PAN AFRICAN WATER INITIATIVE

THE WATER SYSTEMS OF LESOTHO, NAMIBIA, SOUTH AFRICA AND SWAZILAND

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SOURCES OF STRAIN, WATER DEMAND AND SUPPLY DIRECTIONS IN THE MOST STRESSED WATER SYSTEMS OF, LESOTHO, NAMIBIA, SOUTH AFRICA AND SWAZILAND

Prepared for the

International Development Research Centre

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October 1994

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1. EXECUTIVE SUMMARY

Whilst this regional overview highlights the very different ways water is supplied and managed in Southern Africa, it is not an evaluation of those water management systems that are currently in place. The focus of attention is water stress and how governments, institutions and local communities perceive such stress and respond to it. However, as water stress is often the product of institutional and/or management failure, this report tends to overlook the successes and achievements of the countries reviewed. Such achievements have been considerable and the necessary planning to meet future needs is often well developed. Unfortunately, the resources (skills and finance) to sustain these successes and implement new schemes seldom exists. In the highly stressed areas, this has led to water management strategies which are based on survivalism, sometimes at the expense of the environment and economic development. Thus there is a need for a dualistic approach to water supply in the region: firstly, to consolidate existing systems and ensure their effectiveness and sustainability; and secondly, to meet future demand both for domestic use and for economic development.

Despite significant commonalities, each country reviewed has a very distinctive style, and specific strengths and deficiencies, although a number of problems are common to all four countries, e.g.:

- a looming water shortage;
- little popular awareness that regional water resources are finite, coupled with a widespread perception that government has the ability to provide abundant water;
- inappropriate tariffing structures, poor cost recovery, and problems in getting users to pay for the water supplied;
- an emphasis on water supply system installation, rather than maintenance;
- inadequate education, training and support of rural users around water management;
- serious environmental degradation problems, particularly relating to rural land management;
- poor co-ordination between water management agencies; and
- inadequate attention to sanitation;

More positively, there is a wealth of water management experience in the sub-region. Now that South Africa has moved beyond Apartheid, targeted regional co-operation initiatives may become possible, benefiting the sub-continent as a whole.

Lesotho, for example, has many years experience in developing low-cost, low-technology, community-driven, rural water schemes. Swaziland has experience in using Afridev pumps, now widely accepted as the most accessible and manageable borehole technology for rural women. South Africa has excellent technical expertise and an impressive record in the development of bulk water supply infrastructure, and the model Namibia has recently developed for managing rural water supply has widespread application.

The following tables attempt to crudely synthesise the findings of this four-nation survey. In doing so they do not do justice to the wealth of knowledge, expertise and understanding which exists at the foot of the African continent. However, they do serve to indicate where the shortcomings are and where those indigenous skills need to be focused.

At the risk of drawing over-simplified and highly generalised conclusions, there were two key issues that kept recurring in each of the nation studies used to compile this report. These were the lack of demand management strategies and the poor record of skills and technology transfer to local levels.

Despite critical water shortages (either presently or anticipated in the not too distant future) there is little attention being paid by policy makers to curbing the demand for water or creating incentives for water conservation. Not only do the people of Southern Africa believe that their respective governments can supply unlimited quantities of water indefinitely, but the governments themselves seem to be labouring under the same misconception. The attention being given to new and elaborate water engineering projects by recently democratically elected governments suggests a fixation with supply-based solutions. Whether this is the preference of the politicians or the engineers advising them is not clear. However, there does seem to be a reluctance by governments to control consumption, and those practices that threaten the sustainability of water supplies. Indeed, it was suggested that some water supply agencies were unsupportive of non-drought related water conservation initiatives because of the prospect of reduced revenue. Increased international encouragement for governments to consider and adopt demand management strategies (of which a wide variety exist), may well be justified. The development and tailoring of such strategies to the individual countries and situations could be a primary area of research which the IDRC may wish to consider.

It has already been mentioned that Southern Africa is reasonably well-off regarding water supply skills, however these skills continue to be vested in a centralised minority, many of whom are ex-patriate. Apart from the recent training efforts of Namibia, which have still to bare fruit, there are few, if any, programmes to transfer water supply and management skills to individual rural communities. Furthermore, there is no evidence of governments acknowledging the indigenous skills which have historically enabled rural communities to secure reliable water supplies prior to reductions in river flow (due to upstream "development") and population increase. The belief that rural communities are simply not capable of looking after their own water supply system still prevails in many government departments, although it will seldom be openly admitted. In addition, there is no attempt to educate communities to the reality of the water availability situation in Southern Africa and thus provide a foundation for future water conservation.

There is broad consensus among development agencies in all four nations that there is considerable merit in focusing water supply education and training at rural women as their community ties are strongest, and as it is they who benefit most from improved water supply schemes. This realisation is not, as yet, reflected in the policies and actions of governments.

GENERAL STATUS	LESOTHO	NAMIBIA	SOUTH AFRICA	SWAZILAND
Traditional water source	Rivers and springs.	Rivers, pans, holes in dry river beds, hand-dug wells	Rivers, springs, holes in dry river beds	Rivers and springs
Capacity and skills	Well developed system of village water committees.	Insufficient skills but training programmes underway.	Excellent technical expertise, committed to rapid improvements	Critical skills shortage
Coverage	42% of rural people (640000), mostly in remote areas, lack access to safe drinking water. Good coverage in urban areas	55% in rural areas and virtually 100% in urban areas, which is generally good considering aridity and remote populations, although there are problems in the rural north.	16 million people lack access to safe drinking water, approximately half in rural areas and half in urban/peri-urban areas.	20-40% of urban population (140000) and 45-55% of rural population (168000) do not have safe supply of water.
Environmental problems	Silting of rivers and dams because of steep terrain, heavy rainfall and over-grazing	Groundwater in area of greatest human settlement is saline. Over-abstraction of groundwater in the south; over-stocking and overgrazing in the north	Environmental degradation and spreading desertification in the homelands. Major pollution problems from people and industry.	Erosion and river silting as well as contamination of streams and rivers with human and animal waste.
Government awareness of the problems	Adequate	Excellent awareness of the nature of the problems - ambitious plans to improve rural water supply	Good, and improving	Poor
Government capacity to address problems	Poor to adequate, rural land use is a major problem.	Good and improving but stocking levels require attention.	Excellent potential but major problems.	Poor
Constraints on government	Limited finance, limited technical staff, dependence on foreign personnel, access to remote areas difficult	High cost, not enough technical staff, Directorate of Rural Water Supply very new and understaffed	Limited finance, poorly developed local capacity, widespread system failures, huge backlogs	Little political will
Public awareness of constraints	Poor	Improving	Improving but high level of expectation prevails	Poor
Education campaigns	None	Beginning	None	None
Focus of government activity	Simple rural water systems. Emphasis on installation rather than maintenance	High-tech pipelines, canals, inter-basin transfer schemes and major storage schemes for bulk supply. Low-tech schemes for rural water supply.	Hi-tech bulk storage for urban areas and irrigation. Emphasis on construction not maintenance in rural areas.	Urban areas main focus. Improved rural supply largely left to external donors.
Co-ordination with NGOs	Poor; government feels NGOs impose their own will.	Very good	Improving	Poor

RURAL WATER SUPPLY	LESOTHO	NAMIBIA	SOUTH AFRICA	SWAZILAND
Percentage living in rural areas (not peri-urban)	85%	70%	55%	80%
Agency responsible for rural water supply	Ministry of the Interior: Village Water Supply System; problems co-ordinating activity with other Ministries.	Department of Water Affairs: Directorate of Rural Water Supply. Very new, and currently has little capacity.	No single agency. A Directorate of Rural Water and Sanitation has been proposed by the new government.	Dept of Natural Resources and the Environment: Rural Water Supply Board. Depends on external funds, minimal government support.
Village maintenance capacity	Adequate	Poor	Poor	Poor
Government maintenance capacity	Poor, but improving	Poor, an ambitious remedial scheme recently introduced.	Poor	Poor
Effectiveness of water committees	Adequate	Varies widely; new emphasis on training and building capacity	Relatively few exist; generally poor, but could improve rapidly with government support	Varies widely; generally adequate
Payment and tariffing	Users are supposed to cover O&M costs, but non-payers are not followed up which demotivates those who do pay. Villagers contribute to cost of spares, and transport.	Flat rate user tariffs are being introduced to cover basic O&M costs. Too new to assess.	Flat rates, not dependent on consumption. Generally not collected or enforced. The new government wants all users to pay, according to economic status.	Users supposed to contribute R6-R7 per month towards O&M. Many don't, and attempts to prevent non-payers from drawing water has led to vandalism.
Role of women	Women prominent in many areas of rural life, but this is not always acknowledged by the authorities. Most decisions on water supply at all levels are taken by men.	Women are under-represented on water structures, and not targeted for maintenance training. This may change with new training programmes, but these are still male orientated at present.	Men often absent; women often take decisions and do the work. Women starting to make presence felt in progressive communities and at a government policy level.	Men make decisions, women do the work. Women seldom considered in water planning initiatives although they bear the consequences of lack of investment; ie. water fetching and family health.
Drought management	Tanker based crisis relief: expensive. Some borehole drilling.	Tanker-based, but inappropriate. Emphasis now on reliable boreholes. UNDP considering adapting hand-dug wells.	Tanker-based crisis relief in some areas. Emphasis on rehabilitating existing water points and new drilling.	Tanker-based crisis relief. Underfunded and unworkable. Now drilling more boreholes in vulnerable areas.

URBAN WATER SUPPLY	LESOTHO	NAMIBIA	SOUTH AFRICA	SWAZILAND
Co-ordinating authority	Branch of government was commercialised as the Water and Sewerage Authority in December 1991.	Bulk water supply section of the Dept. of Water Affairs will be commercialised in late 1995. Not responsible for sanitation.	Water supply is by ten non-profit water boards, and various metropolitan and local authorities. Boards not responsible for sanitation but this may change.	Former government utility was commercialised in August 1994 - now the Water Services Corporation. Currently restructuring but under-staffed.
Infrastructure: Formal settlements	Good, but starting to deteriorate. Water losses. Silting of urban storage reservoirs becoming a big problem.	Good, with many household connections. Older infrastructure starting to deteriorate - water losses increasing.	Good, but deteriorating in some areas - e.g. townships where service payment boycotts have absorbed capital earmarked for upgrades and expansion.	Good, but deteriorating. Extensive water losses of 60% between raw water and billing.
Infrastructure: Informal settlements	Public standpipes- adequate. Residents don't pay.	Public standpipes - good.	Some public stand-pipes, some tankers. Rudimentary but generally adequate. Sanitation a major problem. Big urban development projects beginning	Majority use unimproved sources. Big urban development projects underway in Manzini and Maseru.
Operating capacity	Technical staff are inadequately trained. Frequent breakdowns. No strategic plan. Management problems.	Good, but hampered by government bureaucracy and financial procedures. Commercialisation should remedy this.	Very good, but resources are poorly shared and allocated. Some re-allocation has started.	Adequate but over-burdened and under-staffed. No strategic plan. Unclear division of responsibility with the Ministry of Housing and Local Government.
Tariff collection	Good, but tariffs do not provide for full cost recovery.	Good, but tariffs need to be trebled to cover full costs and to curtail demand.	Good on the whole. Local authorities, not bulk water supply authorities, bear the brunt of rates boycotts. Payment in informal settlements vary.	Good in formal settlements but little payment in informal settlements. Government is having difficulty persuading people to start paying.

2. INTRODUCTION

2.1 BACKGROUND

The availability of fresh water in Africa is expected to decline markedly by the year 2000 due to population increase, and a less than adequate management of water supply and demand. Conscious of these trends, the International Development Research Centre (IDRC) is willing to make a contribution through research towards identifying viable and sustainable solutions. In this regard it has commissioned a number of research papers, of which this is one, on the sources of strain, and water demand and supply directions in the most stressed water systems of Africa

2.2 TERMS OF REFERENCE

The papers should analyse the sources of stress, including conflicts among uses and users of water, and the consequences of these conflicts on the availability, accessibility and quality of water for different user sectors. In addition, water demand management strategies aimed at resource conservation, and alternative water supply sources and mechanisms should be considered. This paper should address the situation in Namibia, Lesotho, Swaziland and South Africa.

2.3 APPROACH

The approach taken in this study was to first collate all available literature on the water situation in each country and then to follow this up with visits to the countries to interview government staff, academics, consultants and NGOs. The views and opinions collected have not been referenced in order to preserve the confidentiality of the discussions. Data collected was derived mainly from government sources with some inputs from consultants.

The information collected far exceeded that which is presented here.

3. KINGDOM OF LESOTHO

3.1 WATER SUPPLY AND DEMAND

3.1.1 Water availability

The surface water resources of Lesotho (see Table 3.1) are substantial and far exceed the present and future needs of the nation. However, this high runoff is often rapid and occurs in inaccessible mountainous terrain. Major capital intensive engineering works (unaffordable to Lesotho) are required to harness this water for use by people.

Less than 9% of Lesotho is arable. There is an acute shortage of land for settlement, overgrazing is severe, little fuelwood remains and the population is growing at between 2.6 and 2.9% pa. The result is acute environmental degradation in many areas, as manifested by soil erosion and silting of rivers and dams. One reason for this degradation is that the BaSotho people have only lived in the area for the past 140 years, and although their stock management practices were well suited to the sparse settlement patterns of the flat Orange Free State and Transvaal, they have not been sufficiently adapted to their current mountainous terrain.

Sedimentation has serious implications not only for Lesotho's surface water resources but also for South Africa and Namibia - as the headwaters of the largest drainage system in South Africa, the Orange River, are located in Lesotho. About half the total flow of the Orange River is provided by the Senqu River.

Catchment	Area (km^2)	Precipitation (mm/annum)	Total runoff (mm/annum)	Total runoff (m^3/a)
Senqu	20 485	749	167	3420×10^6
Makhaleng	2 911	844	199	580×10^6
Maphutseng	362	733	166	60×10^6
Mohokare	6890	824	97	670×10^6
Totals	30 648			4730×10^6

TABLE 3.1: SURFACE WATER RESOURCES

Despite the high availability of surface water, there are problems with its suitability for community water supply. Untreated surface water is generally not considered potable, due to Lesotho's high livestock levels, and water is rarely boiled because of the scarcity of fuelwood.

Whilst the total potential yield of Lesotho's ground water resources is unknown, this source currently accounts for about 70% of total water consumed in Lesotho, and is derived primarily from a large number of low yielding springs. People in the Highlands use mainly

spring water, while in the Lowlands rural communities are provided with water both from springs and boreholes. Groundwater availability is erratic, and aquifers are generally discontinuous along doleritic dykes. This makes drilling of boreholes unpredictable and expensive. Most boreholes yield less than 0.5 l/s. Recharge is extremely slow, and boreholes are frequently pumped dry.

3.1.2 Water demand

Water demand centres primarily around domestic and stock-watering needs (see Table 3.2). Most towns rely on a mix of surface and groundwater, although groundwater represents only 10% of total urban water consumption. Two urban settlements - Morija and Mapoteng, which have a combined population of about 9 000, rely solely on groundwater.

Demand by sector	1994 (Mm^3/a)	2020 (Mm^3/a)
Urban domestic/industrial	9.5	24.4
Rural domestic	2.2 (estimated)	4.8 (estimated)
Irrigation	negligible	negligible
Stock watering	15.0 (estimated)	17.0 (estimated)
Totals	26.7	46.2

TABLE 3.2: WATER DEMAND BY SECTOR

There has been no long term monitoring of spring yields, but anecdotal evidence suggests many springs are drying up because of the loss of protective vegetation and soil which in-turn promotes rapid surface runoff as opposed to infiltration.

3.2 WATER MANAGEMENT SYSTEMS

3.2.1 National overview

Lesotho's Department of Water Affairs is responsible for hydrological services, resource management, development of a water resources master plan, and water quality monitoring. Co-ordination with other agencies addressing water resources is poor. Management of soil erosion falls under the Department of Agriculture. Rural water supply falls under the Village Water Supply Section of the Ministry of the Interior, and urban water supply under a commercialised parastatal. No master plan or national water supply strategy exists.

3.2.2 Rural water supply

85% or 1.53 m of Lesotho's 1.8-m residents live in rural settlements. Of this number, 58% or 890 000, have access to improved water supply systems; the remainder (640000 people) draw water from unprotected rivers, springs and earth dams.

Rural water supply is the responsibility of the Village Water Supply Section (VWSS), a directorate within the Ministry of the Interior. It operates at three main levels: district,

regional and national. Communication between these levels is generally good. Communication with other government departments is unstructured and informal. Communication between VWSS and villagers is limited. There is very little evaluation of projects, either before construction commences or after commissioning.

Government officials generally have much less faith in the success of local water management than NGOs working in close contact with village committees. The head of the VWSS believes that voluntary community structures don't work without cash incentives, and maintains that if government doesn't provide all the necessary resources, there will be a further breakdown. However, Government lacks the staff and resources to take full control of rural water supply. According to a recent report by consultants, the rural water supply system is starting to work relatively well, with local villagers managing basic maintenance and repairs fairly competently. Table 3.3, which is based on a mid-1994 survey of the Maseru region and which is regarded as typical of the mountainous areas, illustrates this point.

Survey of water projects in the Maseru Region	**No./%**
Number of water projects surveyed	209
Systems comprising handpumps	36%
Systems that are gravity fed from springs	27%
Systems that are a combination of handpumps and protected springs	37%
Villages with fully functional water collection points	> 75%
Villages with a village water committee (VWC)	90%
VWCs with a bank account for repairs	69%
VWCs with a tool box	33%
Villages with a water minder	49%
Villages with a water minder that cannot undertake repairs	71%

TABLE 3.3: WATER PROJECTS IN MASERU REGION

Water improvement projects in Lesotho's rural areas are initiated at village level. Villagers are required to form a water committee and start collecting funds towards construction and future maintenance. They approach the VWSS through village leadership structures, and in due course (this can take several years) the VWSS provides a technical team of masons, engineers and whatever else is needed.

The major task of village water committees is to co-ordinate the inputs of local residents during the construction and installation of an improved water system. This includes free labour and accommodation for VWSS personnel. A major effort is required from local residents, as trenches - often many kilometres long - have to be dug to lay pipes, and stones have to be cut for the construction of siltboxes and water tanks. Average construction time is 170 days, but some schemes can take over two years to complete. Women carry out the bulk of this work, in part because many men are absent as migrant labourers, and because women tend to be the primary beneficiaries of water schemes.

Once the project is completed, the water committee tends to lie dormant until a problem arises. Residents are supposed to try to fix the problem themselves, and where they can't, they notify the District Office of the VWSS; in due course a technician is sent out. The VWSS can barely cope with breakdown maintenance, and does not undertake preventative maintenance. VWSS tries to recover 50% of the cost of repair from local residents, if necessary in instalments over three years. It seldom achieves this.

The distinction between the village water committees (VWC) and village development committees (VDC) is breaking down. In the past, Village Development Committees were regarded as the local arm of the ruling political party, thus separate water committees were introduced in the 1970s to ensure that water development was not derailed by political posturing. This need for separate structures seems to have fallen away now, and there is talk of merging the two bodies.

Mistakes are inevitable in any rapid development initiative. Lesotho's most serious mistake seems to be that, in its eagerness to meet water demand and its own goals, the VWSS installed new water schemes faster than its ability to service them or train users to maintain and manage them. Its aim has been to achieve full coverage of rural areas by 2005, and it is well ahead of schedule. However the sustainability of these systems is questionable. Maintenance is a major problem, and it is estimated that only 40% of boreholes nationally are operational.

Since 1992, the VWSS has been trying to formulate policy, determine strategies and collect supporting data. The first regional report on coverage, condition of water systems, demographic trends and local organisational capacity was completed in August 1994. Field inspections are now generating the kind of detailed data necessary to begin to assess current capacity and evaluate strengths and shortcomings.

3.2.3 Urban water supply

The Water and Sewerage Authority (WASA) , the parastatal set up by the Ministry of Natural Resources, relies on surface water for 90% of the water it supplies to urban settlements. The largest urban settlement is Maseru with a population of 90 000; the next largest town in Lesotho has a population below 10 000. Most urban water is abstracted directly from local rivers and stored in reservoirs. The silting of both the rivers and the reservoirs supplying urban areas is a major problem.

WASA has management problems. Although the coverage of the supply is adequate, WASA will need to spend more on upgrading its infrastructure to reduce water wastage and losses. Moreover, because of high connection costs for individual households, many people are drawing water free from public standpipes, most of whom could afford to pay regularly for water if the connection fee was lower.

3.2.4 The Lesotho Highlands Water Project (LHWP)

If fully developed, the LHWP could see the diversion of 2 200 million m^3/a from the headwaters of the Senqu / Orange River into the Vaal River, making it available under gravity to South Africa's industrial heartland - the Pretoria-Witwatersrand-Vereeniging (or PWV region). The scheme is highly capital intensive, and will inundate some arable land. Given the acute shortage of arable land in Lesotho, the loss of even a small percentage of has serious implications for local subsistence agriculture. Elaborate and sometimes controversial schemes have been instituted to compensate farmers for the loss of productive land.

Although Lesotho residents will not be supplied with water from the two dams that will be built as part of the LHWP, there are significant indirect benefits. For example, the development of infrastructure includes rural roads, health centres, schools and a few village water supply systems; there are the royalties from the diversion of the water; self-sufficiency in electricity generation; and revenue from Lesotho's participation in the Southern African Customs Union Pool which has received a boost from the importation of construction equipment and materials. The indirect costs of the scheme will be some attendant environmental damage, and the loss of some agricultural land.

Some doubt has been cast on the merits of the project. If it is fully completed, water transfers from the Orange River's headwaters could jeopardise the assurance of supply to South African irrigation schemes lower down in the Orange River and in the Fish-Sundays catchment of the Eastern Cape, which receives water transferred from the Orange River. However, the benefits of an assured water supply to the PWV region are believed to exceed the impacts.

3.3 PRIMARY WATER-RELATED PROBLEMS

3.3.1 Erosion and Silting

Problem: Overgrazing on the fragile soils of Lesotho's steep slopes is causing serious sedimentation of rivers and water supply reservoirs as well as reduced recharge of water supply aquifers.
Response:. Piecemeal soil conservation techniques employed by the Department of Agriculture are unable to address the complex underlying socio-economic problem of overgrazing and dense settlement on vulnerable soils.

3.3.2 Rural Water Supply

Problem: 43% of rural households, mostly in remote areas, do not have access to clean water. The VWSS has over-emphasised installation and construction at the expense of developing maintenance capacity. There are no private sector borehole repair teams, and the VWSS has limited capacity to repair breakdowns. Village water minders do not have the skills they require to do preventative maintenance on handpumps.

Response: Despite a profound awareness of the problem, the VWSS does not have the capacity to remedy the situation.

3.3.3 Co-ordination and Planning

Problem: No overall picture of national demand and supply exists, water management objectives are imprecise and inter-agency communication is poor.
Response: Academics at the University of Lesotho have been commissioned to investigate demographic trends and projected urban water demand. This will feed into a Water Resources Action Plan project, scheduled to begin in December 1994. Lesotho urgently needs a water management master plan, and is currently looking for funds to commission this.

3.3.4 Legislation

Problem: Lesotho's Water Act of 1978 has deficiencies and is largely ignored. It does not provide government agencies with the powers they need to resolve water disputes, nor does it provide for effective resource management and pollution control.
Response: The Act is under revision, but no completion date has been set as yet.

4. NAMIBIA

4.1 WATER SUPPLY AND DEMAND

4.1.1 Water availability

Namibia is the driest country in sub-Saharan Africa. It is estimated that 83% of all rain evaporates soon after it falls, which means that effective rainfall is a small fraction of total rainfall. Due to the high evaporation, only 2% of the total rainfall can be captured by surface water storage facilities.

There are no perennial rivers within Namibia, only ephemeral ones. The perennial rivers are all on Namibia's borders: the Orange in the south, the Cunene in the north-west and the Okavango, the Kwando-Chobe-Linyati and Zambezi in the north east. Namibia currently has access to an agreed 180 million m^3/a from the Cunene River and at least 500 million m^3/a from the Orange River. No formal agreements have yet been reached on abstracting water from the Okavango River; however the completion of the last stage of the Eastern National Water Carrier (the largest State water project in Namibia), will lead to the importation of 100 million m^3/a from the Okavango to augment supplies to the central, eastern and western areas of the country.

The flow in the ephemeral rivers in the interior is irregular and unreliable, which limits both the potential for utilising surface water sources and the recharge of aquifers from river courses. The estimated safe yield of surface water works which could be developed on the ephemeral rivers is at least 200 million m^3/a, or 40% of the total surface water resources available in the interior. Ten large dams have so far been constructed on these ephemeral rivers, with a combined safe yield of 87.3 million m^3/a.

Groundwater plays a major role in water supply in Namibia. The safe annual yield from groundwater sources is estimated at 300 million m^3 /a. However, over-abstraction of groundwater is already a serious problem in some areas. In the Karst (limestone) areas, excessive pumping from boreholes can result in the deeper lime-rich water being exposed to oxygen and thereby causing the lime to precipitate and cement the borehole. The borehole then has to be abandoned or redrilled.

A more serious problem is the depletion of the aquifer itself. The Kuiseb River alluvial aquifer in the central Namib area has already been overused, and the water table has dropped significantly. The aquifer can no longer meet the needs of the coastal towns of Swakopmund and Walvis Bay, or the Rossing Uranium Mine, and the lowered water table has seriously undermined the dependence of the local Topnaar people on hand-dug wells for water. The combination of bad farming practices and prolonged droughts in the Kuiseb and Omaruru catchments has reduced the vegetation cover, leading to considerable top soil removal during intense rainstorms and the subsequent sedimentation of the Kuiseb and

Omaruru Rivers. This soil often forms a thin layer of fine material on the river bed that seals the surface of the sand and prevents ground water recharge.

The aquifer under the Koichab River, which supports the town of Luderitz and the industry at Elizabeth Bay, is fossil water which is being mined, and will probably never be recharged under present climatic conditions.

In some parts of the Stampriet artesian aquifer, saline water overlies the fresh water, and poses a contamination threat to the fresh water. Farmers in this area are now required to use a new ground water abstraction technique comprising a specially designed borehole which seals-off the overlying salty water.

In many areas, the abstraction of groundwater and the impoundment of surface water has upset the delicate balance sustaining highly vulnerable ecosystems.

4.1.2 Water supply

Namibia's total population is about 1.5-m people. Roughly a million people, or 65% of the population, live in the under-developed northern regions, mostly in rural settlements. The northern population is further concentrated in the centre of what used to be called Owamboland. Here 400 000 people live in an ephemeral wetland system of pans called the ***oshanas***. Much of the groundwater in this area is too saline for human consumption.

Because of the extreme aridity of much of Namibia, most rivers and aquifers within the country may be regarded as under stress. Extensive water infrastructure investment such as pipelines, canals, inter-basin transfers and improved abstraction technology, have made relatively dense human settlements viable in areas that previously could not have supported urbanisation of any significance.

4.1.3 Traditional water sources:

Depending on the water region, rural people draw water directly from rivers and natural springs, dig for water in dry river beds or use hand-dug wells.

In the Oshana Water Region, groundwater takes two forms: a deep saline aquifer lies under most of the area, and above this are pockets of fresh water - perched aquifers - where rain water is trapped between the surface and the saline water. Rural people dig into the fresh groundwater aquifer by hand, making round wells called ***omifimas***. Water is abstracted with buckets.

Surface water is available during the summer months when there is sufficient rainfall to make the omifimas flow and fill hand-dug earth dams. Initially the quality of the fresh surface water is good, but as the water evaporates, its salinity increases. Traditionally, rural communities would then move on to other water sources in the dry months. Rapid population growth, dense settlement and environmental degradation is making this migratory lifestyle more difficult.

The UNDP plans to set up pilot schemes in 1995 to investigate combining traditional hand-dug wells with infiltration galleries to provide low-technology filtration systems.

4.1.4 Water demand

Table 4.1 shows that 57% of Namibia's current water demand is met from groundwater, and 43% from surface water.

SOURCE	Demand Mm^3 (1993)	Percentage
Perennial surface water	60.0	22
Ephemeral surface water	55.0	21
Surface water total	115.0	43
Groundwater	150.0	57
Overall Total	265.0	100

TABLE 4.1: SOURCE OF WATER

Settlements in the far north are aggregating along the network of pipelines and canals which connect the major rural villages with the Cunene River and supply water to about 30% of the northern population. Livestock are believed to account for 80% of all water demand in Northern Namibia, much of it being met by the pipeline. Moreover, livestock which previously were moved from water point to water point are now settled in fixed areas, leading to overgrazing and overstocking. Fixed human settlement is denuding vegetation, as trees and bushes are used for fuel and building purposes. The oshanas run from north to south, while the pipelines, canals and main roads run from west to east , obstructing the normal flow of the oshanas and increasing evaporative loss. This in-turn reduces groundwater recharge, which threatens the water supply to those traditional settlements not serviced by the pipelines and canals. A quarter of Namibia's population live in the oshana area, and this figure is expected to double in the next 20 years.

4.1.5 Estimated sectoralised water demand

The estimated sectoralised water demand up until 2005 is shown in Table 4.2. Because Namibia relies heavily on major inter-basin water transfer schemes, demand statistics expressed in terms of surface water catchments are not particularly useful. Furthermore, aquifers are seldom contiguous with surface water catchment boundaries and can even be subject to inter-regional transfer, as in the case of the Karstveld area around Grootfontein, where ground water is exported southwards to Windhoek. Therefore, sectoralised demand is best compared with water availability on the basis of existing abstraction patterns as shown in Table 4.3.

Sector	Estimated demand (Mm^3/a) 1990	1995	2000	2005
Domestic[1]	67	81	95	115
Stock	64	67	70	75
Mining	12	15	25	30
Tourism	1	2	3	5
Irrigation	106	130	147	175
Total	**250**	**295**	**340**	**400**

TABLE 4.2: ESTIMATED WATER DEMAND

SECTOR	DEMAND ON WATER RESOURCES: MILLION M^3							
	Perennial rivers		Ephemeral surface		Groundwater		Total	
	1990	2005	1990	2005	1990	2005	1990	2005
Urban : domestic/industrial	12.6	40	13.4	30.0	41.0	45.0	67	115
Irrigation	39.7	95	34.8	50.0	31.5	30.0	106	175
Stock	3.7	10	0.0	0.0	60.3	65.0	64	75
Mining	2.0	10	2.5	10.0	7.5	10.0	12	30
Tourism and Environment	0.0	2	0.3	1.0	0.7	2.0	1	5
Total	**58**	**157**	**51**	**91**	**141**	**152**	**250**	**400**

TABLE 4.3: DEMAND ON WATER RESOURCES

Only 49% of total estimated ephemeral surface water and groundwater sources will be utilised by 2005, but demand on perennial rivers is expected to increase by 270%. Irrigation demand is unlikely to increase dramatically due to generally poor soil quality. Any additional irrigation demand will be met from the perennial border rivers.

4.1.6 Reconciling future demand and supply

Unfortunately much of the potential water resources available to Namibia are not located close to where they are required. For example, there is abundant water in the Fish River, but it is far from any human settlement. Therefore, as the surface drainage system experiences such high losses, the future utilisation of perennial rivers will entail large capital intensive engineering projects. There is some doubt as to the affordability and international acceptability of such schemes. The diversion of water from internationally shared perennial rivers will require extensive negotiations with Namibia's neighbours.

[1] Includes rural and urban domestic demand and industrial demand.

Source	MAR / Yield (Mm^3/a)	1990 use (Mm^3/a)
Groundwater	300	141 0
Ephemeral rivers	200	51.0
Perennial sources:		
Okavango River (at Rundu)	5 500	58.0
Cunene River (at Ruacana)	5 000	0.0
Okavanago River (at Mukwe)	10 000	0.0
Quando River (at Kongola)	1 300	0.0
Zambezi River (at Katima Mulilo)	40 000	0.0
Orange River (at Noordoewer)	7 000	0.0
Total	**69 300**	**250.0**

TABLE 4.4: RECONCILING FUTURE DEMAND AND SUPPLY

4.1.7 Non-conventional water sources:

Desalination: A pilot desalination plant is being established on the West Coast, but the cost will be high - between N$7-9.00 / m^3 , provided the water is used locally. Pumping desalinated water inland to Windhoek is not economically feasible at present because of prohibitive pumping costs.

Most of the groundwater in the far north is saline; desalination schemes for groundwater have been tested, but major investment in desalination schemes is unlikely because the groundwater is a limited resource.

Water recycling is practised in some areas. Windhoek recycles about 12% of its water, and Rossing Uranium mines recycles about 76% of its water. However, it is widely acknowledged that recycling could be greatly improved in other centres.

Assisted recharge: To conserve Omaruru River flood water from being lost to the sea (near Walvis Bay), a dam has been built on the Lower Omaruru River to trap silt-laden water during floods. The silt settles out behind the dam wall, and the clear water is then pumped downstream to sand-filled basins where it rapidly infiltrates to recharge the aquifer. This water is later pumped out via boreholes. Earth dams are used for assisted recharge in some areas, but high evaporation rates reduce their effectiveness.

Drought management: Given Namibia's aridity, drought should not be regarded as exceptional. However, before independence, extensive use was made of water tankers in rural areas during droughts. This practice was revived during the 1992 Emergency Drought Relief Programme at a cost of approximately N$50.00 per cubic metre, to augment other relief measures. However, given the logistics and cost of transporting water over long distances, this was found to be an inappropriate response by the new government. Current drought relief strategies focus on improving borehole reliability.

Other options: Rainwater harvesting, weather modifications and fog harvesting have been investigated, but rejected as they were shown to be uneconomic.

4.2 WATER MANAGEMENT SYSTEMS

4.2.1 Urban areas

Most centres with a population in excess of 2 000 people are supplied from a State water scheme managed by the Namibian Department of Water Affairs (DWA), who draw water from ground and/or surface resources. The DWA sells bulk water to local authorities, where these exist.

Urban water supplies are likely to be placed under the most stress because of rapidly increasing population densities, higher per capita consumption levels, the remoteness of most towns from perennial rivers, and high evaporation rates in urban water supply dams.

At current rates of annual increase, Windhoek could start to run short of water by 1998. Major tariff increases have been identified as one way to curtail consumption and possibly postpone the need to develop new sources. However, demand increases are such that, within the next 10 to 15 years, Windhoek will probably need to access the nearest perennial water source -- the Okavango River, 800 kms away. The final stage of the Eastern National Water Carrier would then need to be constructed to convey the water. The cost of this water could exceed N$7 per m^3.

Construction of the Okavango link could also be postponed if groundwater resources north of Tsumeb prove to be as abundant as are currently anticipated. But the longer Namibia delays abstraction from the Okavango, the more competition it could face from other users for this water source, or objections from interest groups.

Inadequate maintenance of water mains and distribution schemes is a major problem in Namibia which leads to significant wastage. Again tariff increases may resolve this to some extent. Infrastructure maintenance is expected to improve once the bulk water supply section of the Department of Water Affairs is commercialised in late 1995. This will also improve management, cost-effectiveness and planning flexibility. As a commercial utility, it will probably seek to maximise the sale of water; which could undermine long-term strategies to conserve water. By the same token, maximising revenue from water sales by increasing tariffs could curb demand increases.

4.2.2 Rural areas

Despite significant problems, domestic water supply coverage is generally good (around 55%) and well within UNICEF's target for the year 2000. However at least half of existing water points in rural areas are faulty or not in working order.

Responsibility for rural water administration in Namibia has been re-assigned three times since independence in 1990. Prior to independence, rural water supply was the responsibility of the eight ethnic regional administrations, where funding and capacity was limited. The result was a massive backlog of rural communities with inadequate water supplies. Failure to involve and train local users led to a high level of system breakdowns, which was compounded further by the lack of routine maintenance capacity during the war of liberation.

In early 1993, responsibility for rural water supply was transferred to the Directorate of Rural Water Supply (DRWS) in the Department of Water Affairs. With external assistance, a new model of water administration is being introduced which is designed to change the role of the DRWS from that of provider to facilitator. Due to lack of capacity within rural communities, the role of the DRWS extends well beyond facilitation. Much of the work of the DRWS now focuses on developing institutional capacity. However, at this stage only half the posts in the DRWS are filled, and few of the existing personnel are appropriately trained. The success of the DRWS depends on whether it can recruit and train sufficient able staff members, and enlist the co-operation of the rural communities with whom it works.

The country has been divided into ten water supply regions, each with a chain of water committees from local water supply points up to district level. Communities are being required to sign a contract of ownership for their local infrastructure with the DRWS, and undertake and fund routine maintenance. Each water committee will have a caretaker trained in preventative maintenance. For roughly every 20 water supply points (depending upon distances between points, terrain etc.), there will be one Rural Water Extension Officer resident in the area. This person will be able to summon help with breakdowns and maintenance from the DRWS's regional maintenance section. On paper, the scheme looks impressive, but it has not yet been implemented widely and it is too soon for a critical evaluation.

Participation by women varies, and they are generally under-represented in water structures despite their contribution to the development of schemes.

With major donor and NGO assistance, the DRWS has prepared a range of educational materials to improve understanding of the hydrological cycle and the importance of appropriate resource and stock management. Booklets have been designed to assist in promoting literacy and to be used in conjunction with radio broadcasts. Caretaker manuals for diesel and handpumps, with logbooks (printed on water-resistant paper!) to chart daily abstractions, are being distributed to water point committees. All data gathered will be fed into a central data base to monitor consumption and abstraction. Booklets are being distributed with guidelines on how to set up and run water committees

Historically, where water was supplied to rural communities,[2] no levy was charged. The provision of free water by the central government entrenched the idea that water is a free and abundant resource provided by government. Attempts to change this perception are now underway. Given low affordability levels in many areas, the government is not aiming for full cost recovery; however payment may lessen wastage. Water tariffs are being introduced gradually throughout the country, and with modest regular increases, full cost recovery on rudimentary schemes might be achieved by 2007.

4.2.3 Role of NGOs

Relations between the NGO sector and government are generally very good. Representatives meet monthly in water and sanitation forum meetings in both Windhoek and at Cuvelai to discuss priorities and co-ordinate development. Given that the DRWS has extremely few people on the ground, it is imperative that it maintains good relations with the NGO sector, whose role at present is crucial in setting up and maintaining local water schemes.

4.3 PRIMARY WATER-RELATED PROBLEMS

4.3.1 Population and environment

Problem: The two key resource issues facing Namibia are population growth and environmental degradation. Complementing these are a range of subsidiary issues such as overstocking, denudation, erosion and desertification. Stock-reduction schemes are a major issue.
Response: Public education campaigns are being developed.

4.3.2 Technical skills

Problem: Government capacity to implement its policies is limited by staff constraints. Namibians with the necessary technical skills are leaving the public sector for the private sector, where salaries are up to 50% higher. Some of these posts have been filled with ex-patriates on contract who are supposed to train local personnel, but few local personnel are available in the public sector to be trained. The result is a growing dependence on ex-patriate technical personnel on short-term contracts, and increasing use of private consultants. Commercialisation of the bulk water sector will exacerbate the technical skills shortage in the public service.
Response: None.

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[2] During the South African government's war with Angola and liberation movements in Namibia, delivery of free water in Namibia's densely-settled northern region played an important role in the SA Defence Force's `hearts and minds' campaign; major investment went into extending the pipelines and canals linking northern settlements with the Cunene River and oshanas, and making this water accessible to the rural population through taps and watering points.

4.3.3 Local skills

Problem: The rural water supply sector will require time to train people for the posts currently being created, but relatively few posts call for high technical training.
Response: A major recruitment and training programme is under way.

4.3.4 Urbanisation

Problem: Namibia's urban areas are growing at between 5-11% pa. Urban water consumption is far higher than in rural areas because of individual household connections, and poses a particular problem because few Namibian towns have sustainable local water sources.
Response: Raised water tariffs will be introduced in 1995, and alternative supply sources are being explored and developed

4.3.5 Cost recovery

Problem: Urban water tariffs do not achieve full cost recovery, and barely cover operation and maintenance (O&M) costs. The result is a decaying water infrastructure which leaks and wastes water. Water tariffs need to be trebled to cover the full cost of current delivery.
Response: The government has agreed to sanction significant tariff increases after the first post-independence election in December 1994

4.3.6 Bulk infrastructure provision

Problem: Management and development of bulk water supply is under-funded and constrained by .bureaucracy.
Response: Privatisation of bulk-water supply is scheduled for late 1995

4.3.7 Complacency over water availability

Problem: The government's ability to provide hi-tech solutions to many of Namibia's water problems have lulled most residents into believing that the water shortage can be overcome. Urgent public education campaigns are necessary to promote awareness of the need for water conservation and better resource management.
Response: Public education campaigns have been designed and will be launched soon.

4.3.8 Rural water supply infrastructure

Problem: Water supply equipment in rural areas is too heavy and complex for its primary users - rural women - to maintain. Rural water committees are unlikely to be able to develop the technical and managerial skills which the DRWS requires of them.
Response: A very ambitious plan to train a corps of local water minders, assisted by local rural water extension officers is being developed.

4.3.9 Planning

Problem: No detailed masterplan exists, and there is little co-ordination between different government departments. Furthermore, no government department is taking responsibility for co-ordinating and implementing policy around sanitation.

Response: A Water and Sanitation Committee (WASCO) representing all stakeholders has been mooted to improve co-ordination and advise cabinet, but has not yet been formed. This could be introduced in 1995.

4.3.10 Legislation

Problem: Namibia's Water Act is based on South Africa's Water Act, and is clearly inappropriate to Namibia's needs.

Response: A draft revision exists, but has not been finalised.

5. SOUTH AFRICA

5.1 WATER SUPPLY AND DEMAND

5.1.1 Water availability

The greater part of South Africa is semi-arid and subject to variable rainfall, droughts, floods and high evaporation. The mean annual rainfall is only 500 mm, which is 60 per cent of the world average. In addition, this rainfall is poorly distributed relative to areas experiencing economic growth. Only a comparatively narrow region along the eastern and southern coastline is moderately well-watered, while the greater part of the interior is arid or semi-arid. Sixty-five per cent of the country receives less than 500 mm of rain annually (this is the level which is usually regarded as the minimum for successful dryland farming), while twenty-one per cent receives less than 200 mm. Therefore South Africa's existing and future development depends to a large extent upon the State's ability to move water in bulk from the well-watered regions to the drier regions.

5.1.2 Water supply

Under the old Apartheid regime, the Department of Water Affairs and Forestry practised the art of large scale interbasin transfer to the acclaim of the international water industry. However, it performed this role exclusively on behalf of White South Africa and those non-white population groups who were allowed to reside outside of the Bantustans. The supply of water in the so-called independent and self-governing homelands was the responsibility of the individual Bantustan administrations who undertook the task with varying degrees of success.

South Africa has been in a state of socio-political transition since the African National Congress (ANC) was unbanned in February 1990. One result of the period of constitutional negotiation, which ended with the general election in 1994, was bureaucratic inertia. Officials within the myriad of central, provincial and homeland administrations adopted a 'wait and see' strategy resulting in important decisions affecting infrastructural development being postponed until after the election.

A consequence of the 1986 removal of Influx Control (the notorious Pass Laws), the dwindling legitimacy and effectiveness of homeland administrations, the scarcity of State development capital, politically motivated rates boycotts in the urban townships and poor control over the abstraction and pollution of water resources, is that today an estimated 16-million people in South Africa do not have adequate supplies of safe drinking water. To meet minimum present needs in rural areas, an extra 120 Mm^3 of potable water must be made available each year. Relative to total demand, this is very little, but a significant portion of this new demand will have to be supplied in semi-arid areas where very little surface water is available, where infrastructure is poor and where population density is low.

There are also other natural resource related problems affecting rural water supplies. Traditional African land management strategies, which were often migratory-based, are not feasible in most parts of South Africa. Minority white farmers occupy the prime agricultural land and most African settlements are in areas unsuited to agriculture of any kind. In general, African subsistence farmers still aspire to own large herds of livestock, rather than a few prime beasts, and grazing areas are seldom fenced. Goats are a primary source of meat in remote areas; but their impact on resource degradation has been profound. Bad erosion, overgrazing and contamination of drinking water are endemic.

5.1.3 Unconventional sources of water

South Africa's relative abundance of First World technology and skills has led to the investigation and development of several unconventional ways to augment water supplies. None of these can be said to have been motivated by actual water stress. The achievement of First World water supply and treatment standards and a passing interest in international one-upmanship seem to have been the main driving forces. The two most notable areas of research and development were in rainfall stimulation (cloud seeding) and ultrafiltration technology (desalination).

Cloud seeding was practised in the Bethlehem area of the southern Free State where it was found to benefit the yield of farm dams but not the runoff from the Vaal catchment. The programme has since been moved to the escarpment area of the Eastern Cape where some measure of success is being experienced with increasing the rainfall over commercial tree plantations. This is an expensive project and recent investigations have been held into whether the money could not have been better spent on improving water conservation.

Ultrafiltration technology was largely developed in South Africa to deal with the wide range of industrial and mining pollutants which by law have to be returned to the channel of origin where there is usually insufficient dilution potential to render the effluent harmless. Although there is great potential for augmenting South Africa's water supply by desalinating sea water and brackish ground water, the costs of this are still prohibitive. As such this state-of-the-art technology has not as yet been applied to domestic water supply except in exceptional circumstances.

5.1.4 Water demand

The present and projected total water demand of South Africa (inclusive of all the homelands) is shown in Table 5.1 together with the availability of surface and ground water in the country's 22 primary drainage regions.

In April 1994 the new ANC-led Government of National Unity came to power with a clear set of policy objectives to address the gross distortions of the Apartheid era. The Reconstruction and Development Programme (RDP), for example, devotes special attention to rural and urban water supply, and outlines a number of specific targets with clear deadlines. Within the `short-term' - generally understood as being 1997 - the new government aims to provide all rural households with a clean, safe water supply of 20-30

TABLE 5.1 : WATER AVAILABILITY AND DEMAND

Drainage Basin ID	Actual/Estimated Demand (million m3 per annum) 1994	2010	MAR (million m3/a)	Utilisable % of MAR	Utilisable MAR (million m3 /a)	Ground water Abstraction (million m3 /a)	Return flow (million m3 /a)	Return Flow as a Portion of Actual Demand	Total Water Available (million m3 /a)	Total Utilizable water (million m3 /a)	Total Portion utilizable	Estimated 1994 Deficit/Surplus	Estimated 2010 Deficit/Surplus
A	1 565	2 738	2 176	43	936	361	196	0.125	2 537	1 493	0.59	(72)	(1 245)
B	1 263	1 844	2 651	61	1 605	170	75	0.059	2 821	1 850	0.66	587	6
C	2 357	5 278	4 248	51	2 149	526	458	0.194	4 774	3 133	0.66	776	(2 145)
D	1 964	2 701	6 987	82	5 757	163	133	0.068	7 150	6 053	0.85	4 089	3 352
E	476	505	1 008	58	586	22	101	0.212	1 030	709	0.69	233	204
F	13	15	24	17	4	6	1	0.077	30	11	0.37	(2)	(4)
G	625	1 274	1 986	52	1 033	84	87	0.139	2 070	1 204	0.58	579	(70)
H	770	1 124	2 059	61	1 262	113	5	0.006	2 172	1 380	0.64	610	256
J	333	339	662	34	228	55	49	0.147	717	332	0.46	(1)	(7)
K	180	297	1 307	62	812	10	4	0.022	1 317	826	0.63	646	529
L	188	219	495	63	313	25	9	0.048	520	347	0.67	159	128
M	97	226	151	34	52	6	22	0.227	157	80	0.51	(17)	(146)
N	191	312	280	25	71	32	14	0.073	312	117	0.38	(74)	(195)
P	38	53	173	20	34	4	3	0.079	177	41	0.23	3	(12)
Q	396	660	520	39	204	37	33	0.083	557	274	0.49	(122)	(386)
R	149	285	580	67	387	8	13	0.087	588	408	0.69	259	123
S	297	400	1 046	63	662	17	22	0.074	1 063	701	0.66	404	301
T	1 187	1 328	7 388	69	5 104	79	41	0.035	7 467	5 224	0.70	4 037	3 896
U	1 008	2 002	3 128	82	2 563	7	32	0.032	3 135	2 602	0.83	1 594	600
V	561	992	3 992	83	3 310	13	8	0.014	4 005	3 331	0.83	2 770	2 339
W	1 394	1 850	6 744	52	3 484	26	6	0.004	6 770	3 516	0.52	2 122	1 666
X	1 181	1 446	3 361	71	2 398	19	8	0.007	3 380	2 425	0.72	1 244	979
Totals	16 233	25 888	50 966	65	32 954	1 783	1 320	0.081	52 749	36 057	0.68	19 824	10 169

NB : 1. Total water available = MAR + Ground water abstraction
2. Total utilizable water = Utilizable MAR + Return flow + Ground water abstraction
3. Utilizable MAR includes about 1000 million m3 per annum required by South Africa's neighbours

litres per capita per day (lcd) within 200 m and an adequate sanitation facility per household. By roughly 2002, it aims to achieve an on-site water supply of at least 50 lcd. It is imperative that these objectives are met as soon as possible -- yet capacity, logistic and financial constraints suggest that meeting them on schedule will be a major challenge. With this in mind it should be noted that within the first six months of office the new government has announced plans to construct projects which will improve the supply of water to 1.2 million people, many of whom are rural dwellers.

Sectoralised water demand for South Africa is shown in Table 5.2. It can be seen that the bulk of the nation's available water resources are assigned to commercial irrigation. Whilst the land reform debate is starting to acquire substance in South Africa, many rural people are realising that water is the primary limiting factor governing the allocation of land to emerging small-scale farmers. As existing rural water supplies are largely fully utilised, water for rural domestic use and to support new agricultural development will have to be re-allocated from large scale commercial farming operations. This will either entail the expropriation of water rights (which could prove costly and controversial), the development of more storage (also expensive and not always possible), or some sort of differential water pricing strategy which will force commercial agriculture to improve efficiency and to stop irrigating low value crops.

5.1.5 Water demand management

Of course the commercial irrigators of South Africa are not the only water users that should be considered for efficiency or cost-effectiveness improvements. Indeed, by international standards, South African irrigators are some of the more efficient in the world. The trend of the last 12 years towards drip and micro irrigation systems (prompted by the shortage of water rather than the price) has resulted in leaching fractions of less than 15% in many areas. However, the bulk delivery of water to irrigators still incurs major losses in excess of 30%.

SECTOR	1993 (Mm3)	2010 (Mm3)
Domestic	1516	3000
Industry	1031	2500
Municipal use	90	200
Urban losses	280	500
Power generation	224	400
Mining	466	600
Irrigation	8254	11500
Stock watering	264	350
Forestry	1284	1700
Nature conservation	2994	5000
TOTALS	16353	25750

TABLE 5.2: PRESENT AND FUTURE SECTORALISED DEMAND

The other major user sector which needs to consider its consumption levels is the urban domestic user. Recent surveys conducted in South Africa's middle class suburbs revealed that the conservation threshold price of water (i.e. the price at which householders would implement conservation measures) could not be determined with any accuracy because it was too far in excess of what was currently being paid, for respondents to identify a specific price. This suggests that there may be considerable scope for raising revenue in South Africa by means of levies on urban water sales, in order to fund water supply and sanitation infrastructure to disadvantaged communities.

Clearly, there is the potential to curb South Africa's thirst for more water by introducing demand management strategies. Furthermore, there is also some urgency to do this given the new government's intention to expand the economy at a rate in excess of 5% per annum. Unfortunately, there is little indication that policy-makers are thinking along these lines.

5.2 WATER MANAGEMENT SYSTEMS

5.2.1 National overview

Responsibility for water supply is divided between central, regional and local authorities and non-profit bulk supply authorities (water boards), with the central government's Department of Water Affairs and Forestry (DWAF) managing the overall policy framework. The Department is responsible for managing many of the country's major dams, for setting policy, issuing forestry permits (based on estimated water use and runoff reduction) and co-ordinating long-term water resource development. In the past it worked closely with provincial and ethnic 'homeland' governments, but had no jurisdiction over the four nominally independent 'homelands'.

The former homeland governments are currently in the process of being re-absorbed into central and regional administrations. Nine new provincial governments are being established in place of the former provincial and homeland administrations. Despite the detailed wording of the new constitution, there is still uncertainty over the division of responsibility between central and regional government, especially since the new regional governments are keen to assert their independence of central government. Water management is a central government responsibility whereas regional governments are responsible for local services. In any event, the debate is likely to be academic as there is a definite imbalance between the availability of skills and the skills required.

The anticipated lack of capacity at provincial level coupled with the rigid service level targets of the RDP have forced the central government to consider the further establishment of water utilities (non-profit making, democratically-controlled water boards) to implement water supply and sanitation works at a sub-provincial level. While these new utilities have still to be formed, it is widely recognised that the needs of rural communities will only be met with a collective and concerted effort from government, parastatals, NGOs, the private sector and the communities themselves, who must demonstrate consensus and determination in order to benefit from the RDP. The backlog in water supply and sanitation

services, the rapid urbanisation rate, and rural population growth rates of over 3% per annum, presents too great a problem for any single agency to assume total responsibility over.

5.2.2 Rural water supply

Because of the policy of separate development, rural water supply in white South Africa as administered by the DWAF, focused on water supply for commercial agriculture, while water supply for the inhabitants of the ethnic Bantustans was allocated to homeland governments. In general, the latter lacked the resources, capacity and motivation to introduce and maintain sustainable water delivery systems, although there were isolated success stories.

More than half of all rural people rely on unimproved water sources - streams, rivers and unprotected springs. This direct dependence on natural water sources has made many communities highly vulnerable to droughts, increases in surface and ground water abstraction patterns, upstream land-use changes, and effluent discharges. Current water conflicts and detailed catchment analyses are starting to indicate that rural water resources may have been over-allocated (i.e. beyond the safe yield of catchments and dams). Furthermore, nearly all of South Africa's surface water resources are unsuitable for human consumption due largely to contamination by human, animal and industrial waste. This water must be treated if any reduction in rural water-related diseases is to be achieved.

In response to this problem, a Directorate of Rural Water Supply and Sanitation is being set up within the DWAF to support rural communities. The new Directorate will strive to `facilitate' rather than implement water management. NGOs, local authorities, water boards, the private sector and regional authorities will take primary responsibility for implementation. Rural water supply is to be co-ordinated by local water committees.

5.2.3 Urban water supply

South Africa's urban areas were historically segregated into White, Asian, Coloured and Black areas. Water supply in white areas is generally excellent. Because African urbanisation was forcibly discouraged, black townships outside the `homelands' were not designed to accommodate large populations. Since the lifting of influx controls urbanisation levels have been dramatic - and existing township infrastructure is proving inadequate to meet the demands now being placed on it. Politically motivated rent and service boycotts have deprived local authorities of the revenue needed to upgrade and maintain systems, and maintenance capacity has been deteriorating steadily for a long time. The new political dispensation does not seem to have diffused the crisis in many local authorities as residents grow impatient at the State's failure to deliver widespread civic improvements within weeks of the general election. This is exacerbated by the remaining undemocratic nature of local government where elections are only scheduled for late 1995.

In the last five years, dense informal settlements have sprung up around the periphery of towns and cities such as Johannesburg, Durban and Cape Town. Growth is extremely

rapid. In the space of a month, shack settlements of up to 15 000 people commonly develop on vacant land, and local authorities are battling to provide even rudimentary services. Most residents rely on public standpipes in adjacent settlements, or on water tankers. Sanitation is often non-existent and already there have been several outbreaks of typhoid and other water-related diseases.

The involvement of the residents of informal settlements in water management or local administration was initially discouraged by the last government for fear of bestowing some form of legitimacy on what was perceived to be an illegal activity. The new government has adopted the policy of encouraging dialogue with informal community leaders and encouraging the provincial governments to give priority to their needs. However, in order to prevent a free-for-all developing over unserviced urban land, a moratorium has been agreed on over the establishment of new informal settlements.

5.2.4 Cost recovery

The majority of rural users regard water as a free good which the government must provide in abundance. Government makes little attempt to recover the real costs of rural water supply from the beneficiaries, and rural consumers are required to pay a nominal tariff which is seldom consumption related, and then only if the water provided is close by. Very few people actually pay this nominal tariff, and government agencies lack the capacity to enforce payment. In urban areas, mounting debt from long-standing rent and service boycotts in many areas is being covered by government through inter-departmental cash transfers thereby depleting funds for new services.

Payment for sanitation in rural areas has usually entailed the repayment of loans for voluntary owner-built pit latrines. However, disposable income is extremely limited in the impoverished rural areas and priority needs such as water supply, food purchases, health, and education are often considered more important. Service payment schemes for RDP constructed sanitation systems have yet to be developed and implemented.

The non-recovery of even the operation and maintenance costs of water supply and sanitation services has all the usual ramifications that have been experienced elsewhere in the world, i.e.:

- failure by the community to identify with the scheme so long as it is State owned;
- lack of respect for the scheme, leading to abuse, theft and vandalism, which raises maintenance costs;
- inappropriate system design due to there being no attempt to reconcile the needs of the community with affordability levels and capacity to manage sophisticated systems;
- increasing national O&M cost burden, which reduces available funds for new schemes, and leads to a pre-occupation within government with cost-cutting;
- wastage of water;

Homeland governments lacked the legitimacy and political-will to introduce (let alone enforce) better cost recovery. Often zero-cost water supply schemes were seen as a way

to foster rural political support, something that took on greater importance in the run-up to the 1994 elections. Today, in some large scale rural reticulation schemes, the inherited policy of zero cost recovery completely undermines the reliability of the service as people are unmotivated to turn off yard taps preferring instead to run the water continuously onto vegetable gardens and lawns. This leads to pipeline pressure reductions with many villages further down the line not receiving water and having to rely on tanker deliveries.

The task of achieving at least a partial cost recovery, sufficient to meet O&M costs, now falls on the new government. The policy on this has been advanced in RDP documentation where it was indicated that service charges would have to be levied on RDP infrastructure projects. However, the implementation of this policy in an environment where service delivery has been highly politicised and where welfare expectations run high, has still to take place.

The DWAF plans to entrench the principle that all water consumed has a price. A low-level 'lifeline' tariff has been mooted for low income consumers, and higher tariffs on a sliding scale for other consumers could help finance a more equitable and sustainable water supply to all. Higher water tariffs for irrigators are also possible.

On this issue of payment, the achievements of a number of independently-minded rural communities deserve recognition. Either as a result of objections to incorporation into homeland states or because of disfavour with homeland politicians, a number of rural communities in South Africa were left to fend for themselves during the 1980s and early 1990s. In order to survive, these communities established (usually with strong leadership inputs from women) the foundations of an interim local authority which collected funds within the community, and approached NGOs for assistance with basic service provision. In some instances this new found capacity has led to the development of rural industries and enterprises. The interesting feature of the many community-originated water schemes is the reportedly high level of assurance of supply due essentially to schemes having been developed without any government intervention. In such cases it is not uncommon to find the local vehicle mechanic maintaining the village water pump.

5.2.5 Catchment management

Historically, natural resource management has tended to focus on separatist 'conservation', rather than viewing humans as an integral part of the natural environment. Hence, no implementable catchment management plans exist beyond statements of general intent. For example, dense settlements, overgrazing and overburning has led to severe erosion particularly in the ex-homeland areas. Diminished infiltration is affecting local groundwater supplies, flooding is increasing in frequency and severity, and the silting of rivers and estuaries is widespread. The impact of this degradation affects not only people in the immediate vicinity (i.e. the rural areas), but will in a short space of time impact on water supplies to the main metropolitan areas.

Broad policy statements are difficult to implement on the ground, and neither the departments of Agriculture or Water Affairs have the powers or resources they need to

ensure better resource management in the important water supply catchments. In the former homelands, environmental management was largely ignored, and tended to focus on tourism-related conservation rather than veld rehabilitation and community education. Effective public awareness campaigns are an urgent priority -- but in the absence of feasible management policies and the necessary development to alleviate rural poverty, progress is likely to be limited.

5.3 PRIMARY WATER-RELATED PROBLEMS

5.3.1 Top-down development practices

Problem: The historical approach by government agencies has been top-down and paternalistic, with the emphasis on technical rather than institutional development. 'Community participation' tended to mean the chief or headman was consulted on the siting of a borehole. Communication was generally one-way, and addressed to men.
Response: The new Minister of Water Affairs has committed his Department to the principle of bottom-up development, in consultation with all stakeholders, particularly women. Extensive staff recruitment and management re-education programmes will be necessary to achieve this, as the Department of Water Affairs has tended to be white, male and technocratic. Policies are being put in place to address this.

5.3.2 Poorly developed capacity in rural areas

Problem: The existing rural water supply system has fostered dependence and stifled initiative, without being able to meet community expectations. Organisational capacity at local level is generally poorly developed, and if local committees are to play the role outlined for them by the new government, considerable training will be required in organisational development, basic administration, book-keeping, and rudimentary maintenance skills.
Response: In conjunction with NGOs, the government is formulating strategies to address training and organisational development. Also, in response to the realisation that well-developed technical skills often exist in rural communities and merely require re-orientating towards water system maintenance and operation, there are moves to help establish small-scale water and sanitation entrepreneurs in rural areas.

5.3.3 Pollution of water supply aquifers

Problem: Contamination of water sources and aquifers has become a very serious problem, due in part to the rapid growth of dense settlements with poor sanitation infrastructure. Considerable contamination of ground water has already occurred in many places, and it will be some time before government and community agencies have the resources to introduce better sanitation techniques and alternative water supplies.
Response: Improved sanitation is one of the RDP's priorities and the Department of Water Affairs has assumed some measure of responsibility for ensuring improvements do occur.

5.3.4 Overstocking of grazing veld

Problem: In the past, traditional chiefs were responsible for ensuring that lands under their jurisdiction were well managed. However, the erosion of their legitimacy in many parts of the country means they lack the authority to introduce new patterns of stock management, and many are not motivated to try. Government attempts to reduce stock numbers and forcibly introduce different stock management regimes have often been politicised, and have generally failed.
Response: None. Politicians have shied away from tackling this problem, because of the cultural importance of cattle to many African people and because it begs questions about land distribution in South Africa. It is one of the single most pressing problems facing sustainable water management.

5.3.5 Water for the environment

Problem: The weak enforcement of environmental conservation policies and a poorly co-ordinated environmental lobby has meant that when water stress does occur it is invariably the natural environment that suffers. The water needs of wetlands, riverine habitats and even conservation areas such as the Kruger National Park have generally been overlooked.
Response: The Water Research Commission, in conjunction with the Foundation for Research Development, embarked on a programme for determining the water needs of the natural environment in the mid 1980s. It remains to be seen whether the State will adopt the recommendations of this research in view of the stiff competition for scarce water from rural communities.

5.3.6 Legislation

Problem: Responsibility for implementing the Water Act has been dispersed amongst a myriad of authorities operating at various levels of government within SA and the independent and self-governing states. Moreover, South African water law is derived from European law, and presupposes an abundant supply of water; thus the emphasis is on allocation, rather than integrated scarce resource management.
Response: Under the new government, the DWAF is drafting legislation to consolidate and rationalise water legislation into one uniform body of law. From there, the nation's water law itself will be revised to meet current conditions. This will take some time.

5.3.7 Drought management

Problem: Droughts are still seen as exceptional, rather than inevitable and predictable. Drought relief schemes during the 1992/93 raised awareness amongst government officials that in most places the major problem was not an absence of assured water, but rather that existing infrastructure had broken down forcing communities to revert to traditional sources which were soon exhausted.
Response: Better awareness of the need for ongoing maintenance programmes involving local users is realised, but few initiatives are underway.

5.3.8 Co-ordinating the activities of NGOs

Problem: NGOs have played a pivotal role in installing improved water supplies in areas not adequately addressed by government. However, the rapid proliferation of NGOs in the late 1980s and early 1990s resulted in poor co-ordination and communication between organisations.

Response: A new NGO, the Mvula Trust, has been established to fund, and co-ordinate the funding and development of rural water and sanitation schemes.

6. SWAZILAND

6.1 WATER SUPPLY AND DEMAND

6.1.1 Water availability

The water resources of Swaziland may be described in terms of the four main geographical areas, running north to south. From the west, they are:

The Highveld: 1 000 to 1 200mm/a rainfall and abundant surface and groundwater.
Middleveld: 600-800mm/a rainfall with unreliable surface water but good groundwater.
Lowveld: <600mm/a rainfall with little surface water and few successful boreholes.
Lebombo Plateau: The north-east is relatively wet, with 650 mm/a; most rivers have small irrigation dams for sugar, citrus and other crops. The south-east is a rainshadow area, and receives 400- 500mm/a rainfall. Here domestic supply relies on boreholes and a little surface water.

6.1.2 Water supply

The traditional sources of water are springs and rivers, which are shared with livestock. The three main river systems affecting Swaziland are the Komati River, the Usutu River and the Ngwempisi River which all flow in an easterly direction from South Africa through Swaziland towards Mozambique.

The Komati River hosts a number of impoundments on the upstream South African side which are used for supply to coal-fired power stations and for irrigation. Commercial timber plantations in both South Africa and Swaziland further reduce the runoff from this catchment. Historical agreements with South Africa have allocated a portion of the Komati Rivers flow to Swaziland. This allocation has generally been more than could be utilised by Swaziland. However, the droughts of the 1980s and 1990s coupled with increased irrigation abstractions upstream of Swaziland, has meant that the flow in the Komati River, as it returns to South Africa, has been greatly reduced in recent years. This has in part been the motivating force behind the construction of the Driekoppies Dam on the Lomati River (a main tributary of the Komati River) on Swaziland's eastern border.

A second dam in the Komati catchment at Maguga has been proposed. If it goes ahead, it is to be funded 40/60 by Swaziland and SA respectively. However, Swaziland has been slow to set in motion the processes necessary to keep project negotiations on schedule. Maguga will have virtually no impact on domestic water consumption; its primary purpose will be hydro-electric power generation and irrigation (of sugar and, to a lesser extent, citrus and other crops).

6.1.3 Water demand

Swaziland's current and projected water demand is shown in Table 6.1.

SECTOR	1994 (Mm^3/a)	2016 (Mm^3/a)
Urban domestic	5.77	16.35
Rural domestic	4.6 (estimated)	10.0 (estimated)
Industrial	5.71	13.94
Irrigation	400[3]	500
Forestry	120	130
Total	536.08	670.29

TABLE 6.1: CURRENT AND PROJECTED WATER DEMAND

Thirty per cent of the population of Swaziland live in urban areas, and this proportion is increasing rapidly as young people leave the rural areas in search of work. Political change in South Africa has led to a measure of disinvestment from Swaziland in preference to its more developed neighbour. This is expected to place greater pressure on the commercial agricultural sector to generate jobs and wealth, which in-turn will probably increase the demand for irrigation water.

6.2 WATER MANAGEMENT SYSTEMS

6.2.1 National overview

Swaziland is a constitutional monarchy in which the royal palace strongly influences decision-making. There is no single institution outside of the monarchy with the power to co-ordinate water policy in Swaziland. Authority is dispersed among several government departments, each of which seems eager to cede responsibility. Despite much discussion and an agreement in principle taken six years ago, a proposed National Water Authority with the powers to gather information, formulate policy, plan development and oversee implementation, has still not been set up. Development planning falls primarily under the Ministry of Economic Planning, whose priorities do not necessarily address resource management and sustainable water delivery

There is no comprehensive national water development strategy or master plan, and rhetorical commitments to water resource development have not been matched by the necessary financial and human resource commitments. For example, the Rural Water Supply Board (RWSB) depends entirely on external donors for its existence, and these

[3] Official estimates are set at 1 200 Mm^3 pa for irrigation, based on the register of permits allocated for irrigation. However, actual utilisation is estimated to be far less at around 400 Mm^3; no precise figures exist.

commitments are coming to an end. In-principle agreements to give the RWSB the resources and powers it needs from within government, were reached several years ago, but have not been implemented.

Part of the reason for this complacency is that Swaziland is well provided with surface water. However, much of this water is unsafe for human consumption (largely because of human and animal faecal contamination), and so the failure to invest in sustainable rural water infrastructure is reflected in high infant mortality rates, widespread diarrhoea and a range of other water-related illnesses.

Estimates of safe water supply coverage vary widely. Between 20 and 40% of the urban and peri-urban population, and 45 and 55% of the rural population, do not have access to potable water. Given that 70% of people live in rural areas, this reflects a bias towards higher-quality service provision in urban centres.

The three main water institutions of Swaziland are:

The Water Department within the Ministry of Natural Resources and the Environment has few powers and resources. Its main activity is managing water for irrigation.

The Rural Water Supply Board (RWSB) falls under the Ministry of Natural Resources and the Environment, but depends entirely on external funding. It was set up with donor funding and NGO support during the UN Decade of Water and Sanitation.

The Water Services Corporation was privatised in August 1994 to facilitate better planning, budgeting and overall management of urban water supplies. It is answerable to the Ministry of Housing and Urban Development.

6.2.2 The Rural Water Supply Board (RWSB)

The Swaziland Government still regards the RWSB as a temporary parastatal institution. Current funding is short-term and uncertain -- which severely undermines its present and future effectiveness. The majority of staff are in temporary positions, and receive little training. Training in community development has largely been neglected.

The RWSB emphasises low-cost, community-initiated water projects. People wanting an improved water supply are required to form a water committee and to collect contributions for O&M. Once the RWSB is satisfied they have shown sufficient commitment, it applies for donor funding - which can take several years to secure. RWSB technicians install gravity-fed systems from reliable springs wherever feasible, and sink boreholes where necessary. Where the depth is too great for handpumps, the RWSB installs electric pumps wherever possible. Diesel pumps are rarely installed now because of theft of both the pump and fuel. The use of electricity has raised the cost, and affordability is a major problem for many households.

A major factor complicating rural water provision is the entrenched cultural preference for scattered homesteads rather than close rural settlements and villages. Among other factors, this raises the cost and difficulty of rural water supply.

Once a water scheme is installed, many water committees lapse. Of those that remain, only half maintain an ongoing water fund. As water minders are unpaid and usually untrained, very few settlements have a permanent water minder.

Maintenance capacity is limited. Although 45% of rural villages are serviced by improved water schemes, not all of these schemes are in working order because of problems with communication, transport and the shortage of technical staff. Many rural water supply schemes are too complex to allow for greater community involvement, and few water minders are trained in rudimentary maintenance.

People in rural areas are supposed to contribute a monthly flat rate, usually R6 or R7, for O&M to the local water committee. Payment and collection rates vary; in theory, non-payers are not allowed to take water, but this is hard to police in practice. Vandalism by those excluded, plus the health costs of reverting to traditional water sources, are far more expensive.

Without a commitment from government to give the required support, the RWSB will always lack the resources to address the problems facing rural water supply in anyway other than an *ad hoc*, reactive manner. In conjunction with the RWSB, the UNDP has just completed a major evaluation of the projects it is involved in, and is now considering ways to address the problems it identified. This may have a wider impact.

6.2.3 The Water Services Corporation (WSC)

The WSC is understaffed and depends on ex-patriate technical advisors. Recent internal restructuring has distracted attention away from the need to make urgent policy decisions around infrastructure upgrading and expansion. At current levels of consumption and urban growth, Mbabane will start running out of water in 1998. No decisions have yet been taken about how to address this problem.

High-level, metered reticulation networks in formal settlements co-exist uneasily with a dearth of infrastructure in the informal settlements. An estimated 140 000 people in urban and peri-urban informal settlements are without running water, and settlements in the Greater Manzini area are growing at 5% per annum. Urban community structures are not involved in water management.

Current urban development strategies stress full cost recovery, but this is not achieved as tariffs cover O&M costs only, and do not provide for expansion and development. Formal settlement areas have individual metered connections, and revenue collection is administered well.

A few public standpipes were installed in informal settlements in the 1980s after a cholera outbreak, and no attempt was made at cost recovery. Several pilot projects are now underway to get standpipe users to pay for water - in the absence of any precedent for this in Swaziland. One expedient is lockable standpipes, with keys for those who pay a flat rate. However, there are problems with vandalism by those locked out. Water kiosks seem to be more successful.

6.2.4 The NGO sector

Co-ordination between the government and some elements of the NGO sector is poor, and leads to inefficiencies and duplication. The RWSB is highly critical of some NGOs, which, it argues, often install inadequate water schemes fitted with non-standard equipment which the RWSB is then obliged to maintain.

6.2.5 International institutions

As a result of the construction of the Driekoppies Dam, an international water management institution has been established through an agreement between Swaziland and South Africa. The **Komati Basin Water Authority** or **KOBWA** will have the task of monitoring land use and runoff within the Komati catchment which includes parts of Swaziland.

6.3 PRIMARY WATER-RELATED PROBLEMS

6.3.1 Drought relief

Problem: As Swaziland has only one major storage dam (Mnjeli, used mainly for irrigation) and generally inadequate water supply coverage in rural areas, the country is extremely vulnerable to drought. An elaborate scheme to erect water tanks in stressed areas, which would be filled by government tankers, failed conspicuously when it was realised that no funds had been voted to operate and maintain the tankers. Moreover, the logistics of supply in the rural areas proved prohibitive. Local residents expressed their frustration in some areas by vandalising the empty tanks.
Response: A borehole drilling programme is underway to improve rural water supply, particularly in vulnerable areas.

6.3.2 Natural resource management

Problem: Poor resource management in communal lands (controlled by the chiefs on behalf of the King) is compounding erosion and aggravating the sedimentation of rivers and reservoirs in the south-west. The main water supply catchment for the Greater Manzini area (the industrial hub of the country, with rapidly growing informal settlements) lies in badly degraded communal lands where steep slopes, erodable granitic soils, overgrazing and high intensity rainfall has led to major sedimentation. Hence the silting of dams and reservoirs is a serious problem, particularly in the Matsapha / Manzini area. Matsapha Dam also has a major hydro-electric scheme to service local industry.

Response: Major dredging operations have been necessary for the past year to improve the storage capacity of the Matsapha Dam, while the soil conservation measures of the Department of Agriculture have proved ineffectual.

6.3.3 Institutional co-ordination

Problem: There is little overall co-ordination between agencies implementing water and sanitation programmes. Communication between the various agencies happens primarily at a personal rather than an institutional level. There is no monitoring system at the national level.

Response: Little action.

6.3.4 International water sharing

Problem: South Africa abstracts heavily from two of the three main rivers entering Swaziland and has six dams on these rivers. Government officials maintain that river flows through Swaziland are declining because of this. Swaziland wants this water for irrigation. Bilateral negotiating mechanisms were introduced in 1979, ***after*** five of the South African dams were completed.

Response: Limited. Swaziland government officials feel relatively impotent given their size and location, in asserting their right to a more equitable share of river flows.

6.3.5 Water conservation measures

Problem: In urban areas, the estimated volume of water lost between the water supplied and water billed is 60%.

Response: Private consultants were commissioned to investigate loss reduction schemes - like replacing valves, upgrading shut-off devices and redesigning mains. However government is stalling on the implementation of their recommendations. There is no evidence of water conservation measures being applied in the other user-sectors.

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