issues.

### 12 Encourage water conservation and demand management initiatives.

- **Action SADC (and Member States)**

For a water-scarce region, water conservation must remain a key element of the water policy reform process. SADC and member states should promote reforms that encourage water conservation in all water supply and sanitation projects through a wide variety of tools, such as better average cost pricing and introduction of block tariffs, long run marginal cost pricing as incentives for recycling, rationing and restrictions, land zoning and improved technology.

Conservation should also be actively encouraged and promoted in agricultural water use, industrial water use, mining water use and energy water use through public awareness and education programmes, technological innovations, and economic and regulatory instruments.

### 13 Encourage public participation in water resource management.

- **Action Member States, officials and communities**

This will have action at all levels including the community. The competence of the local community should be respected even if they use different terminology; others should get to know and use it too. Capacity-building and formal training should be instituted for promising young members of the community, with bonding so they return and teach others for a fixed period (3-5 years). Communities should take seriously the partnerships with national or regional agencies and technical experts, and try to teach them something about the local resources and how they are used, by the community and by ecosystems, and about local indigenous knowledge systems, not only for water but for the components of integrated water resources management. Communities should be prepared to contribute through funds or in kind or by labour (including participation in committees and decision-making bodies).

### 14 Promote additional studies in key areas.

- **Water pollution and health impacts**

It is reasonable to assume a relationship between ambient water quality and health, especially for those areas without a modern water supply system. However, the relationship is complex, given the many ways in which people can obtain water and/or avoid the worst impacts of industrial, domestic and other forms of pollution.

Methods are being developed to provide macro-level estimates of the health impacts of different interventions, to inform decisions on investment programmes.

The value and future direction of such efforts need to be assessed.

- **Reuse of effluent**

It is clear that reuse or recycling of lower quality water, including treated effluents, will be an increasingly important component of overall water resources management.

A range of technical options are available but there often remain a number of institutional, behavioral or cost obstacles to be overcome before reuse becomes widespread.

Work on this issue should be encouraged and supported, and opportunities for implementation should be identified.

- **Basin studies**

Basin studies similar to those undertaken on the Zambezi basin under ZACPLAN or on the Limpopo basin for the SADC Water Sector should be encouraged. This should involve the rapid collection, cataloguing and analysis of all available socio-economic, ecological and sector-specific information relevant to mainstreaming the environment in water resources management.

- **Water quality**

SADC should also initiate studies to derive regional numerical water quality criteria for protection and management of water resources, which are suited to southern African bio-geographical conditions rather than being imported directly from northern temperate zones.

## AN OVERVIEW OF CHAPTERS IN THE MAIN REPORT

The technical report comprises 11 chapters, organized into four parts. The report,

- discusses the principle areas of environmental management related to the water sector;
- presents practical methodologies and approaches to address the major challenges in each of the key areas;
- draws lessons and best practices information on topical issues related to environmental sustainability of water resources management for dissemination; and
- recommends specific actions for effectively integrating environmental sustainability criteria in water policies, for improving water resources project planning and management decision making, and for strengthening the capacities of water and environmental management agencies.

### Part 1

#### Water Resources Development and Management: Striving for a Sustainable Balance

Part 1, with four chapters, provides the overall context of the report, which is to strive to achieve a sustainable balance between the development of water resources for beneficial uses and their protection.

#### Chapter 1 Environmental Sustainability in Water Resources Management: A Conceptual Framework

presents the conceptual tools for defining and mainstreaming environmental sustainability (in social, ecological and economic terms) in water resources management in the SADC region, and points to opportunities to build upon the existing policy and institutional reforms at both the national and regional levels.

**Chapter 2 Water and the Economy** provides the socio-economic and ecological context of the water sector in the region, and describes the principle characteristics of the water resources, the present and projected multi-sectoral uses of water, and their implications to the region's economy.

#### Chapter 3 The Role and Importance of Aquatic Ecosystems in Water Resources Management

describes the critical role of aquatic ecosystem structure and function, presents the major aquatic ecosystems of

the region and discusses their importance, and describes current initiatives in the region to understand and manage aquatic ecosystems more effectively. The principal threats to freshwater ecosystems are examined, including the regulation of flow, water pollution, habitat destruction and the introduction of alien species of fauna, as is the threat and severity of species extinction.

#### Chapter 4 Valuing the Environment in Water

**Resources Management** focuses on a central issue in the debate on the sustainable management of water resources, and describes the methods for the valuation of environmental damage and the economic trade-offs often made in allocation decisions. It describes the economic benefits of water use, the economic trade-offs involved in allocation decisions, the main causes of aquatic ecosystem degradation, and the valuation of environmental damage using different methods representing the state of the art in natural resource economics. It presents examples of the impacts of environmental degradation on water supply, and the different values of ecosystem services and functions as well as the costs of their degradation. The chapter recommends measures for accounting for environmental degradation in the project decision-making and highlights the principle economic instruments, supply side and demand side measures, for regulating water use.

### Part 2

#### Water Resources Management: Safeguarding the Resource Base

Part 2 also has four chapters, each focusing on particular aspects of water resources management that impact on the sustainability of the resource base. Part 2 contributes to defining the key elements of environmental sustainability in the water sector, and providing operational strategies for achieving sustainable management of water resources.

#### Chapter 5 Environmental Flows: Requirements and

**Assessment** discusses the single most difficult issue in the environment/water management debate: that is, how much water to allocate for downstream ecological purposes when planning a major storage dam or abstraction project for generating power, or for irrigation, municipal supply or flood control. It draws from a rich array of innovative works in progress being carried out in the SADC region, including water policies in South Africa,

Zimbabwe and Tanzania as well as the Instream Flow Requirement Study for the Lesotho Highlands Water Project. The chapter starts with a description of the ecological relevance of different kinds of flows and the purpose of environmental flow assessment, and the effects of regulation of rivers in the SADC region. The chapter shows the linkage between environmental impact assessment and environmental flow assessment, describes the scope and details of an environmental flow assessment, and reviews and summarizes the currently used methodologies for defining environmental flow requirements. The chapter shows implications for incorporating environmental flow allocation principles into water policies and the existing challenges facing SADC with respect to environmental flow requirements.

**Chapter 6 Water Quality Management and Pollution Control** addresses the water quality aspects of water resources management, issues which have not received the attention they deserve because of the misperception that water pollution is not yet a serious problem in the region. In fact it is becoming clear that pollution is an important problem impacting public health and that it also exacerbates water scarcity by diminishing beneficial uses of water. The chapter describes the main sources of pollution, both point and non-point sources, summarizes the consequences of water quality degradation, and its severity and extent. Existing technical and institutional options for managing water quality and controlling pollution are reviewed, and a range of recommendations for strengthening water quality management in the region are provided.

**Chapter 7 Watershed Degradation and Management** links upstream actions (land use and management) with downstream effects on water resources, emphasizing the importance protecting source waters. The chapter discusses the principal causes of land degradation, including poor cultivation practices, overgrazing and deforestation, and associated biophysical and economic consequences which result from the impact of loss of top soil and vegetative cover on runoff and infiltration rates, the impacts of sediment transport and deposition on reducing the economic life of storage structures and hydraulic efficiency of the water conveyance and river channels, the effects of turbidity on water supply and water treatment and on coral reefs in the marine environment. The chapter

describes the extent and severity of watershed degradation in the region, and summarizes a range of watershed management strategies, guidelines and mechanisms together with examples of successful watershed management. These strategies include both structural (engineered solutions) and non-structural measures (such as soil conservation programs, land use planning, zoning, etc.). The chapter presents case studies illustrating successful institutional arrangements and community participation (centralized authorities or community based) and financing arrangements for watershed protection, including incentives for participation in watershed protection, cross subsidies, charges or levies for raw water use, and makes policy recommendations.

**Chapter 8 Aquatic Weeds and Their Control** is a comprehensive review of the growing problem of water weeds and their control in the SADC region, and it evaluates the physical, chemical, biological and integrated methods for controlling water weeds. The chapter reviews the origin, type and extent of water weed proliferation in southern Africa. The five main types of water weeds commonly occurring in the region are identified and their characteristics discussed. The main causes and consequences of the water weed problem are described, including the principle factors that influence the growth of the weeds. The chapter evaluates the different methods (physical, chemical, biological and integrated) for controlling water weeds, as well as the advantages and disadvantages of the main control methods. Selected case studies covering a variety of control strategies are discussed, and the adoption of an integrated management programme is recommended. Policy and capacity-building recommendations are given.

### Part 3 Legal and Institutional Framework: Mainstreaming the Environment in Water Resources Management

Part 3 of the report, with two chapters, addresses the mainstreaming of the environment in the water sector, and provides guidance on the institutional structures and processes which best support the use of the operational tools described in Part 2. The critical role of ownership and participation are presented as essential ingredients in several successful community-based water resources management programmes. The adequacy of existing planning

tools, water and environmental policies and institutional arrangements for the effective integration of environmental quality considerations is reviewed.

### **Chapter 9 Community-based Water Resources**

**Management** focuses on the importance of communities in water resources management, using specific case studies to address a range of issues raised in earlier chapters. The case studies include sustainable cultivation of *dam-bos* (wetlands in Zimbabwe), irrigation management in Tanzania, participatory control of water weeds (for example, in the Kwazulu-Natal), provision of rural water supply through sustainable groundwater schemes (e.g., in Zimbabwe), and the protection and management of watersheds (*eg* Umgeni Water). The cases highlight key principles relating to beneficiary participation in the design of water management projects and programmes. Key design features and specific policy recommendations are provided for institutionalising community based water management practices.

### **Chapter 10 Policy, Legislative and Institutional**

**Framework** reviews the environmental elements of water resources management in existing national environmental policies and national water policies and planning instruments. The chapter also evaluates the adequacy of existing planning and regulatory instruments, such as EIA, for integrating environmental issues into water resources planning and management. Specific case studies are used to evaluate the effectiveness and weaknesses of the EIA

process and actions for strengthening the EIA process are recommended. The chapter recommends the strengthening of environmental management aspects of water policies, calls for developing harmonized sector policies, and improving coordination between sector agencies, and the use of participatory instruments for underscoring the importance of environmental stewardship as an element of national water policy and strategy for water resources management.

### **Part 4**

#### **Lessons Learned and Recommendations for the Way Forward**

The final Part draws from and is a synthesis of all the other chapters, defines a clear set of environmental sustainability criteria for the water sector for the SADC region and recommends specific measures for mainstreaming environmental quality considerations in the water sector.

### **Chapter 11 A Framework for Mainstreaming the Environment in Water Resources Management**

proposes a number of priority areas for action by governments and other stakeholders in southern Africa to enhance sustainability in terms of water and environmental management. The central message is to simultaneously encourage the development of water resources to meet the growing multiple demands, but at the same time to recognize the limits of sustainable use and institute appropriate, cost-effective measures for protecting the resource base.

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