EXECUTIVE SUMMARY

INTRODUCTION

The Directorate of Environmental Affairs of Namibia's Ministry of Environment and Tourism, with support from the Government of Finland, is undertaking a national programme entitled 'Information and Communication Service for Sustainable Development in Namibia.' A major component of this programme will be compilation of State of the Environment Reports addressing all important sectors related to the environment. This process is mandated by the draft Environmental Management Act which states that annual reports on the State of the Environment are to be prepared and communicated.

This report is the first iteration of a State of the Environment Report on Water. This report attempts to identify important components of the water environment in Namibia, as viewed from a broad perspective. Secondly, it provides an overview and brief summary of the state of knowledge concerning these components based on accurate and reliable information. Lastly, indicators have been elaborated to provide a monitoring tool for the state of the environment with respect to a selection of those components originally identified.

The State of the Environment Reports are designed to support sustainable development in Namibia. Sustainability implies long range planning as well as coordinated planning. Such planning must be based on a thorough understanding of trends and conditions to provide a foundation for improved decision making at all levels and to facilitate measurement of progress towards sustainability.

Use of indicators can contribute toward this understanding by asking questions such as:

- is the environment getting better, worse or holding steady?
- why (what are the causes of change)?
- What can we do about it (do we understand the stressors involved)?

To answer these questions indicators must be efficient, effective, economically and logistically feasible and reliable. In the water sector, some areas of concern are backed by long data series so that trends are readily evident. Recognition of other areas of concern is only now emerging and little or no data are available. These areas must be tracked by 'developmental' indicators.

This State of the Environment Report on Water follows the guidelines as designed by the Ministry of Environment and Tourism, Directorate of Environmental Affairs. This

report provides extensive background material on environment and water covering the physical and climatic determinants of water gain and loss in Namibia, surface water in its several forms and groundwater in the varied aquifer types found in the country. It then describes the water supply and demand situation, focussing on economics as an information and management tool. The institutional framework for management of water and the legislative framework are then examined. The final part of the general overview highlights Namibia's dependency on cooperation with neighbouring countries to sustain equitable use of shared perennial river resources.

Each of the seven central information chapters provides an introduction followed by up-to-date, relevant information on the state of the water environment collated for this report. The last section of each of these chapters is similar and focuses on environmental health issues related to water:

- relevance to the water sector of the information in the chapter
- assessment and evaluation of Namibia's water sector with respect to the topic
- major themes and concerns for sustainable management
- potential indicators
- key indicators

This State of the Environment Report on Water is not an 'atlas' of water in Namibia nor does it purport to provide comprehensive information on water in the country. Instead, it is an overview of important components of the water environment highlighting issues, backed up by available information, relevant to economic, environmental and social sustainability of this essential but limited resource.

PHYSICAL AND CLIMATIC DETERMINANTS

Consideration of the water environment starts with the hydrological cycle, which shows how the climatic and physical factors interact to determine the nature of the environment in which we live. Changes to either or both of these factors affects the balance of this global cycle. In a predominantly arid environment such as Namibia's the cycle is distorted and incomplete in that many of the inputs, such as rain and runoff are scarce and irregular, while many of the outputs, such as aquifer leakage and abstraction are relatively continuous. Under these precarious circumstances, the need to formulate strategies and solutions for environmental sustainability cannot be overemphasized. Clearly, the influence of man on the physical factors and of climate change on the climate are key issues which need to be understood and addressed.

Physical determinants are broadly classified as topography, geology, soils and vegetation. Namibia can be subdivided into three main topographic regions, the narrow coastal plain, the eroded escarpment and an extensive interior plateau. The geology and soils associated with these zones are well understood and maps are included in the report.

Climatic determinants include precipitation (rainfall and fog), evaporation, evapotranspiration, wind, temperature, and humidity. In Namibia, rainfall is the most important and variable of these and is discussed in some detail with respect to data collection, long-term mean and median values, annual and monthly variability and intensity.

The majority of rainfall data is collected by Namibia Meteorological Services and the Department of Water Affairs. In total, over 350 stations are operated of which nearly 50 are automatic or continuous meaning that they can be used to measure rainfall intensity and not just daily totals. The number of stations in operation over recent years has declined, which is cause for concern. In addition, rain gauge coverage of many rural areas, in particular all of the northern regions, is poor, despite the fact that this is where the majority of the population live.

Long-term mean and median annual rainfall in Namibia is generally well understood and maps are included in the report, but isohyets for the coastal belt and south-west of the country are based on very few data. Variability of rainfall from year to year is extremely high especially in the particularly arid areas such as the south and the coastal belt. An analysis of rainfall intensity shows that despite low annual rainfall, individual storms can be very heavy. For Windhoek a single storm of 50 – 60mm, which represents 20% of the mean annual precipitation, is not unusual.

Evaporation in Namibia is very high. High evaporation and evapotranspiration rates result in huge losses from open water storage bodies and also make the growing of crops extremely difficult.

A discussion of the processes involved in infiltration and runoff production resulting from rainfall illustrates the paradox of “good runoff” and “bad land management”. From a water supply point of view, regular and high runoff in the rivers is considered a good thing, but it has been shown that “good runoff” is not only a result of high rainfall, but also overgrazing and poor vegetative cover. Under these circumstance the high level of runoff is also accompanied by high levels of soil erosion.

An accurate understanding of Namibia’s climate as well as the interaction between climatic and physical determinants is relevant to the water sector because it is at the heart of the water environment. A major effort to improve data collection, analysis and research is required to achieve this understanding.

Prioritised considerations for sustainability include:

- An improved data collection network for rainfall, especially in the entire north from west to east, and for evaporation data along the coastal belt.

- A holistic approach to catchment management and review of relevant legislation.
- Monitoring of catchment conditions.
- Monitoring of climate in order to track and plan for climate change.

Key indicators relating to data collection and mean annual rainfall have been derived.

SURFACE WATER

Namibia's surface water can broadly be divided into two types, those derived from ephemeral, and those derived from perennial river systems. Since all surface waters can also be considered as wetlands, and vice versa, there are also a number of surface water sources which are derived directly from rainfall or groundwater. These include pans, vleis and open sinkholes.

With the exception of short lengths of the Okavango and Kwando Rivers in the north-east of Namibia, all the rivers in Namibia's interior are ephemeral. Understanding and quantifying the surface water resources is a difficult but essential task and because of the large variations from year to year, which typify the arid environment, require many years of data collection.

River flow data are mainly collected by the Department of Water Affairs, which operate approximately 150 gauging stations throughout the country. While the number of gauging stations could be usefully increased, the main problems with data collection and processing relate to large efforts required to carry out flow gaugings during times of floods and of regular station surveys. The trained manpower required to carry out this work is lacking.

Of the perennial rivers on Namibia's borders, the Zambezi is by far the largest with a mean annual runoff of more than 40 000Mm^3. Both the Okavango and Orange Rivers have similar virgin mean annual runoffs slightly in excess of 10 000Mm^3, but heavy regulation and high consumption of the Orange River in South Africa have reduced the mean annual runoff along the common Namibia/South Africa border to about a third of this. Mean annual runoff of the Kunene River is just under 5000Mm^3, but the variation from year to year is very high. The Kwando River, which is a tributary to the Zambezi River has not enjoyed a significant seasonal peak in its lower reaches for nearly twenty years, and for nearly as long, has ceased to contribute to flow in the Zambezi.

Namibia's ephemeral rivers have been divided into five main basin groupings and within these, many catchments are monitored and have been studied in some detail. In particular the Kuiseb, Swakop, Omaruru, Ugab, Oanob, Fish, Omatako and Nossob Rivers have been studied frequently and are gauged at numerous sites. On the other hand, the Cuvelai System has only been monitored periodically in the past, and only in recent years have efforts been intensified. The Fish River is the largest of Namibia's

ephemeral systems, with a mean annual runoff of 480Mm^3 at its confluence with the Orange River.

There are two large dams on the Fish River. Around the rest of the country there are an additional twelve significant state or municipal controlled dams. In addition, there are thousands of small farm dams scattered around the ephemeral river basins. The effect of both the small farm dams and the larger dams on the environment downstream of them is clearly very significant. This is most evident in the Swakop River where the Von Bach and Swakopoort Dams are to be found. Regulations require that for dams with a capacity larger than 20 000m^3, approval for construction has to be obtained from the Department of Water Affairs. For major dams, full environmental assessment studies are required.

The water quality of all the perennial rivers, except the Orange River, is good. Return flows from large irrigation schemes along the banks of the Orange River as well as high levels of urbanisation in the upper reaches have negatively affected the water quality.

A good understanding of the country's surface water resources is relevant to the water sector since this is fundamental to the planning of how resources can be used in a way that is environmentally, socially and economically sustainable. A key restraint on the realization of this understanding is a lack of sufficient trained personnel and the associated resources.

Prioritized considerations for sustainability include :

- Increased resources to ensure that the existing hydrological surface water network can be operated efficiently.
- More stations, gaugings and field visits are required to the Cuvelai River Basin.
- Attention needs to be paid to updating the water quality databank to make data more accessible and to ensure that frequent sampling for water quality continues on both perennial and ephemeral rivers and at dams.

A key indicator relating to surface water storage in key dams was derived.

GROUNDWATER

Groundwater occurs in various types of aquifers and for much of Namibia constitutes the only viable source of potable water. Aquifer types include formations with interconnected, intergranular porosity and zones of fracturing in otherwise impermeable crystalline rocks. Over the greater part of the country, rural communities and farmers rely on groundwater for domestic and livestock purposes.

Certain large urban areas are supplied with bulk water from wellfields tapping major aquifers or aquifer systems. Bulk water supplies to Walvis Bay, Swakopmund, Rössing Mine, Arandis, Henties Bay, Lüderitz, Uis, Karibib, Usakos and Omaruru are all supplied with water from alluvial aquifers recharged by west-flowing ephemeral rivers. Tsumeb, Grootfontein and Otjiwarongo rely on fractured and karst type aquifers whereas Windhoek and Gobabis are supplied from surface water sources (dams) with considerable standby capacity from groundwater. These schemes are either operated by individual municipalities or by the Namibia Water Corporation (NamWater).

Aquifers used to supply large towns or considered as viable for augmenting water supply to the central areas of Namibia via the Eastern National Water Carrier are of strategic national value and protection of these resources is considered imperative. Groundwater control areas have been declared in many such instances and the Department of Water Affairs carries out a monitoring and management function.

Groundwater, although periodically replenished from rainfall, must be considered a finite resource. Wise management and control of this resource is therefore imperative to sustaining the environment and socio-economy of Namibia now and for future generations. To this end efforts are being made to artificially enhance recharge and to manage demand.

In order to monitor closely the state of the groundwater environment, four key indicators have been selected. These include monitoring of pollution of groundwater, of water levels in non-strategic, regional aquifers, of months of adequate abstraction in strategic aquifers, and of changes in ambient water quality.

WATER SUPPLY AND DEMAND

In the past, people in Namibia settled where water could be found throughout the year, on or near the surface, and moved their livestock between places where water was temporarily available. Throughout most of the century, these various water sources have been increasingly exploited to promote development until many have approached their exploitable limits. More recently, the realisation that water is the primary limiting

factor to development in Namibia has led to a number of innovative approaches to management of water supply with the ultimate goal of increasing the available supply.

Water Supply

A Water Supply and Sanitation Sector Policy (WASP) for Namibia was approved in 1993 in terms of which affordable water supply and sanitation services should be made available to all Namibians. The policy stated that the supply of water for domestic purposes, including livestock watering for both subsistence and commercial farming is the first priority, followed by the supply of water for economic activities such as mining, industries and irrigation.

The primary sources of water in Namibia are the perennial rivers in the north and south. The potential of these is huge compared to the sustainable yield from the other sources. If water from these rivers could be economically distributed to the major demand centres such as Windhoek and the coastal towns, the water supply situation in Namibia would be greatly simplified, but these towns are far removed from any of these rivers and the transfer of water to these centres can only be done at great cost. The greater part of the population of Namibia is concentrated in the north of the country where people live near the northern perennial rivers. However, since this population is mainly rural, the distribution of water to the widely spread communities is also expensive.

Groundwater sources account for 51% of Namibia's current water consumption. The majority of this water is stored in some eight major aquifers but large numbers of farmers and rural communities in the central and southern areas rely on abstraction of groundwater from more isolated sources such as voids in rocks and sediments

The potential of the interior surface water sources is limited and the water can only be used when harnessed in large open water storage dams, which in turn are subject to high losses through evaporation.

Conjunctive use of water in Namibia is based upon the goal of reducing evaporative losses of water from the surface of open dams. Surface water, which evaporates quickly, is used first and groundwater, which cannot evaporate, can be reserved for when surface water is not available. A more pro-active approach to this principle is to artificially recharge underground aquifers with surface water from dams. Conjunctive use principles are fully applied in the supply of water to Windhoek and the Central Area.

Unconventional water sources refer to water supplied through means other than the traditional supply methods already discussed. These include indirect water re-use and direct water re-use, treatment of wastewater and reclamation of waste water for direct potable use, dual pipe systems, desalination, fog and water harvesting and artificial

groundwater recharge. The use of unconventional sources can reduce the cost of water and also help to conserve the water available from limited conventional sources.

Water Use and Demand

Water **use** or water **consumption** is defined as the actual quantity of water consumed by a consumer or at a Water Demand Centre (WDC). Water demand, on the other hand, is the quantity of water required to meet the needs of a WDC or other consumer. If either the yield from a Water Resource, or the supply capacity of the Water Infrastructure cannot meet the Water Demand, water consumption will be less than the demand.

In Namibia, almost half of all water consumed is used by irrigation, with another quarter consumed by urban consumers. Livestock account for all but the remaining 12% which is spread between mines, rural consumers and wildlife and tourism.

Urban residential water usage varies from one income group to another. In the Windhoek area, the estimated 28 000 squatter community consumes 20l/c/d compared to the middle income group (56 031 people) which uses 170l/c/d.

Other than the Constitution of the Republic of Namibia, none of the legislation or policies in place acknowledges that there is an amount of water which is necessary to maintain the health of the natural aquatic ecosystem. The ecological reserve thus represents an important component of the sustainable water supply system.

Unaccounted for water is a major drain on the country's water resources. Leaks, inaccurate meters, illegal connections and administrative errors all contribute to the losses which vary from 10% for a major centre such as Windhoek, which is considered very good, up to 58% for a town such as Khorixas which is unacceptable.

ECONOMICS OF WATER SUPPLY

The value-added of water, i.e. the contribution to GDP of water, in different sectors gives a guideline to the economic value of water. This information can help decision-makers arrive at policies for development given the scarcity of water resources in Namibia and the constraints that this puts upon economic development. Agriculture is the most water intensive activity in Namibia and yields a contribution to GDP of around 10%, while using over 60% of the nation's water. The value-added per cubic metre of water in agriculture, and more specifically irrigation, is very low compared to manufacturing and service sectors, N$7.2/$m^3$ compared to N272m^3$ and N574m^3$ respectively.

Opportunity cost is a spatial concept in so much as the opportunity costs are determined by the opportunities available in a given place. For example, in certain regions of Namibia, irrigation is likely to be one of the only options available. If water is

available, and irrigation is economically viable, then GDP can be increased by the use of water in irrigation. In this case the contribution to GDP will be higher if higher value crops are grown.

Incorporating all aspects of cost in the price of water is important for the price of water to act as an allocation mechanism between competing uses of water whilst maintaining the integrity of the environment. The efficient price should take into account **Financial costs** (capital, operations and maintenance), **Opportunity costs** (some reflection of the competing demands), **Social Benefits** associated with water supply (disease reduction, improvements in productivity resulting from water consumption) and **Environmental costs.**

Economic efficiency in water use will occur should prices reflect these factors precisely. In Namibia, the two pertinent issues of affordability and regulation arise from an "economic" approach to water pricing. However, it is obviously necessary to ensure that those who lack the economic power to compete can also gain access to water. The consideration of social benefits, i.e. water as a "merit good", may help to ensure at least minimal access to all sectors of society. Often block tariffs, which have a price lower than the economic cost for initial levels of consumption, are used to address affordability. However the extent to which water is a merit good for all levels of water consumption is questionable. Furthermore, the extent to which the price of water is the best medium to alleviate poverty is questionable

In rural areas, where water has been historically subsidised by the Government, access to water is seen as a social goal. The question of affordability is critical to the success of the policy of Community Based Management of rural water supply. In rural areas water may be the critical resource for economic development.

In terms of private water supply agencies, such as NamWater, there may be little incentive to consider the external costs and benefits (e.g. environmental costs) of water supply, in the price. Furthermore, private companies may not have an incentive to supply to areas which cannot afford the cost of water. For this reason there is scope for regulation of the water sector to ensure sustainability and an equitable allocation of water. Ecological sustainability and equity are not guaranteed by the economic approach to pricing but efficiency and cost recovery will be achieved provided payment occurs.

The price of bulk water varies from one region to another mainly as a result of the relative capital intensities. In Omaheke for example, the weighted average cost for water is N$23.36 per cubic metre, whilst in neighbouring Khomas the average cost is N$3.24. The total cost for bulk water supply is approximately N$170 million.

In the urban areas the local authorities; municipalities, village and town councils, are responsible for the reticulation of water to the residents and industries and these costs are difficult to ascertain.

The Directorate of Rural Water Supply currently has the responsibility for supplying water to the communal areas of Namibia and this responsibility is being shifted from the DWRS to the communities themselves as a policy of Community Based Management. The current DRWS budget is in the region of N$80 million.

NamWater is implicitly subsidizing water consumption in the interim before full financial cost recovery is achieved. The extent of the subsidy varies by region with the ratio of the current tariff to the cost recovery tariff in Omaheke standing at 12% compared to 73% for Khomas. The total subsidy implied by the 1998 tariffs is approximately N$60 million, a significant improvement on N$102.8 million in 1996. The extent to which water is being subsidised in the urban areas is difficult to ascertain.

The DRWS does not operate on a cost recovery basis and as such the budget of the DRWS could be considered to be the extent of subsidisation. Cost recovery is planned for the future but not on the basis of tariffs for water. The movement towards Community Based Management (CBM) of water points will reduce the extent to which the government funds rural water supply, and hence the subsidy. However, in the interim period the DRWS will need to increase the number of water points through creation and rehabilitation, train water point committees and extension officers and generally do the groundwork for the future success of CBM.

Water Demand Management

Traditionally, increasing the availability of water has involved augmenting supply through capital expenditure on dams, pipelines and tapping of further boreholes. Water demand management (WDM) uses a combination of economic, technological, legislative and informational policies in order to affect the demand for water by consumers and the associated pressures on primary water resources.

The combination of these policies and other related policies for Windhoek has meant that water consumption from primary water resources (e.g. the three dam system and groundwater) has stayed at 1987 levels despite a 43% increase in population. The potential for WDM in Namibia is great, but problems include high levels of unaccounted for water, low levels of maintenance, ineffectual tariff setting, and non-payment of water bills.

In the mining and commercial sector there are good case examples of efficient water management. Recycling of water is common in the mining sector given the often small percentage of costs that water makes up. In the brewing industry some of the most efficient levels of water used to brew beer were noted in Windhoek. Outside of

Windhoek, industries and commerce have showed very little knowledge of WDM. Similarly the towns associated with mines (Oranjemund and Rosh Pinah) often supply water for free to residents, contrary to the principles of WDM.

In agriculture, the use of efficient irrigation technologies by farmers is commonplace. However, the historically free water for irrigation has lead to a high prevalence of flood irrigation and low value crops. The current lack of knowledge within the local authorities on the subject of WDM, and the subsequent lack of incentives given to water consumers to conserve water, leaves Namibia with a great opportunity for improving the efficiency of water use. A National WDM policy is probably the pivotal factor required to realize this potential.

Future Demands

The latest predictions for future water consumption in Namibia predict an increase from 300Mm^3/a in 1996 to 450Mm^3/a in 2012, an average exponential growth rate of 2.2%. This would imply full utilization of domestic water resources, estimated at 500Mm^3, by 2016.

For the central areas of Namibia (Windhoek, Okahandja, Otjiwarongo, Tsumeb and Grootfontein and the surrounding areas), consumption is predicted to rise from 41Mm^3/a in 1995 to around 80Mm^3/a in 2025. This would mean the full use of currently developed sources would occur in 2006. A tentative estimation of the effects of wider WDM measures in the central areas shows that full capacity is met in approximately 2012, a delay of 6 years. However, the failure of the consumption predictions of the past to reflect the actual consumption levels that have arisen should be considered when analyzing these predictions.

Future Water Supply Costs

Many of the urban and industrial centres are far from where water is abundant and relatively cheap. Investments will be required in the future should demand increase as projected and the alternatives are expensive.

For Windhoek the remaining options are therefore increasingly more expensive. Costs of developing new sources vary from N$4.92/$m^3$ for importing water from Hardap dam up to N$10.36/$m^3$ for water from the Kunene River.

Water demand management should also be considered as a realistic option for maintaining the water supply to the growing numbers of consumers in Windhoek. The water saved as a result of the implementation of WDM policies in 1995, 3.2Mm^3, have been achieved at a cost of N$0.042/$m^3$ for total consumption, the total cost of these savings is N$750,000. Unconventional sources and WDM have certain benefits over conventional supply augmentation. WDM, particularly, avoids the environmental and

political costs that are associated with extracting water from shared water resources like the perennial border rivers. Unconventional sources and WDM can help to improve the efficiency of current water use and help to provide the same or greater services from water inputs whilst delaying expensive investments.

Virtual Water

Namibia imports on average 100 thousand tons of grain every year in order to satisfy demands. Were this grain to be grown in Namibia 300Mm^3/a of water would be required for irrigation. Therefore, grain imports can be considered as imports of 300Mm^3/a of water to Namibia, which is now free for use in other sectors. These figures are of course estimates and as such this notion of virtual water is more ambiguous. However, it is estimated that the cost of supplying this water for irrigation in Namibia would be in the region of N$0.55/$m^3$. Imports of virtual water are worth N$170 million to Namibia in this sense.

The issues of food security and food self-sufficiency are highly related to the issue of virtual water. Given that in the long term water will be a binding constraint to pursuing self-sufficiency, policy may look towards virtual water to ensure food security for the nation whilst promoting other economic uses for Namibia's own water resources.

WATER MANAGEMENT INSTITUTIONS

In Namibia, a number of institutions, ranging from dedicated Government departments and parastatal institutions through municipalities and community-based Water Point Committees to private organisations and individuals, are responsible for different aspects of water supply, management and use. Finding and exploiting sufficient water to supply an increasing demand has been the main focus of water management until the present decade. Only recently have concepts such as Integrated Water Resource Management, Water Demand Management and Adaptive Management been recognised and the ecological requirements, goods, services and processes of natural water ecosystems been acknowledged.

The Constitution of the Republic of Namibia claims State ownership and responsibilities of the State extend from identification of water sources, development of water sources, purification of water and bulk distribution to distribution reticulation, quality control and assessment, conservation and protection of the resource, and research and monitoring. Responsibility for bulk water supply rests with the parastatal institution, NamWater, while responsibility for managing the water resource and for rural water supply rests with the Department of Water Affairs, Ministry of Agriculture, Water and Rural Development.

With decentralisation as a national policy, responsibility for rural water supply is being devolved to the regional level where Community Based Management is the basic

premise for rural water management. Institutional arrangements for managing the resource itself have been adapted as responsibilities altered but are not fully adequate. With the creation of NamWater from DWA, responsibility for data gathering and management and for research have been split and are currently unclear. Donor agencies play an important role in supporting integrated water resource management and have introduced the process of Environmental (Impact) Assessments and their application to at least sixteen new water supply development projects.

Prioritised considerations for sustainability include:

- establish overall goals for social, economic and environmental sustainability in Namibia, including the water sector
- avoiding the politicising of water sector management and water supply, and water demand especially
- harmonisation of institutional management and oversight responsibilities for integrated water resource management including catchment management, groundwater management, shared water management, supply management and demand management
- human resource development for water management.

Key developmental indicators related to effectiveness of management in rural and urban situations have been derived.

LEGISLATIVE FRAMEWORK

The Constitution of the Republic of Namibia, the Water Act 54 of 1956 and the Namibia Water Corporation Act 12 of 1997, together with relevant Amendments and Regulations, constitute the limited, primary framework for management of the water sector in Namibia. A major limitation of the existing Water Act, and one that places it at odds with Namibia's Constitution, is that it does not recognise the natural environment as a user of water nor as a provider of essential goods, processes and services. Moreover, it does not stipulate the sustainable use of water resources in terms of social, economic or environmental sustainability. Other legislation of concern to the water sector is derived from various diverse sectors emphasising the need for a holistic approach. However, the draft Environmental Management Act provides for a set of environmental management principles to be applied by all government institutions and private persons in planning and implementing developments likely to have a significant effect on the environment, including water.

Appropriate legislation to support devolution of components of rural water supply to communities is needed. This legislation would focus on community ownership of water points and be harmonised with other legislation concerning communal lands, much of which is currently missing. Legislation covering sanitation and pollution are two additional gaps that require attention and synthesis.

The Water Supply and Sanitation Sector Policy (WASP) represents the only new guidelines drafted since Independence for supporting non-bulk water management in Namibia. The WASP document is the primary guiding principle for supply of water to previously neglected rural areas. Of particular note for urban water supply is the Water Demand Management Policy and implementation strategy of the Municipality of Windhoek that covers technical issues, policy matters, legislation and a public campaign. This policy has succeeded in reducing the water demand per capita in Windhoek in the last decade despite a 43% population increase.

Policies clearly missing to date are a Groundwater Protection Policy, an Ephemeral River Catchment Policy, a clear Communal Land Policy, a Communal Water Policy, a National Water Demand Management Policy and a Pollution Control Policy. These policies should address economic, social and environmental sustainability of the use and management of Namibia's water resource. As new policies are drafted, priority should be given to consideration of ownership of water, ownership of rural water supply facilities and water for the natural environment. Also requiring attention is provision for the coordination or harmonisation of existing data or for collection of new data within the water sector. As a crucial component of conflict resolution, relevant and comprehensive information must be available to be able to judge if legislation, policies or regulations are being complied with and are effective.

Prioritised considerations for sustainability include:

- a new water act in harmony with Namibia's constitution
- a broad based, effective legislation and institutional framework
- legislation and institutional framework that is integrated with other sectors and holistic in approach
- overall goals for social, economical and environmental sustainability
- prioritised entitlements for water use with special reference to the natural environment
- agreed upon principles and instruments for water regulation and management that are enforceable and are enforced
- adequate information gathering, management and dissemination
- human resource development to establish, maintain and enforce the legislative and regulatory framework

A key indicator relating to a white paper and new water act has been derived.

NEIGHBOURING COUNTRIES

Namibia shares water resources with its neighbours. These "shared waters" are mainly the perennial streams on the northern and southern borders as well as the ephemeral

Cuvelai System. A number of ephemeral rivers, such as the Auob and Nossob cross into Botswana and South Africa, but their flows are so irregular that their importance as shared surface water sources is not significant. Groundwater flow in eastern Namibia is generally in an eastern direction, but no attempt has been made to quantify this flow and it has not been raised as an issue of shared resources.

The main shared perennial resources are the Kunene, Zambezi (including Kwando/ Linyanti/ Chobe System), the Okavango and the Orange Rivers. The sources of all of these systems lie upstream of Namibia, so Namibia is dependent on activities in the upstream riparian states. In the cases of the Okavango and Zambezi Rivers, however, there are riparian states downstream to whom Namibia has a responsibility. The Cuvelai System is an important lifeline for a large rural population in the Ohangwena, Oshana, Oshikoto and Omusati Regions in northern Namibia.

It is accepted both world-wide and within the SADC region that there is a need for responsible use of shared water and other resources. There are a number of conventions, United Nations and regional protocols that are relevant to the water sector and in particular, transboundary systems, including

- the UN Biodiversity Convention
- the UN Framework Convention on Climate Change
- the UN Convention to Combat Desertification
- the UN Convention on Ozone Depletion
- RAMSAR Convention on Wetlands
- UN General Assembly Resolution 51/229:
- Convention on the law of the non-navigational uses of international watercourses
- SADC Protocol on Shared Watercourse Systems

With the exception of the UN Resolution 51/229, the Government of the Republic of Namibia has ratified all of these protocols and/or conventions. This is an important commitment to environmental sustainability. In addition, Namibia has entered into various agreements with its riparian neighbours. It is a part of ZACPLAN, and has co-operated with Botswana on a technical level on the Kwando/ Linyanti/ Chobe tributary to the Zambezi since the early 1980s. Namibia has permanent joint technical commissions with its neighbours for the Kunene, Okavango and Orange Rivers.

Despite generally good co-operation, Namibia has an allocation agreement with its neighbour for only the Kunene River.

In view of the fact that much of Namibia's water demand is provided from the border perennial rivers, the importance of good co-operation with riparian neighbours should not be under-estimated. In addition, the scientific groundwork for proper understanding

of the transboundary water needs to be allowed to proceed unhindered by political pressures. Only in this way can integrated management strategies be successful.

Prioritised considerations for sustainability include :

- Full open sharing of all data combined with a joint data collection programme to avoid unnecessary duplication of effort between riparian states
- Combined data verification and collection exercises between riparian states
- Regular technical and managerial meetings between members of the Joint Commissions
- Holistic approach to data collection and analysis. Avoid concentrating on the river only.
- Carrying out of necessary studies to achieve understanding of all environmental and socio-economic aspects of the basin
- Drawing up of an Integrated Management Plan
- Agreement on Allocations.

Key indicators relating to shared water resources have been derived, one providing an indication of Namibia's dependence on resources which are shared with other countries, and one which provides an indication of the level of agreement and co-operation obtained with fellow riparian states.