Water Demand Management

UNIT 2

IUCN
The World Conservation Union

Sida

IDRC CRDI
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Centre de recherches pour le développement international

VERSION 1.1

Municipal WDM

notes

course map

Unit 1: WDM in context

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outcomes

By the end of this unit, you should be able to…

- contextualise your Municipal Water Supply Agency (MWSA) within the water supply chain or web in your country;
- assess the WDM potential for your MWSA and relate this to integrated water resource management and sustainable development;
- map or list the nature of water resources, consumers and users, and demand in your own context;
- list the constraints and incentives affecting WDM implementation for MWSAs and relate these to your own country and situation;
- formulate ideas for exploiting the incentives and overcoming constraints to WDM implementation;
- understand the successes and challenges of some of the municipal case studies in the region, and
- begin to develop your own MWSA's WDM implementation plan using information gathered during the achievement of all the above outcomes.

During the past decade, a drastic change in water governance has taken place in most SADC countries. Many countries have adopted new policies and/or enacted new legislation and revamped the institutional structures of water management. The following countries took this direction in the years indicated in brackets: Lesotho (1999); Malawi (2001); Mozambique (1995); Namibia (2000); South Africa (1998); Swaziland (2003); Tanzania (2002); Zambia (1994) and Zimbabwe (1998).

Two features, which are central to IWRM, are common to all the reforms in these countries:

- Water management is based on spatial hydrological units, each with appropriate institutions.
- Water users and their representatives have a formal role in decision-making about water management.

Most SADC countries have started instituting the reforms on the ground, and now face many challenges.

Among these challenges is a need for fundamental and major change in water governance (institutions and power bases) and the culture of water management. Many government structures may not be appropriate. Change is required from all participants, from the managers and engineers to the end-users. Change (and water) must be managed.

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To do this, effective institutions have to be established.

Source: Adapted from IUCN-WaterNet WDM 'Tertiary Training Module (2003)

In Unit 1 we looked at the generic concepts surrounding IWRM and WDM. In this unit we focus on these concepts as they apply specifically to Municipal Water Supply Agencies (MWSAs), and in the management and change process.

2.1 WHAT IS AN MWSA?

The structures, types of institution, and legal frameworks of municipal water management vary greatly across southern Africa. But though the shape and form vary, we can discuss municipal water management as one subject because entities that deal with municipal water management have much in common. We call this group MWSAs.

MWSAs are typically responsible for an adequate and reliable supply of water to domestic, industrial and commercial users within the private and public sector. They usually face rapidly growing water demand, and may experience political pressures to keep costs down and to improve water access. The role of MWSAs in water policy making is usually limited, and hence they have to operate largely within a given enabling or disabling environment. Moreover, their control over water tariffs varies, but is often limited, particularly when council or ministerial approval of the tariffs is required.

Discussing WDM and MWSAs therefore relates to *direct* WDM actions that MWSA managers can decide upon and implement (e.g. metering, leakage reduction, pressure control) and *indirect* WDM actions that they can take to promote WDM among end-users and to encourage policy makers to establish a favourable WDM environment.

Municipal water management covers one part of the water management cycle. Municipal water managers are able to make a significant impact on water management practices in their areas. The case studies discussed in this unit bear testimony to how water demand management – even in small towns – can guide and inform water management in a whole country or region.

Municipal water management mainly refers to urban situations but may also cover rural areas such as large villages and towns.

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2.2 MWSAs AND WDM

2.2.1 WDM in the MWSA

The main components of a WDM plan include the following:

- An enabling policy environment for end-users and the MWSAs
- Appropriate institutional set-up within the MWSA
- Appropriate measures and implementation taken by the MWSA
- Appropriate measures and implementation taken by the end-user

Specifically, municipal water managers can make a substantial impact on the enabling environment. MWSAs can improve the enabling environment by altering by-laws, introducing water conservation standards and norms, incentives and deterrents, and by showcasing their own implementation of WDM as large water users.

The objective of a WDM plan for an MWSA should be to implement WDM measures for itself (setting up monitoring and reporting systems) and to promote the implementation of WDM measures by end-users and bulk water suppliers that are economically, environmentally and socially beneficial. Therefore, the WDM plan must be conceived within the broad cadre of IWRM and integrated least cost planning.

2.2.2 Sustainability in the context of an MWSA

Sustainability is a concept that has different meanings in different contexts. MWSAs have to examine the *economic*, *social* and *environmental* sustainability of their water services. Economic sustainability refers to the efficiency of water service provision and the MWSA's ability to continue to provide services in future. Social sustainability refers to the ability of the MWSAs to provide affordable water and to make sufficient water available to all residents and productive activities.

A broad definition of environmental sustainability states that economic growth and development must take place, and be maintained over time, within the limits set by ecology in the broadest sense – by the interrelations of human beings and their works, the biosphere, and the physical and chemical laws that govern it. Environmental protection and economic development should be seen as complementary processes.

However, sustainability in the context of the field of service provision of the MWSA relates to whether water continues to be available for the period for which a specific scheme, programme or initiative was designed. The water must also be available in the quantity and quality that was originally planned for.

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Put differently, if a consumer turns on a tap in 15 or 20 years' time and water is available at the same rate and quality as the day the scheme was commissioned, then a sustainable supply has been achieved.

The proviso here is that the scheme must have been maintained throughout the period. If the water flows, then this implies that all elements that are required for sustainability have been in place. This means that during this time there has been:

- Money for recurring expenses
- Money for repairs
- Consumer acceptance of the service
- An adequate supply from the source
- Sound construction
- Monitoring in place
- Proper operation and maintenance
- Rapid response to faults and complaints by service provider
- A capacity building programme
- Adequate competent staff

It further implies that the original design or planning was done properly.

Sustainability can be achieved through WDM. In fact, sustainability is one of the key objectives of WDM.

Source: Adapted from The Water Page URL: http//wwww.thewaterpage.com

To ensure sustainability one must be certain of what resources are available.

2.2.3 Municipal water sources

It is important that MWSAs have full insight into the nature and use of their water sources. Some MWSAs source their own water, but others obtain their water from bulk water suppliers (treated or untreated), such as water boards in South Africa and NamWater in Namibia. Examples of bulk water suppliers in some counties in the region are listed in Table 1. MWSAs may obtain water directly or indirectly from the following resources:

- Fresh surface water
- Fresh groundwater
- Reuse of return flows.

Use of this last source is growing in many countries because of sanitation improvements, yet it is an easily forgotten resource,

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particularly when responsibilities for water service provision and wastewater treatment are institutionally separated.

The quantity and quality of water sources, as well as the reliability of supply, for example during droughts and due to global climate change, are extremely important.

Table 1: Bulk suppliers of water in SADC countries

COUNTRY	BULK SUPPLIER
Angola	• Department of Water Affairs (DWA)
Botswana	• Department of Geological Survey (DGS) • District Council (DC)
DRC	• Department of Water Affairs (DWA)
Lesotho	• Lesotho Highlands Development Authority (LHDA)
Malawi	• Catchment Management Authority (CMA) • Water Boards (WB)
Mauritius	• Water Resources Unit (WRU) • Central Water Authority (CWA) • Irrigation Authority (IA) • Central Electricity Board (CEB)
Mozambique	• National Directorate of Water (DNA) • National Directorate for Irrigation (DNHA) • Regional Water Authority (ARA)
Namibia	• NamWater
South Africa	• Department of Water Affairs and Forestry (DWAF) • Water Boards (WB)
Swaziland	• Department of Water Affairs and Forestry (DWAF) • Water Users Association (WUA) • River Basin Authority (RBA)
Tanzania	• Department of Water Affairs (DWA)
Zambia	• Water Boards (WB) • Zambezi River Authority (ZRA)
Zimbabwe	• Zimbabwe National Water Authority (ZINWA) • Regional Water Authority (RWA) • District Development Fund (DDF) • Municipalities

Source: IUCN WDM Guideline on 'Suppliers of bulk untreated water' (2004)

2.3 MWSAs IN ACTION

2.3.1 The municipal water supply chain

We discussed the hydrological cycle and the water management cycle in

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Unit 1. Let us now look at the municipal water supply chain.

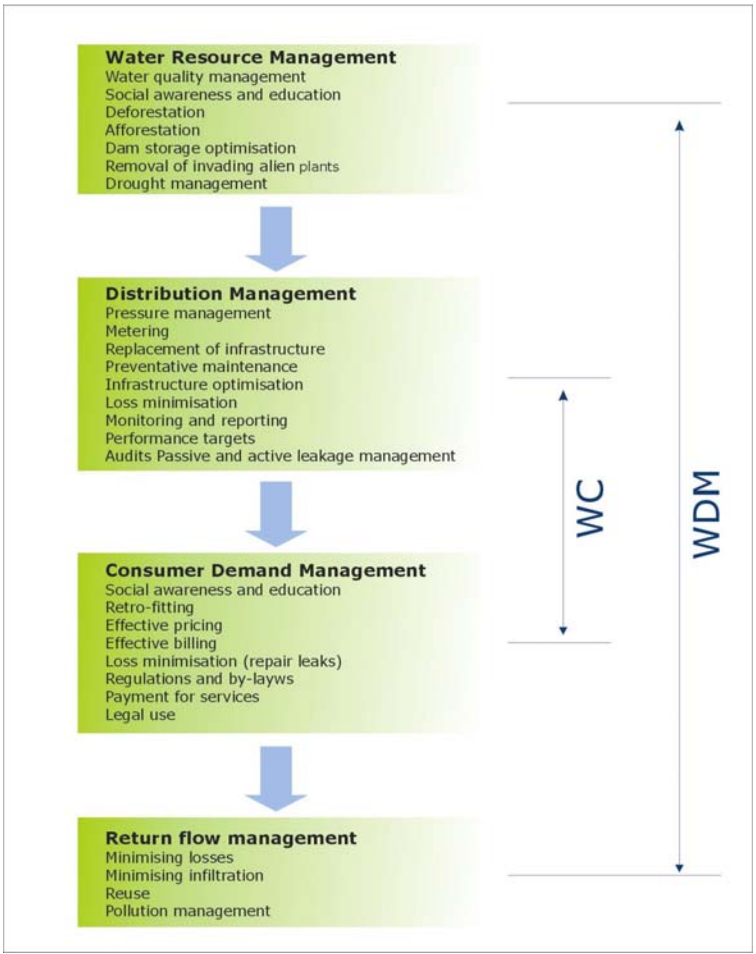
This chain consists of the following stages:

- Water resource management
- Water distribution management
- End-user efficiency and demand management
- Return flow management

WDM measures need to be targeted towards specific stages in the water supply and management chain.

The South African Department of Water Affairs and Forestry (DWAF) has illustrated possible WDM measures at each management stage as illustrated in Figure 1. However, the line between Water Conservation (WC) and WDM as defined by DWAF (2003) becomes thin, and the best results are achieved when both are pursued simultaneously. As Figure 1 illustrates, WDM is broader than WC and all WC measures fall within WDM.

Figure 1: Typical WDM and WC activities throughout the water supply chain



Source: Modified from DWAF (2003)

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2.3.2 MWSA clients

In the course of their business of sourcing and supplying water, MWSAs typically deal with one or more of the following institutions:

- Bulk suppliers (raw or treated water), located within government, parastatals, autonomous suppliers
- Water management institutions
- Regulators
- End-users (subdivided into groups such as domestic users, industries and the private and public service sectors)

activity

What institutions and organisations does your MWSA deal with? Map your institution in terms of its place in water management in your country by answering these questions:

- From whom do you source water?
- To whom do you supply water?
- Which are the main Acts and regulations that affect you?
- Which government departments affect or control your MWSA?
- Which sectors of the economy rely on your MWSA for water supply and/or management?

Use this information later when you formulate your WDM plan.

2.3.3 Accountability of an MWSA

WDM in municipal areas is a shared responsibility of all stakeholders (not just governments or MWSAs). In South Africa, DWAF has made this clear in several WDM principles that they have formulated:

- Water institutions should endeavour to supply water efficiently and effectively, minimising water losses and promoting WDM among end-users.
- Consumers should not waste water, and should use it efficiently.
- WDM should be considered as integral parts of the water resources and water service planning process.

But who is accountable to whom? Theoretically, in most countries, the officials of the MWSA are accountable to the councillors, who in turn are accountable to the electorate. However, in practice, with the changes in

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service delivery models such as privatisation and commercialised utilities, these lines may become obscured.

For example, a water regulator institution may be established to guide and evaluate the operations of MWSAs.

activity

In South Africa, WDM objectives have been formulated for water service providers, covering the following four areas:

WATER RESOURCE MANAGEMENT	
Objective	Ensure adequate information to support decision-making.
Objective	Adopt the ethos of partnerships and transparency.
Objective	Adopt Integrated Planning (IP).
Objective	Ensure the implementation of WDM best practises in new developments.
Objective	Contribute to the Catchment Management Strategy (specifically South African).
Objective	Ensure adequate institutional and financial capacity.

WATER DISTRIBUTION MANAGEMENT	
Objective	Implement efficient distribution management measures.
Objective	Ensure adequate institutional and financial capacity.

END-USER EFFICIENCY AND DEMAND	
Objective	Promote the efficient use of water to consumers and customers.

RETURN FLOW MANAGEMENT	
Objective	Implement efficient water effluent management measures.
Objective	Ensure adequate institutional and financial capacity.

Discuss and evaluate the relevance of the South African objectives for your municipal water supply and management chain. Think about the WDM implementation plan that we will be formulating in Unit 4 and establish whether these objectives apply to your own country. Are there others you could add?

2.4 INTEGRATED LEAST COST PLANNING

The ultimate challenge for government is to minimise the cost of water to the end consumer as though each party in the water supply and management chain was integrated into one body. Integrated Least Cost

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Planning (ILCP) aims to keep the water supply costs to end-users as low as possible by considering the effectiveness of the entire water chain from producer to end-user. The crux of ILCP can be expressed as follows:

If there were one *institution* comprising the entire infrastructure that had to provide water, and if that *theoretical institution* had the skills and knowledge to make the optimal decision (least cost to the end consumer), what decision would that *institution* make? We will explore water tariff design and other financial options further in section 3.4.2 of Unit 3.

So how would we make that decision, bearing in mind that we cannot physically integrate all the role players?

example

A simple theoretical example of application of the concept of ILCP is illustrated below. An MWSA gets its bulk water at a cost of US$0.75/m^3, and has own production costs of US$0.50/m^3. Therefore, the total supply costs are US$1.25/m^3. The MWSA will be interested primarily in reducing its own costs, and hence will focus on reducing the US$0.50/m^3. However, there may be more scope to reduce the cost of bulk water supply, i.e. to reduce the US$0.75/m^3. From an ILCP perspective, measures to cut the costs of bulk water and water distribution are equally important, and need to be considered.

INSTITUTION	WATER SUPPLY COSTS PER CUBIC METRE	ILCP ISSUES
Bulk water supplier	US$0.75	Cheapest source of supply?
MWSA	US$0.50	Lowest cost in terms of treatment and distribution?
Total water costs	US$1.25	Is it possible to reduce the total water cost by improving on any stage in the water supply chain?

ILCP is therefore a methodology that determines the effectiveness of infrastructure augmentation decisions and is a measure of whether or not the right decision is being made. It is of little use making efficient decisions if they are not effective.

case studies

Opportunities for introduction of ILCP

Lack of ILCP could be one of the reasons for the high water tariffs in Gaborone, Botswana (higher than in Namibia, where similar or worse water scarcity problems exist). It is possible that the North-South Water carrier, constructed in the 1990s to supply Gaborone, was not the least-cost

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supply option. Namibia may have selected more effective supply and management interventions that have kept the costs of water down.

In Walvis Bay, the two main utilities - water supply and electricity supply – cross-subsidise other services, such as roads, sewerage, and sanitation, and keep the municipality profitable or viable. In this case, supplying the cheapest possible water to the end-user is not the main aim. If the focus were shifted towards ILCP, then rates, taxes, and tariffs may need to be restructured to ensure viability.

In Zimbabwe, unlike in Walvis Bay, municipalities do not supply electricity, regarded as one of the large money-spinners in service provision and so cannot use this as a source of income. Further, the bulk water supplier (ZINWA) has to make a profit. The municipality sets its tariffs through a public consultation process involving the central government, which tends to lead to low tariffs, which do not recover the costs of raw water purchases, treatment, and distribution.

Because of this fragmentation, there is no institutional framework to adopt the ILCP approach. An apparent clash of interests between the bulk supplier, MWSA, and the consumer, and a lack of transparency in setting water tariffs, results in the MWSA being caught up between the interests of the bulk water supplier and the consumer. This leads to an operating loss for the MWSA.

In Zambia, the National Water Supply and Sanitation Council (NWASCO), as the regulator of MWSAs, has assumed the role of applying the ILCP concept through the whole water supply chain, as it gives final approval for water tariffs. The existence of high levels of Non-Revenue Water (NRW), and the poor levels of service provided by MWSAs have been found to be a problem for the MWSAs in tariff setting, as NWASCO takes these into account. This, together with a public participation process of setting tariffs, might result in viability problems for MWSAs.

Source: Remarks made by participants of the pilot IUCN 'Guideline Training Module for Municipal Water supply Agencies' Lusaka, Zambia (2004)

watch out!

The consumer is the last link in the water supply chain: the tariff paid by the consumer is the sum of all the costs added by the different institutions in the chain. Many different institutions are involved in the water supply chain, and most of them have a monopoly on their tasks. There is not much incentive for minimising costs.

2.5 MOTIVATION FOR WDM

Drought, water stress, and water scarcity are often the strongest incentives for MWSAs and end-users alike to implement WDM. As water demand continues to grow, a choice must be made either to augment water supplies or to limit demand. At this stage, MWSAs have strong

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incentives for implementing WDM measures prior to investing in new water augmentation schemes. Other more obscure but still important reasons for implementing WDM are related to efficient resource use, re-allocation of the resource among competing needs, and equity. The ultimate goal is the implementation of IWRM to ensure sustainability, as discussed in Unit 1.

Direct incentives for MWSAs to adopt WDM measures include the following:

- The escalating costs of new water augmentation schemes
- Financial viability of MWSAs and economic incentives
- Increasing reliance on non-renewable water sources
- High water leakages
- Inefficient water use by end-users

Generally, we can group reasons for WDM into social, financial, and environmental reasons. These are discussed below.

2.5.1 Social reasons

- The saved water can be used to allocate to people without access to water, and to attract new industries and services, hence creating more local employment.
- Better service can be delivered due to reduced water losses.
- Improvements in health can be effected.
- MWSAs are seen to be acting responsibly and as setting a good example.
- MWSAs are seen as providing good customer service, which may lead to a rise in levels of payment for services.
- WDM awareness is raised amongst consumers.
- MWSAs contribute towards maintaining affordable water tariffs.
- Efficient water use through WDM safeguards water resources for current economic growth and for future generations.

2.5.2 Financial reasons

- Greater flexibility and incremental implementation options allow costs to be spread over time.
- The charges to end-users can be kept down.
- WDM measures often have benefit/cost ratios in excess of 10:1 in urban settings.

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- The need for an increased capacity for water and wastewater treatment may be delayed.
- WDM may lead to reduced operation and maintenance costs.
- More efficient water consumption can contribute to better and more effective expenditure planning of capital developments.
- WDM may initially result in reduced water sales but it may also lead to a larger customer base through improved affordability, and better service delivery.
- WDM may lead to a reduction in unpaid-for water losses and unaccounted-for water (UAW) through leak detection and repair in the water supply network, and on private premises.
- Financial ring-fencing of water supply and sanitation services retains revenue within the budget control of those departments. This revenue is then available for maintenance programmes, improved service delivery and even expansion of services.
- WDM can enable MWSAs to deal with drought periods without resorting to expensive augmentation projects, or the application of restrictions or punitive tariff structures.
- Implementing WDM measures such as improved maintenance leads to more effective operation and efficiency in the delivery of water services, reducing the MWSA's own losses.
- Consumers benefit directly from their changed behaviour by reducing their water bills.

2.5.3 Environmental reasons

- More water is left for environmental use.
- WDM promotes sustainable use of water resources by introducing water-efficient practices.
- Pollution levels in water resources may drop as a result of MWSAs applying punitive effluent-quality tariffs to industrial water users as part of an integrated management approach.
- Artificial recharge of underground aquifers with water from surface sources can lead to a saving in evaporation loss.

Source: Adapted from the IUCN WDM Guideline for 'Municipal water suppliers' (2004)

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2.6 WDM CONSTRAINTS

Constraints to WDM are those factors that defer or prevent the adoption or implementation of WDM measures. As WDM is not yet widely implemented, we must conclude that:

- WDM constraints are powerful and prohibitive, and/or
- WDM measures are not widely and properly understood.

What information do we have available to us about WDM constraints in southern Africa? What is really happening around us that blocks the implementation of WDM in the region? We have the following information:

- Various lists of constraints from different authors and studies
- Different ways of saying or expressing similar constraints
- Quick-solution theories, whose empirical or practical value is not really tested.

We do not aim to add yet another list of constraints and vague solutions to those already available. Rather, we will equip you to recognise the most important constraints that you face, organise your understanding of the constraints, and then develop and implement coping strategies.

2.6.1 Understanding constraints

The key to understanding constraints lies in organising your thinking about them and mapping the constraints themselves. You should find the following helpful:

- Identify and structure the constraints.
- Analyse the constraints at different spatial levels – national, district and local.
- Design and implement strategies to cope with constraints and mitigate them.

2.6.1.1 Structuring constraints

Let us begin by identifying and organising the constraints we face as a region. Useful categories of WDM constraints include the following:

- Information and awareness
- Competence and capacity of MWSA
- Lack of cooperation between the technical and financial departments of MWSA
- Infrastructure

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- Habits and attitude
- Policy and regulation
- Costs and benefits
- Uncertainties
- Macroeconomic conditions
- Lack of WDM champions or leadership
- Lack of awareness and political support from top management

It is important for the MWSA to structure the constraints by groups of stakeholders (e.g. water managers, end-users, financiers, councillors, MWSA and suppliers).

2.6.1.2 Analysing constraints of various stakeholders

We need to extend the organising power of the constraints categories by determining at what scale – national, district, and/or local – each category of constraint operates (you may wish to have a second look at section 1.6.5). This will help us understand the importance of each constraint, and enable us to develop a solution that will work at the appropriate scale.

We will use real examples of constraints, and real information from across the region, to explore the issue of scale as applied to the categories we have.

Set out below is a series of nine tables, one for each of the nine constraint categories, indicating whether each constraint is to be found at national, district, and local level across southern Africa. The information in the tables is derived from a variety of sources and refers to the state of WDM in the region as a whole. Examine each table and decide whether you agree with the assessment of the constraints. Consider how that category of constraints impacts on your country – at national, district and/or local level.

Table 2: Information and awareness

INFORMATION AND AWARENESS	NATIONAL	DISTRICT	LOCAL	TREND
Lack of awareness about water scarcity	☒	☒	☒	Confusion and uncertainty
Lack of awareness about WDM contents	☒	☒	☒	Gradually improving
Lack of awareness about roles and responsibilities for WDM	☒	☒	☒	

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Table 3: Human and financial resources

WDM CAPACITY	NATIONAL	DISTRICT	LOCAL	TREND
Lack of human resources and skills	☒	☒	☒	Most pressing at local level
Lack of individual WDM champions to push WDM	Often	Often	Some are found	Improving
Lack of financial resources due to focus on capital investment on grand water supply schemes, non-payment for services and use of water revenues in other sectors	Capital investment bias		Non-payment	Little change
Lack of special WDM funding	☒	☒	Some are found	Often
Lack of coordination through the water supply and management chain				Slowly improving
Lack of technical know-how about WDM measures	Often		☒	

Table 4: Infrastructure

INFRASTRUCTURE	NATIONAL	DISTRICT	LOCAL	TREND
Old and poorly maintained water infrastructure	☒	☒	☒	Varies from country to country
Lack of metering	☒	☒	☒	Varies from country to country

Table 5: Habits and attitudes

HABITS AND ATTITUDES	NATIONAL	DISTRICT	LOCAL	TREND
Resistance to change by water service institutions	☒	☒	☒	Slowly subsiding
Traditional supply bias among water institutions	☒	☒	☒	Slowly subsiding
Lack of political will and commitment	☒	☒	☒	Improving
Protection of interest in supply interventions	☒	☒	☒	Slowly improving
WDM is only for drought relief	Arid countries	Arid countries	Arid countries	Improving as benefits beyond droughts become visible

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Table 6: Policy and legislation

POLICY AND LEGISLATION	NATIONAL	DISTRICT	LOCAL	TREND
No WDM incorporation in policy and legislation	Most countries	Most countries	Most countries	Improving in countries such as Namibia, South Africa and Botswana
Low priority for WDM amongst activities of water institutions				Improving as WDM can assist water delivery elsewhere

Table 7: Costs and benefits

COSTS AND BENEFITS	NATIONAL	DISTRICT	LOCAL	TREND
WDM difficult to achieve in the presence of water subsidies	☒	☒	☒	Subsidies are being reduced
WDM costs are often upfront costs that also may lead to lower revenues of water institutions	☒	☒	☒	
O&M costs are traditionally neglected	☒	☒	☒	
Lack of systematic cost-benefit analysis/comparison	☒	☒	☒	Growing awareness for the need for efficiency assessment

Table 8: Uncertainties

UNCERTAINTIES	NATIONAL	DISTRICT	LOCAL	TREND
Results appear less tangible and secure	☒	☒	☒	Improving with more case studies becoming available
Full implications of WDM not easy to predict	☒	☒	☒	Improving with more case studies becoming available

Table 9: Macroeconomic conditions

MACROECONOMIC CONDITIONS	NATIONAL	DISTRICT	LOCAL	TREND
Shortage of government funds for water and WDM	☒	☒	☒	Volatile and large differences between countries.
Governance	☒	☒	☒	Large differences between countries.

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Table 10: Water scarcity

WATER SCARCITY	NATIONAL	DISTRICT	LOCAL	TREND
Water may not be perceived to be scarce, or scarce enough for WDM.	☒	☒	☒	Large variations among and within countries

activity

Work in groups to discuss and review the contents of the tables above with reference to your country and MWSA. Discuss whether there are gaps or inaccuracies in the information about each constraint as applied to your country. Amend the constraints or add new ones where necessary.

Overview of constraint trends in southern Africa

Having worked through the categories of WDM constraints, let us consider what conclusions we can draw from the information about the constraints and trends in constraints across the region. After this, it will be time to see how the constraints can be overcome. The research available indicates the following:

- Constraints are wide ranging and span several categories or themes, and apply differently at different spatial levels.
- Large variations in constraints exist amongst southern African countries.
- Many constraints seem to be easing and hence the potential for WDM implementation is improving.
- Countries with the most comprehensive WDM approach face serious water scarcity and have relatively good governance.
- Constraints change over time.
- Most importantly, WDM strategies need to work under different macroeconomic conditions.

activity

Would you like to add to this list any other conclusions you may have reached as you worked through the tables?

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2.6.2 Overcoming constraints

We have organised our thinking about constraints into categories and assessed at what scale to place those constraints. Let us now move to our purpose goal for understanding constraints: overcoming them!

In the second phase of IUCN's WDM project, information was gathered about the solutions that had been developed to overcome various constraints and problems. In addition, researchers and practitioners involved in the study also identified the stakeholder group at which the solution would be *aimed*.

activity

Refer to the list of constraints in Table 11, take a close look at each constraint, the solution posed, and the stakeholder identified.

In groups, discuss what trends have existed in the constraints listed in the table over the last ten years, in your country.

- Review the solutions given for overcoming the constraints. Will they work? Are they sufficient?
- How can greater participation by end-users, particularly women, assist in overcoming the constraints?

How could traditional knowledge and water management practices be used to overcome constraints? Imagine that you are the Minister of Culture. The Minister of Water has consulted you about supporting WDM. What are the things you would do to promote traditional knowledge and water management practices to fight WDM constraints? Would these strategies have an impact on human resource constraints?

For each constraint, formulate a strategy that would be appropriate to your situation. Be as specific as you can.

Add any new constraints your group has identified, rank them according to which are the most pressing, and the most prevalent in your country.

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Table 11: WDM constraints and solutions

CONSTRAINTS	SOLUTIONS	STAKE-HOLDERS
• Inadequate public funds for water provision due to macroeconomic problems	• Budget adequately for water and redirect funds to most efficient solutions.	Water managers/ planners
• No private sector investment	• Mobilise private sector investments.	
• Lack of WDM understanding/misconceptions	• Educate and raise awareness.	
• Water abundance	• Design and implement WDM/IWRM policies and strategies, including guidelines.	
• Aged and incomplete infrastructure	• Improve operation and maintenance and mobilise adequate funds for expansion.	
• Political interference	• Raise awareness and win political support.	
• Lack of effluent standards	• Develop standards for water quality, effluent, and products.	
• Available data are not analysed, particularly in cost terms	• Conduct research and data analysis. If necessary increase research capability and skills.	
• Lack of financial resources.	• Earmark extra revenues for WDM. Mobilise private sector funding, e.g. through public-private sector partnerships.	Water Service Providers
• Lack of human resources, particularly at district level.	• Source external multidisciplinary and IWRM expertise.	
• Bias towards supply augmentation due to vested interests of consultants and decision-makers.	• Conduct compulsory comparative analysis of supply and demand management options.	
• More difficult to implement.	• Incorporate WDM training and applications. Change attitudes.	
• Lack of WDM understanding/misconceptions	• Change attitudes and broaden skills across disciplines by incorporating WDM training	
• Lack of metering of end-users and high levels of UAL.	• Make use of technical measures (loss reduction, metering, pre-paid systems)	
• Poor revenue collection	• Apply improved computerised billing systems.	
• Improperly designed financial instruments (e.g. flat rates related to area and not water units).	• Adopt appropriate water tariff system and pricing strategy.	

Source: Adapted from IUCN WDM Research paper on 'Overcoming constraints to WDM implementation' (2003)

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case studies

2.7 WDM PROGRAMMES AT MUNICIPAL LEVEL

Southern Africa has several local level WDM programmes, perhaps the best known being Hermanus in South Africa, Windhoek in Namibia, and Bulawayo in Zimbabwe. WDM programmes have also operated in Kwekwe in Zimbabwe.

One of the most commonly quoted indicators of a successful WDM programme for an MWSA is the level of Unaccounted-for Water (UAW), also called Non-Revenue Water (NRW). In the case studies described in this section, NRW is used as a measure of water use efficiency. The concept of NRW and its use as an indicator is explained in more detail in Unit 3. A simple definition of NRW is that it represents the difference between *net production* (the volume of water delivered into a network) and *consumption* (the volume of water that can be accounted for by legitimate consumption, whether metered or not, i.e. revenue water).

NRW = net production – legitimate consumption, metered or unmetered

2.7.1 Hermanus

Background

- Small coastal town in South Africa; first municipal WDM programme
- Rainfall of 760 mm p.a.
- Population of 24 000, but 70 000 during peak tourist season (November – March)
- Situated in a winter rainfall area, therefore the tourist season is also the dry season.
- Current supply: De Bos dam with a safe yield of 2.8 Mm^3 p.a., believed sufficient until 2005. Proposal to raise the dam wall and capacity and safe yield (4.1 Mm^3). Hermanus exceeded 2.8 Mm^3 in 1994 with a maximum of 3.1 Mm^3 p.a.

WDM reasons

Water demand rises beyond the water allocation from the dam, particularly during the peak tourism season, when the population triples.

notes

WDM measures

The local authorities designed and implemented a water conservation programme in 1996. WDM programme objectives:

- Save 30% of water in three years
- Increase revenues by R1.1 M p.a. to finance water conservation

The programme is based on common resource economics principles such as the user pays principle (UPP), the polluter pays principle (PPP), lifeline payment structure (subsidised/free water in lowest user band), and sustainable financing of local authorities.

The programme included the following measures:

- Water loss management
- Clearing alien vegetation
- Water-wise gardening with 26% of water consumption for gardening (two demonstration plots)
- Water-wise food production
- Water regulations
- Intensive communication campaigns
- Education and school water audits
- Retrofitting (difficult and expensive)
- Escalating eleven block tariffs
- Assurance of supply tariff to deal with empty houses
- Informative billing
- Security-prepaid system for Mount Pleasant

Results of WDM measures

- Reduction in water consumption by 25.5% in summer months of year cf. previous three years, drop of 16.5% after one year (only based on water tariffs).
- Decline in NRW from 18 to 11%.
- Cost savings
  - 20% drop in peak time O&M costs (electricity, treatment, pumping, sewerage)
  - Savings on infrastructural costs: deferring new capital works; less pressure on network; savings on pumping costs
- Impact of tariffs on consumption needs further investigation.

notes

- Very positive responses to informative billing. Increased public awareness about the need for water conservation.
- Water audits and water loss management proved very effective. The audits led to a 50% decrease in school water consumption.
- Retrofitting proved expensive and unpopular among house owners, and difficult because the right products were not available.

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2.7.2 Windhoek

Background

- Average rainfall: 360 mm p.a. – evaporation 3 400 mm
- Nearest perennial river: 700 km
- Population: 213 000 (1998)
- Table 12 summarises actual and potential water sources

Table 12: Actual and potential water sources of Windhoek

WATER SOURCE	DETAILS	DISTANCE	CAPACITY	SAFE YIELDS
Boreholes	50			1.93 Mm^3 pa.
Dams	Avis dam (1933)	Close	2.4 Mm^3	0
	Goreangab dam (1959)	Close	3.6 Mm^3	1.1 Mm^3 pa.
	Von Bach Dam (1940)	70 km	48.6 Mm^3	
	Swakoppoort dam (1977)	100 km	63.5 Mm^3	
	Omatako dam (1982)	200 km	43.5 Mm^3	Aggregate of 3 dams is 20 Mm^3 (17 for Windhoek)
Reclamation	Goreangab water reclamation plant		2.9 Mm^3 in 1999; new plant of 7.7 Mm^3 ready in 2000	2.1 Mm^3 used in 1999

notes

WATER SOURCE	DETAILS	DISTANCE	CAPACITY	SAFE YIELDS
Reuse of treated effluent	Dual pipeline system with 99 clients			1.2 Mm^3 used in 1999
Artificial recharge	Reduction of evaporation	Close		Savings of 1.2 Mm^3

Notes: 1. Von Bach, Swakoppoort and Omatako dams are managed integrally with water transfers increasing the safe yields from 13.7 to 20 Mm^3 and reducing evaporation by 6 Mm^3.

2. The water production of three dam systems in 1997 was 15.7 Mm^3, while evaporation was 35.5 Mm^3. There are good grounds for artificial recharge with the capacity of the aquifer at around 50 Mm^3.

WDM reasons

- Water scarcity
- High population growth
- Full exploitation of WDM measures would lead to a decline in water consumption to 33% of the unrestricted level.

WDM measures

- Reuse of treated effluent for irrigation and industrial use through dual water reticulation system, with the following consequences:
  - 1.14 million m^3 made availabe for irrigation of fields, parks, etc. in 1997 with 99 consumers.
  - The reduction of the normal quota of 1 $m^3/1\ m^2$ to 0.7 m^3/m^2 during drought. A penalty tariff of double normal tariffs was applied if the quota is exceeded.
  - After completion of Goreangab Water Reclamation Plant in 2000, unrestricted high-quality irrigation water became available.
  - Irrigation increased by 400%.
- The installation of a citywide dual water system would be at least three times as expensive as upgrading effluent to potable water standards.
- Reclamation of wastewater for direct use was started in 1968.
  - Capacity was 8 000 m^3/day or 18.8% of daily potable water consumption.
  - Production costs of the water are same as NamWater costs (N$2.40/$m^3$).
  - New extension plant in 2000 with water costs of N$2.50/$m^3$ or only 42% of production costs of water carrier from Okavango.

notes

- Savings from WDM measures are estimated at 18 Mm^3 p.a., roughly equal to the cost of the emergency Okavango pipeline scheme (17.3 Mm^3).
- Per capita water consumption down from 329 L/d/capita in 1991 to 217 L/d/capita in 1999.
- Health risks are controlled by the stipulation that a maximum of 35% of the potable water may be reclaimed.
- **Water pricing**
  - Block tariffs
  - Polluter-pays principle
- **Public awareness campaigns**
  - Media
  - Schools
  - Communities
  - Training of gardeners in water management
- **Legislation**
  - Use of water-efficient appliances
  - Plumber registration
  - Water meters on boreholes
  - Swimming pool covers
  - Garden watering timing regulations (banned between 10:00 and 16:00)
  - Water control officers
  - Compulsory retrofitting
  - Control over groundwater abstractions
- **Operational practices by MWSAs**
  - System replacement programme
  - Telemetry control system to monitor out flows of reservoirs and shut when pipes burst
  - Effective water meter management
  - Decreased municipal water use
  - Water audits
  - Regular meter readings
  - Decrease in NRW
- **Artificial recharge**

notes

Costs of WDM

Cost of WDM measures	Around 4.2N$ cents per m^3 less than 1 % of the estimated income on the water account.
Costs of WDM implementation	N$0.64 million cf. estimated total water expenditures of N$75.5 million in 1998/99.
Revenues	Maximum of 1 % on income from water account.

Results of WDM measures

- Water needs from conventional sources in 1997 lower than in 1987, while the population doubled.
- Dual irrigation system has led to savings of 6.6 % on potable water.
- Savings of reclamation of water estimated at 18 %
- Stabilisation of total water consumption and a decrease in per capita water consumption (savings of at least 30 % in 1997)
- Lower water production costs
- Deficits for MWSAs
- Delay in capital investment saves an estimated US$8.7 million p.a.
- Potential water savings estimated to be 30 to 42 %.

References

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notes

2.7.3 Bulawayo

Background

- Average rainfall is 500 to 600 mm p.a.
- Population: 920 000 in 1996/97
- Nearest perennial river: 500km
- Table 13 summarises the existing water supply sources for Bulawayo

Table 13: Current water supply sources for Bulawayo

SOURCE	DETAILS	CAPACITY	SAFE YIELDS
Umzingwane river	5 dams	353 Mm^3	Adopted 48 Mm^3 pa. (4 % safety level)
Aquifer	Local	3.7 Mm^3 poor quality	
	Nyamandlovu Aquifer with 68 boreholes	4.4 Mm^3 pumping capacity; needs rehabilitation; no current pumping	
Reclaimed water			27 Mm^3 pa.

Possibilities for expansion

- Rehabilitation of Nyamandlovu well field
- Umguza well field
- Four new dams
- Zambezi pipeline

WDM reasons

- Water supply constraints and water scarcity
- Recurrent droughts
- Consumption determined by availability not demand
- Programme implemented by the local authority. In 1993, a Water Conservation Study was carried out, identifying the following high priority measures:
  - Reduction of NRW
  - Retrofitting
  - Recycling effluent (direct and indirect use)
  - Tariff incentives
  - Public awareness
  - Developing new ground water sources

notes

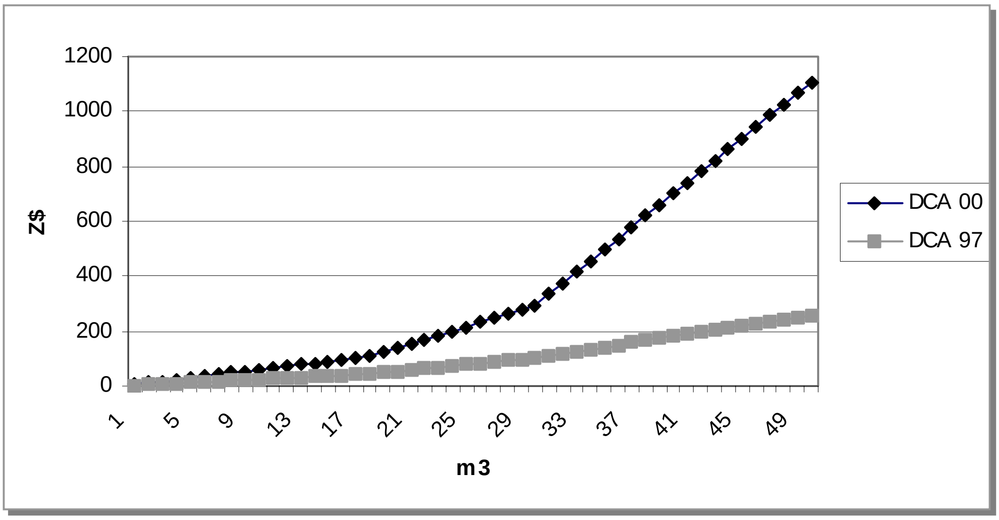
WDM measures

The overall strategy focuses on loss reduction programme to the point where the benefits equal the costs of implementing the programme.

- All connections are metered
- Revision of tariff structure in 1996
- Block tariff with thresholds at 18 and 30 m^3/month/ household
- Tariffs are supposed to be based on long-run marginal cost (LRMC), but are still far below this level
- Water rationing, including a regular ban on use of hose pipes
- Norms for rationing:
  - 800 L/day/metered house
  - 400 L/day/bulk metered flats and cottages
  - 100% of average water use June-Nov 1994 for hotels, hospitals, industrial and commercial users
  - 100% of entitlement for irrigation scheme
  - No water allowance for swimming pools, weddings and other gatherings
  - No use of hosepipe for industrial users
  - For first leakage offence: tariffs + 50% penalty
  - For second offence: tariffs + 75% penalty
  - For third offence: tariffs + 100% penalty
  - For further offences, services are terminated.
- Reduction of NRW
  - Average NRW 1992 – 2002: 23%
  - Average NRW 1997 – 2002: 16%
- Recycling of sewage effluent for non-potable uses. An average of 8 000 m^3/day is reclaimed and re-used for irrigation (Macy, 1999).
- Water tariffs have increased rapidly, as shown in Figure 2 below for domestic city area use for the period 1997 and 2000.

notes

Figure 2: Monthly water bill by level of consumption



Key: DCA: Domestic City Area; DPU: Domestic Peri-Urban; NDCA: Non-Domestic City Area; NDPU: Non-Domestic Peri-Urban

In 1997 1 US = 14Z$.

Costs of WDM

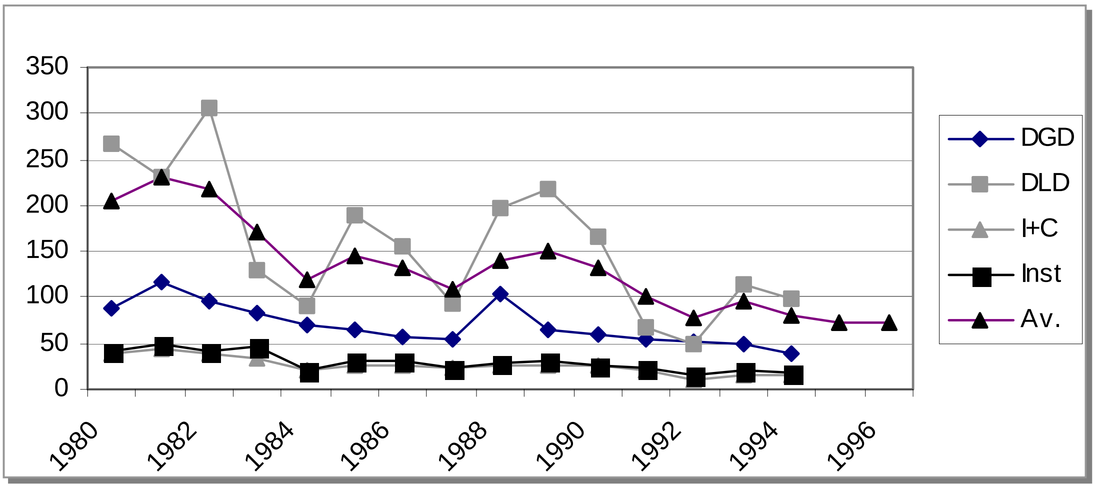
Current costs of water:	Z$ 8.18/m^3
Future costs of blended water:	Z$ 99.5/m^3
Future variable costs of water:	Z$ 19. 0/m^3

Results of WDM measures

- NRW reduced from 33% in 1990 to less than20 % in year 2000.
  - Using year 2000 water prices, the optimal loss level was 6-8 000 m^3/day cf. current 22 000 m^3/day or 16% of current consumption.
  - Using current water prices, net savings of around Z$35/$m^3$ per annum.
  - Further loss reduction has been shown to lead to declining benefits. With the use of future blended raw water price the optimal loss level is about 15% and results in an estimated saving of Z$561.1 M per annum.
- Substantial reduction in per capita water consumption especially for domestic low-density areas (high income).
- During the 1991/92 drought, industrial demand declined to 50 – 70% of previous year and average domestic use down to 60 L/day/person, as shown in Figure 3.

notes

Figure 3: Per capita water consumption in Bulawayo (L/day)



Key: DGD: Domestic High Density: DLD: Domestic Low Densisty; I + C: Industrial + Commericial; Inst: Institutional; Av.: Average.

The Bulawayo City Council (BCC) has a clear set of short-term, medium-term and long-term targets for WDM.

- Pressure management led to a decrease in water consumption from 7.1 L/s to 6.4 L/s in a low-density suburb. Pressure management can significantly reduce night flows.
- Reclamation of around 8 000 m^3/day for parks, sports fields, road margins, etc.
- Ten-year delay in new capital works if NRW are cut to 10%.

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notes

2.7.4 Kwekwe

Background information

- Fifth largest city in Zimbabwe (urban water use 45-50 Ml/day in 1998)
- Water supplied from a dam
- ZISCO mine is the largest water consumer (63% of total)

Reasons for WDM

- Drought forced a WDM programme and water rationing in 1992-1994.
- There is a need to expand water treatment capacity from 90 Ml to 120 Ml/day.

WDM measures taken

- Leak detection and reduction programme
- Block tariffs
- Water rationing
- Awareness creation

Impact on water consumption

- Decrease in average monthly consumption from 1.5 Mm^3 in 1991 to 1.0 Mm^3 in 1992, 1.2 Mm^3 in 1994 (after lifting of rations) and 1.3 Mm^3 in 1995
- Decrease in leakages from 30% to 14%
- Postponed need for expanded water treatment works

References

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2.8 FINALLY

This unit has illustrated the potential for WDM in the municipal situation.

notes

Having applied the contextual information from Unit 1 more directly to the municipal situation in Unit 2, we are ready to move to Unit 3 where we will examine our WDM options and their associated benefits.

notes