Integrated Water Resources Management

Cuvelai-Etosha River Basin

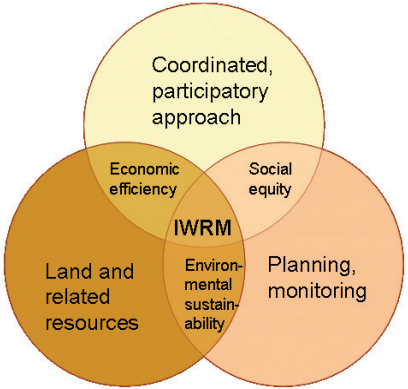
About this booklet

This booklet is intended for all water users to increase 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.



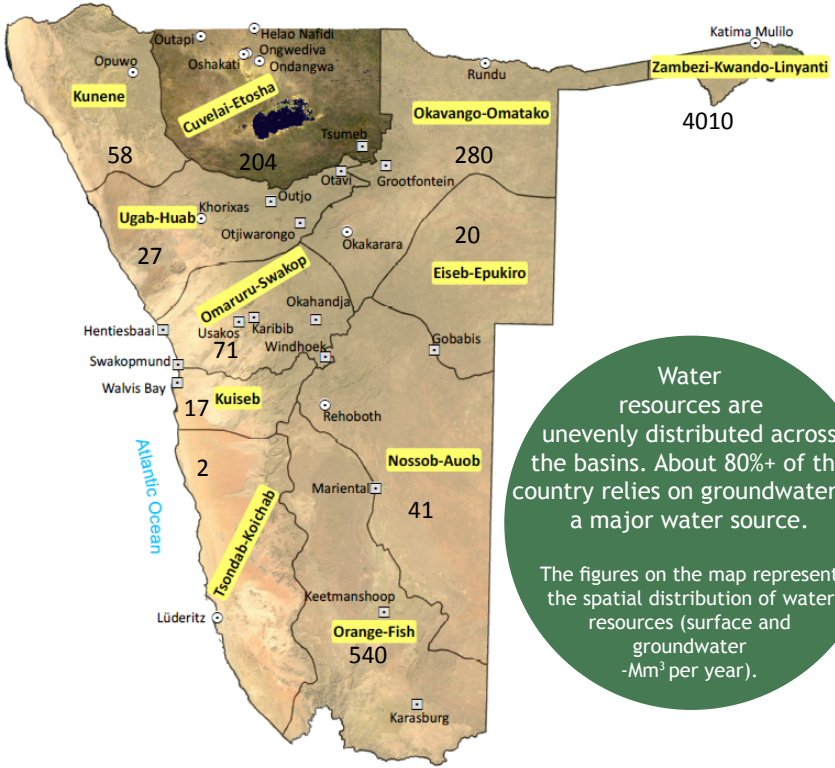
The Department of Water Affairs and Forestry (DWAF) in the Ministry of Agriculture, Water and Forestry (MAWF), assisted by a Steering Committee representing various sectors, formulated an IWRM Plan (IWRMP) for Namibia.

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 Cuvelai-Etosha 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 **Cuvelai-Etosha** River Basin is located in the north-central part of Namibia stretching across four regions, namely Ohangwena, Omusati, Oshana and Oshikoto. The basin is further sub-divided into four sub-basins namely Olushandja, Iishana, Nipele and Tsumeb. The basin is characterized by an interconnected system of shallow water courses, called *oshanas*, which is the “life-support system” to the most densely populated area in the country.



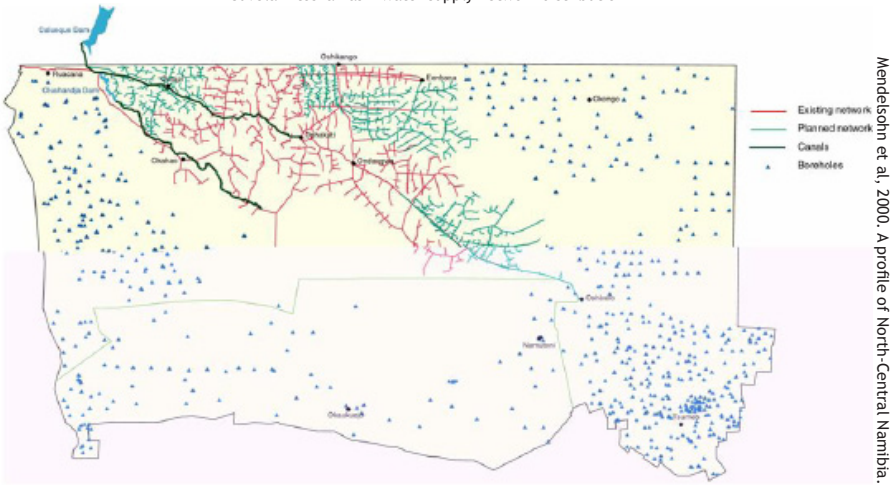
Water resources are unevenly distributed across the basins. About 80%+ of the country relies on groundwater as a major water source.

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

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

Where does the water in the basin come from?

Cuvelai-Etosha Basin water supply network distribution



Mendelsohn et al, 2000. A profile of North-Central Namibia.

The water in the basin comes from local rainfall, runoff in ephemeral rivers and aquifers (underground water storage). The Cuvelai drainage system originates in Angola and spreads across the flat plains in Namibia, resulting in shallow **ephemeral** watercourses (called "*oshanas*"). Major floods (called "*efundja*") from local rainfall and floods from Angola contribute to the formation of a wide network of waterways (called the Cuvelai Delta). These waterways drain into the Omadhiya lakes. The Ekuma oshana flows southwards out of this series of lakes and pans (mainly the Oshituntu pan) into the Etosha Pan. Etosha also receives water from the Omuramba Owambo, in the east, which feeds into Fischer's Pan. However, most of the water supplied by NamWater in the basin is imported from the Calueque Dam in Angola on the Kunene River. Water from Calueque can also be stored in the Olushandja Dam, which is connected to the Etaka Canal and Ogongo-Oshakati Canal. A network of pipelines and water points supply the basin population and livestock with water.

Rainfall is highly variable across the basin and ranges from 250-830 mm per year.

Groundwater is abstracted mainly from the Ohangwena Kalahari Aquifer and the Discontinuous Perched Aquifer (where fresh water is only found in certain parts of the aquifer) by means of boreholes. Shallow wells (known as "*omithima*") and deep wells (known as "*oondungu*") are used to supply water, especially to isolated villages in the basin. The underground water system in the Tsumeb sub-basin is known as the Karst Aquifers (water bearing structures in dolomite rock formations). There is a large water filled cave, Dragon's Breath Cave, and sinkholes filled with water (formed when the roof of an underground cave collapsed), namely the lakes at Otjikoto and Guinas.

Several excavation/earth dams are found in the Cuvelai area. The dams are constructed in oshanas and collects seasonal surface water, which are primarily used for livestock water supply. Although the dams are expensive to build, the water is free for people and livestock to use. The major disadvantages of earth dams are that it can only recharge water in one place and it is not good for storing water because they loose most of the water through evaporation. The water in earth dams is usually dirty and is not safe for people to drink, unless it is filtered and boiled.

Many people think that water in the oshanas should be dammed so that it can be saved for later use by livestock and people, but it is a better idea to let the water in the oshanas recharge wells and omithima and support trees and grass for grazing, than to loose water from evaporation in dams

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 (such as in Tsumeb) for delivery to end users.

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 and development 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.

For this purpose, the process of establishing the Cuvelai Basin Management Committee in phases started in 2003 by establishing one sub-basin committee. As a result, the Iishana sub-basin committee was formed in 2005, with the focus on water management (institutional arrangements) and health (water quality and groundwater monitoring) aspects. The process to implement the rest of the sub-basin committees in the following phases is still pending, based on demand and priority assessments.

Furthermore, the Karst Water Management Body (KWMB) was established in 2003 and plays an advisory role in the management of the groundwater sources in the Karst aquifers. This body will eventually be integrated into the Tsumeb sub-basin committee once it is established.

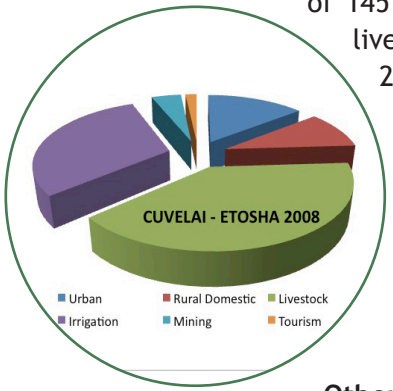
For further information contact:
Department of Water Affairs and Forestry,

Tel: 061-2087696

Who uses water and how?

The supply of water from surface and groundwater resources to competing demands are 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.

The Cuvelai-Etosha basin is the most densely populated in the country, with an estimated urban population of 145 000 and a rural population of 680 000. Livestock plays a central role in the livelihoods of both the rural and urban population of the basin. It is estimated that 25% of the cattle, 43% of goats and 70% of donkeys in Namibia is found in this basin.



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

Large-scale crop irrigation (mainly maize, wheat and pearl millet-known as mahangu) is taking place both on a commercial basis as well as on large public research farms at Etunda, Mahenene and Ogongo.

Other water-use activities in the basin are:

Subsistence and small-scale (rain-fed) farming: This includes both livestock and dryland crop farming with mahangu and sorghum as the main cereals supplemented with vegetables (mainly beans, pumpkins and melons).

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

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

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

Fishing: There is an abundance of fish resources in the basin, especially when the oshanas are flooded. Fish is popular and, as a result, aquaculture farming is taking place especially at Omahenene-Onavivi and Epalela farms under auspices of the Ministry of Fisheries and Marine Resources. Fish is an important source of protein and is eaten fresh or dried (mainly for subsistence or sold locally).

Wildlife conservation: The Etosha National Park is one of the most famous international and local tourist destinations in the country, and supports an abundance of wildlife (including lions, elephants and rhinos) obtaining water from surface water sources such as open pans, during the rainy season and groundwater from natural springs or borehole water supply points.

Environment: Trees, bushes and grasses are abundant in the area especially palm (omilunga) trees that are supported by oshanas. Trees in the basin serve multiple purposes, which include building material, fuel, bark, rope and storage baskets. Numerous wildfruit trees provide shade and fruits used for making drinks and livesock fodder. Grass is used for livestock grazing and is also important as thatching for houses.

The environment is a silent water user, thus ecological water requirements should also be considered.

Etosha Pan is Namibia's only inland Ramsar site (according to the Ramsar Convention of Wetlands of International Importance). The wetland is home to more than 1% of the world's population of great white pelicans, flamingo's, capian and chestnut-banded plovers (birds).

Water Demand Management - how to use water more efficiently

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

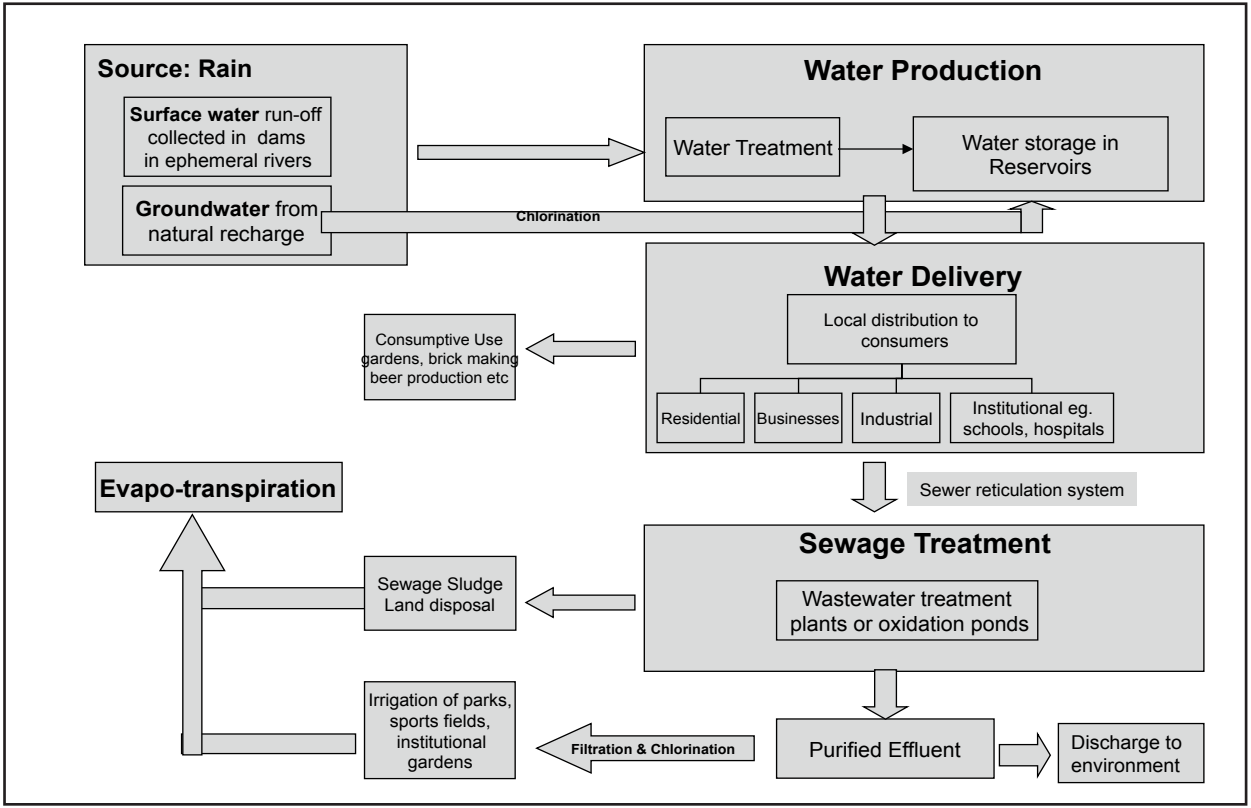
WDM is implemented through education and information; training; using economic and financial principles; water pricing and tariff policies (eg. rising block tariffs) and technical measures.

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 biggest danger in the basin is "overusing of what seems an unlimited source of water", and thus there is great need to implement demand management measures strictly.

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.

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.

"The price for water services should be set in such a way that the price does not prevent consumers from obtaining sufficient water (quantity and quality) to meet fundamental domestic needs."

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). Also consider gardening with wastewater from showers, bath or rinse water from washing clothes.
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 are being used more and more. Reducing the volume of existing toilet cisterns can be achieved 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.

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 (colour, smell, turbidity), the chemical and the bacteriological quality. There is a direct link between water quality and health and therefore it is important to be able to differentiate between safe and unsafe water sources. Water quality is determined by both natural and human-induced contaminants (pollutants) that may have found their way into the water supply. 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. The water is described to be highly saline when the concentration of salts dissolved in the water is high. This includes nitrates, fluorides, sulphates as well as sodium chloride and carbonates. Water with high salinity tastes salty and is usually called 'brackish' water.

Salinity of the water causes soils to be salty as well (especially after water has evaporated), leaving it unsuitable for large-scale irrigation of crops in the central area of the basin.

The Omusati and Oshana regions are prone to high sulphate concentrations causing laxative effects on humans. High fluoride concentrations are found in the Ohangwena, Okongo and Outapi-Ondangwa areas and south of Okahao towards the eastern half of Omusati. This can lead to severe dental and skeletal deformation in both humans and livestock.

In a few areas, contaminated water, mainly through animal waste (especially where cattle troughs are close to wells) has been declared as 'unsafe' for human consumption due to high concentrations of nitrate. Water quality improves further south, east and west - away from the central zone - with the best quality of water found in the Tsumeb (Karst) groundwater area. In general, the quality of groundwater across the basin is poor (saline water), especially in the shallow aquifers in the central areas of the basin extending south from the Angolan border towards the Etosha Pan. 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.

The quality of drinking-water may be controlled through a combination of protection of water sources, control of treatment processes and management of the distribution and handling of the water.

Many people in the basin are exposed to "dirty" unsafe water from open wells, canals and oshanas.

Dirty water can have a colour (yellow, brown or black), but it can also be clear and contain invisible bacteria or chemicals that are harmful to humans and animals. Therefore it is advisable to "clean/ boil" water before drinking it.

The following ways are used to clean water:

- **Step 1**: Remove dirt that you can see, through filtering by using a sieve wire or a dense cloth of material
- **Step 2**: Boil water or keep water in a clean container in the sun for two days
- **Step 3**: Store clean water in a clean container with a cover.

Fences are often erected around shallow wells to prevent access to livestock who would otherwise contaminate the water with their droppings.

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.

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 facilities, 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.

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

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

The IWRM challenges in the basin are linked with climate variability and associated changes. In particular, the basin is highly prone to the following challenges:

- Floods: It is predicted that flood plain areas would reduce due to decrease in annual perennial drainage, which could severely disrupt agricultural systems and wetlands in the basin.
- Land degradation and deforestation: The topsoil of land contains valuable nutrients for vegetation to grow. When vegetation cover or trees are destroyed (either through high population growth or overgrazing due to high livestock concentrations in an area) the land becomes vulnerable and results in topsoil being easily blown away by wind; increased run-off (rainwater not infiltrating in the soil) and therefore causes loss of agricultural productivity (soil fertility).
- Bush encroachment: Invader bushes, especially in the Karst area is the highest single consumer of groundwater, with detrimental long-term consequences on the sustainability of groundwater resources and availability of fodder.

Climate change predictions suggest increases in temperature resulting in high evaporation rates and salt content in the oshanas. It is further predicted that rainfall in the Cuvelai-Etosha basin will start later and end earlier, with an overall decrease in rainfall seasons. 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

Increasing demands from an increasing population and large-scale farming (crop and livestock) are evident, hence increased pressure on natural resources, including water, is being predicted.

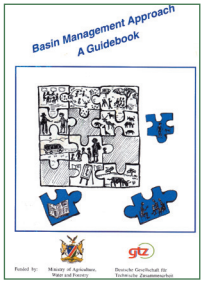
The origin of the water courses in the basin are shared between Angola and Namibia and hence any alterations to the system has to be agreed between these countries. Nevertheless, it is estimated that the current water sources would be ample to meet the future water demand in the basin. The challenges, however, are the security of water supply from the Kunene, the maintenance/expansion of the water supply infrastructure (distribution network) and to protect water quality. Future exploration to find more fresh groundwater sources is one of the priority research activities in the basin. Small-scale desalination, using saline groundwater, will be tested and the water made available to residents of two villages in the Olushandja sub-basin.

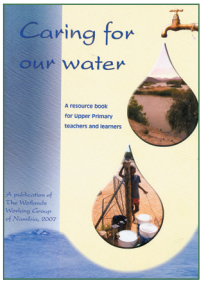
The oshanas of the Cuvelai system and Karstveld lakes, Otjikoto and Guinas, are wetland areas in the basin that are being considered as potential Ramsar sites according to the Ramsar Convention on Wetlands of International Importance.

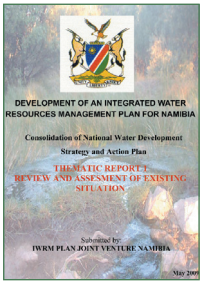


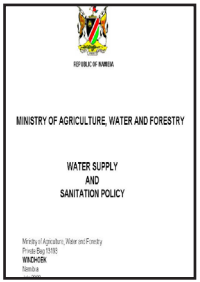


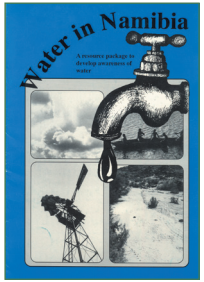

Basin management related information

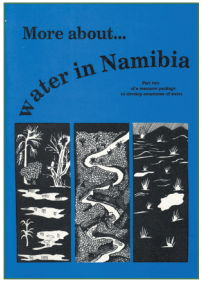


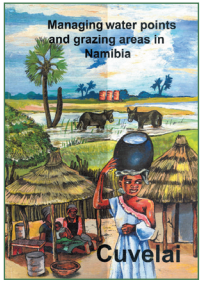


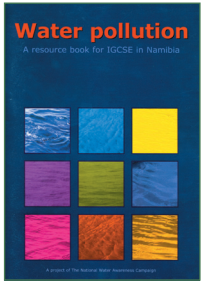


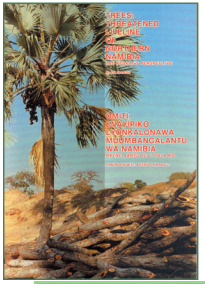


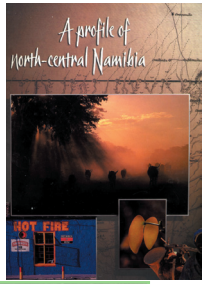




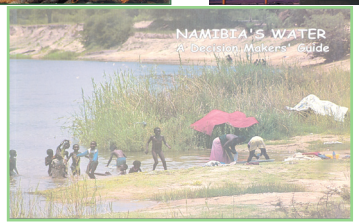








Note: some information used in this booklet is extracted from the above-mentioned material.



Accountability and responsibility for water resources (especially the protection of water sources against pollution and wasteful uses) are the best measures for sustainable water management.

Adapted from John Mendelsohn, Selma el Obeid and Carole Roberts -A profile of north-central Namibia

Acknowledgements

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Photo credit: DRFN; Department of Water Affairs and Forestry: Water Environment Division

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, 1992.