Integrated Water Resources Management

Orange-Fish 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:

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

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.
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 **Orange-Fish** River Basin is located in southern Namibia across parts of the Hardap and Karas Regions. It can be divided into Orange and Fish sub-basins, occupying 15% of the Namibian land surface in total. It is home to an estimated 77 000 people, which represents 56% of the total population of the two regions.

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?

The water comes from perennial surface water (Orange River), ephemeral surface water (Fish River) and groundwater sources. **Groundwater/borehole schemes**, operated by Namibia Water Corporation (NamWater) and the Directorate of Water Supply and Sanitation Coordination in the Ministry of Agriculture, Water and Forestry, form the major water source for many of the villages, settlement areas and farms.

Urban centres and irrigation schemes are dependent on three major **surface water dams**. The dams include the Hardap Dam (on the Fish River) supplying potable water to the Municipality of Mariental, while surface water is piped from the Naute Dam (on the Löwen River) to the Municipality of Keetmanshoop and from the Dreihuk Dam (on the Hom River) to the Municipality of Karasburg. Several excavation/earth dams are found in the basin which collect seasonal surface water and 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 lose most of the water through evaporation.

NamWater supplies perennial water from the Orange River to Noordoewer, the Skorpion and Rosh Pinah mines and settlement areas. Namdeb supplies groundwater from the Orange River to Oanjemund.
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, control, 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 (e.g., 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 urban areas**: Local Authorities and Regional Councils buy water from NamWater or supply their own water from boreholes for delivery to end users.

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

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 (encouraging gender equality where possible) is to equip basin communities 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 principles such as stakeholder participation, transparency and information sharing.

For this purpose, the Interim Fish River Forum Committee was formed with the aim of establishing a BMC enventually focusing on:
- Efficient water supply services
- Establishing a groundwater monitoring system
- Improving environmental sensitivity
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.

Hardap Irrigation Scheme has 2200 ha under irrigation and is one of the biggest water users in the Basin, taking 46 million m³/year from the Hardap Dam. The major crops grown at the scheme are wheat, maize and lucerne.

Other water related activities in the basin include:
- The 1100 ha Aussenkehr irrigation scheme consumes 16.5 million m³/year to produce table grapes.
- The Noordoewer/Vioolsdrif irrigation Scheme mainly use 4.5 million m³/year to produce vegetables and fruits.
- The mines (Namdeb, Skorpion and Rosh Pinah) are using about 10 million m³/year in conjunction with seawater used at Oranjemund.
- The Ai-Ais National Park (including the Fish River Canyon) has open access to surface water or is provided with water from groundwater sources by the park management, mainly to sustain the wildlife and tourist establishments.

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 (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).
Making water available for environmental flow requirements is being considered, especially for reed management to supplement natural flow conditions during the rainy season.

- Domestic and commercial livestock and game watering in the main towns, commercial farms and communal areas. There was more than 1 million sheep, 228,000 goats and less than 50,000 cattle recorded in the 2006 Household, Income and Expenditure census. Other domestic animals include pigs, donkeys, horses, ostriches and poultry.
- Limited fish farming, mainly with indigenous fish species, is taking place at Hardap Dam as well.
- The Orange River mouth supports a vast amount of bird and wildlife species and is recognised as a Ramsar site according to the Ramsar Convention on Wetlands of International Importance.
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. In OFRB, efficient application of irrigation systems (for example drip and micro irrigation) is very important. By doing so, water consumption could be reduced between 15-25% of the total water requirement. In addition to increasing their yield, farmers can reduce water consumption as well as fertilizer costs resulting in minimizing disadvantages to the environment due to high return flows and nutrient levels.

The price of water is determined by the cost to develop a water source; the distance the water has to be transported by pipeline to the consumer and the topography which determines the pumping head or cost to supply 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. Typical examples in the Basin are Gibeon and Kalkrand, where the water consumption was reduced significantly as a result of pricing structures and the implementation of proper credit control measures. There is proof in most supply centres in the Basin that water demand decreased during the past three years as a result of water tariff increases.
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.

Different ways to save water in urban households:
1. Schedule garden watering 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:

“The price of providing water supply and sanitation services must correspond to the investment and running costs thereof.”
3.1 Low flush and dual flush cisterns that 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.

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 knowledgeable 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.

Most of the groundwater within the Orange-Fish River Basin is considered suitable for drinking, although certain areas are prone to high fluoride concentrations that can lead to severe dental and skeletal problems. High nitrate values make the water unsuitable for babies under the age of one year.

Increased nitrate concentrations are almost always a result of contamination from human and livestock activities close to boreholes. This type of pollution cannot be reversed, but new abstraction points can be protected by siting habitation, sewerage systems and maintaining livestock pens appropriately.
Potential pollution hazards in the Basin include private, municipal and industrial activities, particularly the discharge of wastewater effluent (e.g. sewage), the siting of landfills or refuse dumps, the use of artificial fertilisers and the large-scale use of agrochemicals (especially downstream of the Hardap and Naute Dam). High concentrations of salts and chemicals are major causes of groundwater pollution. Hence caution should be taken when combating reed growth with herbicides as a flood control measure. 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.

Unused boreholes and wells should never be used as refuse tips. Their surface openings should be sealed when not in use.
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 diarrhoea, 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.

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

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

Washing hands with soap at key times such as after going to the toilet can reduce the occurrence 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:

- **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 is the highest single consumer of groundwater, with detrimental long-term consequences on the sustainability of groundwater resources and fodder availability.

It is predicted that the winter rainfall in the basin will decrease, which will have negative effects on the local fauna and flora, as well as reduced river flow in the lower reaches of the Orange river. 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

The proposed Neckartal Dam and Irrigation Scheme could become a major development in the area. The dam site is in the Fish River about 25 km upstream of Seeheim and 40 km west of Keetmanshoop. Should it go ahead, the dam would be the biggest in Namibia with a storage capacity of 846 Mm$^3$ (approximately three times the capacity of Hardap, higher up on the Fish River, and currently the largest dam in Namibia), inundating almost 40 km$^2$, with a planned irrigation scheme of 5,000 ha. The feasibility study to develop this project (including social and environmental impact assessments) is expected to be completed by March 2010, with the design phase completed by the end of 2010 and construction completed by October 2013. The dam is aimed at addressing food security, unemployment and poverty in general with the focus on the development of Keetmanshoop in particular.

Crop diversification opportunities are currently being explored in the basin, with olive production topping the list. Due to the specialized processing required, olive farming could be done co-operatively should a number of farmers start producing olives. Operations at the !Aimab Dairy Farm located close to Mariental were officially inaugurated in 2010. This will also have an added effect on the water use in the basin.

Future development of proposed copper mining at Haib in the Karasburg district will be dependent upon bulk water supply from the Orange River. Since the Orange River is shared with South Africa, developmental activities in the basin are done through close collaboration with the Orange-Senqu River Commission (ORASECOM) between Namibia and South Africa.
Various water management projects are currently taking place in basin:

- The Ephemeral River Basins Project (2005-2010) led by the Desert Research Foundation of Namibia (DRFN), focussed on ephemeral rivers in Namibia, Botswana and South Africa. The aim was testing the potential for the basin management approach in the respective basins.

- The Local Authorities Capacity Building (LA-CAP) Project (2008-2010), led by the DRFN, focuses on empowering managers to manage their water, waste and sanitation throughout the basin through sharing information and best practices. Currently the project is in the process of drafting manuals on identified theme topics such as maintenance of infrastructure and cost recovery approaches.

- The Renewable Energy and Ecological Development Solution (REEDS) Project of the DRFN investigates the use of invasive reeds for biogas production and creation of Small and Medium Enterprises (SMEs).

- The Flood Risk Monitoring Project under the auspices of the Department of Water Affairs and Forestry established the Mariental Flood Task Force as a result of the 2006 flood, to investigate the causes of the flood and developing measures to prevent such floods in future.

- The SPAN Project under the MET has a directive to address Prosopis (invasive plants) problems in the Lower Orange and Fish basin area. Thus, the potential for an initiative to convert Prosopis to charcoal (or fuelwood) and availing it to the formal settlements at Rosh Pinah and Aussenkehr will soon be investigated.

The resource potential indicated for the Orange and Fish River catchment areas include groundwater, water from ephemeral rivers and assumed future allocations from the perennial river subject to development of further infrastructure and international negotiations as part of the mandate of the Orange-Senqu River Commission.
Note: some information used in this booklet is extracted from the above-mentioned material.
The wars of the 21st Century will be fought over water.

-Ismail Serageldin, World Bank Vice President for Environmental Affairs, quoted in Marq de Villiers’ Water, 2000

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.

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Photo credit: Desert Research Foundation of Namibia