NAMIBIA has a low and variable rainfall, ranging from less than 20 mm per annum along the west coast to just over 600 mm per annum in the extreme northeast. The estimated average mean annual rainfall for the country is only 250 mm and occurs mainly as summer rainstorms.

Annual evaporation rates are extremely high, between 2 600 mm in the northwest and 3 700 mm in the southeast. This combination of low, variable rainfall and high evaporation leads to a water deficit during the dry winter months, according to which most of the country is classified as extremely arid, arid or semi-arid. As a result, periodic droughts are a natural occurrence in Namibia and water resources should be managed accordingly. The natural aridity of the country, the highly variable rainfall patterns and periodic droughts should form the basis of all development plans. Water consumptive industries and agriculture should be avoided and water conservation encouraged.

LIMITED WATER RESOURCES
Namibia has very little surface water, particularly in the interior of the country. Perennial rivers are limited to the northern and southern borders and the Caprivi Region. The five perennial rivers, the Orange, Kunene, Okavango, Kwando/Linyanti/Chobe and Zambesi Rivers are shared with neighbouring countries. At present 23 percent of the water used in Namibia is supplied by these rivers, but most of the country does not have access to these perennial water sources due to the vast distances involved. The present Namibian consumption is only 0.1 percent of the total annual flow in these rivers, suggesting a vast, as yet untapped, water resource.

The rivers in the interior are ephemeral rivers, flowing only after good rains in their catchment areas. Most of these are westward flowing rivers such as the Hoarusib, Homanib, Huab, Ugab, Omururu, Swakop and Kuiseb Rivers. These serve as life-giving linear oases in the otherwise dry Namib Desert. The Fish River and the Nossob River flow southward whilst the Omatako Omuramba is a largely fossil drainage to the northeast.

The main surface water storage impoundments are situated on some of these rivers. The largest is Hardap Dam on the Fish River with a storage capacity of some 300 million cubic metres. The Swakoppoort and Von Bach Dams on the Swakop River and the Omatako Dam supply the Windhoek and Okahandja districts with water. The Otjivera and the Tilda and Daan Viljoen Dams supply Gobabis, the Oanob Dam Rehoboth and the Naute Dam Keetmanshoop. At present 20 percent of the water used in Namibia is supplied from these dams.

Most of the water used in Namibia is from ground water sources or aquifers. Important aquifers are the Omaruru Delta and the Kuiseb Delta aquifers which supply the

Above: Large impoundments such as the Oanob Dam near Rehoboth provide 20 percent of Namibia’s water. The damming of ephemeral rivers affects the maintenance of ecosystems. New dam projects must include an environmental assessment as part of the planning process.
Erongo Region, Koichab pan which supplies Lüderitz, the large Stampriet artesian aquifer which irrigates fruit and vegetable crops, the Maltahöhe aquifer, Karstland aquifer and the artesian Oshivelo aquifer. This aquifer is saline on its northern perimeter.

All the ephemeral rivers and their network of tributaries also contain alluvial aquifers. Some 32,000 boreholes deliver water throughout the country. However, only about one in five of the boreholes drilled delivers water of an acceptable quantity and quality. In many areas even if there is water it is often too saline to drink.

These ephemeral surface and ground water resources, particularly in the central area, are at present virtually fully exploited. To solve this, the Department of Water Affairs in its Central Area Water Master Plan suggested alternatives such as water conservation measures, long-distance water transfers from the perennial rivers and alternative water sources such as desalinated sea water.

**INCREASING WATER CONSUMPTION**

People, cattle and small stock compete with mines, industry and irrigation for Namibia’s scarce water resources. At present, 28 percent of the bulk water supplied by the Department of Water Affairs is used by people for domestic consumption. The consumption rates vary from about 85 litres a day per person in rural areas to an unacceptably high consumption of over 500 litres a day per person in towns and cities. Stock uses about 25 percent, with cattle needing about 45 litres per day each. The mines use only three percent of the total bulk water supplied whilst irrigation requires a huge 43 percent. Recreation and tourism currently use only one percent.

Bulk water supplies exclude water used by commercial farmers from their own boreholes and small dams, water collected directly from village wells and from perennial rivers, oshanas and rainwater collection. Much of this rural water supply is centred around the cattle trough - mainly for stock watering.

Central to these consumers is the natural environment and the plants and animals living there. A decrease by other consumers will to some degree impinge on the water required to maintain ecosystems and their related ecological processes. The damming of ephemeral rivers, large-scale withdrawal of water from perennial rivers and large-scale abstraction of ground water from rock and alluvial aquifers will also affect the maintenance of ecosystems.

Water consumption in Namibia is expected to increase greatly as a result of an ever-increasing population. In 1991 Namibia had a population of 1.4 million people and a population growth rate of above three percent, amongst the highest in Africa. Rapid urbanisation with an estimated 40 people a day moving to cities and towns, and rising
living standards will demand more water. At present only 50 percent of people in rural areas have proper access to reliable sources of safe water. To meet the needs of these people, the rural supply network needs to be increased. This will result in greater consumption. Industrial and mining developments and towns associated with new mines, increasing development, especially of irrigation projects, will further increase the national water demand.

MEETING THE CHALLENGES

Sound planning and engineering, including environmental impact assessments, wetland conservation and active demand management are needed in order to meet the challenge of ever-increasing water requirements in an arid country with limited water resources. In Namibia limited water resources are a major obstacle to socio-economic development and growth. This was recognised twenty years ago when the Department of Water Affairs developed and adopted a National Master Water Plan.

One of the projects in this plan was the Eastern National Water Carrier. This is an integrated long-distance water supply scheme that is designed to eventually supply water from northern sources such as the Karstland boreholes and the perennial Okavango River via a series of pipes, canals and storage impoundments to the drier central regions of Namibia. Basically the ENWC consists of four components: the two storage dams on the Swakop River, Von Bach and Swakoppoort, which were completed in 1970 and 1977 respectively; the Omatako Dam and the pipeline linking it to Von Bach Dam, completed in 1983; the 263 km long Grootfontein-Omatako canal, completed in 1987, which links the Karstland borehole scheme to the Omatako Dam; and the, yet to be constructed, 250 km long Okavango-Grootfontein pumping main, which will finally link the ENWC to the Okavango River.

After Independence attention was focused on the central area, especially Windhoek and its rapidly expanding water needs. In 1993, Namibia completed phase 1 of the Central Area Water Master Plan to investigate a reliable and accessible safe water supply strategy for the central areas up to the year 2020, making optimal use of the available resources and minimising costs. The central area water plan includes the Omaheke, Otjozondjupa, Erongo and Khomas Regions as well as part of the Okavango Region. It also impinges slightly on the Oshikoto, Hardap and Kunene Regions.

The Central Area Water Master Plan identified two key areas: the western, mainly coastal, towns and the central area east of the escarpment. A more detailed investigation of supply options, including the possibility of desalination, is underway for the Namib area.

Bulk water supply to various users by the Department of Water Affairs between 1978 and 1993.

**What happens to our rainfall?**

This diagram illustrates that most of the rain which falls, evaporates back into the sky. Only a small fraction is available for river and aquifer recharge.
The Okavango River is an important potential resource and its ultimate link with the existing water supply infrastructure would be necessary to augment the scarce water resources in the central area of Namibia. A thorough environmental assessment of the river basin is to be done, in cooperation with neighbouring users, Angola and Botswana, before any abstraction takes place. The proposed abstraction for Namibian use would be less than 3 percent of the minimum low flow volume of the river. Although the environmental impact would be low, an environmental assessment is viewed as essential ultimately to develop a sustainable water management strategy for the Okavango Basin as a whole.

An international commission, known as OKACOM, was established between Angola, Botswana and Namibia in September 1994 to ensure the involvement and commitment of all three countries in this. In June 1995 OKACOM approved a project proposal for a six year environmental assessment of the Okavango River Basin.

In developing the Central Area Water Master Plan all local, regional and national water resources were analyzed so that the limited resources are developed optimally and negative environmental consequences are limited.

Additional steps essential to conserving precious water resources are the promotion of wetland conservation and water saving strategies in agriculture, industry and the home. Good wetland conservation requires a whole catchment approach, sound land-use practises, controlled development, multi-disciplinary assessments and management and international agreements on shared resources. As irrigation accounts for almost half of the water used, methods more suited to arid environments should be used. At Hardap, for example, if drip or root irrigation were used instead of the very wasteful flood irrigation only 10 percent of the water would be needed for the same production. Vegetable farming in tunnels would reduce evaporation losses and should be further investigated. Other steps are already implemented to reduce evaporation, such as in the Omaruru Delta. Here the water collected in the Omwel Dam is transferred into the aquifer and stored in the sand.

At present the west coast towns and industries are supplied with potable water from the Kuiseb and Omaruru Delta aquifers. Rössing Uranium Mine, as a major consumer of this supply, has succeeded in drastically reducing water consumption since 1980. In 1980 at full production the water consumption was 9.5 million cubic metres per year (30 000 cubic metres per day). This high abstraction from the Kuiseb River aquifers caused severe depletion. After negotiations between the Department of Water Affairs and the mine, the mine implemented a recycling network. By 1985 the daily freshwater con-
sumption had been halved to below 15 000 cubic metres per day. In the past five years freshwater use was again halved. Among the factors contributing to this are the reduction of production, currently at half the normal production, and the reduction of the tailings pond, eliminating the need for water to transport tailings. In the meantime water for the mine was extracted from the Omdel aquifer to relieve pressure on the Kuiseb Delta aquifer.

More use can be made of recycled water. The municipalities of Windhoek, Swakopmund and Walvis Bay already re-use treated water on gardens and sportsfields. In 1969 Windhoek became the first city in the world to recycle purified sewage water for household use. The purification plant, which can treat sewage water to meet drinking water standards, is being upgraded to increase its capacity from 1.5 million to 7 million cubic metres a year. To augment water supplies during the current water shortage the water purification plant recycles 2.5 million cubic metres per year.

In homes and schools steps can be taken to re-use water. For example rinsing water and water used to bath in or wash dishes can be used on the garden and more use can be made of rainwater.

Alternative water sources are being investigated, these include the option of desalination, both on a small scale for brackish ground water sources and on a larger scale from sea water to supply the coastal towns of Walvis Bay, Swakopmund and Henties Bay as well as Arandis and Rössing Uranium Mine.

Possibly the most important way to conserve water is to place the true monetary value on it. Until recently bulk water was supplied in Windhoek at N$0.95 per 1 000 litres. In an effort to curb excessive water consumption, the Municipality has introduced a block tariff system. Prices range from N$1.65 per 1 000 litres for the first 10 kl and N$5.30 per 1 000 litres for consumption exceeding 60 kilolitres.

In Mali, a dry west African country, a litre of water costs the equivalent of N$10. We also need to appreciate the true costs of getting water from the sources, be they dams, ground water or perennial rivers. For example, one kilometre of pipeline between the Omdel aquifer and Swakopmund costs a million Namibian dollars. At present, water is subsidised by the State and tariffs do not reflect the true economic or environmental value. Increased tariffs will go a long way towards ensuring that water conservation is taken seriously and encouraging the implementation of appropriate conservation measures.

The Namibian Water and Sanitation Policy was approved by Cabinet in September 1993. In principle it requires all water users to pay for the service. This applies equally to urban and rural dwellers.

Environmental education is vital to promote an awareness of Namibia's water resource limitations and aridity and to encourage water conservation. The Department of Water Affairs has opened a media office to develop public awareness campaigns. This material is available to teachers and to the environmental education network in the country.

A National Water Awareness Campaign was launched by the President on World Water Day, 22 March 1995. This interministerial campaign involves NGOs such as the EnviroTeach group at Gobabeb and international agencies such as SIDA and UNICEF. Several municipalities and local authorities also aim to create greater awareness of the true value and scarcity of water. Successes to date included nation-wide World Water Day and World Environment Day activities, active involvement of schools and the development of suitable resource material and good media support. Six of the top 15 projects in the recent Conservo school science project competition dealt with water conservation.

As water supplies become increasingly scarce in the southern African region, more and more attention is being focused on shared water resources such as those perennial rivers which flow through several countries. To avoid potential conflicts a series of international water commissions have been established to discuss shared waters. Besides OKACOM, there is a similar agreement and committee with South Africa on the Orange River while Namibia participates with five other basin states in ZACPLAN on the resources of the Zambezi River.

Namibia is an arid country with limited water resources, but increasing consumption. Only with good planning and management based on sound environmental assessments and a will to conserve the most precious natural resource, will Namibia be able to meet the challenge and avoid conflicts over this limited, shared resource for the foreseeable future.

The Kunene is one of Namibia's five perennial rivers, all of which are situated on the country's borders. The cost of transporting water to the interior will increase the cost of water provision by at least 50 per cent.

The author:
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