# Water Demand Management

# UNIT 1

IUCN
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Sida

IDRC CRDI
International Development Research Centre
Centre de recherches pour le développement international

VERSION 1.1

## WDM in context

**notes**

## course map

**Unit 1:** WDM in context

**Unit 2:** Municipal WDM

**Unit 3:** WDM options and benefits

**Unit 4:** WDM plan

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# The foundational unit

Welcome to the foundational unit of the IUCN Water Demand Management Guideline Training Module (WDM GTM).

This unit provides the basis for the other, more specialised units that cover the various water user sectors such as Municipal Water Supply Agencies, Large-scale Irrigators, Industrial Water Users, etc.

In this unit we aim to ensure that you understand the need for WDM as a component of Integrated Water Resource Management (IWRM), as well as the challenges and rewards associated with its implementation.

The summary of the technical report on *Defining and Mainstreaming Environmental Sustainability in Water Resources Management in Southern Africa*, (Hirji *et al.*, 2002) contains the following passage:

*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 utilisation 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.*

We need to keep this in mind as we work through this unit.

# notes

## outcomes

After working through this unit you should be able to…

- give a brief overview of Integrated Water Resource Management (IWRM) and contextualise IWRM within the global movement towards efficiency, sustainability and equity as demonstrated by the Dublin Principles, the World Summit on Sustainable Development, and the Millennium Goals;
- outline foundational IWRM and Water Demand Management (WDM) concepts such as the nature of water demand, water scarcity and water stress in the southern African context;
- examine various definitions and misconceptions of WDM and outline the motivation behind the approach;
- give an overview of available WDM measures;
- detail the constraints and incentives affecting WDM;
- outline the WDM status in each Southern African Development Community (SADC) country, and
- discuss the various opportunities for and goals concerning WDM within SADC.

Integrated water resource management (IWRM) has become popular in policy and water management circles since the early 1990s. This represents a shift in water management thinking away from supply-orientation, i.e. water resources development and supply infrastructure provision, towards a more holistic water management approach based on supply and demand concerns, i.e. management of water from source to use and to return flow. IWRM can be considered the sustainable development concept applied specifically to water resources. Water Demand Management (WDM) is one of several IWRM strategies – others include the allocation of environmental water requirements and catchment land use management.

A key goal of managing a resource is sustainability. The challenge is to manage water resources so that use and development remain within environmentally sustainable limits. This has to be achieved simultaneously with poverty reduction and economic growth. It means managing water wisely for the best interests of people and countries, without prejudicing the interests of our children, future generations and the environment.

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## 1.1 WHAT IS SUSTAINABLE DEVELOPMENT?

The term sustainable development is defined as ...*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*... (World Commission on Environment and Development (WCED), 1987). In a water resources context, sustainable development means that:

- Renewable water resources should not be abstracted beyond their regeneration capacity, either through the inflow of surface water or the recharge of groundwater
- Non-renewable water resources should be used in such a way that alternative water sources are accessible before the non-renewable resources are depleted
- Water pollution should be kept below the natural absorption capacity of water resources

Ecosystems have ecological water requirements that need to be met for their survival. Water resources cannot be utilised to such an extent that serious environmental damage is caused.

Sustainable development links the social, economic, biophysical and political aspects of any initiative. (Department of Water Affairs and Forestry (DWAF), 1999)

The delegates to the World Summit for Sustainable Development stated in their Declaration and Programme of Action in 1994 that they:

...*are deeply convinced that economic development, social development, and environmental protection are interdependent and mutually reinforcing components of sustainable development, which is the framework for our efforts to achieve a higher quality of life for all people. Equitable social development recognises that empowering the poor to utilise environmental resources sustainably is a necessary foundation for sustainable development. We also recognise that broad-based and sustained economic growth in the context of sustainable development is necessary to sustain social development and social justice.*

Water is as essential to sustainable development as it is to life. Protecting a water resource is not an end in itself. Water is our life-support system. The environmental, social and economic values of water are interconnected. We do not wish only to conserve the world we have. Our aim is to create a better life for all, especially the poor, and to ensure a world that is sustainable for future generations.

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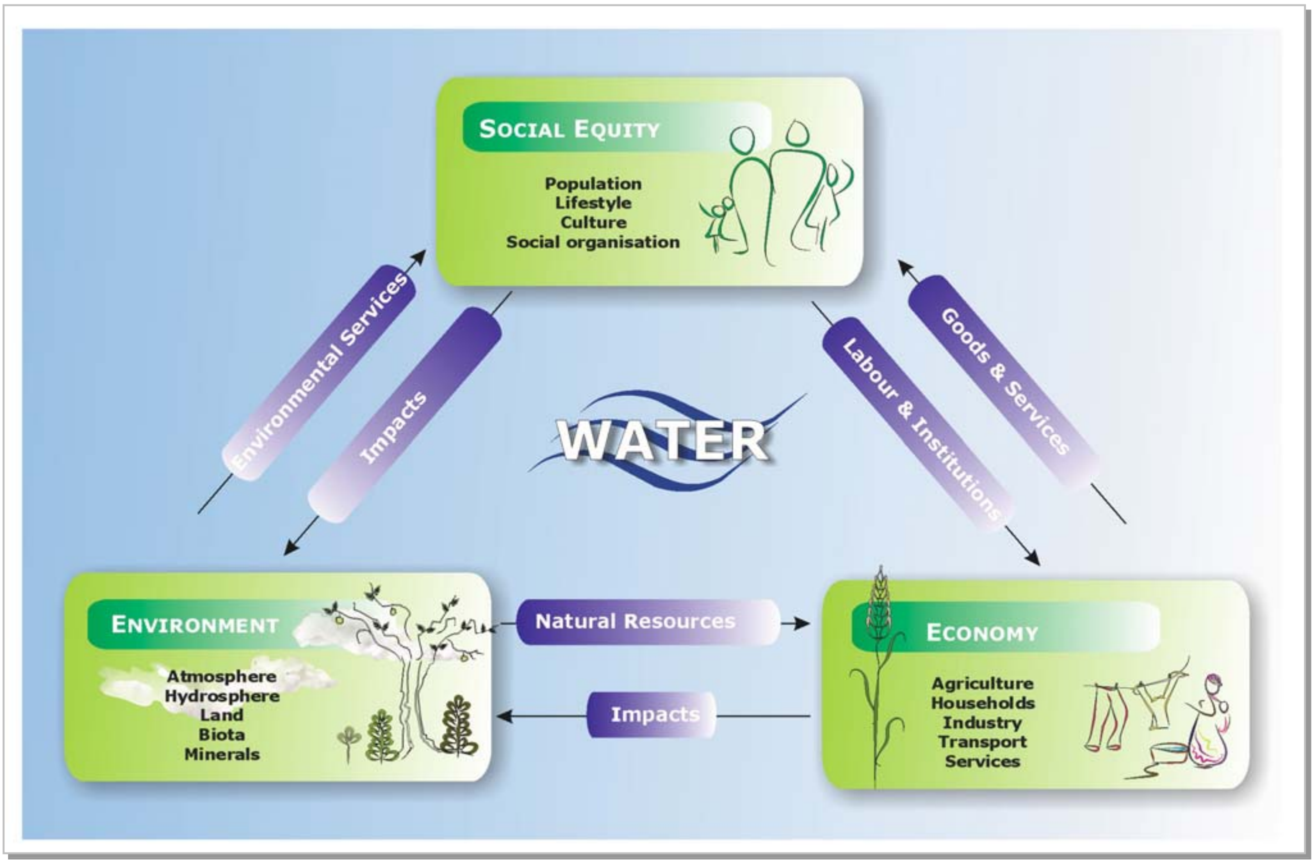
Sustainable development or sustainability involves three broad interdependent spheres: the natural environment, social well-being and equity, and economic development and efficiency. These three spheres are sometimes referred to as the *triple bottom line*, an accounting term coined in the late 1980s by John Elkington.

Figure 1 illustrates this concept of the triple bottom line by which sustainability can be quantified. We need to see positive returns for social equity, the economy, and the environment, and to recognise that each of the components is equally important and interlinked.

**Figure 1: The role of water in sustainable development**




*Source: Adapted from WMO (1997)*

## activity

- What does the concept of sustainable water resource management mean to you?
- How important do you think it is within your organisation, country and region?

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# 1.2 WATER AND WATER RESOURCES

## 1.2.1 What is water?

Water plays many complex roles in human activities and natural systems. But what is water? The American Heritage Dictionary of the English language gives these definitions:

- A clear, colourless, odourless, and tasteless liquid, $H_2O$, essential for most plant and animal life and the most widely used of all solvents. Freezing point 0°C (32°F); boiling point 100°C (212°F); specific gravity (at 4°C) 1.0000.
- Any of various forms of water, for example, wastewater.
- A body of water such as a sea, lake, river, or stream.

Let us look at certain aspects of water and why water is necessary. Water is:

- Essential for all life: plant, animal and human
- Important for health and for the economy
- Precious and finite
- Regarded as a resource

**activity**

Add your input to this checklist about the importance of water as a resource:

- Water is a precious resource.
- It is finite, limited, and scarce in many countries.
- It is an economic good; it can be bought and sold.
- It is valuable.
- The availability of water is related to the health of the environment.
- ____________________________________________________________
- ____________________________________________________________
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## 1.2.2 What is a water resource?

In each of our countries, we have different water resources (surface water resources such as rivers, lakes, estuaries, and wetlands, and ground water resources such as aquifers, springs, boreholes, and wells) that may vary in quality and reliability. How we define water affects how we manage it.

Water resources are commonly described as one of the following:

- Freshwater sources and return flows (e.g. rainfall, run-off, effluent)
- Renewable or non-renewable sources (e.g. a rain-fed stream or an well)
- Local/national water resource or shared water resource (a river which has its catchment within one country or a river with countries up and down stream)
- Potable, saline or polluted water

Finding a definition for the term *water resource* is not as easy as it might seem.

A definition that is implied by the context of the South African National Water Act, is that a water resource is an ecosystem, which includes the physical or structural aquatic habitats (both instream and riparian), the water, the aquatic biota, and the physical, chemical and ecological processes that link habitats, water and biota.

Water resources are fundamentally linked to the hydrological cycle, and hence are not lost, but change in composition and location (Figure 2).

Human interference in the natural hydrologic cycle has altered some of the flows or fluxes, e.g. land use changes has either increased or decreased surface runoff in certain areas of southern Africa (Pallet, 1997; Hirji et al., 2003)

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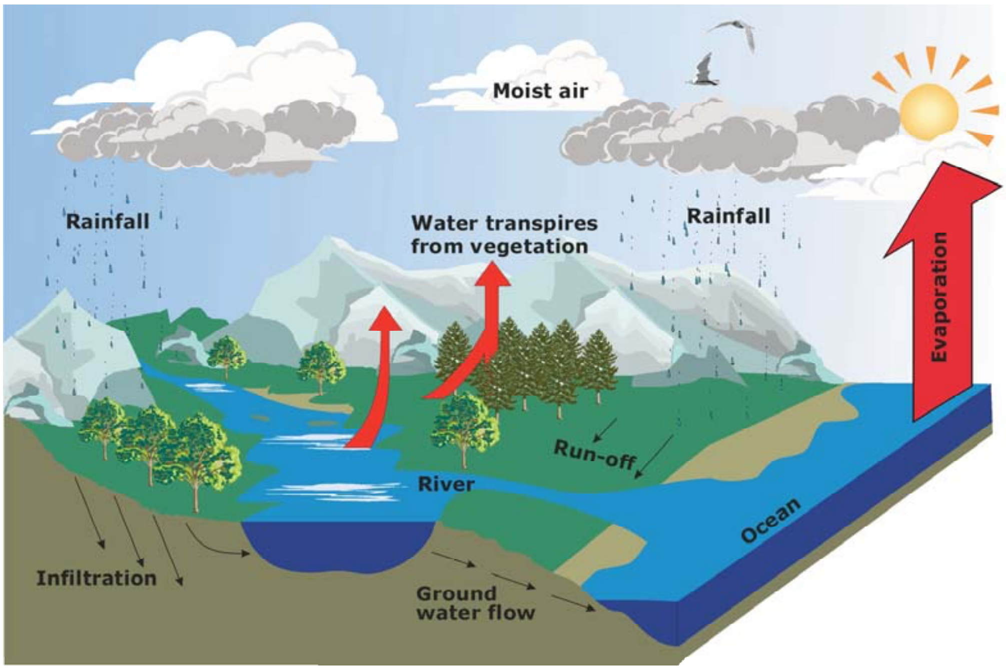
### Figure 2: The hydrological cycle




*Source: Pallet (1997)*

In southern Africa, most of the rainfall evaporates back into the atmosphere (white water), or is used directly for vegetative growth (green water), either by natural vegetation or crops.

Only a small portion of the rainfall flows into rivers as surface water and recharges groundwater (blue water). This water is used for domestic water supply, industrial production, irrigated agriculture, etc. This blue water is the water that we harness through infrastructure development such as dams and wells, and that we tend to pollute (Figure 3). The values quoted in Figure 3 are an average for the region. They possibly represent the arid and semi-arid parts, and therefore may be different for the water-rich areas of the region.

## notes

## rainbow of water

Water has many colours:

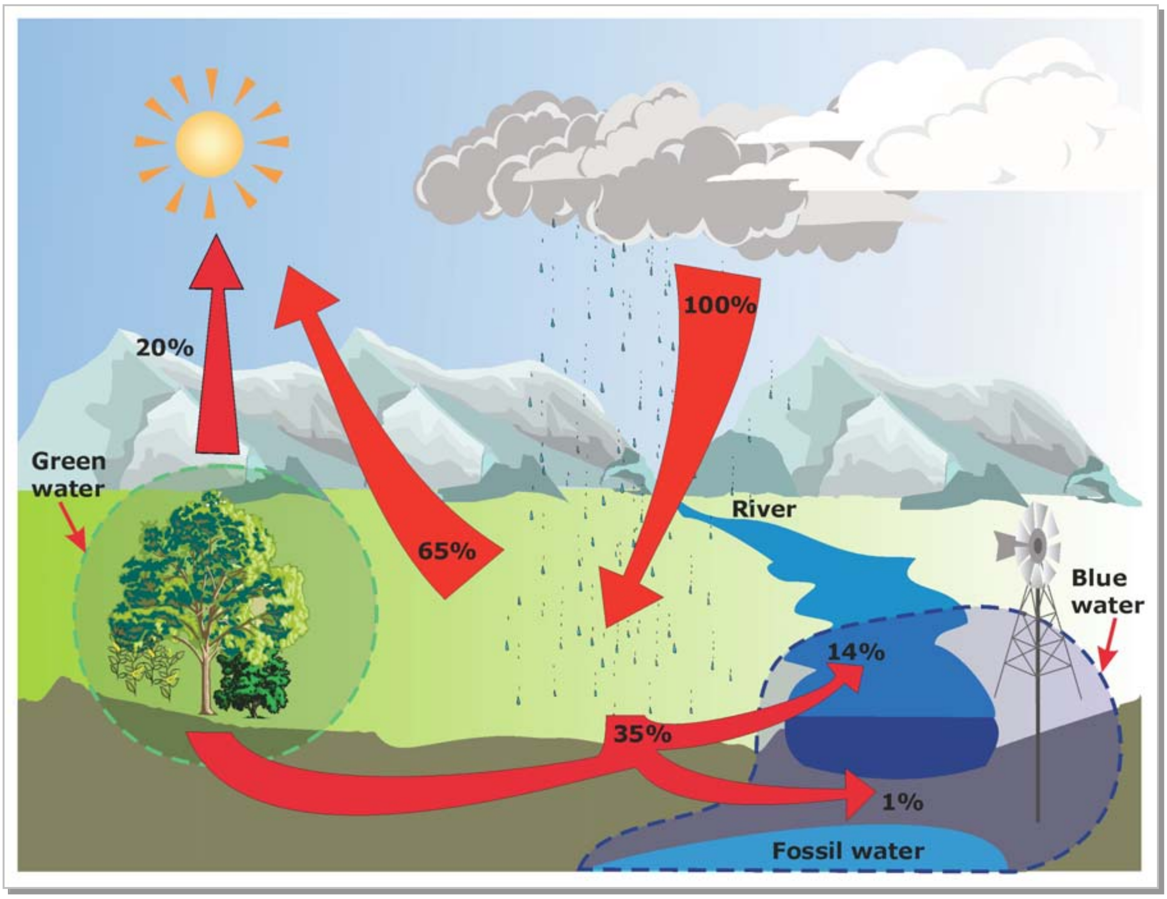
- *Green water* is soil moisture in the top layer of soil (unsaturated zone), which is utilised by natural vegetation and agriculture through transpiration (in the absence of irrigation). Transpiration also occurs from deeper layers depending on the root depth of plants.
- *Blue water* is the water that we can manage by engineering interventions and that we can allocate, re-allocate, and measure by traditional monitoring. Blue water is the combination of surface water and “renewable” groundwater. The un-renewable or “fossil” groundwater is not part of the blue water, and should be considered a mineral resource.
- *White water* is the part of rainfall that feeds back directly to the atmosphere through evaporation from interception and bare soil. In addition, the term white water can be used to describe the rainfall which is intercepted for human use, e.g. from roof catchments.
- *Grey water* is wastewater from showers, baths, spas, hand basins, laundry tubs, washing machines, dishwashers and kitchen sinks. (It doesn't include water from toilets.) It is below drinking water standards but may still be safely used for other purposes, such as for garden watering. Grey water may contain greases, oils and harmful detergents, and hence might not be reusable without treatment.
- *Black water* is wastewater, the return flow of blue water used by humans. Black water consists of *Brown water* (faeces plus flush water), *Grey water,* and the so-called *Yellow water* (urine with or without flush water).

Note: The above terminology and definitions have not been universally agreed on.

*Source: Falkenmark (1995), Savenije (1999), Otterpohl (2001)*

## notes

**Figure 3: Schematic water balance for southern Africa, showing the average partitioning of rainfall**




*Source: Pallet (1997)*

In the context of municipal water supply, the intervention of man in the hydrological cycle through the introduction of the water diversion cycle, including water withdrawal and water drainage, is important. Figure 4 illustrates the interaction of the water diversion cycle with the hydrological cycle. In southern Africa, this diversion cycle exerts significant influence on the terrestrial water cycle, especially in more economically developed or densely populated areas.

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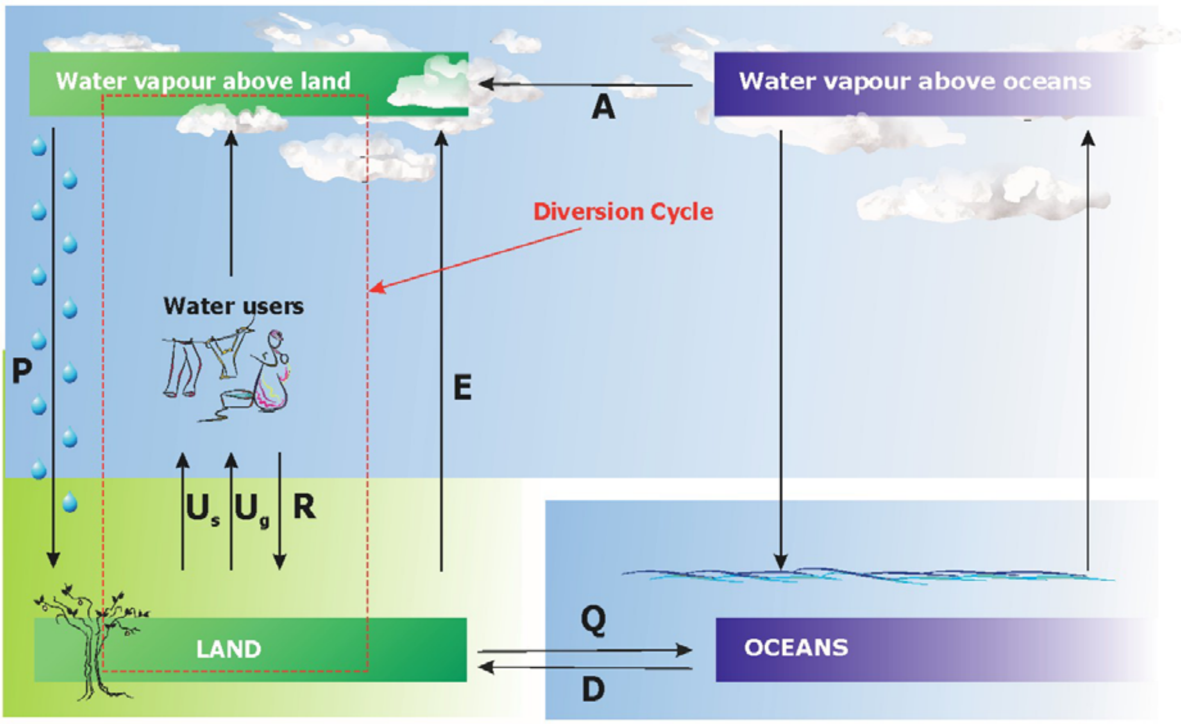
### Figure 4: Interaction of the hydrological cycle with the diversion cycle




| | | |
|---|---|---|
| **P** | = | precipitation (white water) |
| **E =T + I + O** | = | total evaporation from the land surface (transpiration + interception and open water evaporation) (white water) |
| **Q** | = | runoff from land to ocean (blue water) |
| **$U_s + U_g$** | = | intake from surface and groundwater (blue water) |
| **R** | = | return flows to surface and groundwater (grey, brown, yellow and black water |
| **D** | = | desalination (blue water) |

*Source: Rodda and Matalas (1987)*

Rainfall, surface water such as rivers and lakes, and groundwater are unevenly distributed throughout the region, and are not always located where municipal water demand arises. Pollution threatens surface and groundwater sources, and may make them unfit for many uses, or may require expensive treatment to rehabilitate them and/or improve water quality. Pollution is especially serious where groundwater resources are over-exploited and suffer from reduced recharge rates due to deforestation, land use changes, and urbanisation, and where surface water sources are located downstream and receive untreated or semi-treated sewage flows.

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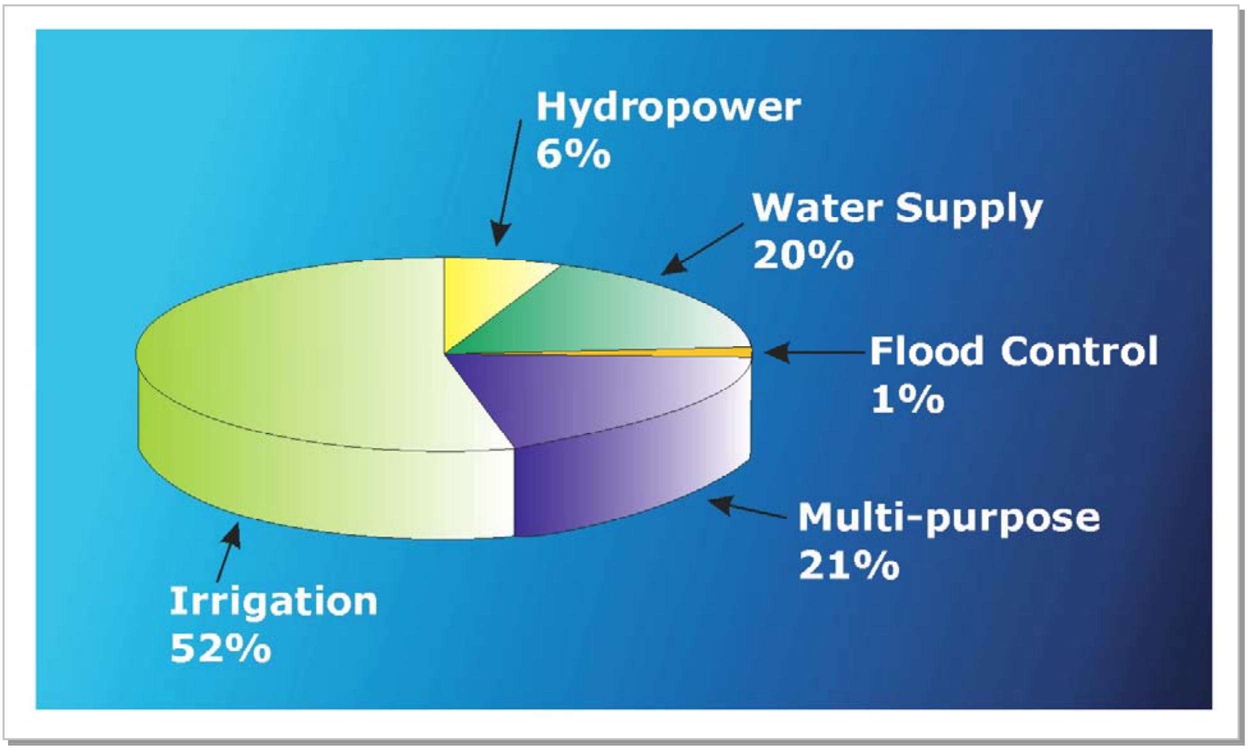
Dams, major pipelines and inter-basin water transfer schemes have been developed in the region. They are an important means of meeting actual and perceived needs for water and energy services, and as long-term, strategic investments with the ability to deliver multiple benefits. According to the International Commission on Large Dams (ICOLD) World Register of Dams released in 2000, of the over 1 270 large dams in Africa, South Africa and Zimbabwe together account for more than 60% of the dams on the continent.

According to the World Commission on Dams (WCD, 2000) irrigation is the single largest driver for building large dams in southern Africa, especially in the more southern regions that have large arid or semi-arid zones (Figure 5). In the northern and central SADC countries, which are less arid, hydropower is the primary reason for dam building. Countries that are much drier (more variable rainfall and hence runoff) have tended to build dams with large storage capacities to meet water demand with stored supply, and for security against the risk of drought. In South Africa, large dams have a capacity equivalent to 50% of mean annual river flow (WCD, 2000).

**Figure 5: Breakdown of purpose of dams in Southern Africa**




*Data Source: WCD (2000)*

The SADC Protocol on Shared Watercourse Systems was signed in 1995. Signatories to the agreement include: Angola, Botswana, Lesotho, Malawi, Mozambique, South Africa, Swaziland, Tanzania, Zambia and

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Zimbabwe. Since 1995 Mauritius and the Democratic Republic of Congo (DRC) have joined SADC, and as a result, have acceded to the protocol. The protocol came into force in September 1998 after being ratified by the necessary two-thirds majority of SADC member states.

An amendment process began in April 1998, and resulted in a revised protocol. This revised protocol fits more closely with the *United Nations Convention on the Law of Non Navigable Uses of International Watercourses*. To date, eight member states, namely Botswana, Lesotho, Mauritius, Mozambique, Namibia, South Africa, Malawi, and Swaziland have ratified the protocol. When two-thirds of member states have ratified the revised protocol, it will automatically come into force. These guidelines are based on the revised protocol, titled *Revised Protocol on Shared Watercourses in the Southern African Development Community.*

The protocol provides a sound basis for the IWRM of shared watercourses in the SADC region.

**remember**

There are fifteen major shared rivers in southern Africa, with each country sharing one or more river basins. In the absence of co-operation, the potential for conflicts among riparian countries has increased in recent years, and is likely to intensify in the future, as water scarcity increases... Water quality deterioration is another form of demand on available water resources. At best, it increases the cost of water resources development; at worst, it increases water scarcity.

*Source: http://www.waterandnature.org/q1.html*

MWSAs should ascertain whether *their* water resources are domestically controlled or are shared resources with other countries. Use of the latter is subject to the conditions of the SADC Protocol on Shared Water Resources.

If we use the broadly accepted definition of a water resource as an ecosystem that is linked to other features and processes of the natural environment, we must find a holistic and inclusive approach to its management. It cannot be managed in isolation, and separate parts of the resource must also be managed as holistically. This can be achieved through IWRM.

**activity**

Make a list of the most important water sources in your country or local area. Categorise them in terms of surface or ground water, domestically controlled or shared.

## notes

- Use your results as input to or background information for your WDM implementation plan, which you will have to develop in Unit 4 of this training manual. The WDM plan is one of the major outputs of this training, and will be evaluated by the facilitators.

## 1.3 WHAT IS INTEGRATED WATER RESOURCE MANAGEMENT?

The definition of IWRM adopted by the GWP in 2000 reads as follows (GWP-TAC4, 2000):

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

**tip**

You can find this definition and other interesting snippets about IWRM in the CD-ROM accompanying this training manual in the resource material folder. The GWP folder contains much background and detailed information on principles, policies, and examples of IWRM. Alternatively, visit the GWP web page:

URL: http://www.gwpforum.org/gwp/

Internationally, there has been an increased realisation in recent years of the importance of improved IWRM and the universal provision of adequate basic water and sanitation services. This concern has been captured in various international and regional fora including the following:

- Global Consultation on Safe Water and Sanitation for the 1990s, New Delhi, 1990
- International Conference on Water and the Environment, Dublin, 1992
- United Nations Conference on Environment and Development, Rio de Janeiro, 1992 (Earth Summit)
- Earth Summit+5 Programme of Action, 1997
- World Water Vision, Second World Water Forum and Ministerial Conference, The Hague, 2000
- Water for the 21$^{st}$ Century: Vision to Action – Southern Africa, 2000

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- The Millennium Summit and the Millennium Development Goals, September 2000
- International Conference on Fresh Water, Bonn, December 2001
- The Abuja Ministerial Conference on Water (AMCOW), Abuja, 2002
- Water and Sustainable Development in Africa – Regional Stakeholders' Conference for Priority Setting (Accra declaration), Accra, April 2002
- World Summit on Sustainable Development, Johannesburg, September 2002
- Third World Water Forum and Ministerial Declaration, Kyoto, March 2003

As opposed to the traditional approach of supply management, IWRM compares and evaluates the merits of:

- augmenting traditional supplies, in particular constructing more dams and well fields
- reducing the growth of demand for water
- developing non-traditional supply sources such as desalinated water, wastewater reuse, and rainwater harvesting

This approach to water management is the product of global thinking on development issues and embraces several issues, principally those of sustainability, equity and efficiency. IWRM aims to promote and balance these issues. The overall goal of IWRM in the short and long term is to ensure water provision that is:

- productive and efficient (i.e. low-cost and welfare-increasing)
- equitable (i.e. meeting essential needs and providing affordable water to all)
- environmentally sustainable (see the discussion on sustainable development in section 1.1)

The following examples illustrate the need for IWRM.

**example**

### Poor investment decisions due to neglect of WDM potential

In Marondera, a Zimbabwean town of 54 000 inhabitants, a dam was constructed some 20 km away from the town by central government to overcome water shortages. The dam was completed in 1997 at no cost to the municipality. At the same time, the municipality planned to build a water treatment plant using biological nutrient removal technology to solve sanitation problems. When it was found that this plant could produce a re-use flow of eight million litres per day, the municipality decided to build the plant, and postpone the pipeline to connect the dam to

**notes**

the town's water supply. Similar examples of poor investment decisions are likely to be found in other southern African countries.

*Source: IUCN WDM Research paper on 'Incorporation of WDM in national and regional water policies' (2003)*

**Example of supply-minded thinking**

In 1998, many areas of Zimbabwe's capital Harare ran out of water in the middle of a heatwave. The City Council admitted that its pumping capacity was no longer capable of providing enough water for the city. Furious residents in the former townships and in the city's exclusive northern suburbs awoke on 9 October to find they had no water. The Mayor admitted that the problem with pumping capacity had been anticipated but refused to say why nothing had been done about it. By 14 October schools in the capital had been forced to close because of water shortages (Worldwater and Environmental Engineering, 1998).

*Source: IUCN WDM Guidelines for municipal water suppliers (2004)*

In the first example, the costly intervention was undertaken in isolation, reflecting a lack of integrated planning. The second example shows that supply did not meet demand due to the failure of the municipality to predict the increase or to put WDM measures in place to deal with it. In the second example, it is apparent also that continuous public awareness and education is essential in managing water demand.

## 1.3.1 Features of IWRM

In general, the following are multidisciplinary features of IWRM:

- A holistic, fundamental, and comprehensive water management approach that balances social, environmental and economic sustainability concerns
- The recognition of the essential ecological functions of water and the allocation of associated ecological water requirements
- The recognition of water competition among economic sectors and consideration of allocative efficiency
- Planning taking place at the appropriate level of governance
- The decentralisation of water management to river basins, watersheds, and aquifers
- A long-term approach towards water resource management

The roots of IWRM can be found in the declarations made in the Dublin Conference in 1992, the 1$^{st}$, 2$^{nd}$ and 3$^{rd}$ World Water Forums, the World Summit on Sustainable Development in 1992, and most recently confirmed in the the Millennium Development Goals declaration in 2000 and the second World Summit on Sustainable Development held in

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2002. A review of these can help us track the progress and global acceptance of the concept.

#### 1.3.1.1 The Dublin Principles

The Dublin Principles, agreed upon at the International Conference on Water and the Environment held in Dublin, Ireland in 1992, can be summarised as follows:

- Freshwater is a finite and vulnerable resource, essential to sustain life, development, and the environment.
- Water development and management should be based on a participatory approach, involving users, planners and policymakers at all levels.
- Women play a central part in the provision, management, and safeguarding of water.
- Water has an economic value in all its competing uses, and should be recognised as an economic good.

**activity**

To what extent do the Dublin Principles echo the approach of indigenous African knowledge systems to water management? Do you know of examples of practices or sayings/idioms that reflect this?

#### 1.3.1.2 The Millennium Development Goals

The Millennium Development Goals (MDGs) emanate from the Millennium Declaration signed in September 2000 by 189 countries, including 147 heads of state. The MDGs set targets for reductions in poverty, improvements in health and education, and protection of the environment. They commit the international community to an expanded vision of development that vigorously promotes human development as the key to sustaining social and economic progress in all countries, and they recognise the importance of creating global partnerships for development and the elimination of poverty (Cosgrove and Rijsberman, 2000). The goals have been commonly accepted as a framework for measuring development progress (MDG, 2000; UNDP, 2003).

Although the goals and targets are interrelated and should be viewed holistically, the pertinent ones for this paper are Goals 1 and 7. Goal 1 refers to eradicating extreme poverty and hunger, whilst Goal 7 refers to ensuring environmental sustainability. In particular, Target 10 of Goal 7

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reads: *Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation* (MDG, 2000; UNDP, 2003). For SADC member states, this translates to extending water and sanitation services to a population of about 100 million within a decade, which is a huge challenge indeed. Poverty reduction is a complex issue, and specific targeted actions are needed to ensure support to weak and marginal communities.

**watch out!**

In spite of the efforts during the International Drinking Water Supply and Sanitation Decade (1981-1990) 1,2 billion people around the world lack access to safe drinking water and about 2,4 billion lack adequate sanitation (UNDP, 2003). The targets set by the MDGs are a huge challenge and require massive resource mobilisation. There are already fears that the ambitious targets might not be achieved by 2015.

#### 1.3.1.3 The World Summit on Sustainable Development

At the World Summit on Sustainable Development (WSSD) held in Johannesburg in 2002, the international community took an important step towards improved sustainable water management. A call for all countries (with an emphasis on support to developing countries) to develop *integrated water resource management and water efficiency plans* by 2005 was included in the WSSD Plan of Implementation (GWP-TEC10, 2004; GWP, 2004a). Other resolutions made include:

- To improve efficiency of water use and promote efficient water allocation among competing uses
- To support technology diffusion and capacity building for non-conventional water resources
- To support developing countries in their efforts to monitor and assess the quantity of water resources, by using networks, databases and indicators
- To develop regional/national strategies for river basins, watersheds and groundwater management

With these decisions, the concepts of IWRM became concrete promises for action. Whilst the wording of the WSSD Plan of Implementation appears simple, major challenges exist. The GWP has published an informal stakeholder baseline survey on the status of global water sector reform processes. The survey provides information that allows an operational assessment of the readiness of countries to meet the 2005

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WSSD implementation plan target on IWRM plan preparation (GWP, 2004b).

Of the twelve SADC countries assessed during the survey, two are classified as having made good progress (South Africa and Zimbabwe); five have made some steps but need to increase their efforts (Malawi, Mauritius, Mozambique, Namibia and Tanzania); whilst five are still in the initial stages of the process leading to integrated approaches (Angola, Botswana, Lesotho, Swaziland and Zambia). The survey also identified key types of support required for SADC countries to undertake the IWRM planning process. These included technical, human and financial capacity, mobilisation of stakeholders and their involvement, and building political will.

## 1.3.2 The implications of IWRM

Like many management philosophies, IWRM is easier to formulate than to implement: *planning* it is not too difficult; *doing* it is more challenging. IWRM implementation is more demanding than traditional supply-biased water management. Effective IWRM requires radical technological changes, strong political commitment, and substantial funding from both the public and private sectors. In addition, effective IWRM requires a reorientation of how water management money is spent.

There are five main economic features of IWRM that should always be kept in mind:

- Recognition that water is finite and that not all demands can be met, calling for demand prioritisation and demand management
- Comparison of the net benefits of supply- versus demand-oriented measures
- Recognition of present and future water needs
- Recognition of the close linkages between land and water management
- Recognition of water as an economic good with a value

## 1.3.3 Common challenges in SADC affecting IWRM

The SADC Water Division has organised the implementation of the Regional Strategic Action Plan (RSAP) for Integrated Water Resources Management and Development in the SADC countries, in the form of a coherent set of projects (SADC, 1998).

Recent research within SADC has highlighted a number of common issues that are negatively affecting the adoption and implementation of

**n o t e s**

IWRM (Eberhard *et al.*, 2003; SADC, 2003). The issues identified include the following:

- A lack of participation by civil society
- A lack of involvement of women
- Limited capacity in terms of human and financial resources
- Inadequate water and sanitation infrastructures
- Water stress and scarcity, now and in the future
- Poverty
- The HIV/AIDS pandemic

## 1.4 WATER STRESS AND SCARCITY

Water availability and use vary a great deal across southern Africa.

According to the IUCN (2000), estimates show that water will become an increasingly scarce resource in the region. The need for IWRM becomes important and urgent when there is water stress and scarcity.

Global climate change and atmospheric pollution (global warming in particular) is predicted to bring forth more challenges. Warmer temperatures will lead to a more vigorous hydrological cycle: this translates into prospects for more severe droughts and/or floods in some places and less severe droughts and/or floods in other places. Several models indicate an increase in precipitation intensity, suggesting a possibility for more extreme rainfall events. Increased warming may also lead to changes in the geographical distribution of severe storms, e.g., tropical cyclones.

Given their limited technical, financial, and management resources, southern African countries will face a heavy burden on their national economies in adjusting to shortages and/or implementing adaptation measures.

There is a need to highlight that water *stress* and *scarcity* is one of the main drivers of WDM. Without water stress and scarcity, there is little incentive for IWRM and WDM. When they are present, they provide economic, environmental, and social impetus for planning and implementation.

Water stress and water scarcity provide comparable rating systems that indicate the level of challenge facing water management in a region, country or area. These basic indicators allow comparisons on the availability of water relative to how much is used – in a particular place, country, or region.

## notes

### 1.4.1.1 Water stress

Water stress indicates the proportion of available water that is already in use. Water stress is a simple ratio, expressed as a percentage, of the amount of water drawn from a source or sources, divided by the estimated total available water from those sources, multiplied by 100. Available water consists of the renewable blue water component. Water stress indicators therefore range between 0 and 100, where 100% means that all possible water is withdrawn and used (Eberhard *et al.*, 2003).

$$\frac{\text{Water withdrawn}}{\text{Water potentially available}} \times 100 = \text{Water stress}$$

The water stress score is expressed as a number from 0 to 100, usually as a range.

### 1.4.1.2 Water scarcity

Water scarcity indicates the amount of water potentially available per person, and is expressed in cubic metres per person per year, i.e. $m^3$/person/annum. Table 1 shows the commonly used descriptors of water stress and scarcity, and relates them to measurable criteria.

**Table 1: Degrees of water stress and water scarcity**

| WATER STRESS | | WATER SCARCITY | |
|---|---|---|---|
| % | | ($M^3$/PERSON/ANNUM) | |
| Low | < 10 | None | > 2 000 |
| Moderate | 10 to 20 | Occasional | 2 000 – 1 700 |
| Medium | 20 to 40 | Periodic | 1 700 – 1 000 |
| High | 40 to 60 | Chronic | 1 000 – 500 |
| Catastrophic | > 60 | Absolute | < 500 |

*Source: Eberhard et al. (2003)*

**watch out!**

There can be hazards associated with the use of commonly available data, as the analysis of water scarcity in southern Africa has yielded very different and often surprising results due to differences in indicators used, and in the empirical data, which is often not verifiable.

A few examples:

- Lesotho, currently a major water exporter, will face water stress in future. If this is true, the current water exports may not be sustainable.

**notes**

- Botswana's water situation is rated adequate in Ohlsson (1995) while Eberhard *et al*. (2003) argue that the country has absolute water scarcity.

Figures for per capita water availability vary greatly, from 6 672 to 27 373 $m^3$/capita, for Namibia. The variation in figures is much less for Botswana and South Africa. Finally, estimates for Malawi vary from 1 700 to 3 000 $m^3$/capita/annum. There is also variability within the countries themselves.

### 1.4.1.3 Levels of water stress and scarcity in SADC countries

In a recent study undertaken by Eberhard *et al.*, (2003) for the SADC RSAP, water stress and scarcity indicators were derived for all SADC countries. The descriptors should be regarded as broad and approximate descriptors of relative levels of water stress and scarcity in SADC countries.

Whilst the results of this analysis correspond better than some others to the common perceptions, this does not necessarily mean that they are more accurate or that they apply at the local level within these countries.

Some relevant information extracted from the report of this study is shown in Table 2, and Figures 6, 7 and 8.

In very general terms, the higher the water scarcity is, the higher the water stress will be, except in the case of Swaziland (Figure 6). According to the study, Botswana and Namibia have the most serious water scarcity and stress as shown in Table 2.

**Table 2: Levels of water stress and scarcity in SADC countries**

| COUNTRY | AVERAGE ANNUAL RAINFALL IN MILLIMETRES PER YEAR | WATER STRESS INDEX | WATER SCARCITY INDEX | NOTES |
|---|---|---|---|---|
| Angola | 1010 | Low | None | Good water resources overall, much still undeveloped. However, very dry region (desert) in southwest and severe shortage in infrastructure across country to provide clean potable water as a result of the war. |
| Botswana | 416 | High | Absolute | Arid country, highly dependent on international watercourses and agreements with neighbours. Very limited irrigation. High level of cost-recovery pricing practiced. |
| DRC | 1543 | Low | None | Abundant water resources but chronic breakdown in infrastructure to provide clean potable water as a result of the war. |

**notes**

| COUNTRY | AVERAGE ANNUAL RAINFALL IN MILLIMETRES PER YEAR | WATER STRESS INDEX | WATER SCARCITY INDEX | NOTES |
|---|---|---|---|---|
| Lesotho | 788 | Low | None | Overall adequate resources (exports water to South Africa). However, limited resources in lowlands where population resides, and likely to require expensive internal transfer schemes in future. |
| Malawi | 1181 | Moderate | Occasional | Generally adequate water resources but requires careful management of the resource. |
| Mauritius | 2041 | Medium | Occasional | Water quality needs to be managed and opportunities for recycling developed over time. Economy heavily dependent on tourism. |
| Mozambique | 1032 | Low | None | Overall adequate resources, but highly dependent on upstream shared watercourses (more than 50% of river flows). Dry areas with low rainfall (400 to 600 mm pa) and periodic droughts. |
| Namibia | 285 | High | Absolute | Arid country, very limited internal resources. Highly dependent on shared watercourses and international agreements. Very limited irrigation. Recycling already well developed. |
| South Africa | 495 | High | Periodic | Water sector highly developed with extensive internal transfers between regions. Water scarcity is expected to become chronic in future and there will be shifts from low value use to higher value use (within and out of irrigation which accounts for about 50% of use). High variability of rainfall and periodic droughts. |
| Swaziland | 788 | High | None | High withdrawals due to intensive irrigation (mainly sugar). |
| Tanzania | 1071 | Moderate | None | Generally adequate water resources, however high variability with periodic droughts. The internal water resources are estimated to be insufficient in the near future. |
| Zambia | 1020 | Low | None | Generally adequate water resources but high variability in rainfall and rain-fed agriculture vulnerable to droughts. |
| Zimbabwe | 692 | Moderate | Occasional | High variability with periodic droughts. Rain-fed agriculture particularly vulnerable. |

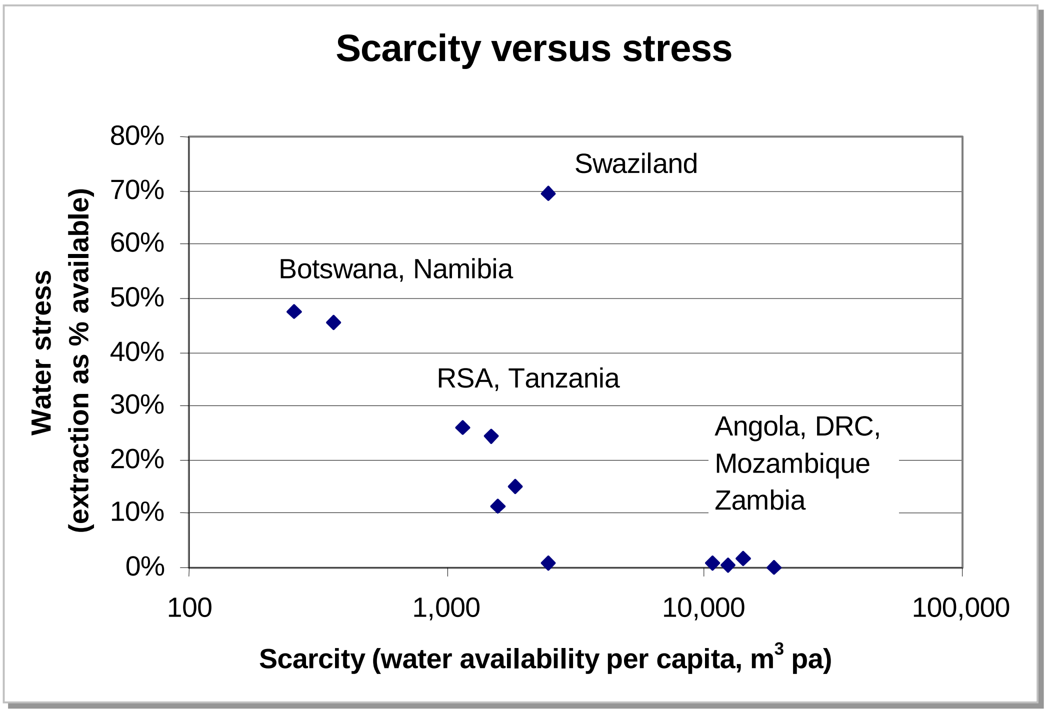
*Source: Eberhard et al., (2003)*

Using data from the same survey, the relationship between water stress and water scarcity is shown in Figure 6. (Actual numbers shown should be regarded as approximate only.) Most northern SADC countries have a low level of water stress and scarcity at the national level. Water scarcity is highest in the south, where water extraction is already high.

# notes

We must remember, however, that water stress and scarcity may be found in parts of most SADC countries.

**Figure 6: Scarcity versus stress in SADC countries**




*Source: Eberhard et al. (2003)*

What is the effect of water stress and scarcity on the potential for economic development of countries in the SADC regions? Conversely, what is the impact of economic development on water scarcity and stress? Still using the same survey data, Figure 7 shows the relationship between per capita water use in litres per day and per capita income measured by Gross Domestic Product (GDP). There is a clear positive relationship between per capita income and per capita water use. Bearing in mind that Botswana, Namibia and, to a lesser extent, South Africa are the most water-scarce countries, water scarcity does not seem to hold back economic growth, but does lead to increases in water consumption. Therefore, water resource planners need to realise that economic growth and development are likely to put growing pressure on water resources.

Alternatively, Figure 7 may imply that South Africa, Namibia and Botswana have to focus more on WDM, as they have higher per capita water use. At the same time, WDM is not primarily about limiting water use but increasing the use efficiency. The values indicated in Figure 7 could also be misleading, as there are no threshold values based on WDM good practice in the region to act as benchmarks. What is clear

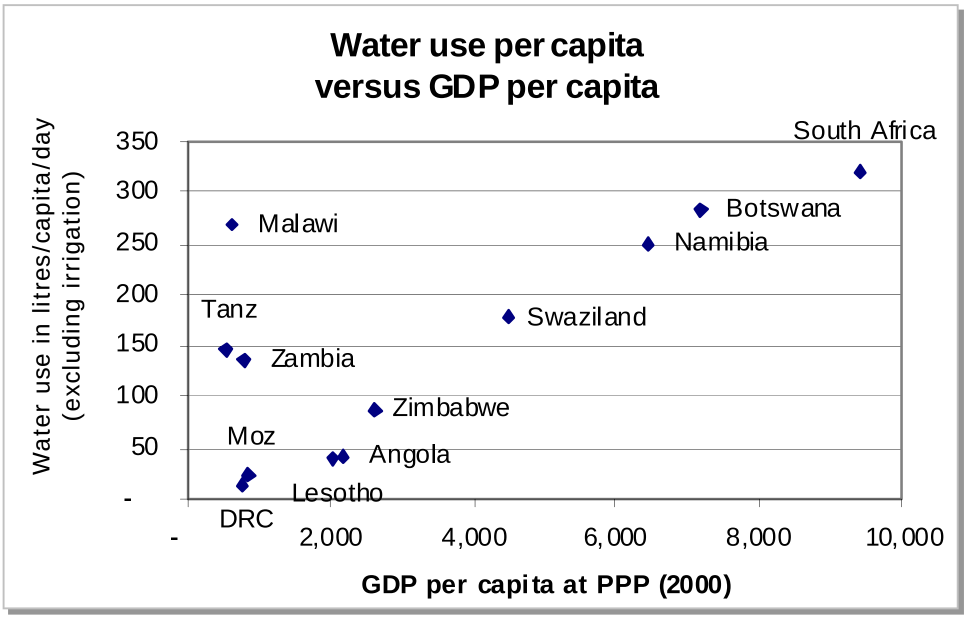
**notes**

however, is that water usage tends to increase with increased levels of development and affluence.

**t i p**

The significance and reliability of the figures presented in Figure 7 will be revisited in Unit 3 of this training manual, where specific case studies are given in detail.

**Figure 7: Water use per capita versus GDP per capita**

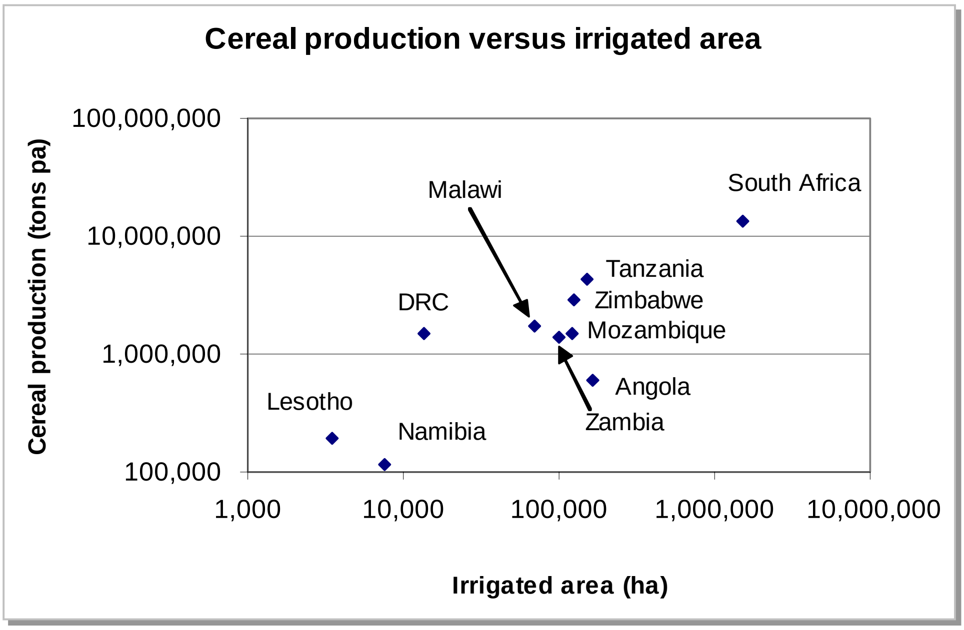



*Source: Eberhard et al., (2003)*

Agriculture, particularly irrigation, is the major water consumer in the region. The irrigation sector is therefore an important target of IWRM and WDM. Water planners have, however, to consider the broader context of food security in their deliberations. If we compare the extent of irrigation and cereal production in Figure 8, a positive relationship between irrigation and food production exists. Therefore, WDM efforts for irrigation should consider the impacts on food production and security. The figure also shows that the most water-scarce countries (Botswana and Namibia) have a very small irrigation sector, presumably because of water shortages, among other reasons. South Africa faces a major policy dilemma, with both a large irrigation sector and water scarcity.

**notes**

**Figure 8: Cereal production versus irrigated area**




*Source: Eberhard et al. (2003)*

**activity**

- Do you have a sense about the levels of water scarcity and water stress in your own country?
- Develop a description using your own experience, the outcomes of group discussions and any information or literature available, and feed the resulting information into your WDM management plan.

Table 3 illustrates the most common water issues and constraints in SADC countries, showing that, at national level, water stress and scarcity are not commonly listed. This is consistent with the earlier assessment of Eberhard *et al.* (2003), that a few countries are most affected by water scarcity. The recognition of water scarcity is a critical step towards designing and implementing WDM measures. If it is not perceived to be a national problem, WDM should be pursued primarily at the local, MWSA level of water-scarce areas.

**remember**

Water scarcity and water stress are just one reason to motivate for the implementation of WDM. Even the countries that are water resource rich need to effect WDM measures to ensure efficient and equitable use of available resources. Wastage and excessive use of water is not sustainable and usually lead to severe pollution problems. WDM is also about pollution control, pollution

**notes**

prevention, and protecting fresh water sources. Many cities in Africa have varying levels of service in terms of water supply.

Since WDM contains prospects for the equitable allocation of benefits from water and the services dependent on it, it is important that these opportunities for healthier and more productive lives among the most at-risk and disadvantaged urban population groups are not lost, but are transformed into reality. It is difficult to justify a situation where the quantity of unaccounted-for water exceeds that of water consumption, while at the same time large sections of the population do not have access to safe drinking water and/or experience interrupted water supplies.

**Table 3: Water issues and constraints in 12 SADC countries**

| FREQUENCY | WATER ISSUES | CONSTRAINT |
|---|---|---|
| Widespread (at least in 76% of countries) | Public participation | Inadequate community participation<br>Inadequate involvement of women |
| | Infrastructure | Inadequate access to sanitation<br>Inadequate access to safe drinking water |
| | Sustainable development | Overgrazing |
| Common (in 51 to 75% of the countries) | Legal aspects | No comprehensive national water law |
| | Institutional strengthening | No overall water policy/strategy<br>Weak national water institutions<br>Inadequate manpower |
| | Sustainable development | Inadequate water conservation measures<br>Pollution from sewage<br>Soil erosion and deforestation |
| | Information | Inadequate water resource data base<br>Inadequate hydro-meteorological monitoring network |
| | Infrastructure | Inadequate water resources infrastructure |
| Less common (in 26-50% of the countries) | Legal | Non-ratification of protocols |
| | Institutional strengthening | Poor co-ordination mechanisms<br>Ineffective shared basin institutions |
| | Sustainable development | Pollution<br>Aquatic weeds<br>Land salination |
| | Information | Inadequate water user information<br>Inadequate monitoring of sediments and water quality |
| | Infrastructure | Inadequate flood control |
| Not common (in 25% or less of the countries) | Sustainable development | Potential water stress<br>Herbicide pollution<br>Cross-border pollution |

*Source: SADC (1998)*

## notes

#### 1.4.1.4 Management reactions to water stress and scarcity

What are the management reactions to water scarcity? Once the situation is recognised, what steps can be taken? Table 4 gives an overview of the types of interventions that can be expected when IWRM strategies are applied to water scarcity problems.

**Table 4: Major IWRM strategies and interventions for water scarcity**

| STRATEGY | POSSIBLE INTERVENTIONS |
|---|---|
| Expansion of supplies | Increase storage capacity (dams), well field development, desalination, artificial recharge, transfer schemes and conjunctive use |
| Resource intensification | Greater user efficiency, technology development, water pricing, negotiated binding agreements among stakeholders |
| Economic diversification | Improve how water is shared, i.e. improve allocative efficiency, water pricing, water market competition, food security instead of self reliance |
| Curb demand | Prioritisation of needs, drought regulations, user restrictions, relocation of people and human activities |

*Source: Adapted from IUCN Research paper on Incorporation of water demand management in national and regional water policies (2003)*

Water stress and water scarcity can provide the impetus for IWRM and measures such as WDM. If we are to discuss WDM, we first need to understand water demand.

## 1.5 WHAT IS WATER DEMAND?

Water demand is a more complex concept than it might first appear. It is subject to fluctuation and has a certain inherent elasticity. Let us first consider the factors that constitute water demand.

Water demand may be differently understood as:

- Actual consumption during a certain period
- Planned demand given a certain water price (the traditional economic demand curve)
- Water needs – both met and unmet.

Water demand also comprises consumptive and non-consumptive use. Drinking water is an example of consumptive use; the use of water for transport is an example of non-consumptive use.

Unfortunately, the term *water demand* is often loosely used, and this causes confusion. It is therefore always important to specify what you mean by water demand.

**notes**

Water demand includes different categories, such as the following:

- Domestic demand for sanitation, cooking, gardening, etc. Domestic consumers range from indigent people to high-income groups.
- Non-domestic demand, mostly for productive sectors such as agriculture, mining, industries and the service sector. Government is part of this category.

Water losses are associated with water delivery to and the demands of end-users, but water losses also have production features, e.g. the distribution network. It is most important that losses are not overlooked in IWRM, and the simplest solution is to state that water production = water consumption + distribution losses.

Demand is not stable over time, and shows large daily and seasonal fluctuations. This makes IWRM more complicated. Concepts that are used include:

- Average and peak demand flows
- Dry and wet season demand
- Day and night demand flows
- Drought and non-drought periods

The demand changes in response to the price of water and the income situation of end-users. This is usually measured by:

- **Income elasticity of demand:** How does the water demand change with a 1% increase in real income? Water demand usually increases with income (positive elasticity), meaning that the demand curve shifts to the right.
- **Price elasticity of demand:** How does the water demand change after a 1% increase in the price of water? Economic theory predicts that the demand will decrease (negative elasticity), but this does not always happen.

Southern African data on income and price elasticities of demand for water are very limited. This makes it difficult to forecast water demand and to predict the effectiveness of water pricing as a WDM tool.

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**remember**

Water demand is often equated with water consumption, although conceptually the two terms do not have the same meaning. Especially in rural parts of southern Africa, the theoretical demand considerably exceeds the actual consumptive water use.

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**notes**

We see, therefore, that demand is not a static, fixed thing. Rather it is as fluid as water itself, and can increase and decline in accordance with a range of crosscutting variables such as the following:

- **Weather**
  - Rainfall
  - Temperature
  - Evaporation rates
- **Population**
  - Growth or decline due to, for example, natural increase, migration or refugees
  - Urbanisation rate
- **Food security**
  - The need to increase irrigated land portion
  - Increasing need for water for rural agriculture as a key to livelihood security
  - A decision to alter crop types, with different water use profiles, to respond to market pressures (e.g. move to less labour-intensive cash crops after onset of AIDS)
- **Service delivery**
  - Change in consumption level due to improved or water-borne sanitation
- **Health and epidemiology**
  - Outbreaks of water-borne diseases, like cholera
  - Setting of disease reduction targets, like reducing childhood mortality from diarrhoea
  - Impact of pandemics like HIV/AIDS, malaria and tuberculosis
- **Political developments**
  - War
  - Inclusion of equitable access to water in a country's bill of rights
- **Economic growth or decline**
  - Wet-industry growth or decline (e.g. bottling factories)
  - Irrigated agriculture growth or decline

This list shows that the factors affecting water demand are many and varied. Demand for water in Southern Africa is likely to continue to grow in the years ahead as regional health and prosperity grow.

**notes**

For this reason the timely and correct management of water demand is very important (remind yourself of the MDGs mentioned in section 1.3.1.2).

Water demand is expected to increase rapidly in future due to:

- Improved living standards and increased domestic water consumption
- Population growth, although HIV/AIDS must be taken into account
- Food security and production needs and the role of irrigation
- Water needs for rural production and overall economic growth

The potential for demand reduction is significant, and ranges from 20 to 50% in the short term, for example during droughts, and even 40 to 60% in the long term (Macy, 1999). DWAF estimates that for South Africa, WDM can lead to water savings of 39% in the water service sector (DWAF, 2003).

If the potential is there, the key question is why WDM is not practised on a much larger and wider scale. Later on, we will discuss WDM constraints and the possibilities of overcoming those constraints. In the meantime, we are wasting natural resources, and even if these are not scarce, waste is an economic cost that reduces competitiveness and economic growth. Indeed, since the emphasis is on using WDM as a tool to *ensure* sustainable growth and development through the efficient and effective use and management of water resources, WDM should be an economic priority for all countries, even those that face no national water scarcity.

**activity**

How would you define water demand? Is it water use? What definition do you currently use in your work situation? Write it down here:

____________________________________________________________________________

____________________________________________________________________________

____________________________________________________________________________

Now that we are comfortable with the concepts and definitions that give us a basis of understanding, let's turn our attention to WDM itself.

## notes

# 1.6 WATER DEMAND MANAGEMENT

WDM is a management approach that has conservation of both the quality and quantity of water as its primary aim. This conservation is achieved through the control of demand through the use of specific incentives that promote the following aspects of water:

- Efficient and equitable use
- Efficient and equitable allocation

## 1.6.1 Myths and misconceptions about WDM

Let us take a look at some of the myths and misconceptions that surround WDM. Perhaps because it is an approach and a methodology, rather than a formula or empirical procedure, there are a number of misconceptions surrounding it.

Some misguided statements about WDM state that it is:

- A luxury that poor countries can ill afford
- A fashion that will pass
- A hobby of environmentalists
- A government conspiracy to make people's lives more difficult
- A goal in its own right
- Too vague to implement
- An approach which does not show tangible benefits
- Nothing more than tariff increases

## 1.6.2 What is WDM?

WDM does not have one universally used definition. Rather it is a work-in-progress approach, defined by the scale and depth with which one applies it.

### 1.6.2.1 Different definitions

Four main definitions are used:

- WDM aims to increase water efficiency through both wise use and reduction, which in turn will reduce or postpone the need to build more dams and drill more boreholes (Macy, 1999; Arntzen, 2003).
- WDM seeks to maximize the usage of a given volume of water by curbing inessential or low-use values through price or non-price measures (SADC-WSCU, 1999).

**notes**

- WDM is the development and implementation of strategies aimed at influencing water demand in order to achieve water consumption levels that are consistent with equitable, efficient and sustainable use of the finite water resource. (IUCN-WaterNet Postgraduate Training Module on Water Demand Management, 2003).
- WDM is a management approach that aims to conserve water by influencing demand. It involves the application of selective incentives to promote efficient and equitable use of water. WDM has the potential to increase water availability through more efficient allocation and use. This is guided by economic efficiency; equity and access; environmental protection and sustainable ecosystems functioning; governance based on maximum participation, responsibility and accountability and political acceptability. (IUCN, 2000)

The fact that WDM has at least four definitions should not be interpreted as meaning that it is a vague *all things to all people* approach. The definitions provided are similar, and they reflect that WDM is a specific yet flexible approach. For the purposes of this training manual the IUCN definition will be used.

**tip**

The regional Water Demand Management Initiative for Middle East and North Africa (WaDI*mena*), with the support of the International Development Research Centre (IDRC), have produced a WDM Glossary of Terms on CD-ROM with over 400 WDM terms and definitions in English, French and Arabic. The glossary has been designed to provide concise definitions in a trilingual format for policymakers, researchers and practitioners working to promote water-use efficiency, equity and sustainable development. The glossary is included on the CD-ROM accompanying this training manual and can be used as long as there is full acknowledgement of IDRC and WaDI*mena*. The material is the property of IDRC. Alternatively, visit the IDRC web page:

URL: http://www.idrc.ca/waterdemand

### 1.6.2.2 Different interpretations

Two interpretations of WDM exist in literature:

- The narrow interpretation refers to interventions that influence water demand only. This usually takes the form of reduced consumption or reduced consumption growth.
- The broader and more common interpretation refers to interventions that influence water demand and increase supply from non-traditional water sources.

 

## notes

The following examples of key WDM issues help us form a clearer picture of what WDM is and indicate the differences in interpretations:

- Narrow interpretation
  - Water-user efficiency, e.g. retrofitting and efficient irrigation
  - Water allocation efficiency, e.g. water allocations based on the economic merits of a sector (such as output and jobs per unit of consumption)
  - Direct use of return flows
- Broad interpretation includes the above measures and adds the following:
  - Rainwater harvesting
  - Desalination of salty ground or seawater
  - Demand prioritisation and ranking

**watch out!**

Wastewater reuse potential in many countries is constrained by the institutional separation of water service providers and agencies in charge of the collection, treatment and disposal of sewage affluent and sludge. This institutional separation breaks the water supply chain, which naturally should also focus on the return flows. Opportunities to recycle water may not be obvious to a water supply company, and a wastewater-handling agency might not want to oversell its product because of the unreliability of the product and its quality assurance.

### 1.6.2.3 Different components

There are several components of WDM that need to be in place for its proper implementation. These include the following:

- **An enabling policy environment:** This is mostly determined at the national and water catchment area level, but can also be determined at local level, for example, MWSAs can improve the enabling environment by making by-laws, adopting standards and norms, and by implementing WDM as large water users themselves.

  MWSAs may, however, also encounter factors that inhibit WDM implementation such as a backlog in water provision (e.g. for historical reasons), non-payment for services by consumers leading to large debts, and political considerations such as free water for basic needs.
- **Right institutional set-up:** Who is in charge of IWRM planning? Who is responsible for WDM? How are the responsibilities divided

## notes

between central and local government as well as parastatals and the private sector? Most countries have developed their own distinct water management structures over time, based on local features. It is important that the WDM structure takes this into account, and finds the most suitable niches in the existing water institutions. Two important new elements should be noted:

- A specific institution should be responsible for WDM
- A decentralised water basin approach should be adopted as a good platform for IWRM and WDM

- **Right measures and implementation:** Select the appropriate measures and have a proper implementation plan. This is usually done by national and local agencies. In view of the limited WDM capacity, start with a few WDM measures that can easily be implemented and have a large impact on water consumption.

**activity**

- Compare the definitions of WDM and note the similarities and differences.
- Which definition is most suitable for your MWSA and why? If none of them is, develop your own definition of WDM that suits your needs.

### 1.6.3 Motivating factors for WDM

What are the motivating factors behind the introduction of WDM to southern Africa? In other words, what are the push factors that are motivating increasing numbers of water managers to opt for WDM in water stressed regions and elsewhere? These will vary from country to country and from case to case.

Table 5 provides examples of environmental, economic, equity and empowerment motivating, or push, factors. We can relate these to the concept of the triple bottom line discussed earlier in the unit.

**Table 5: Push factors for WDM**

| | |
|---|---|
| Environmental push factors | • Current or perceived future water scarcity<br>• Droughts<br>• Avoidance or postponement of the negative environmental impacts<br>• Social and environmental impacts of dams and well fields |

**notes**

| | |
|---|---|
| **Economic push factors** | • Lower costs of WDM compared with new supply schemes<br>• Possible savings on operation and maintenance costs<br>• Increased competitiveness of enterprises that adopt WDM<br>• Use of saved water to promote economic growth |
| **Equity push factors** | • Use of saved water to provide water to more people<br>• Increased water security and risk aversion<br>• Lower costs leading to improved affordability |
| **Empowerment and growth push factors** | • Building upon indigenous knowledge and resource management systems<br>• Incentive for technology development and innovation<br>• A means to meet water and sanitation policy goals<br>• Opportunities for re-use and recycling |

### 1.6.4 WDM measures and interventions: an overview of what is available

WDM measures target four different stages of the water supply chain to influence the associated stakeholders (DWAF, 2003).

There are four stages in the water supply chain:

- Water resource management (e.g. types of supply, allocation)
- Water distribution methods (e.g. cutting distribution losses)
- Consumer demand management (e.g. decreased wastage)
- Return flow management (e.g. considering direct use of return flows)

A wide range of WDM interventions can be applied to these. The types of WDM measures can be grouped as follows:

- Technical measures
- Planning processes
- Regulatory measures
- Economic incentives and restraints
- Consultative processes

The synergy of these interventions within the water management cycle is depicted in Figure 9. Examples are given in Table 6.

**notes**

**Figure 9: WDM target groups and measures**

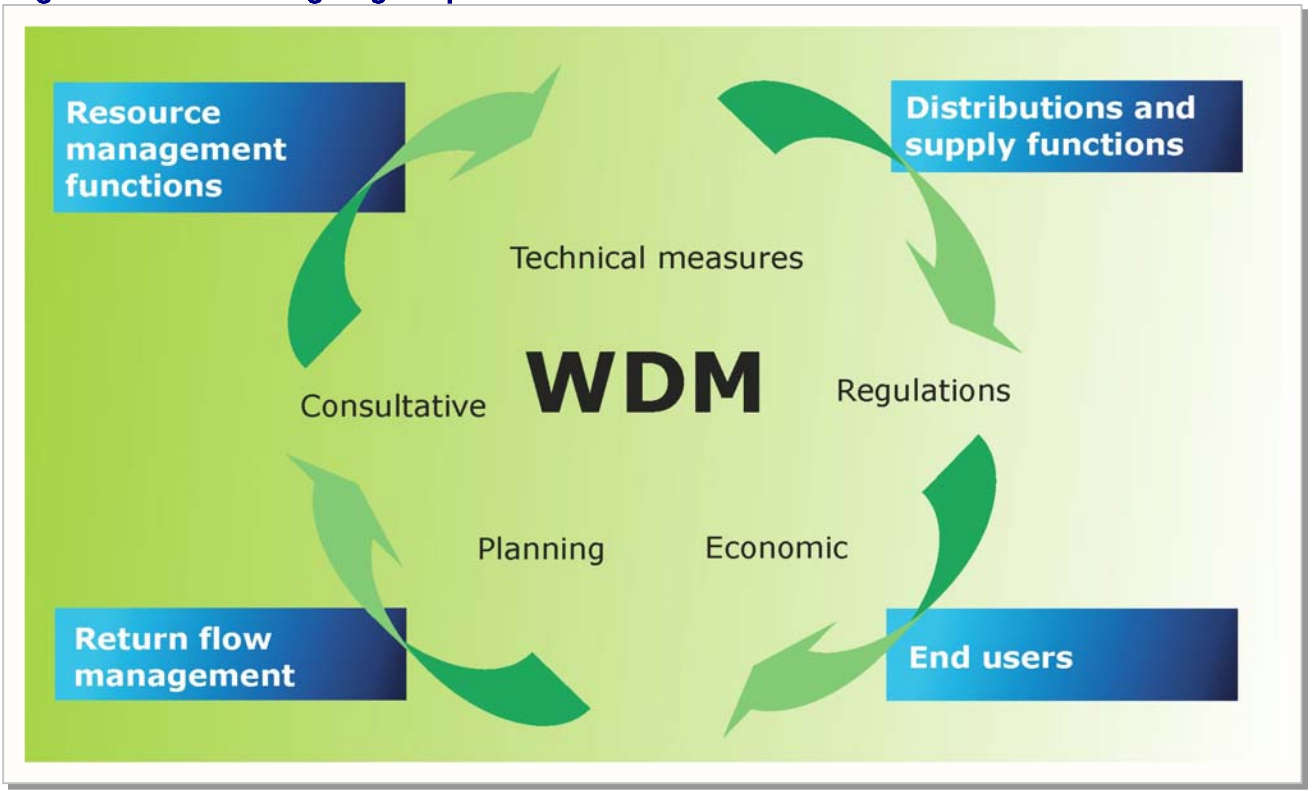


Table 6 gives examples of the types of WDM measures that can be applied during the four stages of the water cycle.

**Table 6: Examples of the range of WDM measures**

| WATER CYCLE STAGES | TECHNICAL WDM MEASURES | WDM IN PLANNING | WDM IN REGULATIONS | WDM IN ECO-NOMICS | WDM IN CONSUL-TATIVE PROCESSES |
|---|---|---|---|---|---|
| Resource management functions | Removal of invading alien species<br>Wetland rehabilitation<br>Dam storage optimisation (e.g. less evaporation)<br>Optimisation of dam operation rules<br>Artificial recharge and below surface water storage | Water catchment management<br>Protection from over-utilisation<br>Managing land use<br>Water quality management<br>Drought contingencies<br>Allocative efficiency<br>Efficient green water management | Best Available Technology (BAT) water practices as compulsory alternative in Environmental Impact Analysis (EIA)/Social Economic Analysis (SEA) procedure in water stressed areas | | Awareness and education, social marketing |

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| WATER CYCLE STAGES | TECHNICAL WDM MEASURES | WDM IN PLANNING | WDM IN REGULATIONS | WDM IN ECO-NOMICS | WDM IN CONSUL-TATIVE PROCESSES |
|---|---|---|---|---|---|
| Distribution and supply functions | Infrastructure optimisation<br>Parallel infrastructure for different water classes<br>Loss minimisation<br>Metering<br>Pressure management<br>Prepaid metres<br>Common-property management of standpipes | Town planning services<br>Re-use and reclamation<br>WDM in building standards | Regulations, norms and guidelines | Incentives<br>Higher energy prices make pumping expensive<br>Volume-based effluent charges | Education, awareness, training<br>Covenants for monopolies of WSPs |
| End-users | Metering<br>Different service levels<br>Loss minimisation<br>Retro-fitting existing systems | Irrigation scheduling<br>Crop choice<br>Agricultural extension<br>Auditing<br>Minimising institutional use | Domestic use guidelines and restrictions<br>Guidelines for private and public sector<br>Drought restrictions<br>Proper level and structure of tariffs<br>Amendment of water irrigation fees | Effective billing and pricing<br>Product standards<br>Differential tax rates (e.g. VAT)<br>Higher energy tariffs make pumping expensive<br>Volume-based effluent charges<br>Tradable water rights | Education, awareness, training |
| Return flow management | Minimising infrastructure<br>Minimising pollution<br>Minimising losses<br>Minimising infiltration<br>Reclamation | Infrastructure optimisation<br>Minimising pollution | Effluent standards | Effluent charges | Education, awareness, training<br>Covenants for irrigation sector and public sector |

*Source: Adapted from IUCN WDM Research paper on 'Incorporation of water demand management in national and regional water policies' (2003)*

## 1.6.5 Constraints and incentives

The constraints that make implementing WDM challenging vary according to each water management situation.

In the IUCN research papers on WDM, *The institutional requirements for water demand management in southern Africa*; and *Overcoming constraints to the implementation of water demand management in*

**notes**

*southern Africa (2003),* the following key constraints to the implementation of WDM in the region are quoted:

- A lack of financial resources, range of skills, and institutional capacity among most water service providers to implement WDM and operate and maintain their infrastructure effectively
- A lack of proper understanding of the benefits to be achieved from WDM.

They also list other WDM constraints, including the following:

- Water supply bias among, amongst others, water engineers, decision-makers, politicians
- Inappropriate training of professionals in the water sector
- Customers kept uninformed or dissatisfied with service
- Lack of understanding of the need for WDM among water sector institutions
- Lack of WDM planning and implementation skills
- Lack of appropriate institutions and funding
- Weak policy and legal instruments for WDM
- Negative attitudes toward WDM arising from existing myths and misconceptions about it

Overcoming these constraints is a **MUST**.

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**a c t i v i t y**

Identify and review the WDM constraints in your country and your local situation. Record and capture these constraints and later, in Unit 4, these will have to be linked to your proposed WDM implementation plan for the selected MWSA.

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The incentives for implementing WDM in both the region and in individual countries are numerous. Let us look at a few:

- **Resource protection:** Managing demand eases pressure on scarce resources.
- **Increased production:** It is more productive to encourage or adopt measures for efficient use of water than to invest in additional sources of supply.
- **A sound basis for planning:** Estimates of present and future sectoral water use can be made.

**notes**

- **Water loss reduction:** This promotes the sustainability of the resource.

## 1.6.6 The status of WDM in SADC countries

The status of WDM in southern Africa is documented below. The information was compiled for the SADC Water Policy Review (Eberhard *et al.*, 2003).

### 1.6.6.1 Angola

The main problem in Angola at present is how to raise the level of water consumption by the population in a country that is generally well endowed with water resources. The Water Sector Development Strategy notes that, as the capacity of supply systems is augmented, measures should be introduced to reduce losses and encourage end-users to use water efficiently. It is further noted that loss reduction needs to be taken to a point where the costs of further reduction do not exceed the benefits. On the consumer side, an important step will be to ensure that the majority of consumers are metered.

### 1.6.6.2 Botswana

Water is very scarce in this country. In order to meet long-term demand, Botswana needs a water-efficient society in which people are conscious that water is scarce and can evaluate how much water they can afford to buy.

There is little done to manage demand at present, even though the National Water Master Plan identified WDM as an area that needed immediate action. Water conservation and the development of non-conventional water sources are areas that are becoming an integral part of the water sector (a draft 1999 strategy is in place and a water conservation unit has been established). These will include wastewater reuse, rainwater harvesting and water conservation. There is an urgent need for demand management and/or conservation projects to be initiated backed by a comprehensive national WDM policy and strategy. National water awareness must be improved to inform people about the need to use the least amount of water possible, particularly the use of potable water.

### 1.6.6.3 DRC

Although there is an intention at policy level to manage water demand, this is a low priority in practice, probably due to the lack of water scarcity and political problems. Wastewater is not recycled in the DRC.

**notes**

### 1.6.6.4 Lesotho

Little attention has been paid to demand management to date. This is evidenced in the inappropriately low water prices in many cases and in the high levels of unaccounted-for water in Maseru.

### 1.6.6.5 Malawi

In Malawi, WDM is practised using two main approaches:

- **Water Resources Act 1969:** This controls the demand for raw water and gives consent to discharge waste through the licensing system. There are also regulations that restrict water use during times of water shortage.
- **Water pricing:** This has been used to manage the demand. The tariffs are designed for fixed charges for minimum water consumption at lower rate while higher rates are charged on greater consumption.

Other initiatives used include public campaigns, leakage control and monitoring, rainwater harvesting, rehabilitation of boreholes and hand-dug wells and sedimentation monitoring. The main incentive one can point to is that consumers are only charged for the water they use. It is assumed that those that consume less will not waste the water since the charge is lower.

### 1.6.6.6 Mauritius

Demand management practice is not generally in place and there is no strategy for water awareness, advice about water-saving measures, public participation, setting of realistic water conservation objectives, use of technology to reduce water loses, water pricing incentives, or punitive measures.

### 1.6.6.7 Mozambique

Demand management is underdeveloped in Mozambique due to a broad set of constraints. One of the problems identified is the country's dependence on water from shared watercourses. In this view, the problem is that agreements with neighbouring states on the equitable distribution of shared water resources are lacking, while there is lack of adherence to those agreements that are in place. This means that Mozambique often does not receive its fair share of water in these shared rivers. Until such time as it can be guaranteed that Mozambique will receive its equitable share of water from upstream countries, it will be extremely difficult to implement WDM principles successfully.

**notes**

### 1.6.6.8 Namibia

WDM practice has been developed to a fine art in Namibia. The value of a successful WDM campaign has been proven beyond any doubt. The major components of such a strategy are as follows:

- Water awareness
- Advice about water-saving measures
- Public participation
- Setting realistic water conservation objectives
- Using technology to reduce water losses
- Water pricing incentives and punitive measures when all else fails

### 1.6.6.9 South Africa

WDM is encouraged in terms of a national water conservation and demand management strategy, which has been extensively discussed among stakeholders, and is now being finalised. The National Water Act (Act No 36 of 1998) provides for catchment area water management; each catchment having its own authority and good opportunities for WDM and water conservation. WDM guidelines for different economic sectors have been prepared.

### 1.6.6.10 Swaziland

WDM practice has not yet been fully developed to a fine art in Swaziland, but the value of a successful WDM campaign has been recognised beyond any doubt (Eberhard *et al*., 2003). The major components of such a strategy are the following:

- Water awareness
- Advice about water-saving measures
- Public participation
- Setting realistic water conservation objectives
- Using technology to reduce water losses
- Water pricing incentives and punitive measures when there is inadequate consumer co-operation

### 1.6.6.11 Tanzania

Due to the absence of a clear policy framework for promoting efficient use of water, WDM has not been adequately implemented. Some efforts are now being made by the water supply companies and river basin boards to undertake WDM measures in their areas.

**notes**

### 1.6.6.12 Zambia

WDM is being applied, though it is not institutionalised by way of regulations or by-laws. Some WDM measures include the following:

- Having meters on abstractions especially for irrigation purposes is a requirement by The Water Board (S.I. No 53: The Water Board Water Measurement Regulations). This, however, can only be effective with a vigilant monitoring mechanism.
- Payment for water, which encourages efficient use of water because wastage is intrinsically penalised. The Water Board (Charges and Fees) Regulations have encouraged large water users in particular to apply only for the quantities of water that they actually require. Pricing has proven to be a very powerful tool for managing the demand.
- Public awareness campaigns to promote efficient use of water by the water utility companies, various NGOs and the National Water Supply and Sanitation Council.

### 1.6.6.13 Zimbabwe

The Water Resources Management Strategy enunciates strong arguments in favour of WDM.

The approaches specifically mentioned include market-based instruments such as water pricing and technology-based strategies such as reduction of unaccounted-for water, recycling and re-use and improved efficiency in the irrigation sector. In practice, WDM remains largely in its infancy in Zimbabwe. The most notable exception is Bulawayo, which has carried out a comprehensive WDM project embracing both the engineering side together with higher tariffs and public awareness on the consumer side. In the agricultural sector, the 1992 drought stimulated research on technically and economically efficient use of water in the production of irrigated crops.

The status of WDM in some countries in southern Africa is summed up in Table 7. This Table is an update from the original publication by Rothert (2000).

**watch out!**

There are a number of terms used to describe water tariff systems that are designed to increase in cost as the volume consumed by the end-user increases. The terms generally encountered to describe this tariff setting in the region include *block tariffs, escalating tariffs, banded tariffs* and

**notes**

*stepped tariffs*. The term *block tariff* is preferred in this training manual. The alternative to a block tariff system is what is called a flat rate, or fixed tariff, system.

**Table 7: Status of WDM planning and implementation in selected SADC countries**

| COUNTRY | POLICY/ LEGISLATION | NATIONAL STRATEGY OR PROGRAMME | APPLIED IN URBAN SECTOR | APPLIED IN AGRICULTURAL SECTOR |
|---|---|---|---|---|
| Angola | No/no | No | No | Extremely limited |
| Botswana | Developing policy/legislation to follow | Reviewing draft strategy | Block tariffs, leak detection | Extremely limited |
| Lesotho | Yes/in progress | Adopted in 1999 | Block tariffs only | Extremely limited |
| Malawi | Revising policy/legislation to follow | National programme to follow new act | Block tariffs only | Extremely limited |
| Namibia | Yes/in progress | In development | Comprehensive in Windhoek | Limited |
| Mozambique | Under revision | Under formulation | Block tariffs only | Extremely limited |
| Swaziland | Water Bill enacted in 2003 | Water Authority to develop Master Plan | Block tariffs only | Extremely limited |
| South Africa | Yes/yes | National strategy in development<br>Urban providers developing programme | Full programme in a few major cities | Limited application |
| Zambia | Under Revision | Under formulation | Block tariffs in some urban centres | Extremely limited |
| Zimbabwe | Yes/no | Strategy Policy developed | Block tariffs in all urban centres | Extremely limited |

*Source: Adapted from Rothert (2002)*

**a c t i v i t y**

Take a look at the analysis of your country. Do you agree with the synopsis made? Can you provide some examples of the issues mentioned? Would you like to add to or amend it? Use your comments and examples during the development of your WDM implementation plan.

notes

| COUNTRY NAME | ADDITIONS AND CHANGES TO THE SYNOPSIS |
|---|---|
| | |
| | |
| | |
| | |
| | |

Having looked at Table 7, which summarises WDM progress across southern Africa, we can conclude that SADC countries:

- Are at different stages of WDM preparation and adoption
- Seldom have integrated WDM into policies and legislation (Namibia and South Africa being the most advanced)
- Seldom have institutions charged with IWRM, WDM and shared watercourses (Botswana, Namibia and South Africa have)
- Have seldom started with systematic WDM implementation although there are many local initiatives found throughout the region

## 1.6.7 The pursuit of WDM at regional, national and local level

We first examined what WDM is, what measures it involves, and what constraints and benefits affect the adoption of WDM in your situation. We then moved on to get an overview of the state of WDM in each SADC country. Let us continue by broadening our view and considering how WDM is being addressed and applied at regional, national, and local levels amongst southern African countries.

### 1.6.7.1 Regional

The SADC region has the potential to accelerate and support national WDM efforts through shared or common sustainability commitments, the Regional Strategy and Action Plan, and the Shared Water Course Protocol.

#### Shared or common sustainability commitments

The World Summit on Sustainable Development that took place in 2002 concluded with SADC countries committing themselves to two particular WDM actions, namely

- To develop water-efficiency plans by 2005

**notes**

- To improve efficiency of water use and promote efficient water allocation among competing uses

## Regional Strategy and Action Plan

SADC is in the process of implementing the 1998 Regional Strategy and Action Plan for Integrated Water Resources Development and Management (RSAP). Sustainable water resources management is seen as instrumental in achieving an integrated regional economy that achieves poverty reduction, food security and industrial development. The RSAP is one of the clearest indications that WDM is a SADC-supported approach.

The RSAP is based entirely on IWRM, and makes direct reference to WDM in terms of:

- Best management practices
- Water conservation
- Balancing demand and supply
- Promoting allocative and user efficiency

## Shared Water Source Protocol

Much of the available water in southern Africa comes from shared rivers and lakes. As discussed earlier, the Shared Water Source Protocol is a treaty signed by the SADC countries, the aim of which is to improve the equity of distribution of water amongst countries sharing water sources. Although the protocol does not mention the term WDM, it makes clear reference to aspects of WDM in its broad interpretation, including the following:

- Programmes for prevention of the proliferation (increase) of alien plant and fish species
- Evaluation of WDM as an alternative to the use of shared water
- Development of river basin guidelines and standards
- Harmonisation of national water conservation guidelines and standards
- Utilisation of WDM as alternative when environmental impact studies are conducted for new land and water use

## Regional challenges and opportunities

Across the SADC region there are a number of challenges amongst and between countries about WDM. These challenges, which also provide opportunities, include the following:

notes

- Accelerating and supporting country-based WDM efforts by:
  - Pooling and sharing expertise
  - Developing regional instruments like product standards and norms
  - Implementing the RSAP
  - Implementing the Shared Watercourse Protocol
- Integrating WDM into water privatisation and public-private sector partnerships
- Exploring the role of comparative water advantages in regional economic integration and trade
- Building capacity to include and implement WDM in the negotiations and implementation of protocols and multi/bilateral agreements

### The role of international donors and non-governmental organisations

The international community has played a major role in developing and promoting the concepts of IWRM and WDM globally, as well as in southern Africa. Efforts are underway to develop IWRM and WDM training opportunities in southern Africa through Waternet. A water research fund offers opportunities for IWRM and WDM research (WARFSA), and IUCN has promoted the implementation of WDM through a regional project. These are only a few examples of international efforts and projects. It is wise for IWRM and WDM practitioners to check the international and NGO programmes (e.g. websites referred to in this training manual).

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**activity**

What do you think about these constraints and benefits? Can you see opportunities for yourself or your organisation to support the regional development of WDM to meet these challenges? Record your ideas here:

_______________________________________________________________________

_______________________________________________________________________

_______________________________________________________________________

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**notes**

#### 1.6.7.2 National

Individual countries need to develop their own ways of implementing WDM. Some general approaches that countries may need to adopt may include:

- Identifying their own national WDM priority areas
- Integrating the WDM approach and methods into policies and legislation
- Hastening the preparation for and adoption of WDM measures
- Converting or extending the goals of existing institutions or developing new bodies to act as watchdogs and promoters of IWRM and WDM

Within any country, there are a number of clusters or groups of similar water users, like farmers, households, mines, etc. Countries can promote or legislate WDM measures aimed at user groups for the sake of efficiency. Take a look at the following points – can you make further suggestions appropriate to your country and situation?

- **Water planners:** improve allocative efficiency, monitor/regulate self-providers, and provide incentives for WDM
- **Water providers:** reduce leakages and unaccounted water, reuse and recycle wastewater and water from hydroelectric power stations
- **Productive end-users:** increase user efficiency in irrigation, public sector and key industrial and mining sectors
- **Domestic users:** water-wise gardening and removal of invasive aliens, efficient collection/use of water in the home

**activity**

**Discussion questions**

- Discuss the factors that determine the progress made with WDM in countries (e.g. governance and water scarcity).
- Why is WDM not yet integrated in the policies and legislation of most countries?
- Why are few or no institutions charged with IWRM and WDM, and what are the implications?
- What opportunities for enhanced WDM do you consider possible and necessary?

**notes**

### 1.6.7.3 Local level initiatives

Around southern Africa there are a number of local level and municipal initiatives that showcase WDM. There are examples of WDM activities that have been prompted by water shortages and by forward-thinking, visionary leadership. In this regard, Windhoek (Namibia) and Hermanus (South Africa) provide useful examples, which are discussed below.

**e x a m p l e**

**Water conservation in Hermanus, South Africa**

Hermanus is a small coastal town located 120 km east of Cape Town. A dam supplied water, but demand rose beyond the water allocation from the dam, particularly during the peak tourism season, when the population triples. In response, the local authorities designed and implemented a water conservation programme in 1996. The programme included water loss management, clearing of alien vegetation (efficient use of green water), promotion of water-wise gardening, communication campaigns, education and school water audits, retrofitting, and escalating block tariffs and informative billing. The results: a drop in water consumption of 16.5% one year after the project implementation and a drop of 25.5% during the peak seasons (November-February). The results exceeded expectations. Water audits and water loss management proved very effective. The audits led to a 50% decrease of school water consumption.

Water losses decreased from 18 to 11%. Informative billing was appreciated by end-users; retrofitting proved expensive and unpopular.

*Source: Goldblatt et al., 2000.*

This example highlights the fact that substantial savings flow from the implementation of appropriate WDM measures. This ensured end-user buy-in. However, it is also obvious that expensive WDM measures are unpopular.

**e x a m p l e**

**Water conservation in Windhoek, Namibia**

Windhoek has low rainfall (360 mm p.a.) and high potential evaporation (3 400 mm p.a.). Urbanisation, the hidden water demand of low-income groups, and economic growth are expected to put significant pressure on water resources. The city currently relies on surface water (17 $Mm^3$), reuse of water (2.9 $Mm^3$) and groundwater (2.3 $Mm^3$).

Plans exist to expand the reuse of wastewater and the feasibility of artificial recharge is being studied. The city adopted a wide-ranging Water Demand Management Programme with the following components:

**notes**

- Policy measures: block tariffs, abolition of water subsidies, water reuse, smaller plot size, commitment to reduce water consumption by 50%, guidelines for wet industries, new wet industries being required to reuse water, WDM campaigns with information dissemination and WDM advice
- Legislative measures: water control officers, product standards, poll covers, and control of groundwater abstractions inside Windhoek
- Technical measures: leak detection programme and artificial recharge – savings of N$6.8 million per annum (excluding benefits from delayed infrastructural investments) are expected from the implementation of these measures.

*Source: Goldblatt et al. (2000).*

## WDM and irrigation in southern Africa

Irrigation accounts for around 70% of the region's water consumption.

Efficiency rates of different systems vary widely:

- Surface systems 45-55%
- Sprinkler 75%
- Centre pivot mechanical 80%
- Microirrigation 85-90%

*(Macy (1999); IUCN WDM Research paper on 'The costs and benefits of water demand management' (2003)*

A switch from surface to drip irrigation could save up to 45% of water. Surface irrigation is still common (38% in South Africa and 25% in Zimbabwe).

In Swaziland, a switch from dragline sprinkling to drip irrigation saved 1.5 megalitre/ha, led to increased production (volume and value), and led to cost savings of $192/ha (lower operation and maintenance costs).

Goldblatt *et al.* (1999), estimate that 10 to 20% of irrigation water can be saved. A 20% water savings in the agricultural water consumption of South Africa amounts to more than the aggregate water consumption of Botswana, Lesotho, Namibia, and Swaziland together. The savings would be 10 times the expected yields of the Katse and Mohale dams of the Lesotho Highland Water Scheme.

Constraints for WDM in irrigation include no meters, low water prices reducing the benefits of water savings, high costs of new technologies, water payments per hectare and not per $m^3$, and finally, strong agricultural lobby groups.

*Sources: Goldblatt et al. (2000); Lange et al. (1999); Macy (1999); IUCN WDM Research paper on 'The costs and benefits of water demand management' (2003); IUCN WDM Research paper on 'Overcoming constraints to the implementation of water demand management in southern Africa' (2003)*

This example highlights that an assessment of each situation can reveal specific constraints and benefits to WDM, but that the potential for demand management can be significant.

**notes**

**activity**

Having read through these examples, can you think of other examples of WDM in practice in your country? It would be very helpful to all of us working with WDM to learn from each other. Please take the time now to make notes about your local examples, if you have them. Note down the information you already know and make a list of the information you need to source from colleagues or documents. When you have prepared your own case study example, share it with your co-learners.

## 1.7 FINALLY...

- WDM is an integral part of IWRM, but not yet commonly applied in southern Africa.
- WDM can have large economic benefits.
- WDM can be interpreted in a narrow and a broad sense.
- WDM targets different stakeholders, including water planners, service providers and end-users.
- WDM has not yet been widely adopted or implemented in southern Africa.

*Source: IUCN WDM Research paper on 'Incorporation of water demand management in national and regional water policies' (2003)*

**notes**