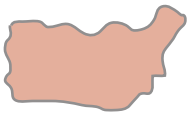
Integrated Water Resources Management



Kuiseb River Basin

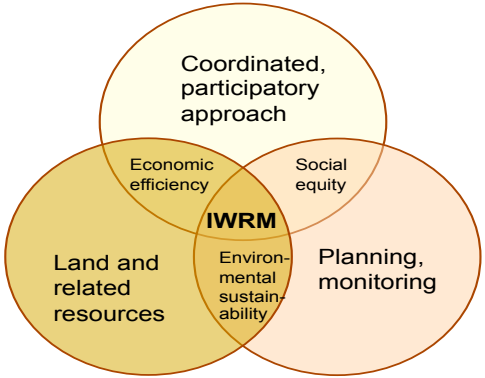
About this booklet

This booklet is intended for all water users to encourage awareness of the water sources, water use and its values, especially in a dry country as Namibia. There are no perennial rivers within the borders of Namibia and water resources are very unevenly distributed across the country. The water resources challenges in Namibia can only be addressed through efficient water resources management including development of an integrated framework and provision of infrastructure to ensure water security. In this regard, this booklet is compiled for the Ministry of Agriculture, Water and Forestry to introduce the concept of Integrated Water Resources Management (IWRM) and how it can be implemented with emphasis on stakeholder participation and decision making at the lowest appropriate level. The contents of the booklet includes:

What is IWRM and why is it important?

Integrated Water Resource Management (IWRM) is defined as a process that promotes the coordinated development, management and use of water, land and related natural resources (people, vegetation, animals and eco-systems) for economic, social and environmental sustainability. The IWRM process further involves participatory approaches which include discussions, planning and negotiations between stakeholders of the basin on important issues to achieve social equity, economic efficiency and environmental sustainability.

IWRM is implemented at a basin level in Namibia, linking all aspects of the basin, so that the users can understand the interactions between resource use, economic value and conservation, as well as the impacts of their activities on eco-systems and the goods and services they provide.



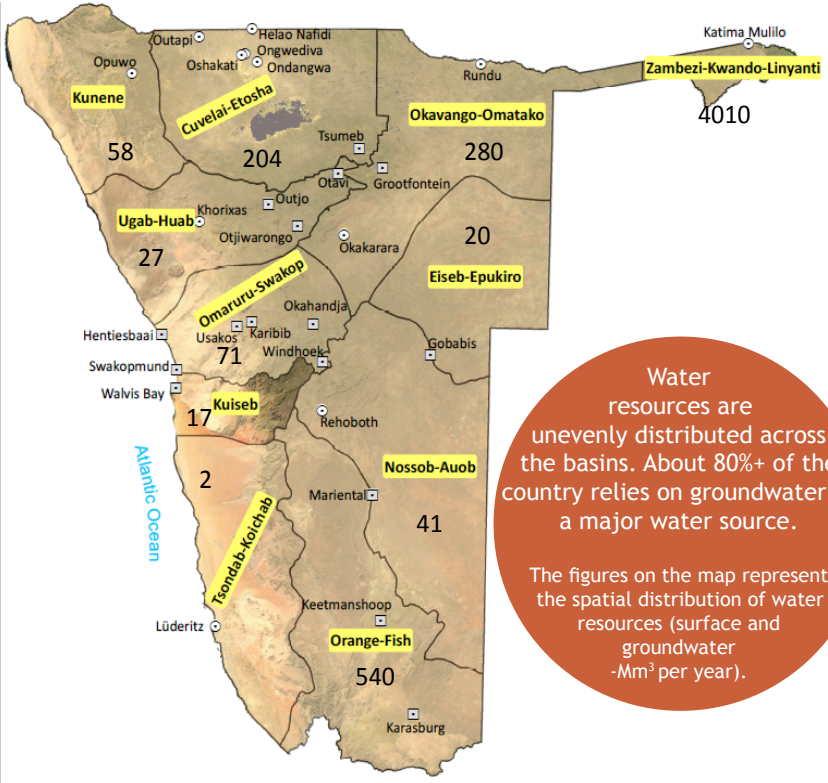
The Department of Water Affairs and Forestry (DWAF) in the Ministry of Agriculture, Water and Forestry (MAWF), assisted by a Steering Committee, representing various sectors, formulated an IWRM Plan (IWRMP) for Namibia.

The knowledge gained from the IWRM process, enables the stakeholders to understand the threats, prescribe mitigation measures and predict changes, and then manage them accordingly.

Welcome to the Kuiseb River Basin!

Water and land resources management in Namibia is carried out at the lowest management level, known as the basin level, to broaden the management process. Hence, Namibia is divided into 11 water management areas referred to as “water basins” according to the common drainage flows of major water sources such as rivers, groundwater systems (aquifers), water supply canals and pipelines.

The Kuiseb Basin is located across parts of the Erongo and Khomas Regions. The basin is characterised by upper, middle and lower zones. The upper part consists mainly of the highlands and commercial farms. The middle part has the Namib-Naukluft Park and small scale farmers (mainly Topnaar communities), while the lower part entails Walvis Bay and surrounding areas. The basin is home to an estimated 68 000 people, of which the 70 per cent is found in the lower basin area.



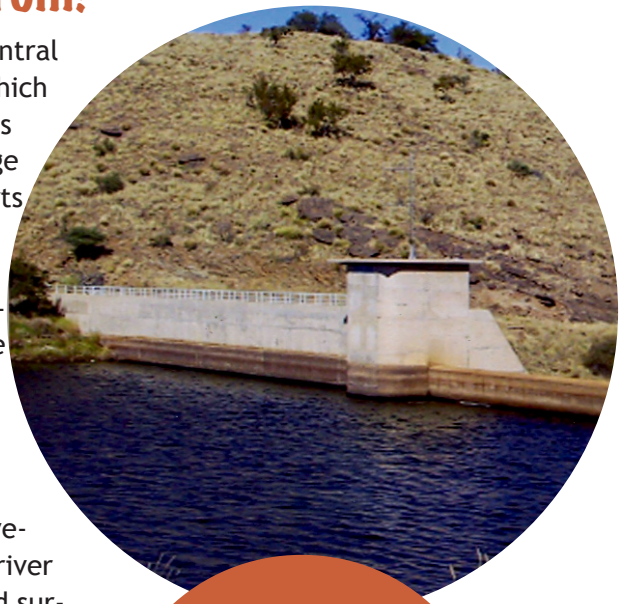
Map provided by **Uazukuani Uazukuani,** National Planning Commission - *Central Bureau of Statistics, February, 2010*

Water resources are unevenly distributed across the basins. About 80%+ of the country relies on groundwater as a major water source.

The figures on the map represent the spatial distribution of water resources (surface and groundwater -Mm^3 per year).

Where does the water in the basin come from?

Water in the basin comes mainly from rainfall and runoff from the central highland. The **Kuiseb River** is a westward flowing ephemeral river, which flows for a short period following heavy rainfall. The Kuiseb river does not reach the sea very often, and ends in the sandy riverbed of a large delta. The river also serves as a "linear oasis" meaning that it supports dense vegetation along the river course.



There are about 300 farm dams and one larger dam on the river, the Friedenau dam, with a storage capacity of 6,7 Mm^3, is the biggest in the upper basin.

The river has good **groundwater** flow and large aquifers in the lower basin area. The stored water is abstracted by means of boreholes or shallow wells. Boreholes and wells supply water to the people and livestock living close to the river. The large aquifers in the lower Kuiseb river are at Rooibank and Swartbank. They provide water to Walvis Bay and surrounding areas through a **network of boreholes, reservoirs and pipelines** operated by NamWater, while the **Directorate of Water Supply and Sanitation Coordination** in the Ministry of Agriculture, Water and Forestry, provides water to the Topnaar communities along the lower Kuiseb through **communal water points**.

The rest of the basin relies on borehole and surface water in the farm dams when the rainfall is enough to generate runoff into the dams.

Rainfall in the basin is low and unreliable with high evaporation rates. The rainfall ranges from 350 mm in the upper catchment to less than 50 mm per year at the coast.

The water resources can be divided into three catchments:

Upper catchment (highland)

- There are more than 300 farm dams for commercial farming, which enhance groundwater recharge.
- There are more than 1 300 boreholes – some up to 150 metres deep - but the yields are usually poor, ranging from 200 to 2 000 litres per hour.
- About 75 percent of the runoff is not accounted for and only 13 per cent is believed to enter the middle Kuiseb as runoff.

Middle catchment (escarpment and plains)

- The main water source in the middle and upper catchment consists of groundwater, abstracted by boreholes

Lower catchment (most western part)

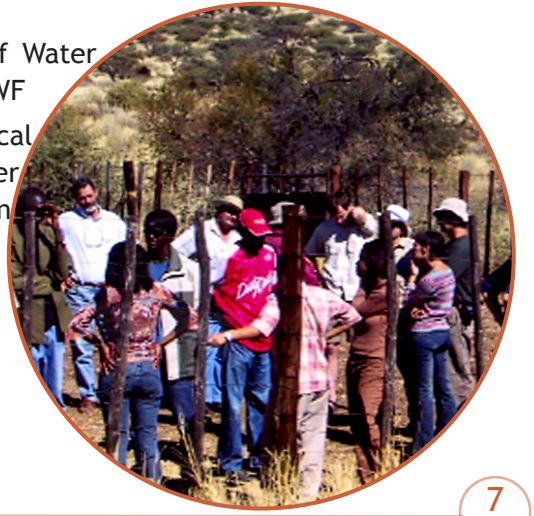
- Underground water is found in the Swartbank, Rooibank A, Rooibank B and Dorop South aquifiers. The water is abstracted to supply the central Namib area with potable water.
- Fifty-seven production wells are located in the lower Kuiseb abstraction areas. These are operated by Namwater.
- An integrated bulk water supply network supplies water from these aquifers to consumers at Walvis Bay.

Who supplies and manages the water in the basin?

The institutions responsible for water resources are divided into the following categories for ensuring efficient and effective management thereof:

- **Overall water resource inventory, monitoring, contol, regulation and management:** Directorate of Resources Management within the Ministry of Agriculture, Water and Forestry (MAWF)
- **Bulkwater supply:** Namibia Water Corporation (NamWater) abstracts water from primary sources (eg. rivers, aquifers or dams) and supplies to some end-users directly.
- **Self-providers:** These are commercial farmers, tour operators, mines and nature conservation parks), subject to appropriate agreements and licences, supply their own water.
- **Water supply to rural areas**: Directorate of Water Supply and Sanitation Coordination in the MAWF
- **Water supply to urban areas**: Local Authorities and Regional Councils buy water from NamWater or supply water from own boreholes for delivery to end users.

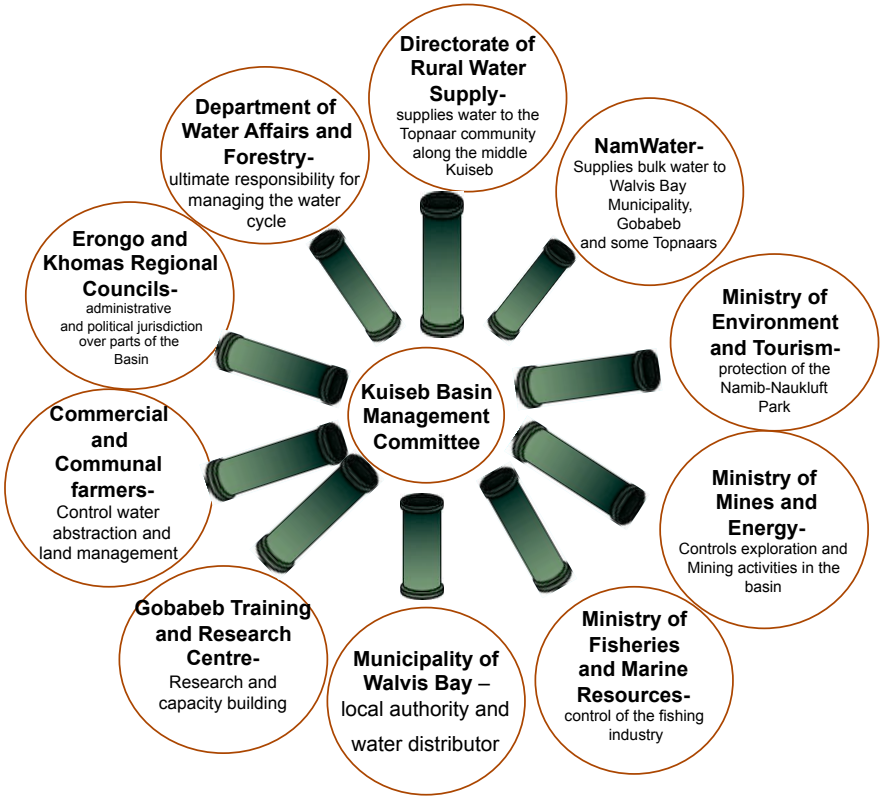
"Accountability through transparency (effective information sharing and stakeholder involvement) is the key for sustainable institutional development".



The Constitution of the Republic of Namibia is the primary law for sustainable resource management and equal distribution of water to the people. Specific documents dealing with water management include the: Water and Sanitation Policy of 1993; Namibia Water Corporation (NamWater) Act of 1997; National Water Policy White Paper of 2000; Water Act 54 of 1956 and Regulations, soon to be replaced by the Water Resources Management Act (2004) [which has not yet entered into force and is currently under revision] and the Water Supply and Sanitation Sector Policy of 2008.

The Water Resources Management Act makes provision for the establishment of basin management committees (BMCs) to make sure that integrated management takes place at the basin level. The role of a BMC is to provide scope for addressing various issues affecting water resources in the basin, ranging from efficient water use to monitoring the health of the basin.

The aim of such a committee is to equip basin communities (encouraging gender equality where possible) to take full ownership of their own development (through developing a strategic basin management plan) with strong support from the relevant service providers. The committee is ideal for knowledge and experience sharing to realize a common vision for the basin, through IWRM principles such as stakeholder participation, transparency and information sharing.



The KBMC is representative of all stakeholders who share the water resources in the basin.

The Kuiseb Basin Management Committee was the first BMC in Namibia and was formed in 2003. A Water Resources Management Plan for the Kuiseb was drafted by a mutli-disciplinary team in 2007. The plan serves as a road map for the KBMC and entails action plans focusing on:

- Agriculture and related issues
- Environmental issues
- Water planning and utilisation
- Geohydrology
- Socio-economic assessments
- Institutional development and capacity building
- Water education

For further information contact: Department of Water Affairs and Forestry,

Tel: 061-2087696

Who uses water and how?

The supply of water from surface and groundwater resources to competing demands is prioritised in Namibia. The first is water for domestic purposes (including livestock water for both subsistence and commercial farming) and the second is water for economic activities such as mining, industries and irrigation. Ninety-nine per cent of the population in the basin has access to safe drinking water. The main issue in the Basin is thus not so much providing access to potable water, but rather to ensure the supply of water is reliable, sustained and affordable.

The major water using activities/users in the basin include:

Upper and middle basin area:

- **Commercial livestock farming.** There are 109 farms (providing a livelihood for an estimated 1 700 people) in the freehold farming area. The estimated number of livestock is 30 000, of which 17% are small stock (mainly sheep).
- **Game farming/trophy hunting**. The estimated number of game is 17 000 and include kudu, zebra, oryx and other species.
- **Communal livestock farming**, mainly by the Topnaar community. The estimated number of people is 1 000, keeping approximately 200 cattle, 2 500 goats, 120 donkeys and 50 sheep.

How much water do we require (in terms of 10- litre buckets):

- One person uses on average 15 litres (one and half bucket) per day
- One goat/sheep/kudu/zebra/oryx drinks on average 12-45 litres (one to four buckets) per day
- One cow drinks on average 30 litres (three buckets) per day

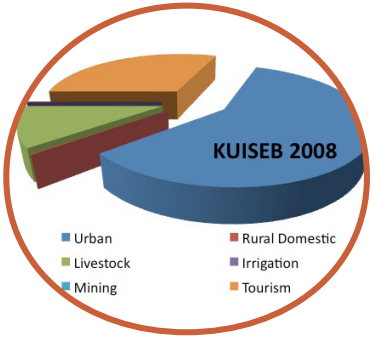
*An average household of four people thus consumes 60 litres per day (6 buckets).

- **Mining.** There are two active mines, mining minerals such as granite/marble and salt.
- **Gobabeb Training and Research Centre.** There are about 50 people and fog is harvested for small-scale vegetable gardening.

Lower basin area:

- **Urban area:** Walvis Bay town (estimated population of 50 400) places the biggest single demand on water resources in the basin.
- **Deep sea port and fishing industry, including mari-culture.** Namibia has one of the most productive fishing grounds in the world, rich in populations of demersal and large and small pelagic fish. The fish is processed in Walvis Bay.
- **Walvis Bay Wetlands:** This is a Ramsar site of International Importance and is considered the most important coastal wetland in Southern Africa, supporting more than 40 wetland bird species as well as mudflats, salt pans and sewage ponds.
- **Tourism**: there are about 15 tourism establishments in the upper and middle basin areas and 28 in the Walvis Bay area.

The environment is a silent water user, thus ecological water requirements should also be considered as necessary to support the river itself to maintain the eco-systems (for example trees and animals) dependent on the river water.



Water-use allocation in the Kuiseb Basin
Source: IWRMP Joint Venture, Theme Report 2. 2010

Water demand management – how to use water more efficiently

Water demand management (WDM) is a very important part of IWRM. WDM aims to improve efficiency by reducing water losses or changing the wasteful way people use water. WDM is an approach to achieve "water use efficiency".

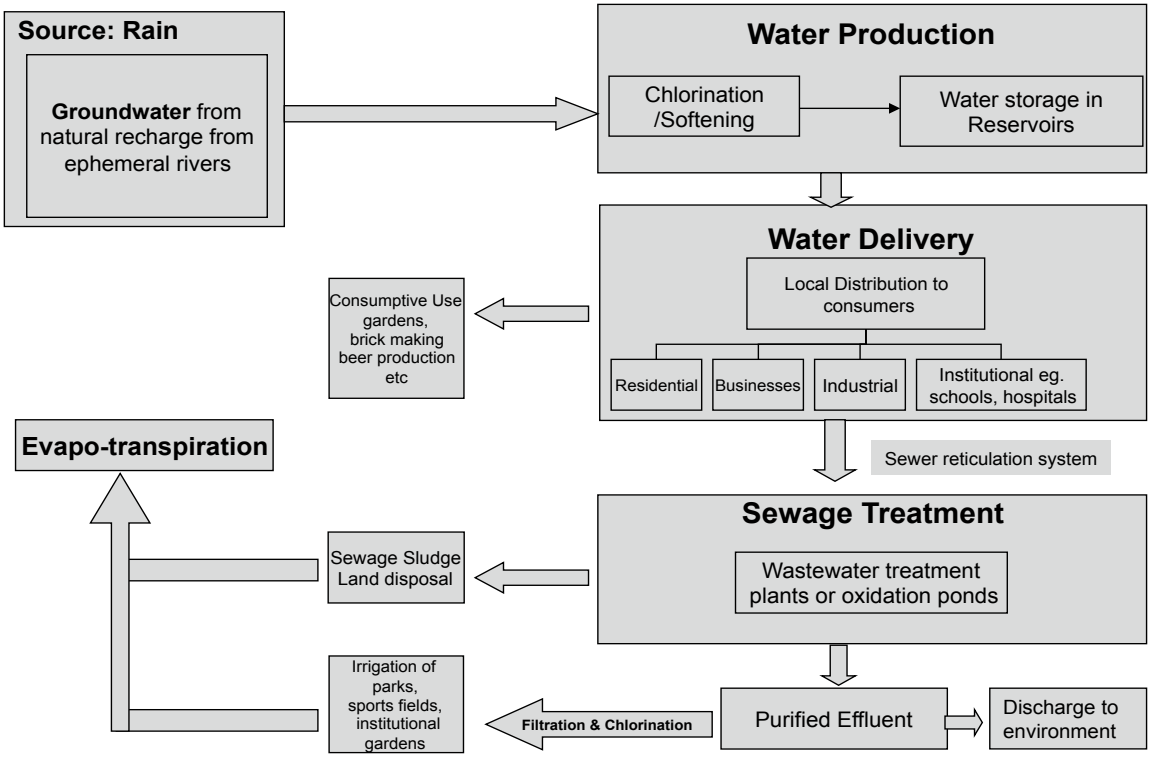
WDM is implemented through education and information; training; using economic and financial principles; water pricing and tariff policies (eg. rising block tariffs) and technical measures.

Water lost through leakage in the distribution system in Walvis Bay is currently about 12 to 14 per cent, which is considered highly efficient compared to international standards, which is 10%.

Walvis Bay Municipality reported 38 per cent reduction in water consumption in 2007. This is mostly because of the following reasons:

- reduced water consumption measures through appropriate pricing of water services;
- sale of recycled semi-purified water since 2003 for use in gardens;
- the fishing industry switching to seawater (as opposed to drinking water) for some of their processes.

The price of water supply services are determined by the cost to develop a water source; the distance the water has to be transported by pipeline/canal, the treatment costs, storage of treated water, pipelines to the consumer and the topography which determines the pumping cost to supply the water. The consumer base and technology, i.e. household taps or pre-paid meters, that is affordable to various income groups, also have an effect on the cost of water. The ability of Local Authorities to enforce credit control measures also influences water consumption.



Water supply chain, showing the process from source to the tap of a household, is the basis on which water services are charged.

Municipal costs to provide a household with water and sanitation services include charges for water collection from a source; water production (treatment of raw water to drinking water standards); water delivery to the consumer and wastewater treatment and disposal. Wastewater collection and treatment contribute to hygienic environments and form part of the water chain to prevent pollution in order to ensure that good water quality and sanitation is achieved. Therefore it is essential that water consumers PAY for water services to ensure continued quality and efficient service delivery.

The average water bill in Walvis Bay town was N$140 in 2009 (lower water tariff of N$7,33 for 19 m^3) Noteworthy is that there are no pre-paid meters or communal taps in Walvis Bay town, thus all households are linked to water meters.

"The price of the providing water supply and sanitation services must correspond to the investment and running costs thereof. Adequate pricing of water services is therefore essential for financial sustainability, to ensure service providers can maintain infrastructure and serve the demand with quality services."

Different ways to save water in urban households:

1. Schedule watering of gardens for early or late in the day (before 10 am and after 4 pm)
2. Avoid the use of hosepipes for cleaning pavements, floors or cars; instead use buckets
3. Make use of retrofits (replacement with equipment specifically designed to reduce water use) such as:
    3.1 Low flush and dual flush cisterns that are being used more and more. Reducing the volume of existing toilet cisterns by:

* Placing a 1 to 2 litre plastic bottle filled with water, or a brick wrapped in plastic, inside the cistern. This will decrease the volume of water held within it. Bending the swimmer arm inside the cistern downwards so that the inflow valve is shut off when the water reaches a lower level than previously.

4. Fix or report to the municipality any moisture or leak problems immediately. Most water leaks occur from toilet cisterns. A single leaking toilet cistern can lose up to 7 000 litres of water per day in a household.
5. Explore rain water harvesting (collection and storage of rain from run-off areas such as roofs) options. Remember - the first flush of new rain should be run to waste, before collection starts.
6. Keep track of water usage by regularly reading the water meters.

In rural areas, the community based water management programme under the Directorate of Water Supply and Sanitation Coordination, established mechanisms for users to pay for water services. In addition, mechanisms for transparent and targeted subsidies for those who are unable to pay for water services are being considered. Local water point committees manage local aspects of water services, preventing issues such as illegal connections and vandalism to pipelines.

A Word of Caution:

It is important to seek good advice from a knowlegeable dealer as not all water-efficient fittings and devices are appropriate for every location. Also consider whether the fittings can withstand rough and frequent use.

Water quality

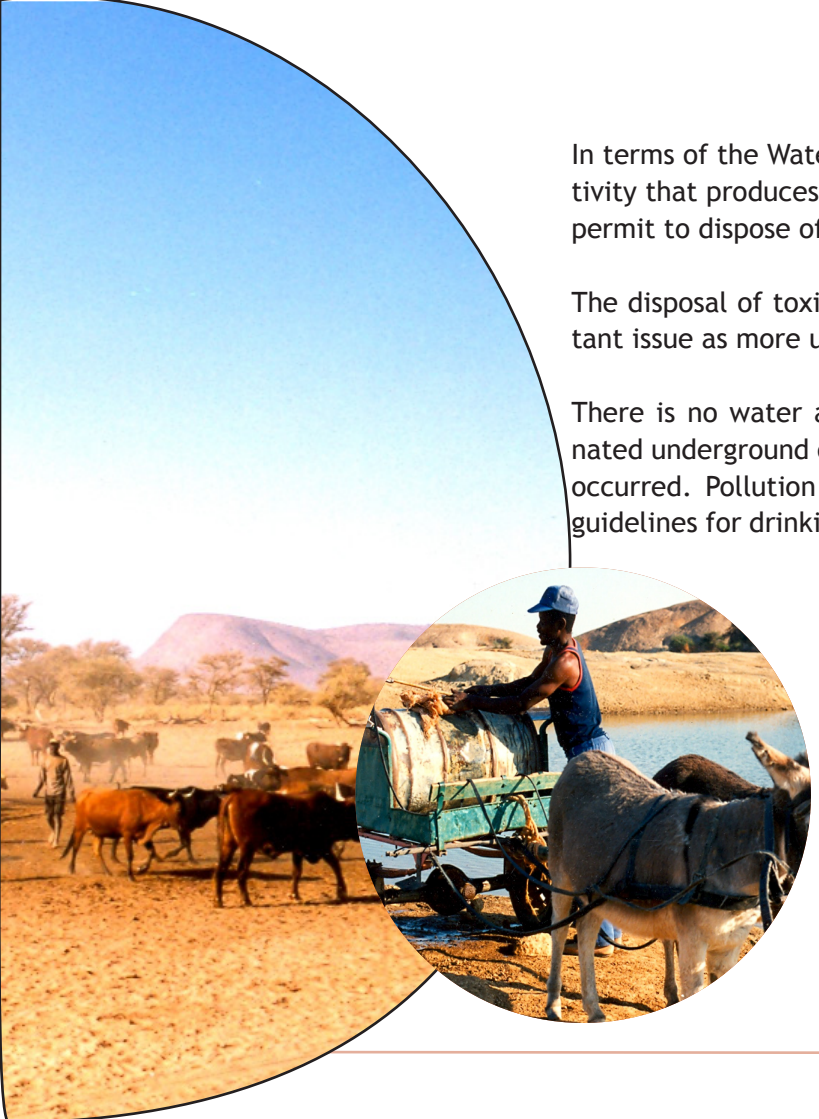
The quality of water is determined by its aesthetic quality (colour, smell, turbidity), the chemical quality and the bacteriological quality. Most of the groundwater within the Kuiseb River Basin is considered suitable for drinking. Water drawn from primary sources is seldom 100 per cent pure because it is not disinfected and the bacteriological quality may not be safe.

Pollution from Walvis Bay harbour and other land based sources may lead to the contamination of Walvis Bay lagoon and other wetlands.

Water quality is reduced by both natural and human-induced pollutants. Naturally, water contains varying concentrations of dissolved oxygen and other gases, microscopic living organisms, tiny particles of dead decaying organic matter, inorganic salts and sediments of sand. Water that contains naturally occurring salts is called 'brackish' water. It often has high concentrations of salt and other dissolved solids. It can taste salty and can appear cloudy.

Human activities that cause water pollution include:

- In **urban** areas: rapid urbanization – unserviced informal settlements are a major threat due to untreated/uncollected human sewage dumped directly into rivers; seepage of un-protected rubbish dumps into groundwater sources
- In **rural** areas: lack of serviced water and sanitation facilities; overgrazing and trampling results in excess removal of vegetation and leads to excess run-off when rainfall is high. This causes the erosion of topsoil which causes sedimentation in rivers and dams in the upper basin area.



In terms of the Water Act, 54 of 1956, all water users engaged in any activity that produces waste water are required to apply to the DWAF for a permit to dispose of wastewater or effluent.

The disposal of toxic mining effluent will become an increasingly important issue as more uranium and other mines come on stream.

There is no water available to dilute or flush pollutants from contaminated underground or surface water sources once such contamination has occurred. Pollution should therefore be totally prevented. The quality guidelines for drinking water have been set out by the Department of Water Affairs and Forestry, Water Environment Division.

Groundwater monitoring is considered very important, not only to understand and identify water quality trends and related indicators, but also to determine the availability of acceptable quality water sources. The Geohydrology division in the MAWF is responsible for groundwater investigation and monitoring.

Water sanitation and hygiene

Sanitation is vital for human health, generates economic benefits, contributes to dignity and social development, and protects the environment. Sanitation promotion focuses on stimulating demand for ownership and use of a physical good. Access to basic sanitation refers to access to facilities that hygienically separate human excreta from human, animal, and insect contact. Hygiene promotion focuses on changing personal behavior related to safe management of excreta, such as washing hands and disposing safely of household wastewater. Both are essential to maximize health benefits. Lack of sanitation facilities and poor hygiene cause water-borne diseases such as diarhoea, cholera, typhoid and several parasitic infections. Provision has been made for both urban and sanitation management objectives and principles in the Water and Sanitation Sector Policy of 2008, to contribute towards improved health and quality of life.

Communities have the right to determine which water and sanitation solutions are acceptable and affordable to them

Considering that Namibia is a water-scarce country, in most (rural and urban) instances, the most affordable individual household or community sanitation option are ecological or dry sanitation facilties, however where possible it should be left to the individuals to decide on the most appropriate technological and payment options as well as maintenance responsibility allocation.

The institutions responsible for water sanitation and hygiene are divided into the following categories:

- Public health issues and awareness: Ministry of Health and Social Services; Directorate of Water Supply and Sanitation Coordination within the MAWF; Regional Councils and Local Authorities
- Health policies and legislation: Ministry of Health and Social Services
- Advice and research on alternative sanitation options and development: Habitat Research and Development Centre

Washing hands with soap at key times such as after going to the toilet can reduce the occurance of diarrhoea

Challenges of IWRM in the basin

In addition to water demand increasing drastically (by 2,15 per cent annually over the next 10 years), several potential threats to groundwater quality are predicted as follows:

- seepage from tailings dams of an increased number of uranium mines
- nitrate contamination from cattle feedlots and farming practices
- wastewater and effluent disposal of tourism operations
- possible seawater intrusion into the production area of the lower Kuiseb Aquifer

Due to the arid and highly variable climate in Namibia, water resource managers and users have to focus on improving efficiency of water resource use through improvement of water demand management practices.

Future of water in the basin

It is expected that between 2009 and 2014, nine new uranium mines will come into operation in the Central Namib Area. These are predicted to provide 5 700 new jobs and would require 52 Mm^3 water per annum.

In addition, a number of mineral deposits have been identified in the basin, leading to renewed prospecting at two old copper mines, Hope and Gorob.

Apart from the known copper and uranium deposits, there are also substantial gypsum and marble deposits that are not yet fully mined. Accelerated economic development in the basin will not only increase demands for water, but introduce environmental risks due to lowering of the ground water table as a result of intensive groundwater abstraction in the lower Kuiseb valley.

The Kuiseb River Basin is regarded as one of the most important archaeological environments in Namibia. Archaeological sites throughout the basin provide evidence of both pre-colonial and historic copper working.

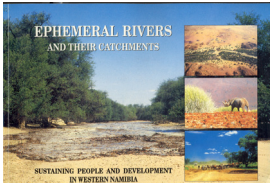
The consequences of a lowering of the water table would lead to:

* the death of the dense acacia woodland which forms a linear oasis in the river water course across the desert
* the unhindered northward advance of dunes from the Namib Sand Sea
* the depletion of drought reserves for plains game and Topnaar domestic livestock through the loss of the acacia woodland and associated vegetation (fodder)
* saltwater intrusion in the aquifers

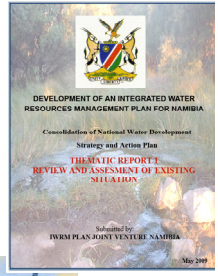
As economic development accelerates along the coast, demand for building sand increases. Sand harvesting is therefore likely to become an issue that will impact negatively on river ecosystems.

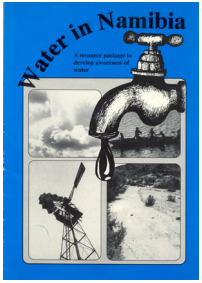
To satisfy future water demand, desalination - the removal of salt from sea water/salty groundwater- is an alternative option currently being explored for both human consumption and new mining developments. A desalination plant at Woltzkasbaken was launched in October 2009 by Areva mine.

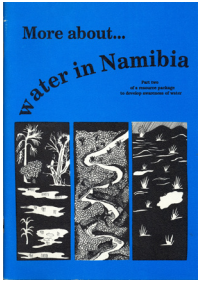
In response to these challenges, the development of environmental monitoring programs for mines (based on environmental impact assessments and resulting management plans) are prescribed and provided for in the Environmental Management Act, 2007.

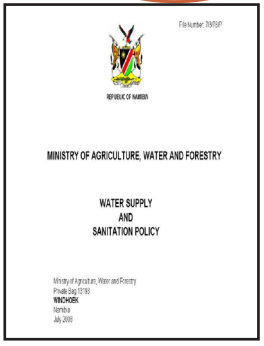


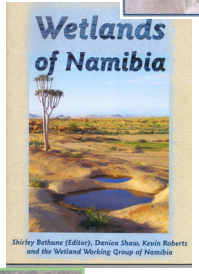
Basin management related information:

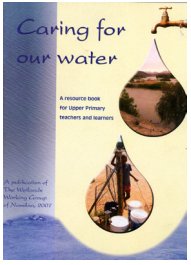


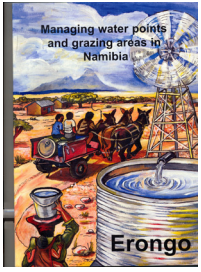


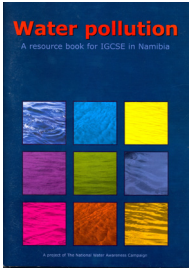


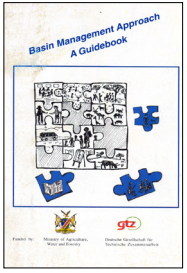












Note: some information used in this booklet is extracted from the above-mentioned material.

Knowledge is a
treasure,
but practice
is the key to it!

(Thomas Fuller)

Acknowledgements

The booklet is compiled by the IWRM Joint Venture Consultants (Namibia) as part of the development of an **Integrated Water Resources Management Plan** for Namibia, on behalf of the Ministry of Agriculture, Water and Forestry.

This booklet was reviewed by the multi-sectoral Steering Committee of the IWRM plan.

The booklet is funded by **African Water Facility administered by the African Development Bank.**

Photo credit: Desert Research Foundation of Namibia

Dublin Principles adopted for IWRM in Namibia

I. Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment

II. Water development and management should be based on a participatory approach, involving users, planners and policymakers at all levels.

III. Women play a central part in the provision, management and safeguarding of water.

IV. Water has an economic value in all its competing uses and should be recognized as an economic good.

Source: International Conference on Water and the Environment in Dublin,