RESEARCH DISCUSSION PAPER
Number 21
August 1997

Environmental threats and opportunities in Namibia: A comprehensive assessment

Bruce A Byers

Directorate of Environmental Affairs
Ministry of Environment and Tourism
Private Bag 13306
Windhoek, Namibia

Table of contents

Figures

Acknowledgements

This assessment of environmental threats and opportunities in Namibia involved the preparation of topical reports by a team of experts in a variety of disciplines (see Appendix 1), and those reports provided the foundation of this synthesis report. The topical reports were largely desk studies, based primarily on existing documents and published literature, and we acknowledge our dependence on the authors of these documents, who are cited in the report. Information from published sources was supplemented and updated with fresh information from interviews and meetings in Namibia; we hope that these added some useful insights not found in the existing literature. We are grateful to the persons interviewed for their help; they are listed in Appendix 2. We are also grateful to participants in a summary workshop, who helped think through the implications of our findings for the Government of Namibia, USAID and other donors, and NGOs; they are listed in Appendix 3.

My sincere thanks go to Rod Davis, Jenny Day, Tony Ferrar, Christoph Schumann, Bertus Kruger, and Mick O'Toole, fellow members of the assessment team and the authors of the topical reports, for their inputs. Without the detailed and high-quality information they provided in the topical reports, this synthesis report could not have been written. Although I have depended on them for most of the information in this synthesis report, errors of omission or interpretation are my own. It was a personal, as well as professional, pleasure working with this diverse and talented team.

Rod Davis, head of Namibia Resource Consultants, deserves special thanks for facilitating my communication from the US with other team members based in Namibia and South Africa, and for keeping on top of local logistical arrangements. Murray Macgregor and Bessie Bester were involved in the initial team planning workshop, and they too deserve thanks, as does Auriol Ashby, who agreed on short notice to facilitate the plenary discussion at the half-day workshop held in Windhoek.

I am grateful to Barbara Belding of USAID, Namibia, for her help and support throughout the assessment process, and to Joao de Queiroz of REDSO/ESA for his interest and ideas. Chris Brown and Phoebe Barnard of the Directorate of Environmental Affairs (DEA), Ministry of Environment and Tourism, deserve thanks for their patience during the assessment process. Many other members of the DEA have helped answer my questions as well. All of the participants in the assessment workshop (see Appendix 3) provided insights based on their detailed knowledge of the Namibian situation.

Wanting to keep this report as short as possible, and believing that "one picture is worth a thousand words", I have used a number of maps and graphs. These were copied directly from other published documents, without obtaining permissions from the authors or copyright-holders of those documents. The sources of all of these maps and graphs are given in full.

My participation in this assessment was made possible through the USAID-funded Environmental Policy and Training (EPAT) Project based at Winrock International in Washington, DC. Management Systems International (MSI) provided logistical and travel support on behalf of the EPAT Project.

The views expressed here are my own, and do not necessarily represent those of U.S. Agency for International Development, the Government of Namibia, the EPAT Project, or MSI.

Acronyms and abbreviations

BDDSA	British Development Division in Southern Africa
CATAD	Centre for Advanced Training in Agricultural Development
CBNRM	Community Based Natural Resources Management
CITES	Convention on International Trade in Endangered Species
CSIR	Council for Scientific and Industrial Research
DANCED	Danish Co-operation for Environment and Development
DEA	Directorate Environmental Affairs
DRFN	Desert Research Foundation of Namibia
DWA	Department of Water Affairs
EEAN	Environment Evaluation Associates of Namibia
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
ENSO	El Nino–Southern Oscillation
ENWC	Eastern National Water Carrier
EPAT	Environmental Policy and Training
GDP	Gross Domestic Product
GRN	Government of the Republic of Namibia
GTZ	Gesellschaft für Technische Zusammenarbeit
HIV/AIDS	Human Immunodeficiency Virus
IFAD	International Fund for Agricultural Development
IMSCLUP	Inter-Ministerial Standing Committee on Land-Use Planning Conservation
ISA	Initiative for Southern Africa
IUCN	World Conservation Union
LIFE	Living in a Finite Environment
LUEB	Land-Use and Environmental Board
LVAN	Loxton, Venn and Associates Namibia
MAWRD	Ministry of Agriculture, Water and Rural Development
MET	Ministry of Environment and Tourism
MFMR	Ministry of Fisheries and Marine Resources
MHSS	Ministry of Health and Social Services
MLRR	Ministry of Lands, Resettlement and Rehabilitation
MME	Ministry of Mines and Energy
MRC	Multidisciplinary Research Council, UNAM
MRLGH	Ministry of Rural and Local Government and Housing
MSI	Management Systems International
NAPCOD	Namibian Programme to Combat Desertification
NBRI	National Botanical Research Institute
NCAs	Northern Communal Areas
NDP#1	First National Development Plan
NEPRU	Namibia Economic Policy Research Unit
NGO	Non-Governmental Organisation
NNF	Namibia Nature Foundation
NOLIDEP	Northern Communal Area Livestock Development Programme
NPC	National Planning Commission
NRC	Namibia Resource Consultants
NRM	Natural Resources Management
ODA	Overseas Development Administration (UK)
RCSA	Regional Centre for Southern Africa

REDSO/ESA	Regional Economic Development Support Office for East and Southern Africa
SADC	Southern African Development Community
SARDEP	Sustainable Animal and Range Development Programme
SSD	Social Sciences Division (UNAM)
TA	Technical Assistance
TAC	Total Allowable Catch
UNAM	University of Namibia
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
UNFPA	United Nations Population Fund
USAID	United States Agency for International Development
USA	United States of America
WWF	World Wide Fund
ZACPLAN	Zambezi Action Plan

Executive summary

Threats to the Namibian environment

This assessment was carried out in collaboration between USAID and the MET's Directorate of Environmental Affairs with funding provided by USAID, Namibia. The assessment is an independent analysis of the broad causal relationships and assumptions underlying one of USAID, Namibia's Strategic Objectives, which is to help bring about "increased benefits to historically disadvantaged Namibians from sustainable local management of natural resources". The term "environmental threat" is used here to mean an unsustainable environmental trend, caused by human activities in an arid and highly variable environment, which leads to the degradation or depletion of valuable natural resources.

Since Namibia's Independence in 1990, there have been a number of excellent studies and assessments of the country's environment and natural resources. Despite this abundance of information, the DEA and USAID, Namibia nevertheless agreed that a fresh and independent look at the existing information could be helpful. The assessment team identified four key threats:

- depletion and degradation of water and aquatic resources;
- desertification and land degradation;
- loss of biodiversity and biotic resources; and
- decline of marine fisheries.

Root causes of environmental threats

The key proximate causes of these environmental threats are:

- overexploitation of water resources;
- overgrazing and unsustainable range management;
- lack of adequate protection for some key ecosystems; and
- overexploitation of marine fish stocks.

These proximate causes are often linked. Overexploitation of water resources, for example, not only depletes and degrades wetlands and aquatic resources, but contributes to desertification and land degradation and to loss of biodiversity. Likewise, overgrazing and unsustainable range management damages not only rangelands, but also harms both terrestrial and aquatic biodiversity and biotic resources.

The ultimate, root causes of environmental threats identified in the assessment include:

- lack of secure and exclusive tenure over land and resources at the local level;
- limited intersectoral co-ordination at the national level;
- limited human resources and capacity for sustainable planning and management at all levels;
- insufficient information or knowledge transfer for sustainable management;
- limited international agreements; and
- population growth.

It was clear from our analysis that many different threats are linked by common causes, both proximate and ultimate. This linkage means that they cannot be addressed sectorally and separately; solutions that are intersectoral, integrated and holistic will be required.

Needs in addressing the causes of environmental threats

In order to address the proximate causes of environmental threats, sustainable policies, practices and technologies in water, land and fisheries management are needed, including those to:

- control water demand within sustainable levels, and to remove subsidies and other incentives for unsustainable use (e.g. providing water at less than full cost recovery prices);
- develop flexible range management systems to replace traditional management institutions and practices that have largely broken down and have no modern replacements (e.g. large-scale transhumance); meanwhile, policies are needed to slow the breakdown of traditional, flexible systems that still exist, and remove subsidies for inflexible management (e.g. developing new water-points, providing fodder for drought "bridging");
- develop mechanisms and incentives for conserving biodiversity and biotic resources outside of protected areas, in the communal and privately-owned lands of Namibia; and
- develop marine fisheries management that is based on a better understanding of the dynamics of the Benguela ecosystem.

Addressing the ultimate, root causes of environmental threats will require a number of actions.

The lack of **secure and exclusive rights to land and resources on the communal lands** of Namibia must be addressed, because this is one (although not the only) ultimate, root cause of unsustainable resource exploitation. Policies and legislation to bring about secure and exclusive land and resource tenure throughout Namibia are needed, in order to enable sustainable natural resources management on the ground. Such secure and exclusive tenure is a principle of the recent draft Land Policy. Tenure over wildlife in communal areas is now enabled by the "conservancy" policy and legislation. Extending the conservancy approach to key resources such as water and rangelands for grazing is an option to consider. Tenure reform is needed in order to move toward sustainable management of natural resources at the local level that is integrated and intersectoral.

Developing intersectoral, integrated solutions to environmental problems at the local level requires **communication and co-operation between sectoral ministries at the national level** (e.g. MET, MAWRD, MLRR, MRLGH). Such communication and co-operation is weak, although becoming better in some cases, mainly through informal mechanisms. Relevant ministries must work together to create the enabling environment needed to bring about integrated, holistic resource management on the ground. This requires:

- policies, legislation, and institutional development;
- extension and technical support capacity; and
- monitoring and research capacity.

Developing the human resources to carry out all of the diverse actions required to manage Namibia's environment and natural resources sustainably is a major need. Education, training, and capacity-building at all levels, from central government to grassroots resource users, will be required. Environmental education, broadly conceived, should give Namibians not only the awareness and knowledge needed for making sustainable environmental choices, but also the skills, options, and motivations to do so.

The **knowledge needed to manage resources sustainably** is still lacking in some cases. There is a general need for more applied research to inform sustainable environmental management on the following:

- climate and hydrology;
- biodiversity and its distribution;

- rangelands productivity, resilience, and carrying capacity;
- natural resources economics and other social dimensions of resource use; and
- the dynamics of the Benguela ecosystem.

Monitoring of natural resources and the environment is needed for sustainable management. Monitoring techniques that are simple and cheap are urgently needed, especially as planning and management responsibilities are devolved to the regional and local level. Simple techniques for monitoring rainfall, availability of fodder for stock, wildlife populations, and fish stocks from year to year and place to place are needed, for example, to enable sustainable local management of these resources.

Sustainable management of some key environmental resources for Namibians will require **international agreements with neighbouring countries** and the wider international community. International agreements are needed, for example, regarding:

- fisheries of the Benguela ecosystem;
- livestock marketing agreements that will foster sustainable stock production;
- international trade in wildlife products under CITES;
- water abstraction from northern border rivers and the Cuvelai–oshanas system; and
- fisheries of the northern border rivers and Cuvelai–oshanas system.

Population growth in Namibia is rapid, and the demographic momentum of its relatively young population will inevitably cause the population to grow much larger. Because people require resources in order to live and develop, population growth is an ultimate root cause, a driving force, of the overexploitation of natural resources and environmental degradation. Ultimately, sustainable development requires that population growth be reduced to zero, and a stable population achieved. In order to reach this goal, immediate action is needed, even though the goal will take decades to attain. A national population policy is needed, which explicitly recognises that because of Namibia's aridity, the capacity of its natural resource base to support people is very limited. In addition to a population policy that sets objectives and provides a strategy for achieving them, institutions with the capacity to implement the policy on the ground are needed. Such a capacity includes the provision of contraception and family planning services, population education, and adequate maternal and child health care. It can and should be integrated with the national HIV/AIDS prevention programme. Excessive population growth often goes hand-in-hand with poverty, and one way of reducing population growth rates is by improving standards of living. Basic education for girls and adult women is typically correlated with fertility reduction, and this should also be integrated into a national population programme.

1. Introduction

1.1 Natural resource management objectives of Namibia's First National Development Plan

The Namibian Government (GRN) gives a high priority to "sustainable and integrated natural resource management" in its First National Development Plan (NDP #1), which covers the five-year period from 1996–2000. The National Development Plan commits the GRN to:

> "...promote sustainable development within all sectors and across all regions, to ensure present and future generations of Namibians gain optimal benefit from the equitable and sustainable utilisation of Namibia's renewable resources; to protect the nation's biodiversity and maintain essential ecological life-support systems; to promote participatory, cross-sectoral and integrated programmes to improve understanding of the management of natural resources on a sustainable basis."

The First National Development Plan is congruent with Article 95(1) of the Namibian Constitution and states that the State shall promote and maintain the welfare of the people by adopting policies aimed at

> "...the maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilisation of living natural resources on a sustainable basis for the benefit of all Namibians, both present and future; in particular the government shall provide measures against the dumping or recycling of foreign nuclear and toxic wastes on Namibian territory...".

1.2 Purpose and objectives of this assessment

The *purpose* of this assessment is to evaluate the condition of the Namibian environment with three *objectives* in mind:

- To identify and assess the severity of environmental problems;
- To identify the root causes of the principal environmental problems; and
- To produce a preliminary list of environmental threats that could be successfully addressed by the Namibian government, NGOs, donors and other development partners.

2. Methods

Since independence in 1990, there have been a number of excellent studies and assessments of Namibia's environment and natural resources (Ashley 1994; Brown 1992; DEA/DRFN 1994; Fisher 1995; Tarr 1996). Despite this abundance of information, the DEA and USAID, Namibia nevertheless agreed that a fresh and independent look at the existing information could be helpful. One objective was to synthesise the information in a form that could help Namibia and its development partners adaptively manage their environmental activities.

The first task was the research and writing of six topical reports on the following subjects:

- wetlands, riparian habitats, freshwater systems;
- coastal and marine resources;
- forestry, protected areas, and terrestrial biodiversity conservation;
- rangeland resources, pastoralism and agropastoralism;
- legal, institutional and policy issues relevant to environmental conservation; and
- donor activities relevant to the environment and natural resources management.

These topical reports were to be desk studies, based primarily on published information and existing documents; these sources are cited throughout the report. Information from these existing documents was supplemented and updated with fresh information from interviews and meetings with key individuals in Namibia (see Appendix 2). The reports aimed to summarise the body of current knowledge and views about the topics above. A generic outline for the topical reports was developed at the team planning workshop; it guided the writing of the topical reports, ensuring that each provided the information needed to reach the objectives of the overall assessment.

Following completion of drafts of the six topical reports, this synthesis report was written by the team leader. It summarises the main findings of the thematic reports, but also goes beyond a simple summary to identify linkages and interactions between environmental sectors, and common denominators among environmental threats that are not being addressed by the Namibian government and donor community.

A summary of the findings of the assessment were presented at a meeting on August 20, 1996, with the director and key staff members of the DEA, and their reactions and comments gathered in a roundtable discussion.

A half-day workshop was held in Windhoek on August 23, 1996, to which representatives from relevant ministries (MET, MAWRD, MME, MFMR), the University of Namibia, NGOs and donors were invited (see list of workshop participants, Appendix 3). USAID staff from Namibia, the Regional Centre for Southern Africa and REDSO/ESA also participated in the workshop. The objectives of the workshop were to present the findings of the assessment in order to validate them and correct any errors and omissions, and to gather input from the participants on priority needs and options for addressing those needs.

A general summary of the assessment findings was presented by the team leader, and more detailed summaries of findings on biodiversity, rangelands, and water and inland aquatic resources were then presented by two members of the assessment team. Participants then broke into working groups to discuss four main topics that were identified as key needs in the assessment:

- intersectoral and interministerial communication and co-operation;
- land and resource tenure reform and integrated resources "conservancies";

- capacity building for implementation of integrated natural resources management (education, training and human resources development); and
- research and monitoring for sustainable natural resources management.

For each topic, working groups discussed:
priority needs;

- what actions and initiatives were currently underway to address the priority needs;
- where the gaps are — needs that are not being adequately addressed; and
- what the priority options (actions, initiatives) are for closing the gaps that could be taken by government, donors and others (e.g. NGOs, private business).

Input from this workshop has been incorporated into this synthesis report.

3. The state of the Namibian environment[1]

3.1 The natural environment

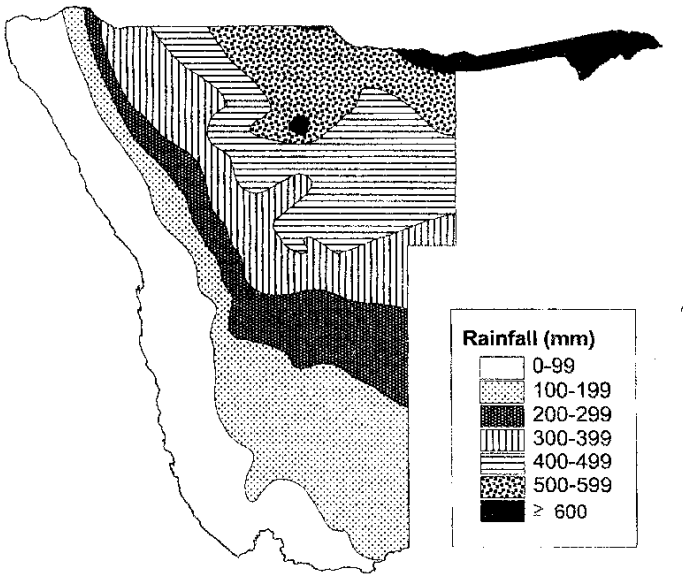
3.1.1 Geographic setting

Namibia is a vast country situated on the south-western coast of Africa between the latitudes of 17.5º and 29º South. The Tropic of Capricorn bisects the country just south of Windhoek. Its land area of about 824 000 km^2 makes it a little larger than Pakistan or Turkey, and about twice the size of the U.S. state of California. The narrow coastal plain (100–150 km wide), encompasses one of the world's oldest deserts, the Namib. The Namib extends to fringing mountains that rise to 2000 m above sea level, and on to a flat inland plateau at 1000–1200 m.

3.1.2 Climate and water

In spite of its latitude, the cold Benguela Current has a moderating effect on regional weather patterns. Namibia is sub-Saharan Africa's most arid country, and one of the most arid countries in the world. The entire western coastal zone is true desert, with a mean annual rainfall of less than 100 mm per year, and mean annual evaporation about thirty times as great. Rainfall increases from the South-west to the North-east, ranging from less than 50 mm to 700 mm (Fig. 1) (Ashley 1994; Brown 1993). Only 8% of the country receives more than 500 mm per year, the minimum considered necessary for dryland cropping.

Figure 1: Mean annual rainfall



[1] Note on sources: this section of the report is based largely on the existing, published information about the Namibian environment. The two sources relied upon most heavily for the information in this section are *Namibia's Green Plan* (Brown 1992) and *Namibia Environment* (Tarr 1996). Specific sources have not been cited for each piece of information given here. Some information, such as geography and climate, can be found in almost any general source on Namibia. Readers interested in sources for information given in this section that are not cited here should consult the two documents just listed, or the topical reports written by members of this assessment team from which this synthesis was abstracted.

As is the case in most arid regions, rainfall is extremely variable from year to year, and in inverse proportion to the mean annual rainfall. In the North, the variability is about 30% while in the South and West it exceeds 70% (Fig. 2) (Ashley 1994; Brown 1993). From agricultural and ecological perspectives, this variability is the most important climatic parameter.

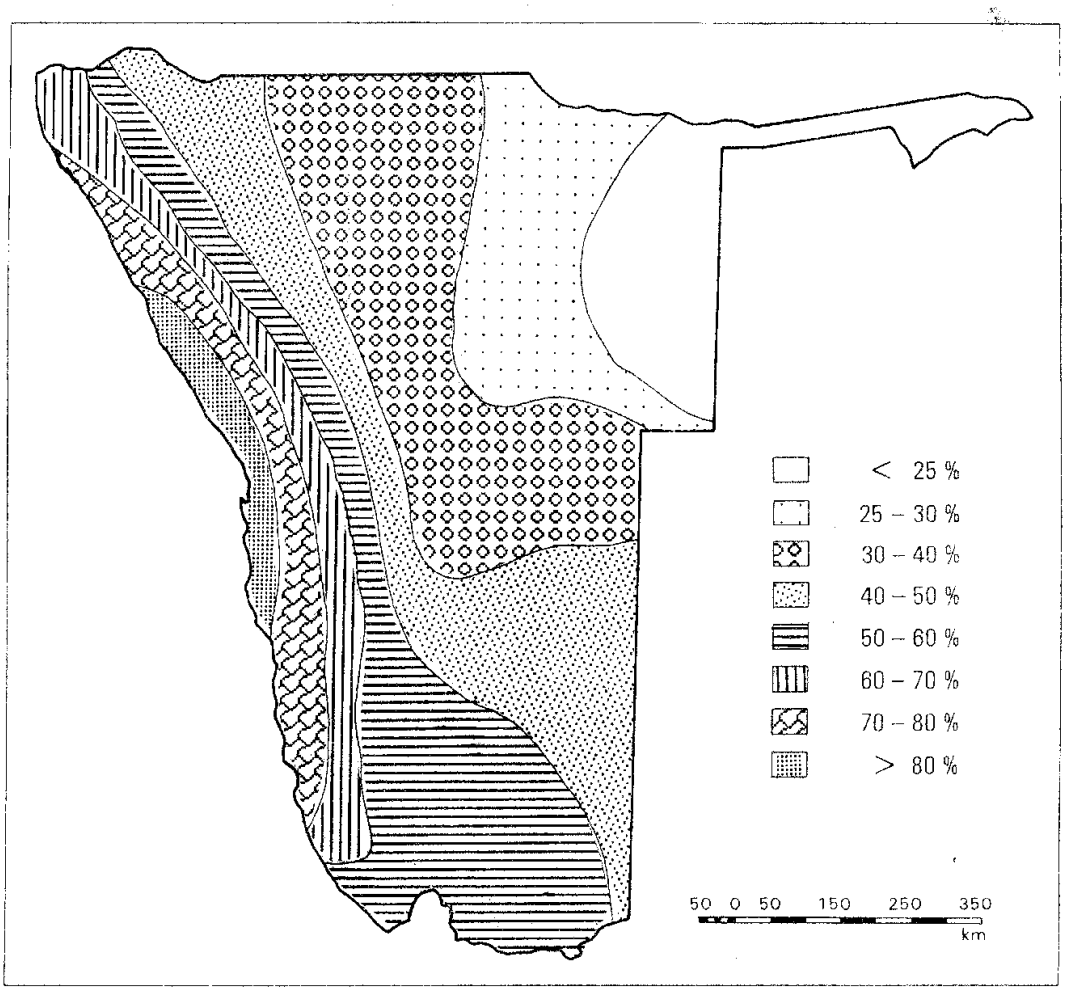
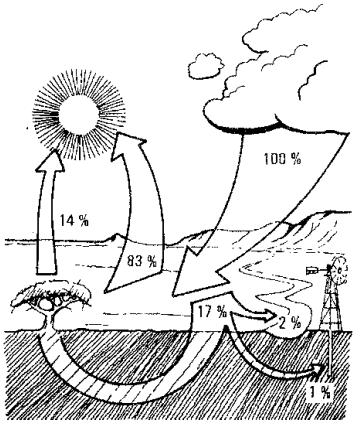


Figure 2: Variability of rainfall (% typical deviation from mean) (Adapted from van der Merwe 1983)

In addition to this negative correlation between the amount of rainfall and its variability, rainfall variation is also negatively correlated with latitude, so dry tropical systems are among the most variable on earth. Rainfall variation also increases in regions — including southern Africa — influenced by sea surface temperature anomalies associated with El Nino–Southern Oscillation (ENSO) patterns. Because of the tropical and ENSO effects, parts of southern and eastern Africa co-efficients of variation in rainfall may exceed 33% even where rainfall exceeds 1000 mm per year; these latter effects can sometimes dominate or overwhelm the typical correlation between increasing total precipitation and decreasing precipitation variability.

Furthermore, in arid regions such as Namibia, most rain falls in short, intense episodes so that infiltration of water into the soil is low: on average, 83% of rainfall evaporates, 14% is transpired, 1% recharges groundwater, and 2% appears as surface runoff (Fig. 3) (Brown 1992).

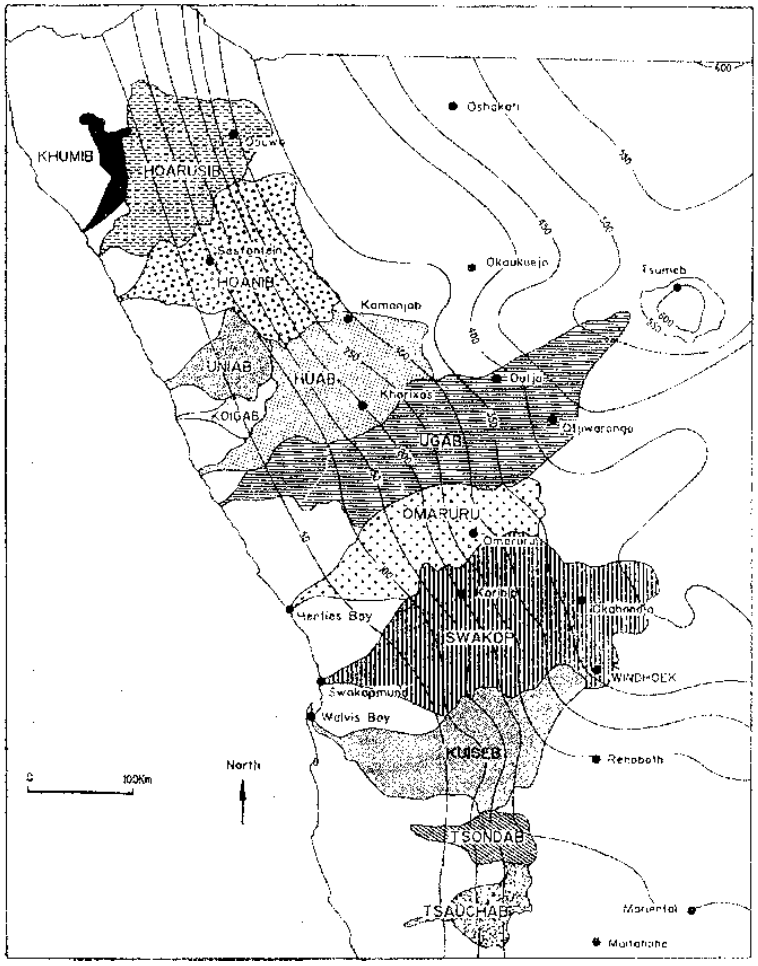
Figure 3: Water budget (Brown 1992)



The only perennial rivers in Namibia are found along the northern and southern borders: the Kunene and Okavango Rivers, which form the northern border with Angola, the Kwando, Linyanti, Zambezi and Chobe Rivers, which form the borders with Botswana and Zambia in the North-east, and the Orange River, which forms the border with South Africa in the South. The headwaters of all of these rivers are in other countries.

Most of the interior catchments are characterised by ephemeral rivers, which flow following heavy rains in the interior highland headwaters of their catchments (Fig. 4) (Jacobson, *et al.* 1995).

Figure 4: Ephemeral rivers and their catchments. (Jacobson, et al. 1995)



The northern border area, west of the Okavango River and east of the Kunene River, is very flat, and is traversed roughly from north to south by numerous seasonal rivers whose waters originate in Angola. These rivers include the Cuvelai (which sometimes gives its name to the area), the Caundo and the Etaka. The drainages of these rivers converge south of the Namibian border, near Lake Oponono, and from here the Ekuma River flows into Etosha Pan (Fig. 5).

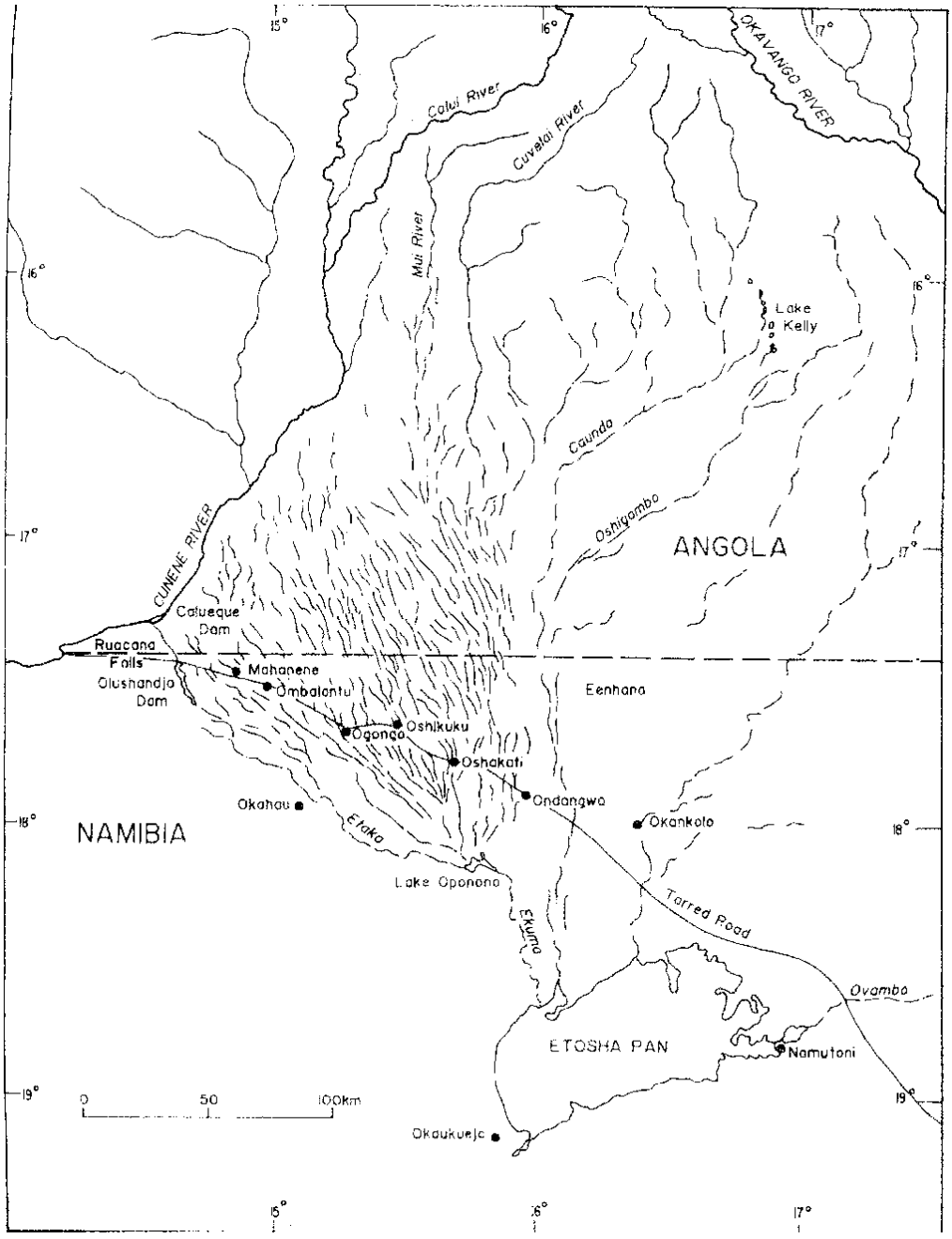


Figure 5: Cuvelai Drainage System and oshanas in northern central Namibia. (Marsh and Seely 1992)

More general aspects of the oshanas region and its peoples are well detailed in Marsh and Seely (1992).

3.1.3 Terrestrial ecosystems and biodiversity

Namibia has three natural vegetation biomes: the desert (16% of the land area), the savanna (64%) and the dry woodland (20%). These three major biomes are defined primarily on botanical criteria and follow the south-west to north-east rainfall gradient (Fig. 6) (Brown 1992). These biomes can be further divided into approximately 13 vegetation types (Fig. 7) (Strohbach-Fricke 1996).

Figure 6: Natural vegetation biomes of Namibia (Brown 1992)

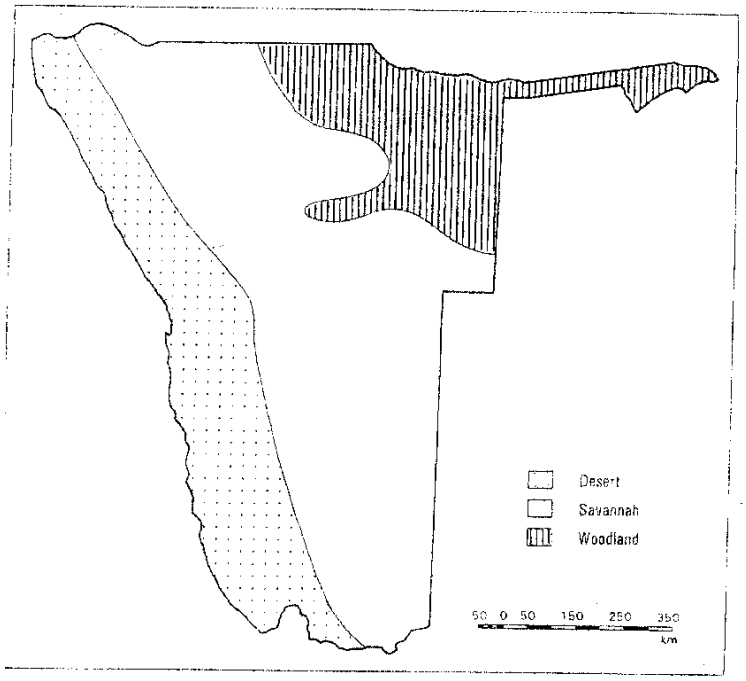
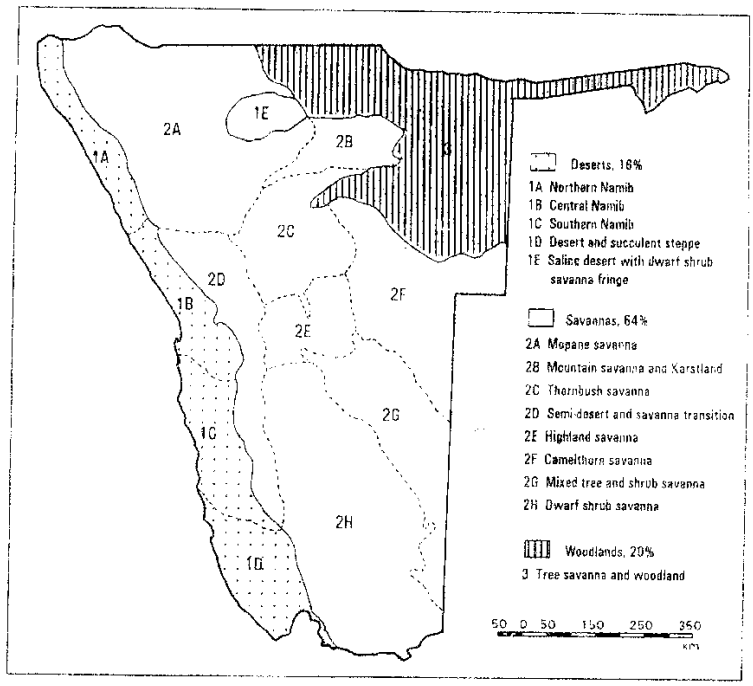


Figure 7: Main vegetation types of Namibia. (after Giess 1971)



Comparing maps of rainfall (Fig. 1) and vegetation biomes (Fig. 6) shows a clear correspondence between precipitation and vegetation. "Water is the limiting resource: In a semi-arid to arid climate, rainfall is the key factor that drives all the important ecological processes upon which we depend" (Brown 1992).

Inter-annual variability in rainfall means that the amount of standing vegetation varies extremely from year to year, and so does the carrying capacity of terrestrial ecosystems. This variability also plays a major role in Namibia's wetland ecosystems, many of which are ephemeral and only occasionally flooded or wet.

The soils, in areas where rainfall is sufficient to support exploitable vegetation, are dominated by Kalahari sands of very low nutrient status, or by highly saline or rocky soils with low production potential.

The Namib Desert is one of the world's oldest, with, consequently, a high level of biological specialisation and endemism.

3.1.4 Inland aquatic ecosystems and biodiversity

Wetlands comprise about 4% of Namibia, a remarkably large proportion of the landscape for such an arid country. Namibia's wetlands are the country's most productive and biologically diverse ecosystems. They include springs and ephemeral wetlands such as those of the Namib Desert, ephemeral rivers, the oshanas of northern central Namibia, and the floodplains of the perennial border rivers.

Although the Namib is one of the driest deserts in the world, a number of different kinds of wetland are found there. Relatively permanent pools, streams and lakelets fed by groundwater springs may, depending on the extent of evaporation, be relatively fresh or may be hypersaline. Ephemeral waters vary from rivers that run for short periods after rain has fallen upstream in the catchment to the pools they leave behind after flow has stopped, and pools formed as a result of rain falling in inward-draining basins.

Namibia's ephemeral rivers act as linear oases (Jacobson, *et al*. 1995). Although water is not found on the surface, the beds of most of these rivers hold significant quantities of water, and deep-rooted trees and other plants can tap directly into the water supply. The presence of this vegetation provides food and shelter for a variety of other organisms, so that longitudinal terrestrial ecosystems develop with complex communities that may even include lions, hyenas, gemsbok and baboons.

All of these wetlands are of intrinsic interest and value from the point of view of biodiversity because they support highly specialised species of invertebrates such as crustaceans and insects (and a few frogs). They also provide sources of drinking water for terrestrial vertebrates such as birds and mammals, which means that the distribution ranges of these animals expand during wetter periods.

Because of the isolated nature of many wetlands in Namibia, and of the island nature of Namibia as a centre of aridity, one might expect many groups of organisms to have endemic representatives. This is certainly true for some groups of organisms such as crustaceans, amphibians, reptiles, birds and plants. The taxonomy of many other groups is too poorly known at present for definitive statements to be made about levels of endemism.

Despite the fact that Namibia is an extremely arid country, and has no perennial rivers except at its borders, the Namibian freshwater fish fauna is fairly rich, with about 103 species having been recorded (van Zyl and Hay 1994). Almost all of these are found in the northern and north-eastern rivers, particularly associated with the rich floodplain wetlands of the Okavango and Zambezi catchments. Although only three species are endemic to the interior of Namibia, a number of others are confined to one or more of its bordering rivers. As is commonly the case with organisms exhibiting restricted distribution, many of these species are classified as "rare" (Skelton 1993).

It is very difficult to provide details of the comparative species richness of different types or areas of wetlands in Namibia, but it is generally agreed that the northern rivers, and particularly their floodplains, are the richest in species, probably by an order of magnitude or more for most taxa (e.g. H. Kolberg, M. Griffin, *pers. comm.*).

3.1.5 Marine and coastal ecosystems

Just off the coast of Namibia, the Benguela Current flows in a north to north-westerly direction, bringing cold Antarctic water into warmer subtropical regions. Seasonal southerly winds induce upwelling at the coast and make available an abundant supply of nutrients in the upper layers. These nutrients together with sunlight promote extensive blooms of phytoplankton, rich resources of zooplankton and an abundance of fish, and support some of the highest concentrations of marine life found anywhere in the world. The mean annual productivity of the Benguela ecosystem is exceeded only by the Humboldt Current off the west coast of South America; both of these systems are 4–6 times as other areas with rich fishing grounds, such as the North Sea or the north-eastern shelf of North America. Productivity of the Benguela ecosystem is characterised by large interannual and interdecadal variability, however. Stocks of fish such as pilchard (sardines) and anchovy frequently exhibit marked fluctuations in abundance associated with these changes. Abundant fish support large populations of seabirds and marine mammals. Bivalves, such as oysters, and crustaceans, such as lobsters and crabs, are also found in these rich waters.

The occurrence of low-oxygen water and sulphurous anoxic sediments in coastal waters of the central Namibian shelf is well documented. Mass mortalities of fish due to low oxygen and sulphurous eruptions frequently take place along this part of the coast. Although much of the sea bed along the coastal and continental shelf regions of Namibia has been broadly categorised according to sediment type (Rogers and Bremner 1991), the assemblages of bottom-dwelling animals, and the ecological interactions, are poorly understood.

3.2 The socio-economic environment

3.2.1 Population and its distribution

The population of Namibia is presently approximately 1.6 million people. It is one of the least densely populated countries in the world with an average of about 1.9 people per square km (Ashley 1996) — about a thirtieth the population density of Turkey or Pakistan, which are of similar area.

The majority of Namibia's population lives in the northern communal areas, which hold approximately 60% of the total population. Population is concentrated especially in the four central regions in the North (former Owamboland, or Owambo[2]), which support about two thirds of the total population of the northern communal areas, or almost half of the total population in Namibia (Ashley 1996; IFAD 1992) (Fig. 8). In the Cuvelai drainage, or oshanas, area, about 28% of the entire Namibian population lives on less than 1% of Namibia's land area. Densities reach 100 people per km^2 in places, although the average population density here is approximately 11 people per km^2 (Fig. 9) (Marsh and Seely 1992). The concentration of population in this area results from the fact that the Cuvelai catchment is rich in alluvial soil and therefore has some of the highest agricultural potential in Namibia.

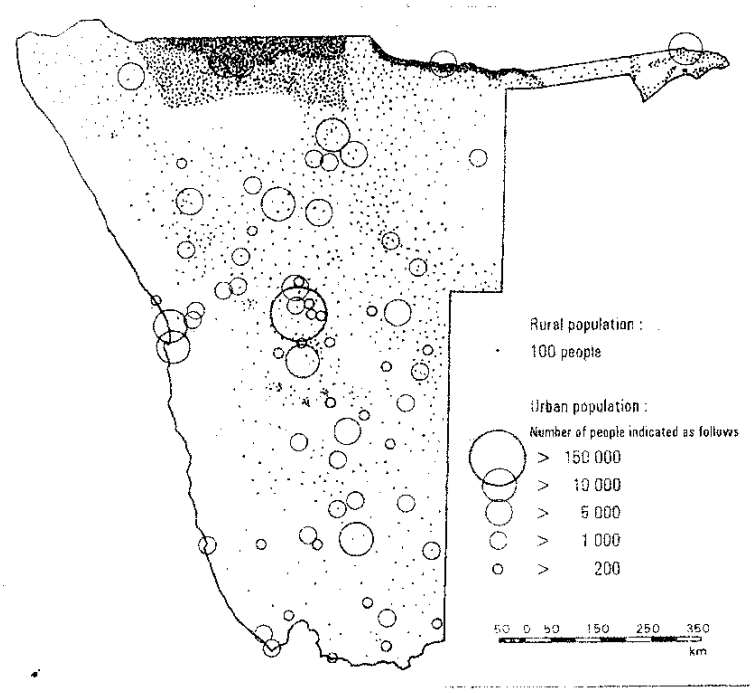


Figure 8: Human population distribution. (Ashley 1996)

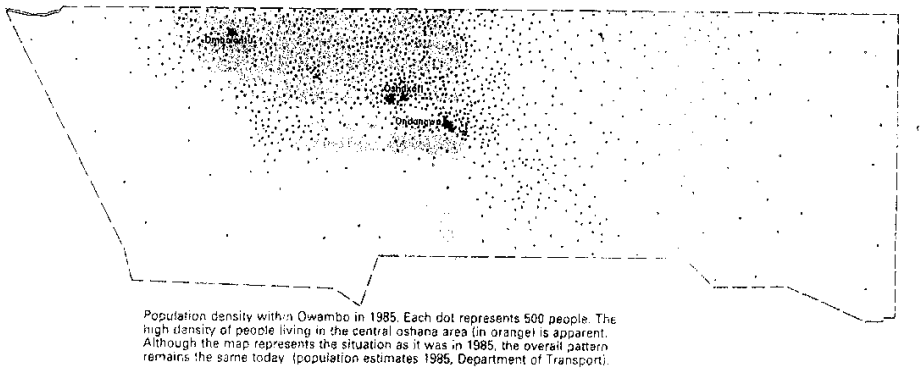


Figure 9: Population density in northern central Namibia (Owambo). (Marsh and Seely 1992)

[2] The term "Owambo" is used throughout this report as a short way of identifying the "four Os" — the four regions of Omusati, Oshana, Ohangwena, and Otjikoto — the former Owamboland, in north central Namibia. In this I follow the lead of Marsh and Seely (1992), whose book *Oshanas: Sustaining People, Environment and Development in Central Owambo, Namibia* came out before the new regional names for the four Os. Many Namibians also use the spelling "Ovambo" (and "Ovamboland").

Most of the population of Namibia is rural, and depends heavily on natural resources for subsistence. The only major urban centre is Windhoek, with a human population of a little over 150 000; fewer than ten other towns have populations in excess of 10 000, and there are only 18 towns of over 5 000 people (Ashley 1996). Urbanisation has been a marked recent trend, however: between 1981 and 1991, the population of Windhoek has increased by 46%, of Rundu by 911% and of Katima Mulilo by about 3 000%.

The population growth rate is estimated to be between 3.1% and 3.3%. At this rate the total population can be expected to double in about 22 years, to approximately 3.5 million by about 2020 AD (Dewdney 1996). The total fertility rate (average number of live births to women of reproductive age) is approximately 5.4 (MHSS 1993). This high fertility and growth rate gives Namibia a very youthful population; 42% of the population is under age 15. This young age structure means that there is strong demographic "momentum" that will keep the population growing in the short term, and severely constrains the impact of any national population programme in the short term.

3.2.2 Economy

Namibia has a mercantile economy growing at about 4% per year and linked strongly to South Africa. It depends heavily on exports, over two thirds of which are minerals, the remainder being livestock and marine derived products. The participation of people in the economy is still typically colonial, with about 5% of the population earning over two-thirds of the income and half the population earning about 5% of the income. Most of this disadvantaged half of the population lives in the far North, the remainder being scattered thinly throughout the commercial farming areas.

Namibia's economy relies almost totally on natural resources, both renewable and non-renewable. The sectors showing the fastest economic growth and long-term potential are those using or relying on renewable natural resources (fisheries and tourism). In addition, two-thirds of Namibians in rural areas are directly dependent on the soil and on living natural resources for their survival and well-being.

According to USAID (1995):

> "Despite the economy's relatively good performance since Independence, there has been no positive trend with respect to the nation's most pressing economic and social issue: the wide disparity in incomes among citizens. Namibia's economy is based on a few natural resource-based sectors, most of which are capital intensive, and have, as yet, made little contribution to increasing employment and reducing income inequality." (USAID 1995)

Namibia's energy resource base can be broadly classified into two groups, commercial and traditional forms of energy. Commercial energy resources comprise petroleum products, electricity and coal, and amount to about 78% of energy consumption, while traditional fuels (wood, charcoal and animal waste) account for 22%. Traditional fuels, however, are the primary energy source for about 60% of Namibians.

3.2.3 Land use and tenure

There are three basic forms of rural land tenure in Namibia. At present, about 45% of Namibia, mostly in the southern and central areas, is privately owned; about 40% is state owned communal tenure land; and the last 15% is proclaimed state land, designated mainly for conservation (national parks, nature reserves, and protected areas) and mining (Fig. 10) (Brown 1992).

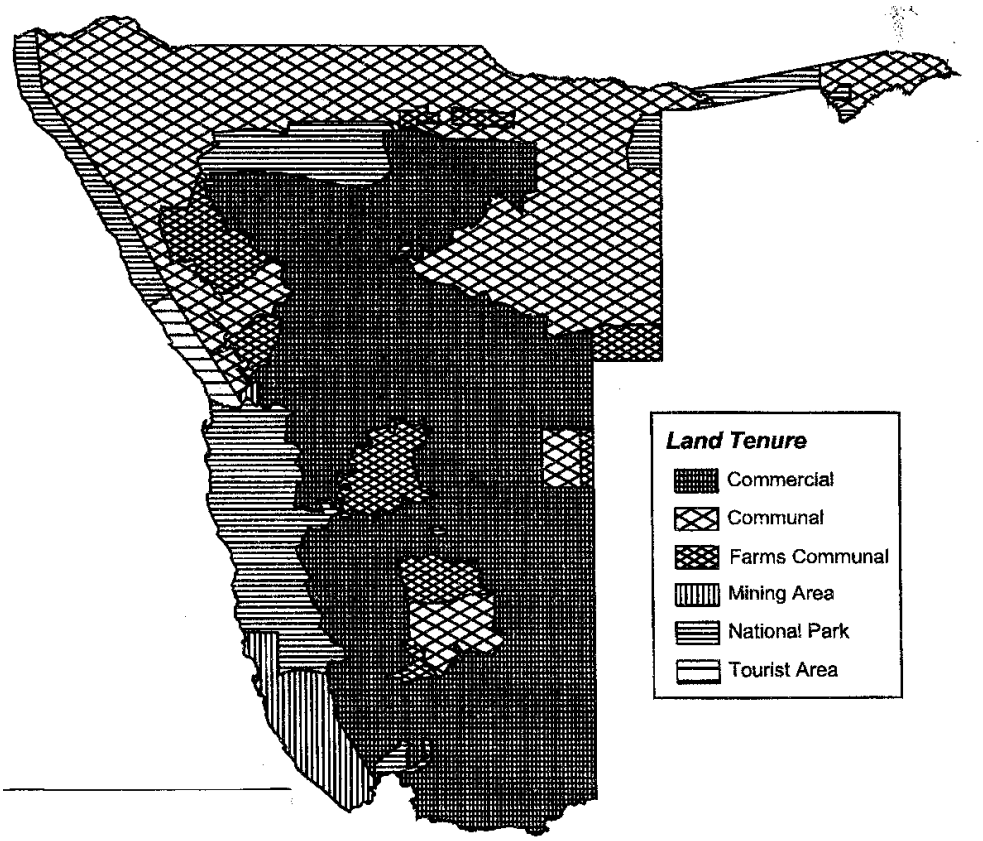


Figure 10: Land tenure in Namibia

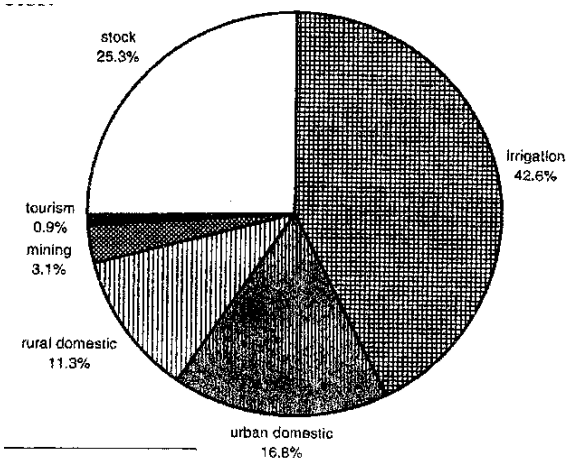
The distribution of the rural population is very skewed, the legacy of the colonial land tenure system in operation before Independence. The privately owned commercial farmland is divided into about 6 300 farms belonging to about 4 200 farmers and occupied only by these farmers, their dependants and employees. These farms mainly occupy the better quality pastoral land of the central savannas and the southern arid shrublands. Over 60% of Namibia's population live as subsistence farmers in communal lands, over 85% of which are located in the North, concentrated in the well watered areas of the former Owambo, Okavango and Caprivi. A large fraction of the proclaimed conservation and diamond mining areas are in very arid and largely unpopulated regions.

3.2.4 Water use

Namibia's precious water is used mainly for irrigation, livestock and domestic purposes (Fig. 11) (Brown 1992). The greatest absolute amount is used for irrigation, followed by livestock watering, and then urban and rural domestic uses. One hectare of irrigated land uses as much

water as about 1 000 cattle or 1 600 rural residents. The major increase in demand in the last 13 years has been from the urban sector.

Figure 11: Water uses and consumption (Brown 1992)



A very important "use" of water, not often accounted for in official breakdowns such as that just presented, however, is the *ecological use* of water to sustain critical ecosystems in Namibia. For example, although only about 4% of the surface area of Namibia consists of wetlands, and most are inundated only seasonally or even less frequently, close to 75% of the population lives in close association with the riverine and floodplain wetlands in the far North of the country. Over one third of Namibia's population lives alongside its northern wetlands in the Cuvelai and Okavango drainage basins. The effect of water abstraction — both surface and groundwater — on the environment in certain areas is a matter of concern.

Access to water is the single, dominant, limiting factor in Namibia, both for urban and rural development and for the region's natural biota. Ground water accounts for roughly 57% of recorded water consumption, over 80% of which is used for rural and agricultural purposes (Brown 1992). Indications are that the groundwater potential is frequently fully committed and even overutilised in some cases.

Most of the water used in Namibia is stored locally, either underground or in surface reservoirs. Although relatively few large reservoirs exist, thousands of small farm dams harness a significant but unquantified percentage of runoff.

There are already supply deficits in some regions of the country, requiring costly inter-regional water transfers, for example, the Eastern National Water Carrier (ENWC). Major water sources in the interior are virtually fully exploited and Namibia's economic development will become increasingly dependent on long-distance water transfers. An increasing percentage of water from the perennial border rivers will have to be used in the future to meet the growing demand for water.

Rural livestock water supply is an area for which it is difficult to provide a clear picture. In the commercial farming areas it is the responsibility of the farmers themselves and in communal areas where a water-point is created for domestic consumption by the Department of Water Affairs, facilities are created for livestock as well as to avoid pollution and degradation of the domestic water-point. The provision of groundwater sources in communal areas — without associated land-use management plans — has resulted in the overexploitation of other natural resources such as grazing. There is at present no limitation on livestock numbers and the livestock population will usually increase in proportion to the provision of water-points thus

exacerbating ecological damage. Because of the great variations in the costs of water supply throughout Namibia, the ability of communities to pay for the actual costs of services will be assessed and if subsidies are needed, they may be applied. Cost recovery in the water sector involves two issues: reducing subsides to the relatively well off and increasing incentives to use water carefully. In this context the planning work of the Department of Water Affairs now entails studies related to demand management, water tariff structures and affordability of water for all large-scale development programmes.

The Directorate of Rural Water Supply encourages and facilitates the formation of Central Water Committees for Regions, Local Water Committees and Water Point Committees, to address problems at various scales. Community participation is emphasised in all aspects of water provision and maintenance: selection of sites, types of facilities, appropriate technology, and level of service to be provided. Communities will be responsible for the daily operation of water-points, including small repairs and maintenance. Government support will be provided on the basis of an agreement between the community and the authorities setting out the respective responsibilities and commitments. The Water Point Committee members will also advise on appropriate tariffs for water.

Water conservation is one of the water sector objectives for NDP#1.

3.2.5 Agriculture and rangelands

Because of the generally arid and variable climate, Namibia has a very limited potential for reliable crop production, and consequently extensive livestock production is thus the major agricultural activity. Agriculture currently contributes more than 8% to overall economic activity. The sector is the main source of employment and livelihoods for the population, with an about 70% dependent to a greater or lesser extent upon it. In light of the modest growth projections for other sectors of the economy, the bulk of the population will therefore continue to rely upon the agricultural sector for their livelihoods.

The sector is also an important source of foreign exchange — providing more than 15% of visible export earnings during recent years — as well as being an important source of raw materials for local industries. The principal export commodities are meat and meat products, as well as live cattle and small stock, the bulk of which are destined for the South African market. These four commodities made up 91% of total agricultural exports in 1992.

Given the high degree of inequality and partial neglect which were features of the agricultural sector before Independence, the strategy which GRN has pursued with regards to the sector since 1990 has been to redirect development efforts towards farmers in the impoverished and underdeveloped communal areas. Agricultural production is inadequate to meet basic food needs even in the best production seasons among many northern households, and food insecurity is a serious problem among much of the rural, and even urban, population — in particular for members of households headed by women.

Namibia has developed a National Agricultural Policy (1995). Among other things, the policy emphasises the fact that agriculture is to remain one of the priority economic sectors for the foreseeable future. The overall objective of the agricultural sector is to bring about the continued growth in agricultural incomes, across the broadest possible socio-economic base, in a sustainable manner.

Traditionally, many of Namibia's indigenous peoples practised nomadic pastoralism, moving animals long distances if necessary to find water and grass where it was available (Fig. 12). Permanent settlements could be found only in the oshana region of northern Owambo, along the Okavango and Zambezi rivers, and near Windhoek's springs (Brown 1993). Present-day populations are larger and more settled, and tend neither to move, nor to suit the sizes of their herds to available vegetation. As a result, virtually all human and livestock populations, except for those living on the well-watered northern border, are now dependent on the "engineered" provision of water for all purposes, especially for irrigating crops and watering stock animals.

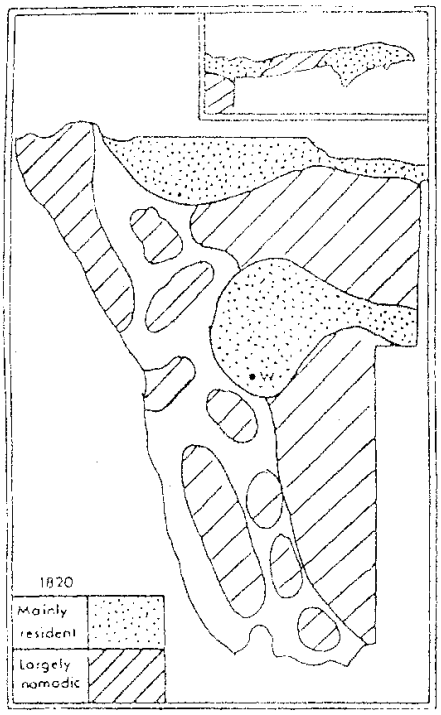


Figure 12: Traditional livelihoods and pre-colonial land use (Ashley 1994, from Brown 1993)

Nomadic pastoralism was widely practised in catchments of the western ephemeral rivers for at least the past four thousand years (Jacobson *et al.* 1995) but started to disappear with the arrival of Namibia's first colonisers in the nineteenth century. Movements of Himba people within the Khumib and Hoarusib catchments in Kunene Region (former Kaokoland), have been cited as an excellent example of an appropriate rotational grazing system in an arid rangeland. The Himba are still largely nomadic pastoralists (Paskin 1995). Their nomadic movement actually makes for an excellent rotational grazing system, with the result that range condition in the "Himba areas" is somewhat better than in the other areas of Kunene, despite the usually lower rainfall in these areas, and soil erosion is much less obvious (Paskin 1995). Transhumance — the movement of animals into wetter areas — is very common in many areas, mostly at the end of the dry season. Transhumance has obvious economic advantages for the livestock owners; since they are able to exploit better grazing areas during a period of fodder constraint, they can keep larger numbers of livestock.

In most of the communal areas, livestock ownership is very skewed, with a few large herd owners, and many with few animals. The majority of households in many areas — up to 90% in some — do not own enough animals to earn a livelihood from livestock production alone (CATAD 1993). The concentration of livestock in the hands of a few large herd owners, or "cattle barons" — an increasing trend — may present problems for the long-term sustainability of such a system. In several other parts of Africa the same process has occurred and has led to

degradation of the rangelands and an ultimate decline in carrying capacity. This has happened because the herding strategies of large herd owners differs from the traditional, flexible, transhumance strategies. There is a stronger tendency for large herds to become sedentary, and many of these herd owners do not herd their cattle themselves, but employ herders. Hired herders have short-term incentives to maximise the number of cattle in the herd, rather than to manage the rangeland for long-term sustainability, because they are generally paid on the basis of the size of the herd.

Most of the land in communal areas is unfenced, and access to grazing is free for the residents within their community borders. Fencing is an issue of great concern throughout the communal areas. Many illegal fences have recently been erected, and there are a lot of conflicts between "fencers" and "non-fencers". The creation of fenced private ranches in communal areas has been under discussion as a possible solution to the "open access" and illegal fencing conflicts that occur. In some communal areas, however, if the whole area is split into private fenced farms, large numbers of households would lose access to any land at all — more than 66% in the eastern communal areas, for example (EEAN 1992) — creating major food security problems. The costs of erecting such fences will also be very high (GTZ 1991).

The species of livestock kept varies from region to region depending on the climate and culture of the people. Small stock such as goats and sheep are the major animal species kept in the most arid regions since they can cope with fodder shortages, and after a drought the herd recovery rate is rapid because of the high reproduction potential of the animals. In the North-west, households keep a combination of cattle, donkeys, goats, and sheep. It is estimated that there are 2.09 million cattle, 2.56 million sheep and 1.60 million goats in the country's herds (BDDSA 1996).

In most communal areas, livestock are considered an investment; and since animals can be turned into cash in cases of emergency, they are important for household security, a kind of insurance fund also. In Owambo and Okavango, the offtake rate of cattle is well below that which is likely sustainable (Tapscott 1990). Among some groups such as the Herero, cattle have very important socio-cultural, as well as economic, values. Efforts to reduce herd sizes must take into consideration the fact that cattle represent wealth and are in actual fact a status symbol. To find a substitute for this function would require a change of values in a society which is still centred around cattle (CATAD 1993).

Traditional pastoralists in arid and semi-arid areas typically follow the strategy of maximising herd sizes to minimise risk resulting from frequent droughts. The chances of being left with a viable herd after a drought rises with the number of animals owned. In many communal areas, many households now have herds that are too small to insure their ability to restock after a drought. For them livestock production is a high risk activity. This also means that most of these people do not have the possibility of further reducing livestock numbers, and explains why destocking is so difficult in the communal areas in general. Destocking and restocking are not accepted as part of good management by most communal farmers. Many farmers prefer to maintain their livestock herds at all costs, rather than convert them to cash income during dry years (Jacobson *et al.* 1995).

The main factor obstructing pastoralists on communal lands in managing their rangelands properly and sustainably is the current lack of secure and exclusive land tenure. The communal system works well where there is adequate land and a firm adherence to nomadism, but where a sedentary lifestyle is followed there must be strict management of the rangelands. Currently, when one stock owner takes his animals away in an effort to spare some grazing for the dry years, another one will simply move in and destroy everything (Paskin 1995).

The Kunene region (former Kaokoland), the northern central regions of Omusati, Oshana, Oshikoto and Ohangwena (formerly Owamboland or Owambo), Okavango and Caprivi are collectively known as the Northern Communal Areas (NCAs). Almost the entire area suitable for rainfed agriculture in Namibia lies within the NCAs, which also contain much of the highest potential grazing lands. The alluvial plains are the most favoured areas for settlement and crop growing, hence they are densely populated and almost fully utilised. Away from the perennial rivers, water sources are widely dispersed and serious degradation is resulting around the larger permanent water-points. Owambo has no perennial rivers and inadequate functional boreholes, and in the dry season faces the greatest water constraints of the four regions. During the wet season the ephemerally flooded pans and oshanas provide adequate water in the central and southern part. The existing pipelines and canals also contribute tremendously towards providing water for human and livestock consumption, although it might cause serious threats to the environment, especially the rangelands. Eastern Caprivi is almost entirely bordered by rivers and has a generally high water-table, hence is the region best served with water resources (IFAD 1992).

In Owambo, the local land-use system is an agrosilvopastoral one where crops, trees and livestock are used. The crop component consists mainly of omahangu with sorghum, beans, pumpkin and melons. The livestock component consists of cattle, goats, sheep and donkeys, and the tree component consists of diverse mix of local, multipurpose species, including mopane, palms, figs, and baobabs. The majority of the population are transhumant pastoralists. The traditional subsistence strategy of these pastoralists is based around two principal activities: livestock farming supported by migratory seasonal grazing and rain fed agriculture. Livestock production under this system is closely integrated with crop production. Livestock numbers in Owambo increased dramatically over the past 45–50 years, according to Marsh and Seely (1992). A similar kind of land use occurs in the Okavango and Caprivi regions.

The continuation of the traditional, transhumant grazing practised by pastoralists in the northern central regions, and the oshanas area in particular, is a key factor in preventing massive land degradation and ultimately desertification of this area. This traditional movement of stock allowed natural regeneration of grass. Seasonal movement was not only dictated by the availability of fodder but, more importantly, by the seasonal availability of water and the tenure arrangements regulating access to water. Specific grazing areas surrounding the oshanas area, such as the Oshimpolo veld (now in Angola), the Ombuza Flats, the Andoni Flats and the Omaheke, were all used on a regular basis (Fig. 13) (Marsh and Seely 1992).

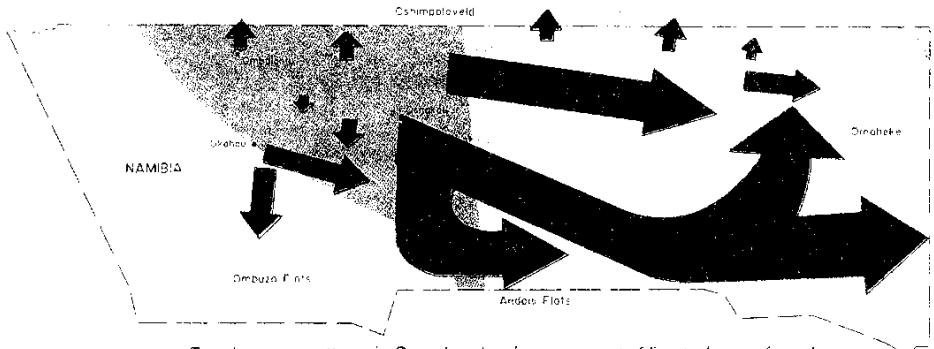


Figure 13: Traditional pastoral movements in Owambo (Marsh and Seely 1992)

The traditional system has recently been modified by several factors, especially the introduction of a reliable supply of water without clear management arrangements, and large-scale fencing of former grazing reserves. Before the construction of the canals and pipelines, lack of water was the main factor necessitating the seasonal movement of cattle. Now the presence of water year round means that cattle can be kept in the inhabited zone longer. This benefits peoples' diets (more milk is available), but it increases the pressures on the grazing, especially along the banks of the canal and at watering points. Exclusion from Angolan pastures has also contributed to the decrease in transhumance and the degradation of the central pastures. It has also led to tensions on the borders with the Kaokoveld and Etosha National Park. In the absence of new management strategies, these factors limit cattle to an ever diminishing area resulting in a massive increase of grazing pressure in the remaining areas (Marsh and Seely 1992).

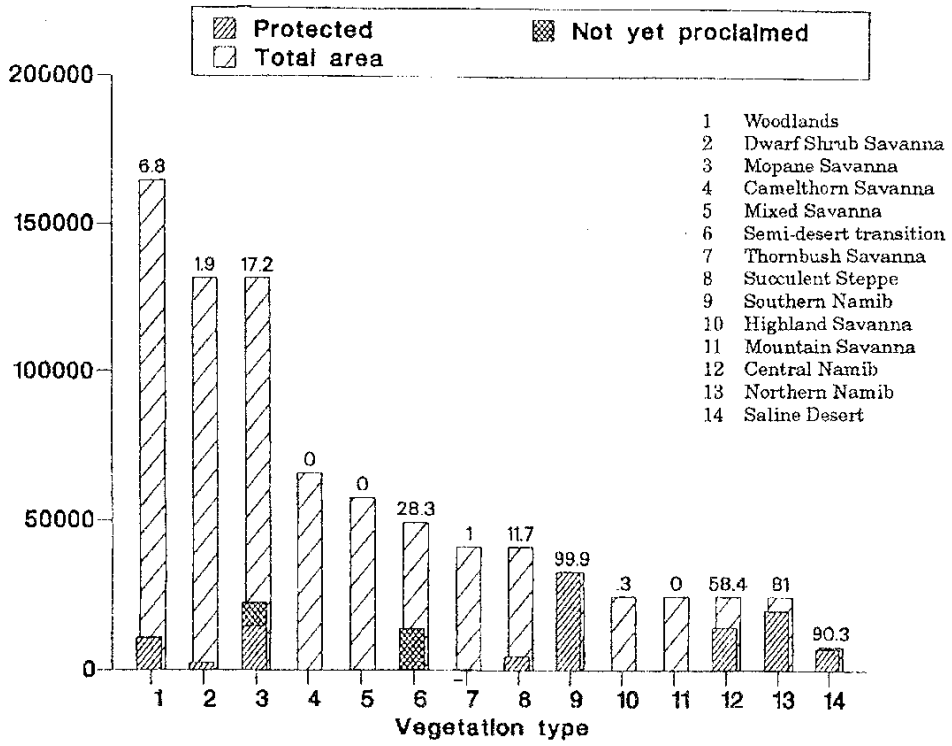
In Okavango, more than 95% of the human population, and much of the livestock, is concentrated in a narrow band along the Okavango river, which is up to ten km wide and constitutes only 5% of the total area of the region. Riverine community land tends to be overgrazed whereas large areas away from the rivers which offer potential grazing have very few cattle. Although total livestock numbers in the Okavango are very low compared to potential carrying capacity, the concentration of the livestock near the Okavango River causes extreme overgrazing. Livestock numbers are increasing — cattle at around four percent per year, for example (GTZ 1991). Headmen supposedly have the authority to control the access to grazing, but in reality everyone moves anywhere to find grazing from the wet season to the dry season. The floodplain of the Okavango River supports crops such as millet or maize, as well as fruit trees such as custard apple, marula and monkey apple.

In eastern Caprivi, crops, not livestock, are the predominant agricultural activity. The role of cattle in the economy, as in the rest of the northern communal areas, is very important however. Cattle are owned individually but grazing land is communal. In general around 70% of the households own cattle, although the variation in numbers can be large (NOLIDEP 1996). A small number of households own a relatively large number of cattle while most households have relatively small herds. The wetlands of the Caprivi region change extensively with the seasons. During the wet season some areas may be flooded; during dry periods these areas may be used for crop production and grazing of livestock.

3.2.6 Biodiversity, forestry and wildlife conservation

Namibia has 21 proclaimed protected areas totalling over 13% of the country. Three large desert parks in the Namib Desert along the coast, together with Etosha National Park, make up over 85% of the total area protected. Another 2% of Namibia's land area is protected by diamond mining exclusion laws in the Namib Desert north of Oranjemund. A large portion of the Namib Desert falls within protected areas, and it may be the most comprehensively protected desert in the world. A further 2–4% of Namibia will shortly fall under "conservancy" legislation.

Namibia's protected area network was never planned explicitly to represent or conserve Namibia's biodiversity (Brown 1996). As with parks in most of Africa, the emphasis was on big game and scenery. Many areas richest in biodiversity have little or no representation in the protected area system. The Namib Desert parks, plus Etosha National Park, make up the vast majority of protected natural areas, leaving less than 1% of the non-desert areas preserved. Certainly the three large vegetation types — Dwarf Shrub Savanna, Camelthorn Savanna (Central Kalahari) and Mixed Tree and Shrub Savanna (southern Kalahari), totalling about 30% of the country, are not represented in protected areas at all (Fig. 14) (Brown 1992).



Proportion of each vegetation type (numbered 1-14) proclaimed as part of the protected area network. The number above each bar is the percentage of each vegetation type protected.

Figure 14: Proportions of vegetation types included in protected areas (Brown 1992)

As far as wetlands are concerned, Mahango Game Reserve and West Caprivi Game Park protect a portion of the Okavango River. Virtually no parts of the Kunene River, nor the Cuvelai drainage and the oshanas, are included in protected areas. Although specific areas elsewhere may be conservation-worthy, there is no doubt that these northern wetlands are the key localities in Namibia with regard to conservation of species diversity and valuable biodiversity for human use. These areas are all on heavily used communal land and so what management there is, is communal. Except in the Caprivi, no conserved land is available to preserve the biodiversity of inland wetland communities (some coastal wetlands are protected). Given the great number of people depending on this land, it is unlikely that it will be given over to protected areas. If biodiversity conservation is to occur here, it must occur outside of protected areas. About 90% of the country's game populations occur outside the protected area system, already, on private commercial farms or communal lands, so it is possible to conceive of conservation taking place without protected areas.

The protection and management of Namibia's forests, woodlands and wooded savannas is now guided by the Cabinet-approved 1992 National Forestry Policy. This policy has some potentially controversial objectives, including: "All uninhabited land covered with forests or vegetation should be administered by the government through the Directorate of Forestry", and "The national goal should be to have a minimum of one tenth of the total land area of the country under forest or tree cover, and administered as state forest".

3.2.7 Fisheries and marine resources

The Benguela Current ecosystem off the Namibian coast has one of the highest primary production rates in the world — in stark contrast to the country's mostly arid terrestrial ecosystems, which have some of the lowest production rates in the world. This means that marine resources are one of Namibia's most important renewable natural resources.

In 1990, after Namibian independence, a 200 mile exclusive economic zone (EEZ) was declared within which fishing by foreign trawlers was prohibited except under license to Namibian companies. A new Ministry of Fisheries and Marine Resources was created in 1991 to take over resource management and regulatory responsibilities. The initial work by the Ministry was the formulation of the government White Paper on fisheries policy, "Towards Responsible Development of the Fisheries Sector", which outlined policies to rebuild the depleted living marine resources, encourage the efficient exploitation of these resources and ensure that the maximum benefits from these resources accrue to Namibians (Amutenya 1995). The government currently maintains strict limits on catches so that fish stocks can recover fully from the decades of overexploitation. It is also pursing a policy of increasing onshore processing capacity and enlarging the Namibian fishing fleet.

The main commercial species of marine fish that are exploited off the Namibian coast are hake, monkfish, kingklip, pilchard or sardine, anchovy, round herring, horse mackerel, and albacore, big-eye and yellow-fin tuna, and the deep sea orange roughy. The rock lobster is a commercially important species from shallow nearshore waters near Lüderitz. The deep sea red crab is relatively common, occurring mainly in northern Namibian waters, where it forms the basis of a small but valuable trap fishery.

The main bottom-living fish that are commercially exploited are the Cape hake, the deep-water hake and monkfish. Kingklip is a valuable by-catch of the hake fishery. Hake and monkfish form the main component of the Namibian white fish trawling industry and are the most valuable fishery resource being used directly for human consumption. Hake stocks have been slowly recovering since 1990 with an estimated 120 000 tonnes caught by Namibian demersal trawlers in 1993 compared with only about 20 000 tonnes taken in 1986.

The deep water adult Cape horse mackerel stocks forms the basis of a large mid water trawling industry located mainly in the rich fishing grounds off northern Namibia. This horse mackerel fishery has been particularly resilient over the last twenty years with annual catches of between 200 000 and 500 000 tonnes being taken by foreign fleets.

The pre-Independence period experienced weak performance of the fisheries sector, characterised by overfishing, bad management and negative environmental factors. After Independence, the new government was faced with the task of redeveloping the fisheries sector by implementing legislation that would promote the conservation of the marine ecology and the orderly exploitation, conservation, protection and promotion of marine resources.

Several years after having been established, the new fisheries policy has begun to bear fruit. Protection and conservation measures have enabled depleted commercial species to recover. To rebuild the overexploited resource base, GRN has since 1990 set Total Allowable Catches (TACs) at levels conservative enough to promote recovery of depleted stocks.

Another important action taken was the gradual strengthening of fisheries research and surveillance capacities. No rational setting of the TACs can be done without fisheries surveys.

Equally, no proper control and protection of marine resources can be achieved without the existence of a well established surveillance service. Besides fishing mortality, research scientists have also to estimate natural mortality in order to calculate TACs. Natural mortalities in fish populations are highly variable depending on changes in environmental conditions and subsequent biological interactions within the ecosystem. However, such uncertainties surrounding natural mortality estimates can make it difficult to predict the accuracy of the TAC levels set.

GRN is encouraging the establishment of onshore processing through the creation of an attractive investment climate. This has had, however, a major negative influence on the water quality at the coast.

Recent perturbations in the marine environment off Namibia in 1994 and 1995 have had a major impact on some fish stocks particularly pilchards and have led to TAC declines. As a result, this has created pressure from the fishing industry to maintain catch levels to protect investment.

The **Cape fur seal** occurs in large numbers along the coast of Namibia with about 75% of the African population present in Namibian territorial waters. Since the 18th century, the species has been heavily exploited for their pelts and which subsequently resulted in wide-scale destruction of the populations. At the beginning of this century, the number of seals were very small but the populations have recovered in recent years to a level where controlled exploitation at a sustainable level is allowed. The seal colony at Cape Cross is an important tourist attraction with over 10 000 persons visiting the region annually. There is also considerable potential for the development of ecotourism at the seal colonies at Atlas Bay and Wolf Bay, south of Lüderitz. The natural beauty of the coastal regions, combined with seals and birds, have enabled a significant coastal tourism industry to develop in certain areas.

The **mining of diamonds** from coastal gravel deposits along the southern part of Namibia is developing into a major industry attracting international attention and investment. Already, marine diamonds make a sizeable contribution to the national GDP and a very valuable export commodity. The trend in current activities and future plans by mining companies suggest an intensification of marine diamond mining especially in the use of a greater number of large surface vessels with on-site processing plants. The nearshore sediments also hold rich deposits of diamonds, diatomite and phosphorite as well as natural gas and possibly oil reserves. In the long run, fisheries will remain one of the most important sectors of the Namibian economy. However, in the short term, marine mining (and possibly oil exploitation) is a highly relevant contributor to much needed government revenue and employment opportunities. As a result, increasing pressure is exerted on the very habitat that shelters Namibia's most significant renewable resource. If not managed well, marine mining not only poses a real danger to the marine ecology but it also presents an interesting Constitutional problem, namely the dilemma between a short-term gain through the exploitation of a non-renewable *versus* the long-term loss of a renewable resource. In order to address the issue, the MFMR, in co-operation with other interested partners, is planning to host an international conference on the impact of marine mining on the marine ecology. Preparation for the conference, to be held in Swakopmund in March 1998, will commence as early as June or July, 1996.

Freshwater fisheries are very important to the food economy of northern Namibia. The human populations of the Okavango and Zambezi drainages rely very heavily on fish as a major source of protein in their daily diets. Of the two systems, the Okavango is under greater pressure because it is smaller and has a relatively larger population. In eastern Caprivi, fishing is not only a source of income, but also an important source of protein: most local people consume about 400g of fish

per week. The only freshwater fish market in Namibia is in Katima Mulilo, where some fish are kept on ice for tourist consumption.

Oshanas temporarily fill with water only after sufficient rain has fallen in their headwaters in Angola, and so most of the time there is no water, and therefore no fish, in the dry drainage lines. On the flood, though, fish move southwards from their normal habitats in the perennial rivers of Angola. Enormous numbers may move southwards during reasonably large floods (which may, however, occur on average only once in every four to five years). Thus fishing is highly episodic and the population cannot rely on fish as a regular source of food. Once the fish reach the oshanas, they are essentially "genetically dead", in that neither they nor their offspring will survive the forthcoming drought. So although catches can be very high, even massive exploitation will have no effect on the parent population. Thus there is no need to conserve these fish in the oshanas; instead, it is essential to conserve the parent stocks in Angola (Marsh and Seely 1992). A more significant factor locally is that, when floodwaters are flowing, intensive fishing in the upper parts of the oshanas may prevent fish from reaching fishermen further downstream. Traditionally, local headmen had jurisdiction over fishing rights (Tvedten *et al.* 1994). This traditional type of management seems to have died out, although it was recorded as recently as 1976 (van der Waal 1991). Most of the catch is dried and sold, or stored for the long period between floods. An informal trade in dried fish is carried on with Angola and with the eastern Caprivi.

The utilisation of freshwater fish resources in the northern border regions is not regulated as there is no legislation on freshwater fish, while relevant legislation administered by the MET is not applicable in the communal areas. Currently, MFMR is looking into the protection and management of freshwater fish. Studies and research were undertaken in this regard and the results were used to draft a 1995 White Paper, "The Responsible Management of the Inland Fisheries of Namibia". According to this draft White Paper (MFMR 1995), approximately 2 800 tonnes of freshwater fish are caught in Namibia each year. It is widely considered that the maximal sustainable yield has already been reached, or even surpassed, in most regions (Hay 1995).

4. Threats to the Namibian environment

4.1 Introduction and definitions

In this report, the term "environmental threat" or "environmental problem" will be used to refer to any unsustainable environmental trend caused mainly by human activities. Used in this sense, the aridity or variability of the Namibian environment, *per se*, is not seen as an environmental threat or problem. Rather, it is a natural, given condition which humans must accept, and to which they must adapt their technologies and practices if they are to live sustainably here. Only if they fail to do so, and begin to cause desertification, land degradation, etc., would an environmental threat occur. Thus, environmental threats come from human actions, not from the environment.

This definition of an environmental threat is similar to view represented by the definition of desertification now being used internationally, and by Namibia's NAPCOD programme: "Desertification is land degradation resulting mainly from negative human impacts combined with difficult climatic and environmental conditions" (Dewdney 1996). Namibia's environment and climate are certainly "difficult" for humans to live sustainably in, but they are not a threat or a problem. They are a natural condition, a fact of life.

4.2 Depletion and degradation of water and aquatic resources

In keeping with the colonial attitude to water supply, for many years the Department of Water Affairs made every effort to provide water on demand, rather than to manage or attempt to limit demand. As a result of attempts to supply all the water required, water-tables have sunk, wells have dried up or become salty, rivers have silted up and fossil water has been, and continues to be, mined.

Namibia's rapid population growth means that the demand for water will likely double by 2020 AD. Poverty reduction, increasing urbanisation and industrial development could all result in a relatively greater increase in the demand for water than the growth in demand resulting from population growth alone.

The assured annual yield of water for the entire country is about 500 million m^3 per year. Water consumption increased by 57% between 1980 and 1993, to approximately 240 million m^3 per year, and is expected to exceed 300 million m^3 per year in 2005 AD. It may reach 400 million m^3 per year by then if irrigation demand is allowed to grow at the same rate as other demands. In other words, by 2005 AD, or soon thereafter, the entire exploitable assured yield for the whole country will be used. If current trends continue, by 2015 AD at the latest, Namibia will no longer be self-sufficient in water (Ashley 1995) — this assumes that water will be redistributed nationwide to where the population and demand is.

Mining of water is dropping the water-table in the lower aquifers of the ephemeral river systems of western Namibia. For example, the water-table at the mouth of the Kuiseb River had dropped from about one metre below the surface sands in 1974 to about eight m below the surface in 1988 (du Toit and Sguazzin 1995). This presents a major threat to the biological communities, including humans, that rely on water in ephemeral river aquifers. If the roots of trees can no longer reach the water-table, the trees will die — as, ultimately, will the rest of the associated biological communities. Much of the subsurface water in the river beds is replaced seasonally

from upstream. When these rivers are dammed in their better-watered upper reaches, this water is no longer available downstream. For example, the Kuiseb is dammed by the Friedenau Dam in its headwaters not far from Windhoek but it is also dammed by about 400 smaller farm dams on its tributaries. Together, these reduce the amount of water flowing down the river, either on the surface or under the ground. When dams prevent replenishment from upstream, and the aquifers in the lower reaches are also being mined, the situation is clearly not sustainable.

Okavango River floodwaters, which are important for replenishing nutrients and silts, as well as supporting large populations of fish, would normally remain on the floodplain for between one and five months of the year. In recent years, whether because of climatic conditions or environmental degradation is not clear, floods have tended to last for no more than one or two months of the year.

Since both the Kunene and the Okavango Rivers rise in Angola, decisions made in Angola can influence the availability of water from these rivers to Namibia in the future. In order to meet increased demand in the North, DWA plans to double the amount of water presently piped from Calueque Dam on the Kunene River in Angola over next ten years; this additional offtake is still within the agreement between the two countries.

Because all wetland ecosystems in Namibia are under pressure of one sort or another because of the large and increasing demand for water in an extremely arid country, the key to conserving inland aquatic ecosystems and resources lies in managing water resources sustainably. Because water is *the* limiting resource in Namibia, major conflicts have frequently arisen, and will no doubt continue to arise, between the "consumptive" uses of water — irrigation, livestock, rural and urban domestic uses, mines — and the maintenance of aquatic ecosystems, either as providers of resources such as fish and wetland plants for rural populations, or for biodiversity conservation.

Hay (1995) is of the opinion that the fish catch from the Okavango along the Namibian border comes close to, or may even exceed, the maximal sustainable yield for the system, since stocks seem to be declining, as are the sizes of individual fish caught, and the proportion of long-lived species in the total catch. It is generally agreed that tribal fishing customs are breaking down, especially among the young. The effectiveness of traditional management is being eroded by pressure on natural resources, by increasing socio-economic stratification and commercialisation, and by the shift of political authority from traditional leaders to the central government. Changes in ecosystems, including destruction of fish habitats, and reduced and inadequate floods, are altering the fishery. There is a tendency for the individual fish that are caught to be significantly smaller than was the case a few years ago, and also for a greater proportion of individuals to belong to species that produce large numbers of small, short-lived individuals. Fishing gear has changed from traditional gear (e.g., baskets, traps) to nets and, more recently, from relatively large-meshed to very fine gill nets. In addition, intensive grazing pressure, use of natural resources such as reeds and clay, pollution by pesticides, and physical damage to rivers and floodplains, are all having an effect on the habitats of fish. Many residents agree that stocks appear to be declining and that careful management is needed. Hay (1995) makes a number of recommendations about steps needed to sustainably manage fishing in the Okavango.

One of greatest threats to the continued health of the wetlands in Caprivi is overgrazing. About 60% of the population is concentrated on about 30% of the land — mainly in the eastern floodplain. The carrying capacity for cattle is approximately 30 000–40 000 but approximately 96 000 head of cattle actually graze there (Schlettwein *et al.* 1991). Overfishing is as much a problem in Caprivi as in the rest of the northern border areas.

Traditional management of fishing rights in Caprivi involved controlling access to fishing areas. Although traditional methods are still practised in some areas, they are breaking down. Both traditional fishermen and traditional leaders are losing their authority in some areas, such as near Katima Mulilo, where population growth and "progress" are most rapid. In the eastern floodplain proper, management systems are still mostly traditional, actively implemented and supported by local fishermen. Overfishing in Caprivi has resulted from a combination of environmental changes and increased fishing pressure from modern gear. Political and other disputes with Zambia and Botswana exacerbate the problem.

4.3 Desertification and land degradation

The major threat to Namibia's rangeland resources both in commercial and communal areas can best be summarised by the phenomenon called desertification. Desertification is land degradation resulting from unsustainable human activities interacting with a dry and highly variable climate. The rainfall, and therefore the availability of fodder, in Namibia is highly variable in terms of time and space. This dictated in the past a highly flexible strategy of using the rangelands. Pastoralists used to be much more flexible in moving animals to areas where sufficient rain has fallen and where enough fodder is available.

In the southern communal areas, in general, the rangeland condition improves with distance from the homestead and water-point. This pattern is the consequence of uncontrolled grazing of livestock. Most farmers are conscious of, and concerned about, the deterioration of the rangeland condition (CATAD 1993) over the last years, but relate these changes mainly to the drought and not to overstocking and poor rangeland management. In the eastern communal areas also, rangeland degradation is correlated with proximity to villages or water-points (EEAN 1992). Overgrazing and degradation of rangeland around water-points has forced a progressive movement of the farming population into unutilised areas further to the East and North. This movement is constrained by the lack of watering points in the respective areas.

Traditional leadership was responsible for allocation of land and land management in the past. Currently the role of traditional leaders regarding this function is not so clear any more, and the newly established regional authorities still lack the capacity and means to perform such functions.

Older people might still have a lot of know-how and experience on nomadic movements of animals and traditional practises of livestock production. It is, however, doubtful whether the transfer of this know-how to the younger generations will happen. Even then this indigenous knowledge might not be fully adequate any longer to enhance sustainable rangeland management and improved livestock production.

Within the different land tenure systems, the ultimate determinant of land occupancy has always been the availability of water — usually groundwater. Wherever water has been most abundant, there has been the most intense land use, for example in the area of the Grootfontein karstveld aquifer, and in the Cuvelai drainage in the former Owambo. These have become centres of the worst bush encroachment and worst deforestation respectively (Bester 1996; Marsh and Seely 1992). A major impact of the provision of pumped water supplies is that it has caused livestock to become sedentary where even in recent times there was a tradition of transhumance. This loss of flexibility increases the likelihood of biodiversity loss, especially in respect of other competing herbivores.

In communal areas, sedentarisation (settling down of formerly nomadic farmers) is an on-going process that can not be reversed. Transhumance and semi-nomadism will decrease in future, urbanisation in the communal areas will continue and migration to urban workplaces will increase. Sedentarisation is a reality in most of the communal areas of the country, and there is no way for the farmers to return to the more nomadic lifestyles of the past. Fences (International, commercial farms, game parks, illegal fencing, etc.) prevent farmers from moving with their animals freely in search of fodder.

In overgrazed areas with a loss of ground cover, water runs off more quickly after a rain. Research done in South Africa indicates that with a slope of 5%, the runoff on veld with a good cover is only 5%, but on veld with a similar slope but totally bare, the runoff can be as high as 30% (de Klerk 1988).

Bush encroachment is an ecological change that has drastically reduced livestock production in the northern central regions of Namibia (Bester 1996). In the communal areas bush thickening is less serious than in the commercial farming areas. This is probably due to differences in climate and in the frequency of fire. Because woody vegetation reduces grass production, bush encroachment can, depending on the level of encroachment, decrease the carrying capacity of an area for grazing livestock like cattle. Bush encroachment may actually increase the carrying capacity for game and browsing livestock, however.

4.4 Loss of biodiversity and biotic resources

It should first be stated that, as in other environmental sectors, there are some positive trends in biodiversity conservation in Namibia. In 1967, legislation conferred on private farmers the ownership rights to certain game species. This gave rise to a thriving trophy hunting and live-game industry which, in more recent years, has expanded vigorously into wildlife tourism. These developments have resulted in commercial land use converting from livestock production to multi-species production (livestock and wildlife), and to wildlife-based tourism. Seventy percent of the country's big game populations are estimated to occur on these privately owned farmlands. Apart from the increase and spread of large mammal species that have direct financial value, biodiversity is enhanced by halting the negative impacts of livestock raising — overgrazing and bush encroachment, the two main land degradation processes that result from poor livestock management.

The major threat to biodiversity in Namibia is desertification. Desertification is manifested by localised reduction of plant biomass, plant productivity, and/or plant diversity due to human activities. Overgrazing by stock, deforestation and overexploitation of water resources all contribute.

Devegetation and deforestation is another manifestation of the loss of biodiversity and biotic resources. Deforestation of the alluvial terraces along the Okavango River is taking place so that the land can be cultivated, and for wood for fuel, building and carving This deforestation is occurring even though, according to the Forestry Act of 1952, it is illegal to remove living "trees, bushes or shrubs" from within 100 m of a watercourse (du Toit and Sguazzin 1995). More than 70% of riparian forest may already have been lost from the Namibian section of the floodplain (Brown 1992). In Owambo, the construction of traditional homes and villages required a great deal of wood. It is likely that Namibia will no longer be self-sufficient in wood within a decade (Ashley 1996).

Except for the most arid desert areas, virtually all of the wetlands of Namibia are degraded to a greater or lesser extent, as a result of abstraction of water for human use, or of overexploitation of wetland resources, or both. In the Namib Desert, impacts on biodiversity are anticipated from mining, upstream impoundment of ephemeral rivers, water extraction from river-mouth aquifers and from uncontrolled vehicle access (Jacobson *et al.* 1995). Quantification has been limited to monitoring the Kuiseb and Omaruru aquifers, which have dropped to near depletion levels (Bethune 1996).

The principal wildlife resources of the northern areas lie in Kunene, eastern Okavango and western Caprivi. Kunene already has tourism based on the local people and the wildlife, which are mainly in the arid western part of the region. Owambo has virtually no wildlife resources left, although the southern area has some potential. The saline grassy plains bordering onto Etosha Game Reserve are more suitable for wildlife than for domestic stock. According to a diagnostic survey done by IFAD in 1992, the local people had negative attitudes towards wildlife (IFAD 1992), although some traditional kings and their people in this area support wildlife protection programmes (Brown, *pers. comm.*.).

In Okavango some problems with hunting dogs and jackals killing stock and monkeys stealing crops were reported by farmers (IFAD 1992). These are also some elephant movements across the Angola border just west of the Okavango river, resulting in occasional damage to water-points. Farmers are quite negative towards wildlife and would like to see them limited to fenced game areas. In eastern Okavango, bordering Botswana and Bushmanland, the situation is different. The potential for wildlife there is much greater, due to the fact that the area is almost unwatered and devoid of domestic stock or crop farming. The region is in a generally rich wildlife habitat and consequently farmers rate damage by wild animals as their greatest crop production problem.

Of the 620 bird species found in Namibia, 430 have been recorded in the Caprivi. At least 73 of these are endangered, mostly because they are dependent on wetland habitats, and these habitats are under pressure.

Namibian ecosystems suffer from the effects of a number of alien organisms, many of which are associated with wetlands and some of which pose severe threats to one or more aspects of the continued functioning or biodiversity of these systems. In western Namibia almost all alien, invasive plants occur in river beds and/or at water-holes because these are the only places where permanent water occurs below the surface. In less arid regions, some invasives may also occur on other disturbed ground (Brown, *et al.* 1985).

4.5 Decline of marine fisheries

At one time, Namibia had one of the richest pelagic fish resources in the world but heavy exploitation by the South African inshore pelagic fleet in the late 1960s and early 1970s led to overfishing and a decline in the pilchard resource. At the same time the abundant deep sea resources of hake were depleted by intense fishing activities by foreign trawler fleets including those from Spain, the former Soviet Union, the eastern block countries and Japan (Stuttaford 1994).

In the case of pilchard (sardine), stocks were at their highest in the 1960s and were estimated at over 2 000 000 tonnes with annual catches ranged from 300 000 to 800 000 tonnes. The stock collapsed during the 1970s through a combination of overfishing and environmental changes, and

in 1994 were only a quarter of former levels. Surveys indicated that stocks of adult pilchard showed good signs of recovery from 1990 to 1992, although population estimates were still relatively low compared with past, historically-high levels. Since 1992, estimates have shown a steady decline. By 1993, pilchard stocks in Namibian waters had fallen to about 6% of levels in the 1960s. Anchovy, although generally not as plentiful as pilchard, have shown similar fluctuations in abundance. Anchovy stocks off Namibia have also shown a steady decline.

Changes in ecosystem balance occurred off Namibia during the 1970s and 1980s where there were major shifts in dominance from commercially valuable pelagic species such as pilchard and anchovy to less economically important species such as horse mackerel and pelagic gobies. The distribution and abundance of jellyfish have also increases in the coastal ecosystem compared with levels recorded a decade earlier.

The northern Benguela Current region can exhibit extremes in temperatures characterised by intrusions of unusually warm water to periods of prolonged intense upwelling giving rise to extensive cold water distribution. Of particular environmental significance has been the "Benguela Ninos" of 1984 and 1995, and the eutrophication of the northern Benguela in 1993/94. This resulted in an abnormal intensification and widespread distribution of low-oxygen water on the Namibian continental shelf, and a poleward expansion of oxygen-depleted water from Angola. These conditions had major impacts on the living marine resources, causing sharp reductions of the Namibian seal population and marked decline in pilchard stocks and pelagic gobies (an important food resource for hake). These changes in turn affected the local fishing industry through altering distribution and migration patterns and affecting the success of spawning. Other unusual features include the periodic occurrence of local sulphur eruptions along the coast and occasional sudden increases in phytoplankton biomass leading to algal blooms or red-tides. Such occurrences can have also have a significant local effect on marine resources. The principal changes taking place in the resources and the environment of the Benguela Current system during the last decade have been documented by Shannon, *et al.* (1992).

Past overexploitation of fish stocks in the Benguela Current region together with the inherent variability of the system has resulted in major changes of fish species abundance in the region. This has been particularly noticeable since 1982, there have been major environmental perturbations and changes in the distribution and abundance of principal harvested species such as pilchard and anchovy. Since 1982, the anchovy stock in the northern Benguela has all but disappeared whereas those off the Cape in the southern Benguela have boomed and declined. The relatively small population of pilchard inhabiting Namibian waters have recently vanished after a few years of recovery in the early 1990s. In contrast, the pilchard population in the southern Benguela has suddenly increased following years of low availability and decline.

Current threats to the sustainable harvesting of marine resources in the northern Benguela Current ecosystem stem mainly from increased environmental variability associated with regional and global climate change and the inability to be able to forecast these events in advance. These factors together with the existing low levels of commercially important small pelagics such as pilchard and anchovy indicate that future recovery of these stocks to economically sustainable levels could be very slow.

Apart from widespread epizoic environmental degradation caused by naturally occurring events such as deoxygenation of coastal and shelf waters, phytoplankton blooms and sulphur eruptions, the northern Benguela Current system in terms of industrial pollution and water quality can be regarded as being in a relative pristine condition. On a more local level, however, the direct root causes of environmental degradation along the coastal zone originates mainly from harbour

activities, fish factory effluent, ship pollution, accidental oil spills, marine diamond mining activities and uncontrolled industrial developments.

The threats posed by diamond mining operations on the local biota and particularly on rock lobster stocks as well as to the quality of the marine environment in general are real but at present unquantifiable. One of the main concerns in the Lüderitz area has been the likely impacts of marine diamond mining of the local rock lobster population which forms a small but valuable fishery in this community. Some mining concessions are located in the main rock lobster fishing areas and potential conflict exists between the mining companies and this fishing industry. Concern has been expressed by fishermen that shallow water diamond dredging and disturbances on the sea bottom puts stress on the rock lobster populations. As a precautionary measure, the Ministry of Fisheries and Marine Resources together with the German GTZ group through the Marenpro project have initiated a study of the environmental effects of diamond mining on rock lobster stocks in the Lüderitz area in which assistance will be given to monitor the process of sedimentation and habitat disturbance on lobster grounds over the next few years.

5. Root causes of environmental threats

5.1 Introduction

The Scope of Work for this assessment required that "... the root causes for each of the environmental threats uncovered by the review will be identified. Both direct (e.g. inappropriate cropping methods, poaching) and indirect (e.g. population growth, inappropriate legal framework) root causes will be identified, and the logical links between them made". In addition, the author of the synthesis report was charged to "go beyond a simple re-statement of each individual report, to identify linkages between sectors that negatively affect different sectors of the environment", and to "... identify common denominators to the different environmental problems and areas — geographic and thematic — of environmental concern that are not being addressed by the GRN and donor community".

It is true that "Ecological symptoms [of environmental problems] may be far removed from the ultimate causes of the problems; the problems typically originate in social and economic policy" (Brown 1996). This section will look at the causal linkages between the major environmental threats, summarised above, and their proximate and ultimate root causes. It was clear from our analysis that many different threats are linked by common causes, both proximate and ultimate.

The key proximate causes of the environmental threats described above are:

- overexploitation of water resources;
- overgrazing and unsustainable range management;
- lack of adequate protection for some key ecosystems; and
- overexploitation of marine fish stocks.

These proximate causes are often linked. Overexploitation of water resources, for example, not only depletes and degrades wetlands and aquatic resources, but contributes to desertification and land degradation and to loss of biodiversity. Likewise, overgrazing and unsustainable range management damages not only rangelands, but also harms both terrestrial and aquatic biodiversity and biotic resources.

The ultimate, root causes of the environmental threats described above include:

- lack of secure and exclusive tenure over land and resources at the local level;
- limited or insufficient intersectoral co-ordination at the national level;
- limited or insufficient human resources and capacity for sustainable planning and management at all levels;
- lack of knowledge and information for sustainable management, and/or transfer of knowledge to appropriate actors (people and institutions);
- limited or insufficient international agreements; and
- population growth.

These ultimate causes are also often linked. Tenure reform related to natural resources can not occur without intersectoral co-ordination at the national level, for example; nor can intersectoral co-ordination occur without the human resources and capacity to make it happen.

5.2 Proximate causes of environmental threats

5.2.1 Overexploitation of water resources

The DWA policy of meeting water demand rather than managing and reducing it, combined with state subsidies for water, are the proximate causes that lead to the overexploitation of water resources. Water is presently supplied to rural areas free of charge, thus giving no incentive to reduce demand and conserve water, or use it efficiently. In some areas where irrigation schemes operate, the real cost of crops produced is actually less than the value of the water used. Clearly, if water were to cost anything like its real value, it would be used far more sparingly (Ashley 1995).

5.2.2 Overgrazing and unsustainable range management

Overgrazing, a proximate cause of desertification and land degradation, results when so many animals graze a given area within a given period of time that the vegetation does not have adequate time to recover in terms of growth, vigour, and seed production. This results in a loss of ground cover, loss of species diversity, loss of ability of plants to tolerate heavy grazing and droughts, deterioration of the physical, chemical and biological properties of the soil and soil erosion caused by wind or water. In some areas, overgrazing also causes bush encroachment, perhaps in conjunction with other environmental changes such as fire suppression and the reduction of wildlife that are browsers.

Overstocking leads to overgrazing, and overstocking is still occurring in some areas. In some areas, especially the northern central regions, the concentration of people, and thus their livestock, is just too high.

Standard range management practices are often based on ideas developed in less arid and less variable environments. Range ecologists working in the dry tropics have begun to rethink the theoretical basis for range management and to suggest alternative concepts and practices. In such systems, the ecological "carrying capacity" for livestock — or wildlife, for that matter — can change rapidly both within and between years (Ellis, Coughenour and Swift 1993).

Overestimation of the carrying capacity of the rangelands is another proximate cause of rangeland degradation. In highly variable environments such as Namibia, maintaining a sustainable carrying capacity requires adjusting stocking levels (based on the biomass of animals) to the available plant biomass on an annual basis. The variability of the rainfall and thus the variability of fodder production is so high that an indication the carrying capacity should be obtained on an annual basis at the end of each rainy season. An additional complication is that high rainfall variability in time is accompanied by high spatial variability. This means that extrapolating estimates of carrying capacity made at one place to other places is very difficult. Carrying capacity varies both from year to year and place to place, in other words. Livestock farmers often fail to recognize and adjust to this environmental variability.

Subsidies to livestock production on both communal and privately-owned lands encourage farmers to keep more livestock than they would keep if they had to pay the full costs of inputs. Therefore, with limited land available, subsidies promote overgrazing and overstocking. In addition to legitimate "enabling environment" activities like extension, research and marketing,

livestock husbandry in communal areas is subsidized through less than full cost recovery provision of:

- veterinary services;
- quarantine services;
- price support;
- income tax waivers;
- rent-free land;
- free water; and
- fodder provision to "bridge" droughts.

The major subsidy is drought aid which has provided fodder, transport and grazing subsidies to both commercial and communal farmers. In 1995 N$50 million was spent by the government on drought relief (Dewdney 1996). These "rescue" operations allow farmers to make it through periods of drought without radical destocking; they are very well intended, and do save many animals from starvation, but they have contributed significantly to rangeland degradation (MAWRD 1992). There has been significant progress since independence to reduce the subsidies to commercial farmers. Large scale irrigation projects (e.g. Hardap and Etunda) are subsidized to a great degree.

Provision of water for livestock in arid rangelands has been another major subsidy that is a proximate cause of desertification and land degradation. Borehole development and the widespread use of groundwater, as well as the provision of water from canals and pipelines have contributed. Water provision has been one factor that has led to sedentarisation and the disruption of the large-scale, traditional nomadic and transhumant pastoral movements that once occurred throughout most of Namibia. This has in turn led to overgrazing, either locally around water-points, or even over much larger areas.

In general, the breakdown of traditional, flexible management institutions and practices has taken place, and no modern replacements that are equally adapted to Namibia's arid and variable environment have replaced them.

5.2.3 Lack of protection for key ecosystems

As discussed in section 3.2.6, Namibia's protected area network was not planned explicitly to represent or conserve Namibia's biodiversity, and many ecosystems with the highest productivity and species diversity have little or no representation in protected areas. Wetland ecosystems in the North, especially riparian areas along the Kunene and Okavango Rivers, and in the Cuvelai–oshanas area, are some of the key localities in Namibia with regard to conservation of species diversity and valuable biodiversity for human use. Other than the Mahango Game Reserve and West Caprivi Game Park, which protect part of the Okavango River, these areas are all on heavily used communal land, and it is highly unlikely that parts of them will be given over to protected areas. If biodiversity conservation is to occur here, it must occur outside of protected areas, making use of other forms of conservation such as conservancies.

Given this situation, the key proximate causes of loss of biodiversity and biotic resources are the overexploitation of water resources, and overgrazing and unsustainable range management. These are the same proximate causes that lead to environmental degradation throughout Namibia, as discussed previously.

5.2.4 Overexploitation of marine fish stocks

During the last two decades, the waters of the northern Benguela Current region off Namibia were intensively overexploited during a "free for all" on pilchard, anchovy and hake by South African purse seine pelagic vessels and international trawling fleets. It is well known from other parts of the world that the impacts of intense fishing pressure such as this can contribute to changes in the species dominance and composition within the ecosystem. This causes levels of primary production requirements to change which affect sustainable yields, trophic level functioning and regulatory mechanisms such as predator prey interactions. These factors coupled with variability in the marine environmental conditions have a marked effect on fish population distribution, spawning success and recruitment. International research on fish population variability worldwide, now suggest that global synchrony may exist between periods of dominance and collapse of fish species and that these flips could also be related to large-scale connections between factors that influence climate and to global climate change (Bakun 1995) rather than totally due to overfishing *per se*. Species flips between dominant species in the Benguela and the likely anthropogenic and physical forcing of these are discussed by Crawford *et al*. (1987).

The direct causative factors influencing the variability of Namibia's marine environment and fisheries resources seem primarily related to regional and possibly global climate changes. In some cases, overexploitation on certain fish species has taken place which in the case of pilchard suggests that the present trends are unsustainable. The root causes of recent problems experience in the marine environment and ecosystem of the northern Benguela Current relate to marked changes in oceanographic conditions rather than unsustainable fishing pressure. These perturbations were associated with a slackening of upwelling, eutrophication and low oxygen conditions in 1993 and 1994 which was followed by a major warm event (Benguela Nino) in 1995. Such unusual oceanographic conditions seems associated with patterns of regional climate change possibly linked with Pacific El Nino effects and global connections between climate-affecting factors.

5.3 Ultimate root causes of environmental threats

5.3.1 Lack of secure and exclusive tenure

Unequal access to land and the means of livelihood is a legacy of the colonial system. Currently, control over access to resources such as land, water and grazing is blurred between traditional leadership and representatives of regional and central government. Absence of any form of land tenure or long-term planning seriously complicates efforts of the growing number of people in the region to achieve control over their livelihoods. To ensure the sustainable use of natural resources, rights to resources must be defined (MET 1995).

A recent report by NAPCOD states that "The introduction of secure and exclusive tenure at the community level is the single most important policy reform needed to prevent degradation" (Dewdney 1996). Tenure reform "... should embrace all natural resources on the land (grazing, trees, wildlife, water). For example, it would be meaningless to grant exclusive tenure over rangeland while allowing open access to all livestock at water-points (or vice versa)" (Dewdney 1996).

There is currently no global government policy document on land allocation or natural resource management. The 1991 National Conference on Land Reform and the Land Question made a number of recommendations but these have not been formally accepted as government policy (Dewdney 1996). The Ministry of Land, Resettlement and Rehabilitation (MLRR) recognizes that this is a problem and has announced that it wishes to undertake a consultative National Land Policy formulation process. A draft National Land Policy has been released for discussion (Republic of Namibia 1996).

The absence of an overall policy framework is a serious constraint on planning and development within both the commercial and communal sectors and thereby encourages short-term overuse of resources and desertification. Uncertainty about the likely extent of land reform can encourage commercial farmers to take an unduly short-term view towards their resources. A clearer statement by the government of the expected extent and nature of land reform could help to reassure commercial farmers and encourage them to use their grazing and other natural resources more sustainably.

5.3.2 Lack of intersectoral co-ordination

It is generally agreed that one of the most critical shortcomings of the GRN in general is the lack of cross-sectoral planning. Policies are set in one Ministerial sector without considering their impact on another Ministerial sector, throughout the economy and on natural resource use. Therefore policy failures occur where land degradation is caused inadvertently.

Co-ordination requires communication and co-operation. Not only is communication poor — whether inadvertent or not — between ministries, but also often between departments, divisions, and directorates within a particular ministry. Thus gaps, duplication and overlaps occur; officials often express their frustration over this state of affairs. In addition, there is insufficient communication between GRN and the private sector, so opportunities for utilizing the experience and expertise from the latter are frequently lost.

The need for adequate cross-sectoral communication is obvious. What is not so obvious are the conflicts of interest and perspective that exist. For example, the MFMR and MET have different views and interests regarding the seal population. The MAWRD and MRLGH have somewhat different views regarding community development. Namibia's government is relatively young, and responsibilities and functions are still being sorted out, and there are legitimate questions about the proper institutional "home" for certain functions, for example: Should Inland Fisheries be part of the MFMR, or MET or MAWRD? Should aquaculture development be promoted by Inland Fisheries, or Agriculture? Where does Forestry belong — with the MET or MAWRD? Should environmental education be co-ordinated between the MET, Ministry of Basic Education and Culture, and the Ministry of Youth and Sports?

Addressing the root causes of Namibia's environmental threats will require "substantial co-ordination between the MET and the far stronger line ministries, e.g. the Ministry of Agriculture, Water and Rural Development (MAWRD), which mirror a less holistic approach to environmental issues" (DANCED 1995).

Given the diverse actors in the field of land-use planning, their difference in mandate and goals, it is evident that if land-use planning cannot be co-ordinated and remains *ad hoc* and fragmented, natural resources, including land, will continue to be used in an unsustainable manner. This in

turn will hinder development and economic growth will not be sustainable, given its dependency on natural resources.

5.3.3 Lack of capacity and human resources

The vast lack of human resources and capacity in Namibia is widely recognized and acknowledged. For example, in NDP #1, the GRN forthrightly recognizes that one of the development constraints it faces is the lack of a human resource base.

Given the diverse actions that are required to bring about sustainable development, this capacity gap is an ultimate, root cause of many of the environmental threats facing the country. This gap, like the inequitable land ownership pattern, is a legacy of the colonial history of Namibia.

Education, training, and capacity-building at all levels, from central government to grassroots resource users, will be required. Some donors have expressed concern about training and human resources development in some ministries, including the MET, particularly regarding the recruitment, training and promotion of black Namibians (BDDSA 1996).

Environmental education, broadly conceived, should give Namibians not only the awareness and knowledge needed for making sustainable environmental choices, but also the skills, options, and motivations to do so. Awareness and knowledge are sometimes lacking, but often other factors play a stronger role in environmental decisions.

5.3.4 Lack of knowledge for sustainable management

A great deal of knowledge about the Namibian environment already exists, and part of the problem is that this knowledge does not always reach, or influence the decisions of, relevant individual and institutional actors. However, the knowledge needed to manage resources sustainably is still lacking in some cases. There is a general need for more applied research on:

- climate and hydrology;
- biodiversity and its distribution;
- rangelands productivity, resilience and carrying capacity;
- natural resource economics and other social dimensions of resource use; and
- the dynamics of the Benguela Current ecosystem.

The role of applied *social and economic research* for sustainable natural resources management has been under-appreciated for far too long. It is now beginning to receive some of the attention it deserves, but there is a great lack of information and capacity in this area.

Management can not take place without *monitoring*. Monitoring involves the routine gathering of the basic information needed for making decisions and taking actions affecting any natural resource, whether water, wood, wildlife, fish, endangered species or grass for livestock. Monitoring techniques that are simple and cheap are urgently needed, especially as planning and management responsibilities are devolved to the regional and local level. Simple techniques for monitoring rainfall, availability of fodder for stock, wildlife populations and fish stocks from year to year and place to place are needed, for example, to enable sustainable local management of these resources.

5.3.5 Limited international agreements

The Government of Namibia is aware of the need for international co-operation to conserve and sustainably manage shared natural resources. The framework agreements are in place are or being developed for sharing water from international rivers that border Namibia, for example. In *Namibia's Green Plan*, for example, it is stated that: "Namibia will continue to participate in the responsible regional development of the shared border rivers in order to satisfy the needs of all countries involved" (Brown 1992).

As a member of SADC, Namibia participates in a number of projects involving natural resources. One is ZACPLAN, a project focused on management of the Zambezi River. Namibia is also working with neighboring countries on a study of the hydroelectric potential of the Kunene River, and "evaluations of the environmentally acceptable water resource potentials of the Orange, Okavango and Kwando Rivers" (Brown 1992). According to the *Green Plan*, "An international agreement is at present being drawn up with the governments of Angola and Botswana to deal with proportional water withdrawal and agree on shared responsibility for the Okavango River Basin ecology" (Brown 1992).

The fisheries on northern border rivers will also require international agreements to enable sustainable management, and these are not in place. Likewise, an international agreement with Angola will eventually be needed if the fishery of the Cuvelai drainage, or oshanas, system is to be sustained. The parent stocks of the fish that move into the oshanas exist in Angola, where the potential for this fishery when the Namibian oshanas dry up, is maintained.

In the Benguela Current ecosystem, Namibia has theoretical control over the fish stocks and marine resources within its Exclusive Economic Zone. Fish populations may straddle EEZs, or move into the EEZs of neighboring countries, or move into international waters. Because of this, international agreements are required for sustainable management of marine fish stocks. The *Green Plan* states that Namibia shares "the concern of many other countries when it comes to straddling stocks and control over high seas fishing operations. The Republic of Namibia therefore offers its support for international efforts to enhance responsible fishing on the high seas and on straddling stocks" (Brown 1992).

5.3.6 Population growth

Namibia's average population growth rate is estimated to be over 3% per year, which means that at current growth rates the population will double in about 22 years. The future ability of Namibia to be independent of other countries, and to live at reasonably high standards of living, can only occur if the human carrying capacity of the land is not exceeded. That will require eventual population stabilisation — a population growth rate of zero. Population stabilisation is a fundamental requirement of sustainable development in any country, not unique to Namibia. The capacity of the environment to supply necessary resources will eventually be exceeded if Namibia's human population continues to grow (Fig. 15) (Ashley 1996).

Excessive population growth often goes hand-in-hand with poverty, and one way of reducing population growth rates is by improving standards of living. However, some poverty alleviation measures actually contribute to land degradation because they subsidize natural resource use. Namibia lacks a comprehensive poverty strategy and, in developing one, both population and environmental linkages should be kept in mind.

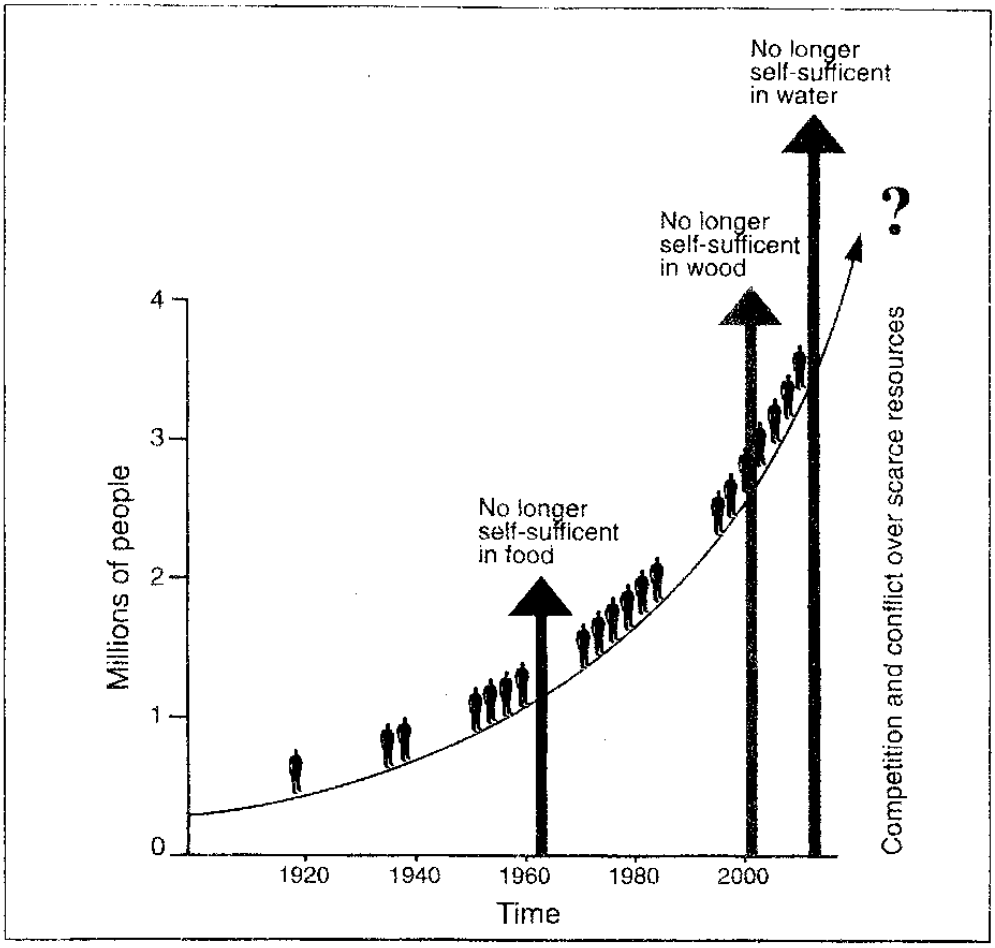


Figure 15: Population versus critical resources (Ashley 1996)

5.4 Links between root causes of environmental threats

In our analysis of root causes of environmental threats in Namibia, it was clear that many different threats are linked by common causes, both proximate and ultimate. Overexploitation of water resources, for example, not only depletes and degrades wetlands and aquatic resources, but contributes to desertification and land degradation and to loss of biodiversity. Likewise, overgrazing and unsustainable range management damages not only rangeland, but also harms both terrestrial and aquatic biodiversity and resources. These proximate causes are all linked. Ultimate, root causes such as population growth, increasing consumption and demand, lack of knowledge, and unsustainable practices and technologies are causally related to many of the threats to Namibia's environment and resources.

Models or diagrams of causal interactions have been used to try to conceptualize social and ecological factors and their linkages (Fig. 16) (Harrison 1994).

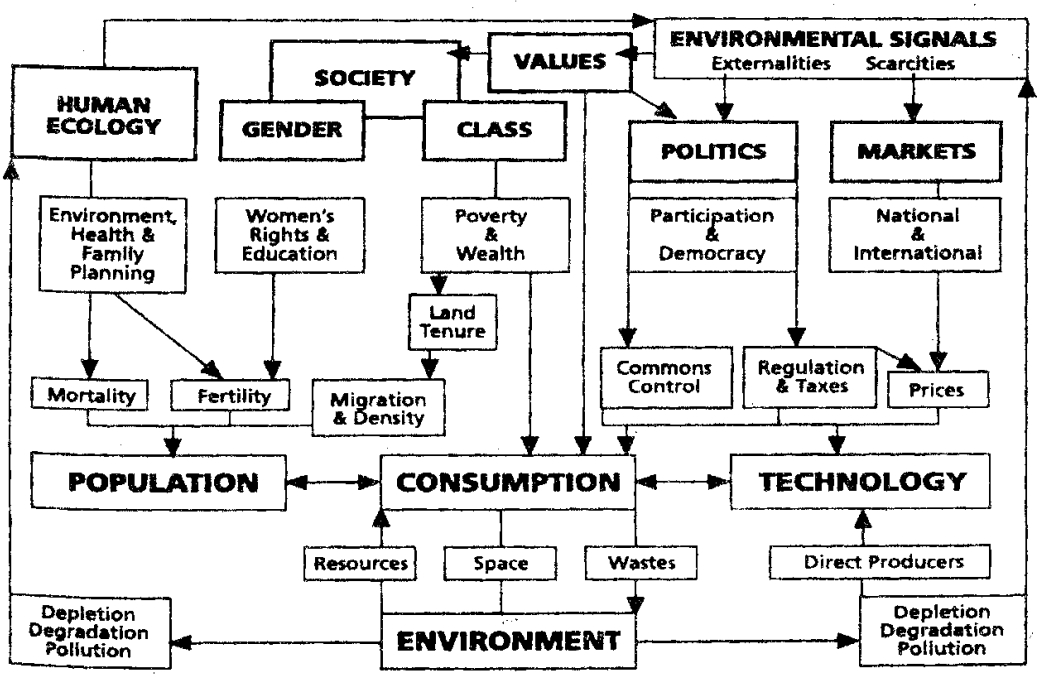


Figure 16: Social system components and environmental linkages (Harrison 1993)

6. Implications of environmental conditions and trends

6.1 Safeguarding the environmental underpinnings of broad-based economic growth

6.1.1 Implications of depletion and degradation of water and aquatic resources

A number of water-related issues will constrain the further development of Namibia. For example, groundwater already supplies more than half of the total water demand but, except in a few areas, the supply of groundwater is already fully committed or even overused. If abstraction is greater than recharge, environmental changes will ultimately occur, and at least some of these are likely to lead to economic losses. Water resources of all kinds in the interior are almost fully utilized.

Because lack of water will constrain all other developments on a national scale, major investments are being made in a variety of water schemes, some of which will have wide-ranging economic and environmental impacts: impacts on ecosystems, on energy use, on household budgets, on competitiveness and, ultimately, on the national economy.

Degradation of water quality, by pollution or salinisation for example, will have the same effects. Degradation of water quality is probably not as great a problem in much of the country as other issues, because the use of fertilizers and other agrochemicals is uncommon. In certain areas, though, particularly in towns and along the border rivers in the North, serious deterioration in water quality is a real possibility that needs to be monitored. For instance, du Toit and Sguazzin (1995) suggest that salinisation of the soil (and thus of the water) is becoming evident in the Okavango and Hardap irrigation areas.

Natural resources obtainable from wetlands, not only water itself, are important for broad-based economic growth in Namibia. Almost three-quarters of the population of Namibia lives near the northern border, able to survive because of the rivers and wetlands, and sustained by wetland and aquatic resources. Wetland resources include plants such as grasses that can be used for grazing; reeds for thatching; palms and reeds, and dye plants, for basketry; crops for food; herbs for traditional medicines; trees for building houses and palisade fences, and for fuel; clay for pottery; and wildlife for eating or for attracting tourists. Some information is available on various aspects of these resources (Marsh and Seely 1992; Jacobson, *et al.* 1995) but virtually nothing has been published on their economic value.

Although the estuaries of most of the western ephemeral rivers are sanded up, some support wetlands of great importance for water birds. Sandwich Harbour, for example, is a five km^2 wetland fed at least partly by subsurface freshwater, and supports some 70 000 wetland birds. The wetlands at Walvis Bay, which include the Kuiseb estuary, extend over some 35–40 km^2 and support migratory birds as well as more than half of southern Africa's flamingoes (du Toit and Sguazzin 1995). The potential for increased wildlife tourism depends in part upon such areas.

Although the quantity of freshwater fish caught and consumed, and the commercial value of the catches, is vastly less than that of the marine fishery, freshwater fish form a vital part of the diets of many people subsisting near the Okavango River, in the Caprivi and, to a lesser extent, in the

oshanas area of the Cuvelai drainage. Virtually all of the inland fishery is artesanal. It has been estimated that approximately 50% of the Namibian population relies on fish for half of their protein needs but this figure does not distinguish between the consumption of marine and freshwater fish.

About 750 people are permanently employed in fishing, and some 64 000 people take part in fishing at least now and then. More than 100 000 people derive direct or indirect benefits from inland fish resources and the fish supply *per capita* is approximately ten kg per person per year, which is about 10% of their total consumption of animal protein.

6.1.2 Implications of desertification and land degradation

Agriculture — mainly livestock production — currently contributes more than 8% to Namibia's overall economic activity. However, agriculture's contribution to rural livelihoods, particularly in the communal-tenure areas, is much more significant than this figure might suggest. In 1993/94, subsistence pastoralism and agropastoralism on communal lands was the main source of income for almost 40% of households in the country. The majority of the total population (an estimated 68%) derives their livelihood directly or indirectly from agriculture and forestry. In contrast, the commercial farming sub-sector — that on privately-owned land — provided employment to about 8% of the total working population. Thus, although the communal livestock farming sector is sometimes characterized as having low productivity, it in fact feeds and employs far more Namibians than the livestock farming sector on private commercial lands.

Agricultural commodities ranked third in 1994 behind minerals, fish and processed fish products in terms of their contribution to merchandise export earnings and comprise about 15% of the total exports. Of this percentage livestock and meat products make the biggest contribution.

6.1.3 Implications of loss of biodiversity and biotic resources

Namibians are strongly dependent on their living natural resources. Only one quarter of the population is urban; the remainder lives in rural areas, where most people depend directly on biological resources, both financially and for essential goods and services (Brown 1996).

Given the country's dependence on natural resources, if these resources are not used sustainably, economic growth will not be sustainable. The sectors of agriculture, fisheries and tourism all depend directly on renewable natural resources, while all sections of the economy require water and the functioning of essential ecosystems. Key sectors with potential for expanding employment are fishing, fish processing, and wildlife-based tourism. The long-term future of each depends on wise management of resources.

Considerable work has been done to document the subsistence uses of indigenous wild species in the northern regions. Marsh and Seely (1992) document the more important food and fibre plants used in oshanas area and Barnes (1995) allocates net economic values to the main non-agricultural goods obtained from wild resources in various northern provinces. If these consumptive wild resource values are added to revenue generated from non-consumptive tourism in the same areas, the net added value per annum was calculated at, N$260 per km^2 for Caprivi, and N$12 per km^2 for former Bushmanland. The Kunene region generated figures of between N$25 per km^2 and N$35 per km^2 in the same study. These are very substantial economic gains

when the large size of the areas and the small numbers of residents are taken into account. Further losses of biodiversity will surely be mirrored by a declining rural economy.

A measure of the direct value of indigenous species is that the wildlife and tourism industry on commercial farms has grown steadily at approximately 3% per year over the last 20 years, with an aggregate economic value in 1992 estimated at N$56 million (Barnes and de Jager 1995). This game farm industry generated over N$30 million in 1991 (Brown 1992).

Tourism has just become the country's third most important foreign exchange earner, estimated to contribute over N$300 million to the country's GDP. Community based tourism projects are restoring the value of wildlife to local people and to Namibia's thriving tourism industry. A measure of Namibia's potential dependence on biodiversity through its nature based tourism industry may be obtained from the following projections by Holm-Petersen (1996): the anticipated total foreign exchange earnings from tourism as a whole are estimated to reach N$1 billion within the next four years, with the creation of about 20 000 jobs. The potential of this industry, is obviously of great significance in linking biodiversity to the country's economy.

This is most advanced in the North where the potential for CBNRM alternatives are most promising. The future development of these regions will tend towards increasing contrast between overused settled areas based on pumped water supplies, compared to the proclaimed reserves and dryland CBNRM conservancies. Unless improved tenure and sustainable "agro-urbanisation" solutions can be found for these settlements, then their social and economic plight will overwhelm the ability of the protected areas to make up the deficit in jobs and revenue.

6.1.4 Implications of decline of marine fisheries

The fish stocks of the Benguela ecosystem support major artesanal and industrial fisheries that make important contributions to food security in Africa and to the economies of Angola, Namibia and South Africa. The annual current market value of hake species caught in Namibian waters is estimated at between N$400 million and N$500 million. Most of this catch is processed and frozen for export, but an increasing percentage of the catch is also being airfreighted fresh on ice to markets in Spain and other European countries. Monkfish, kingklip and West Coast sole form the remainder of the commercial bottom living fish caught in Namibian waters and are keenly sought after with high market demand. These species are not subject to quotas and are caught mainly as a by-catch by trawlers fishing for hake. Monkfish is the most commercially valuable species taken, with a value of about N$60 million in 1994.

6.2 Protecting the integrity of critical ecosystems

The "integrity" of ecosystems relates to their ecological "wholeness" — their complexity, the diversity they contain, their productivity and their resilience. An ecosystem's integrity, wholeness or intactness is thought to be related to its ability to function and to provide a range of ecological goods and services to people.

6.2.1 Implications of depletion and degradation of water and aquatic resources

Wetlands throughout the world are valued because of the variety of economically important services they offer to human beings. Some of these, which are specifically associated with large wetlands that support substantial stands of large, rooted aquatic plants like reeds, are:

- storage of water: retention of water during periods of high flow or rainfall and slow release during drier periods reduces the danger of flooding and provides water over a long period of time;
- filtration of water: the plants act as filters, removing particulate matter such as suspended silts and bacteria;
- removal of pollutants and nutrients: the plants may take up pollutants and nutrients from the water that flows past them; and
- stabilisation of shorelines: the presence of reeds and other wetland plants reduces erosion.

Completion of the Eastern National Water Carrier (ENWC) could have significant effects on the Okavango River and, perhaps more importantly, on the Okavango Delta, which is downstream of the likely take-off point for water for the pipeline. The delta is unique in many respects and it seems unlikely that Botswana will accept without question the abstraction of water to the point that the water balance of the delta may be affected. Although the amount of water that Namibia plans to abstract is a relatively small fraction of the *mean* annual runoff, it may represent a significant proportion in the dry season, especially in years of below-average rainfall.

6.2.2 Implications of desertification, loss of biodiversity and biotic resources

The regions that are already significantly degraded may have slipped below an ecological threshold, above which it is too expensive — or ecologically impossible — to restore them. Bush-encroached areas still function ecologically, they simply have a different species composition and are less productive in terms of livestock production. Conventional approaches to try to return these areas to livestock production often cost much more than the value of the land, let alone the value of livestock that could be produced on it.

The resilience of overgrazed, degraded, and desertified rangelands in Namibia is not really known. The possibility of restoration has not been demonstrated in the severely overgrazed and deforested areas of the oshanas, for example. There is evidence that the extraction of Zambezi teak, *Baikaeaea plurijuga,* and wild teak, or kiaat, *Pterocarpus angloensis,* under loosely-controlled situations such as exist in Caprivi, causes permanent changes to these marginal woodlands, sufficient to prevent their regeneration. Where timber extraction has been practiced in these woodlands in Botswana and Zimbabwe, it has been abandoned or at least acknowledged to be unsustainable.

6.2.3 Implications of decline of marine fisheries

As discussed previously, past overexploitation of fish stocks in the Benguela Current region together with the inherent variability of the system have resulted in major changes in the distribution and abundance of principal harvested species such as pilchard and anchovy. During the 1970s and 1980s there were major shifts in dominance from commercially valuable species such as pilchard and anchovy to less economically important species such as horse mackerel, pelagic gobies and jellyfish. The dynamics of the Benguela ecosystem is so poorly understood

that it is hard to know what implications the decline of commercially important fish stocks have for the functional integrity and resilience of this critical ecosystem.

6.3 Preventing or ameliorating environmental threats to public health

In terms of environmental threats to public health, the depletion and degradation of water resources is the most important issue. Water-borne bacterial diseases seem not to be of major concern, although outbreaks of diseases such as cholera are always possible. The Directorate of Water Affairs monitors fecal bacterial levels in public water supplies in both urban and rural areas.

Water-related parasitic diseases are of major concern, however. Bilharzia and malaria are two of the parasitic diseases that are intimately associated with wetlands because the larvae and pupae of the mosquito vectors of malaria, and the snails that are intermediate hosts of the bilharzia parasite, are aquatic. Malaria is the world's greatest killer (more than 250 million people suffer from the disease and more than a million people, mostly children, die each year in Africa alone). Bilharzia is less frequently fatal but is debilitating. Anything that increases the habitat of mosquito larvae and aquatic snails (shallow, slowly-flowing or still waters) is likely to increase the presence of vectors or intermediate hosts, and therefore to encourage the spread of these diseases. In particular, bilharzia will spread if human hosts are not aware of the connection between human urine and/or faeces and the disease.

As in the rest of Africa, malaria is a major killer and chloroquine-resistant strains are known from Namibia. Malaria has been found as far south as Rehoboth, as well as in Windhoek and the former Damaraland. Bilharzia (schistosomiasis) is endemic throughout the regions of the northern rivers and floodplains. In the Kwando area, 90–95% of the population suffers from bilharzia, and some children die from the disease. As is the case elsewhere, bilharzia can be a debilitating disease that forms part of the "poverty spiral".

7. Needs in addressing the causes of environmental threats

7.1 Introduction

A careful reading of *Namibia's Green Plan* (Brown 1992), or much of the other excellent national literature on the environment and sustainable development, reveals few, if any, gaps in the understanding of what is needed to address the causes of Namibia's environmental threats. This assessment is not likely to produce any surprises in that regard.

The issue is really to translate that conceptual understanding — the understanding of the web of proximate and ultimate root causes of environmental threats — into action, and implement it on the ground. This assessment will suggest some priority options for moving beyond an understanding of the causes of environmental threats, to actions to address them.

7.2 Addressing proximate causes

7.2.1 Need to control water demand within sustainable levels

DWA's water quality and environmental policies are presently being developed, so are not yet available in written form. According to Ashley (1995), though, it is essential for DWA to change its policy of always keeping up with ever-increasing demand and to develop an ethic of water conservation by realistic pricing, tariff incentives, education and planning in the national interest — for instance by deciding that some industries are not cost-effective, and/or might have to relocate to the coast or to the North.

The recent NAPCOD report on *Policy Factors and Desertification* (Dewdney 1996) recommended that reform of *water pricing* was one of the most promising of all options for preventing desertification. The report recommends a more rapid introduction of pricing proposals than is now occurring. For both irrigation and urban domestic uses, full cost recovery in three years is recommended, and for rural users, full cost recovery in four to five years, with cross-subsidy for "lifeline" supply.

7.2.2 Need for flexible range management systems

Rainfall variation, and thus the availability of fodder, is very high in both time and space. This means that grazing capacities vary greatly from year to year and from place to place. Hence stocking rates might be too high for certain places in certain years, and too low for those places in other years. The challenge is therefore not to destock the Namibian rangeland to recommended average carrying capacities, but to find ways and means how farmers can adapt fast and efficiently to changing fodder regimes.

The process by which animals and their feed demands are matched with available fodder sources is called tracking. Effective tracking may be achieved in four ways:

- increasing locally available fodder by importing feed from elsewhere or by enhancing fodder production, especially drought feed, through investment in key resource sites;

- moving animals to areas where fodder is available;
- reducing animal feed intake during drought through shifts in watering regimes, reducing parasite loads or breeding for animals with low basal metabolic rates; and
- destocking animals through sales during drought and restocking when fodder is available after the drought.

Flexible livestock management is needed for tracking environmental variability. Traditional management practices, such as large-scale transhumance, were generally flexible. Policies and programmes should support such traditional practices as much as possible — for example, policies against fencing; support for large-scale communal tenure; and development of mobile clinics, schools and shops to accompany pastoral populations. Policies and programmes should also discourage sedentarisation as much as possible — for example, policies against fencing of communal grazing lands, and limits on, and careful siting of, new water-points.

An obvious problem is that the traditional authorities on communal land are no longer able to assume the full management responsibility, and the recently created administrative bodies are not yet able to effectively control access to and manage natural resources. Existing community based organisations (e.g. farmers associations, development organisations, etc.) need to be strengthened and supported in order to take up the responsibility of managing the resources in a sustainable manner and to the benefit of the whole community.

A challenge for researchers, extension officers and pastoralists is to increase the efficiency of tracking under conditions of restricted flexibility in the communal areas of Namibia. Pastoralists in the past could move much more easily and widely to find enough fodder for their herds. National borders, wildlife conservation areas, commercial farms and even the new phenomenon of so-called "defensive fencing" in the communal areas, all make it more and more difficult for pastoralists to be flexible in their efforts to match animal feed demands with available fodder production. Hence the solution for Namibia will be a combination of elements from both the ranching model and a more flexible open system of rangeland management.

Subsidies for livestock should be removed by changing current policy to develop water-points and to provide drought bridging, restocking after drought, etc. Policy failure occurs when a policy designed to achieve one objective has an unintended, adverse impact on an other objective. These failures can often be addressed by redesigning policy instruments to eliminate such negative impacts while continuing to target their original objective. Livestock subsidies during drought are a good example.

Government support for livestock production in the communal area has been driven by social and political — rather than economic or environmental — objectives. This is an example of policy failure: supporting livelihoods through subsidies to livestock production has promoted land degradation. A solution needs to be found which enhances the standard of living in communal areas without undermining the resource base.

The Drought Aid Scheme provides fodder, transport and grazing subsidies. The scheme does not require communal farmers to de-stock in order to receive assistance. In the communal sector, drought aid has been reactive and does not take into account a long-term strategic approach that would strengthen the resilience of farming systems. Drought relief has included food aid and credit for the acquisition of animal and feed supplements, but most notably borehole development to provide water for livestock. Because this has taken place in an unplanned way, it has encouraged communal farmers to overstock.

With regard to livestock numbers in the communal areas, a clearer policy is required on who may run stock in these areas and up to what limits in numbers. At present much of the stock running on communal land belongs to absentee owners, very often the very civil servants who are in one way or another involved in land-use administration generally. In addition, wealthy cattle owners are running large herds in illegally fenced-off areas at the expense of the true communal farmer.

In order to alleviate pressure on rural communal land, the GRN should aim at the establishment of market access and credit facilities so that livestock does not remain the only store of savings and source of status. In addition, drought relief measures should include incentives for destocking and assistance for restocking once the drought is over.

7.2.3 Need for biodiversity conservation outside of protected areas

Recognition of the need to conserve ecosystem-scale diversity, the diversity of plant communities, and habitat dynamics and patchiness is of particular importance in arid, variable landscapes. These issues are recognized by the MET's planners and ecologists (Brown 1992). Emphasizing the importance of these factors in biodiversity conservation is particularly important where clear understanding for co-operative actions between agencies is essential, and where new and relatively inexperienced staff are moving into management positions.

The most significant progress in the implementation of biodiversity conservation since Independence in 1990 has been to focus on areas outside the formal protected area system. This is biodiversity conservation through incentives for its conservation in "unprotected" areas. A protected area network provides only part of any strategy to protect biodiversity — a very important part, of course. But at least an equal amount of energy must be put into the rest of the landscape through sustainable development programmes if acceptable levels of biodiversity conservation are to be achieved.

The need to provide wildlife protection incentives to residents of communal land like those that had been available since the 1960s to commercial farmers has culminated in the promulgation of an Amendment to the Nature Conservation Ordinance of 1975, to provide for "an economically based system of sustainable management and utilisation of game in communal areas". This recently approved amendment provides for the creation of "conservancies". These conservancies are areas, demarcated by resident communities, with rights to derive benefits from the use of their own wildlife. Conservancies already exist in commercial farmlands, and one or two *de facto* communal land conservancies have been operating for some time with the help of local NGOs (Owen-Smith 1996). Because Namibia's protected area system — like that of most countries — does not adequately cover and represent the country's biodiversity, innovative approaches to conservation outside of protected areas, like conservancies, are especially important.

7.3 Need for land and resource tenure reform

The lack of secure and exclusive rights to land and resources on the communal lands of Namibia must be addressed, because this is one (although not the only) ultimate, root cause of unsustainable resource exploitation. While rural communities bear the costs of overgrazing, deforestation and excessive water extraction, they are not in a position to reap the benefits of sustainable management of these natural resources.

Policies and legislation to bring about secure and exclusive land and resource tenure throughout Namibia are needed, in order to enable sustainable natural resources management on the ground. "The introduction of secure, exclusive tenure at the community level is the single most important policy reform needed to prevent degradation" (Dewdney 1996). Such secure and exclusive tenure is a principle of the recent draft Land Policy.

One objective of Namibia's NDP#1 is to democratize environmental planning and management, and promote integrated planning and management of land, forestry and other natural resources with increased involvement of rural communities, women and local institutions.

The need for land and resource tenure reform that is integrated is becoming more widely recognized. For example, in the 1996 NAPCOD report (Dewdney 1996) this need is clearly identified:

> "Another key element of this institutional reform is that it should embrace *all natural resources on the land* (grazing, trees, wildlife, water). For example, it would be meaningless to grant exclusive tenure over rangeland while allowing open access to all livestock at water-points (or vice versa). This holistic approach must be reflected in the forthcoming National Land Policy and Communal Land Reform Bill. Sectoral legislation and policy should fit within such a framework." (Dewdney 1996)

In fact, the evolution of natural resources management programmes in the SADC region seems to have led to a recognition of this need and opportunity to broaden tenure reforms to include integrated resources tenure (Steiner and Rihoy 1995). Achim Steiner and Elizabeth Rihoy reviewed lessons and experiences from NRM programmes in Botswana, Namibia, Zambia and Zimbabwe, and concluded that:

> "Wildlife, despite its visibility and economic potential emphasized within the four programmes, remains just one of many resources to be managed in a CBNRM context. More importantly, it is in most peoples' minds a secondary resource. Crops, livestock and timber are of primary importance to most rural communities' survival strategies. CBNRM programmes must begin to address integrated resource planning and management, not only to ensure that wildlife becomes an integral part of rural economies and household management strategies, but also to promote land-use planning strategies that optimize the management of the whole resource base." (Steiner and Rihoy 1995)

Tenure over wildlife in communal areas is now enabled by the "conservancy" policy and legislation. Extending the conservancy approach to key resources such as water and rangelands for grazing is an option to consider. Tenure reform is needed in order to move toward sustainable management of natural resources at the local level that is integrated and intersectoral.

The Namibian Government, NGOs, donors, and other development partners should all encourage this process of integrated resource tenure reform that moves beyond wildlife to other resources also, especially water, rangelands, and forests. Conservancy-like institutions would be needed at the local level to manage natural resources within their area.

The First National Development Plan spells out some objectives for land use and land-use planning, including to:

- provide adequate access to land for landless people; and

- promote, facilitate and co-ordinate access to and control over land at all levels following integrated land-use planning techniques involving all sectors so as to support long-term sustainable development for all Namibians.

Secondary objectives given in NDP #1 which contribute to achieving these primary objectives include:

- co-ordinating the process of land-use planning in Namibia by continued support to IMSCLUP and the LUEB;
- creating awareness at the central government level of integrated land-use planning principles;
- preparing relevant policies, guidelines and directives which are necessary to facilitate integrated land-use planning and local resource control as tools in the land reform process; and
- creating an integrated land-use planning capacity which co-ordinates land-use planning at all levels.

These objectives make clear the connection between land and resource tenure reform and the need for intersectoral co-ordination at the national, regional, and local levels.

Forest resources provide materials to the large number of subsistence households in communal areas in the form of fuel wood, fencing, building materials, fruit and other food. It is probably neither possible nor desirable to try to establish markets for these products since most communal residents would not be able to afford them. What is needed is a management system which promotes sustainable use. Local people bear the cost of deforestation in their area. However, without security of tenure over forestry resources there is little incentive to limit use or increase supply. Communities cannot be certain of reaping any benefit from their wise management as access is not restricted.

- The 1992 National Forestry Policy — perhaps inadvertently — sidelines the role of communities in forest management with its emphasis on state-managed forests. A policy on the sustainable management of forest resources should address the following issues:
- the principle of community management of forest resources should be incorporated into the Communal Land Reform Bill (it is included in the new Forestry strategy);
- the recent conservancy legislation should be extended to forest resources; and
- state forest should only be introduced to protect critically endangered species and habitats; there is no case for declaring state reserves simply to try to prevent community access, or to achieve an unrealistic target of forest cover.

The Directorate of Forestry in the MET is currently drafting a Forestry Sector Strategic Plan, which may revise the objectives given in the 1992 National Forestry Policy.

7.4 Need for intersectoral co-ordination

Developing intersectoral,integrated solutions to environmental problems at the local level requires *communication and co-operation between sectoral ministries at the national level* (e.g. MET, MAWRD, MLRR, MRLGH). Such communication and co-operation is generally weak, although becoming better in some cases, mainly through informal mechanisms. Relevant ministries must work together to create the enabling environment needed to bring about integrated, holistic resource management on the ground. Needed are:

- policies, legislation, and institutional development;
- extension and technical support capacity; and

- monitoring and research capacity.

In our analysis of root causes of environmental threats in Namibia, it was clear that many different threats are linked by common causes, both proximate and ultimate. Because of the links between root causes of environmental threats affecting different environmental sectors, addressing the threats will require integrated, cross-sectoral planning and management.

Namibia's Green Plan (Brown 1992) recognizes this need:

> "There is a clear need for co-ordination and co-operation within Government over environmental issues. In the past little attention was given to an integrated approach and legislation has developed piecemeal within a variety of sectors. Development programmes were planned and implemented with scant regard in many cases for environmental impacts. There was no single Ministry tasked with environmental affairs."

There is a very uneven power balance between the MET and a number of other much stronger line ministries that also must be involved in holistic solutions to environmental problems. "All in all eight ministries outside the MET must co-operate if the environmental strategies proposed are to be carried out", and "The share of MET in overall Government expenditures only constitutes 1.8% in the financial year 1995/96" (DANCED 1995). This certainly indicates a need to develop incentives from within government for communication, co-operation, and co-ordination between MET and other ministries.

An example of the challenge of intersectoral co-ordination is given in a discussion of water policy (Ashley 1995):

> "Although DWA has already established... policy objectives, implementation also requires development of commitment and capacity in several other ministries (including Trade and Industry, Finance, Regional Government, Works, Fisheries, the National Planning Commission, Environment and Tourism, and the Department of Agriculture), municipalities and Regional Councils, local communities, and amongst the private sector and Namibian public."

The Ministry of Fisheries and Marine Resources recognizes that some of most crucial factors involved in the degradation of ecosystems necessary to support freshwater fisheries, including deterioration of floodplains through overgrazing, erosion and siltation, are not under their control.

Co-ordination and inter-sectoral co-operation has been established on environmental issues in some cases, as evinced by the Green Plan and partnerships such as NAPCOD, the Namibian Programme to Combat Desertification.

7.5 Need for capacity building

Developing the human resources to carry out all of the diverse actions required to manage Namibia's environment and natural resources sustainably is a major need. Education, training, and capacity-building at all levels, from central government to grassroots resource users, will be required. Environmental education, broadly conceived, should give Namibians not only the awareness and knowledge needed for making sustainable environmental choices, but also the skills, options, and motivations to do so.

According to a recent DANCED report (1995):

> "One of the main conclusions from the institutional assessments is the often alarming *lack of sustainable implementing capacity*. In many areas implementing capacity exists only in as far as more TA can be positioned or NGOs can take over ministerial responsibilities. The strong donor injections in a range of areas conceal the actual priority of the Namibian Government and thus its willingness to sustain activities once donors back out. The NGOs are also affected by the lack of implementing capacity as well as their strong dependency on donor support. This support tends to conceal whether a firm rooting within the community exists." (DANCED 1995)

And according to an ODA assessment:

> "There is a risk that the large number of donor programmes assisting MAWRD in the northern communal areas will place too great a demand on the time of a limited number of extension staff, restricting the amount of time that they can actually spend in the field. ... this risk... will be reduced by using NGOs where possible to implement activities." (BDDSA 1996)

NGOs in Namibia too, however, suffer from a lack of staff and capacity.

7.6 Need for research and monitoring

The knowledge needed to manage resources sustainably is still lacking in some cases. There is a general need for more applied research to inform sustainable environmental management, especially on the topics discussed below.

Monitoring of natural resources and the environment is needed for sustainable management. Monitoring techniques that are simple and cheap are urgently needed, especially as planning and management responsibilities are devolved to the regional and local level. Simple techniques for monitoring rainfall, availability of fodder for stock, wildlife populations and fish stocks from year to year and place to place are needed, for example, to enable sustainable local management of these resources.

7.6.1 Climate and hydrology

The need for better information on rainfall is mentioned in *Namibia's Green Plan* (Brown 1992), which recommends extending the rainfall gauging network to improve the reliability and completeness of the data collected. There is also a need for monitoring water resources, especially the ephemeral rivers, oshanas and river mouths, to protect against overutilisation and disruption of essential ecosystems.

Given their importance to a large fraction of the Namibian population, it is striking that not a single publication is available on the limnology of oshanas ecosystem, except about fish (van der Waal 1991), while the only significant information on the limnology of Etosha Pan is recorded incidentally in a paper (Berry 1972) on flamingo breeding. For sustainable management, there is a need to answer questions such as: How resilient are oshanas? and; How much disruption must occur before the fish don't come back?

The biological and environmental effects of the inter-basin transfers of water within Namibia have yet to be studied, although they have been occurring, and more are planned.

In order to manage water resources sustainably, there is a need for better evidence for long-term changes in climate — such as increasing aridity — over and above the short and medium term variability of the climate (droughts, etc.). It would be useful to know whether the next several decades, or centuries, are likely to be drier than the past several, for example.

7.6.2 Biodiversity

Namibia signed the Convention on Biological Diversity at UNCED, on 13 June 1992. As the basis for developing a National Biodiversity Strategy and in keeping with the provisions of the Convention, the DEA is presently undertaking a UNEP-style National Biodiversity Country Study.

Conventional means of measuring changes in biodiversity are focused on species. The Red Data Book lists of rare and threatened species, as developed by IUCN, are in the forefront. Lists specific to Namibia are now being drafted. Red Data Books for birds, mammals, reptiles and amphibians are expected this year from MET biologists. Those for plants and certain categories of insects are planned (Barnard, in prep). These Red Data Books will form an important part of the biodiversity baseline inventory which is the function of the UNEP Country Study. This will also be the first building block of a National Biodiversity Monitoring Programme.

Patterns of biodiversity also exist at the landscape or ecosystem scale and it is these that must be identified and monitored, probably by combining remote sensing with ground truthing at selected "indicator" sites, such as wetlands, protected areas or estuaries. The pattern and spatial distribution of biodiversity at the scale of ecosystems and habitats is not well documented. The national vegetation map is 25 years old and was admitted to be inadequate and inaccurate at time of publication (Giess 1971).

Namibia's biodiversity collections and data bases are judged to be good (but incomplete, uncollated and not easy to access) by scientists who are themselves familiar with them.

7.6.3 Rangelands

Bush encroachment provides one example of the need for more applied research. Although several causal factors are probably at work — such as overgrazing, reduction in browsing by large game and fire suppression — there is lack of real understanding of which of these factors are most important, and how they interact.

Monitoring rainfall and range condition annually at a large number of stations throughout Namibia is necessary to adjust stock populations to range carrying capacity, which varies greatly both from year to year and place to place. Monitoring at a large number of stations throughout Namibia is needed because extrapolating estimates of carrying capacity made at one place to other places is very difficult due to the high spatial variability of rainfall.

7.6.4 Freshwater fisheries

Fisheries on the perennial rivers of north-eastern Namibia appear to be declining for a variety of reasons, including the breakdown of traditional fishing customs, changes in fishing gear, reduced floods and the degradation of riparian floodplains due to overgrazing and deforestation which are used seasonally by some fish species (Hay 1995). More research is needed to understand the ecology and resilience of these fish species in order to be able to recommend sustainable catch quotas. Monitoring of fish stocks on an annual basis is also needed for sustainable management. Because all of the northern border rivers are international, fisheries research and monitoring should ideally involve joint efforts with Angola, Zimbabwe and Botswana. The Owambo oshanas fishery depends upon parent stocks in Angola, so research and monitoring will have to involve international co-operation in that case.

7.6.5 Benguela ecosystem

Research and information on functioning and long-term dynamics of Benguela Ecosystem is needed. The ability to estimate and predict fish stock abundance and recruitment is important for sustainable management. In the northern Benguela system, where dramatic fluctuations in productivity and species composition take place, this is very difficult.

Present uncertainties regarding natural mortality estimates and the effects of environmental changes on fish behaviour as well as questions on some aspects of survey design and biomass assessment make it difficult for fishery scientists to make confident recommendations on actions to be taken. However, the quality of the scientific advice and the confidence of MFMR fisheries biologists have recently improved through continued training consultations and assistance by international experts.

Added to these uncertainties are the general lack of understanding of the inter-relationship between climatic factors and oceanographic processes operating off southern Angola, Namibia and the west coast of South Africa, and its relation to regional climate changes, Pacific El Nino's and global warming.

With regard to understanding the Benguela Current system as a whole, there is a large gap and at present only limited co-ordinated research, information exchange and co-operation in fisheries and oceanographic research between countries in the region. Such co-operation and joint research planning is essential to sustainably manage and exploit the living marine resources and to address such issues as straddling stocks, high seas fisheries and contingency planning and response in relation to major oil spills or pollution threats on a sustainable basis.

Although a number of projects related to the development and management of natural resources and environmental conservation have been carried out in the Benguela Current region (e.g. South Africa's Benguela Ecology Programme) and through bilateral agreements with donor states — Norway and Iceland in the case of Namibia and Sweden in the case of Angola — there have been little success in the co-ordination of research and management of the marine resources and the environment of the Benguela system as a whole. In all three countries, funding for monitoring, assessment and other ecosystem studies is insufficient to service national needs, let alone those of the region as a whole, Except in the extreme southern Benguela, there is inadequate understanding of the ecosystem functioning, and throughout the region ongoing work lacks a proper socio-economic framework.

Some of the main information gaps are as follows:

- lack of research and poor understanding of the functioning of Benguela Current Large Marine Ecosystem as a whole and of the effects of the environment on fish population dynamics and linkages between them and climate change;
- insufficient information on the long-term fish stock fluctuations in the Benguela Current and the effects of large-scale forcing and global connections between climate-affecting factors on variability;
- no infrastructure for regional co-operation in resource and environmental monitoring, research, and resource management within the Benguela ecosystem;
- lack of standardisation in survey design, resource assessment methodology and calibration of equipment between countries of the Benguela Current region; and
- little retrospective analysis of historical environmental data sets including remote sensing, comparative analyses with other upwelling systems and assessments of regime shifts and past climate scenarios including El Nino's.

7.6.6 Socio-economic dimensions of resource use

It is becoming more widely recognized than in the past that applied research by social scientists can provide necessary information and understanding for promoting sustainable natural resources management. An example is research on traditional uses of natural resources and traditional management practices, which were often quite ecologically sophisticated and sustainable. It is also necessary to understand how and why these traditional practices have changed and broken down as the social and ecological environment changed, however, in order to decide whether parts of the traditional systems can be maintained, revived or adapted to modern circumstances.

Natural-resource economic studies and surveys and natural resources accounting can provide useful information for sustainable management. In such studies, the value of natural resources to humans should be broadly conceived to include unmonetizable and an often unquantifiable values (e.g. socio-cultural, religious, and aesthetic values) not merely monetized, market values.

Socioeconomic monitoring is needed for adaptive environmental management just as much as is ecological monitoring.

7.7 Need for international agreements

Many of the natural resources that sustain Namibians are in fact shared resources with neighboring countries, and international agreements are needed to manage them sustainably. International agreements are needed regarding:

- water and fish in border rivers and Cuvelai–oshanas system;
- transboundary movement of wildlife and livestock; and
- fisheries of the Benguela Current ecosystem.

The Ministry of Fisheries and Marine Resources recognizes that the management of shared rivers is complicated but needs to be continually addressed. The new Draft Inland Fisheries Act recognizes Namibia's need "to enter into co-operative agreements with neighboring states whose freshwater catchments are inter-dependent [sic] with those of Namibia". The Inland Fisheries White Paper (MFMR 1995) mentions specifically that the need for foreign assistance in this sector includes "legal assistance in negotiations with neighboring countries".

International borders often divide a single functioning ecosystem into parts managed by different governments. Communities near Namibia's international borders could, in some cases, benefit from bilateral agreements allowing the movement of wildlife or livestock across these borders. In eastern Caprivi, for example, some communities are beginning to plan or develop wildlife-based tourism. The success of this enterprise will depend upon free movement of animals across international borders, from wildlife rich areas in northern Botswana. Fencing programmes being carried out by Botswana therefore seriously affect economic opportunities for Namibians.

In the northern central area, traditional herders moved their livestock to pastures in Angola (see map of traditional pastoral movements in northern central Namibia, Fig. 13, Appendix 5). As with most traditional transhumance, this had an ecologically-sound purpose, and helped prevent overgrazing of central Owambo pastures. With the return of peace in Angola, it may be possible to restore such transboundary movements of stock, although international agreement will be required.

The Benguela Current ecosystem supports migratory fish stocks that move between the EEZs of South Africa, Namibia and Angola. One of the best means of addressing future threats to the marine resources of Namibia would be the initiation and implementation of an integrated regional management plan for the Benguela Current as a large marine ecosystem. Such a plan would involve Angola, Namibia, and South Africa, and could have the strategic objectives of enhancing national and regional efforts to protect the integrity of the Benguela Current ecosystem and to manage the living resources of the ecosystem on a sustainable basis.

In addition to agreements regarding shared resources, other kinds of international treaties can play important roles in supporting sustainable environmental management in Namibia. For example, livestock marketing agreements can affect wildlife management. Because of a livestock marketing agreement with South Africa, for example, Namibia may have to destroy some buffalo that it is claimed may spread disease to cattle. These wild animals are actually worth a lot of money in terms of hunting, tourism and the live animal trade. The Convention on International Trade in Endangered Species (CITES), is the international agreement regulating international trade in wildlife and wildlife products from threatened and endangered species. Because of the ban on trade in ivory, Namibia, like some other southern African countries, cannot realize some of the value from the sustainable management and utilisation of elephants that otherwise could be realized. Namibia is officially in favor of a downlisting, and eventual delisting, of southern African elephants so that ivory utilisation from these elephant populations could begin again.

7.8 Need for population control

Population growth in Namibia is rapid, and the demographic momentum of its relatively young population will inevitably cause the population to grow much larger. Because people require resources in order to live and develop, population growth is an ultimate root cause, a driving force, of the overexploitation of natural resources and environmental degradation. Ultimately, sustainable development requires that population growth be reduced to zero, and a stable population achieved. In order to reach this goal, immediate action is needed, even though the goal will take decades to attain. A national population policy is needed, which explicitly recognizes that because of Namibia's aridity, the capacity of its natural resource base to support people is very limited. In addition to a population policy that sets objectives and provides a strategy for achieving them, institutions with the capacity to implement the policy on the ground are needed. Such a capacity includes the provision of contraception and family planning services, population education, and adequate maternal and child health care. It can and should be integrated with the

national HIV/AIDS prevention programme. Excessive population growth often goes hand-in-hand with poverty, and one way of reducing population growth rates is by improving standards of living. Basic education for girls and adult women is typically correlated with fertility reduction, and this should also be integrated into a national population programme.

7.8.1 A national population policy

Given the threat posed to sustainable development, GRN should have a population policy that explicitly recognizes that because of Namibia's aridity, its sustainable carrying capacity for people is low, and that its current population is already using about all of the resources of the country. Thus, any population growth will be hard to handle. As for any country, the objective of the policy should be to achieve a zero population growth rate as soon as possible, thus eventually stabilizing the absolute population size.

According to the recent NAPCOD report (Dewdney 1996) the GRN is in the process of developing a population policy, and a draft policy is expected to be discussed in Parliament in 1996, and take effect in 1997. The draft Population Policy of December 1995 sets the following targets:

- to reduce the population growth rate to 3.0% by 2000 and 2.0% by 2025 (from its current 3.1% to 3.3%); and,
- to reduce the total fertility rate (the average number of live births to women of reproductive age) to 5.0 per woman by 2000 and to 3.5 by 2015 (from its current 5.4).

These targets are somewhat lower than the targets that were eventually incorporated into NDP #1: to reduce the growth rate to 3.0% by 2010, and to reduce the total fertility rate to 4.5 per woman by 2010. In an early draft, NDP #1 set a target for population growth reduction of 3.0% by 2000, but this was later pushed back to 2010 by the NPC (Dewdney 1996). "In doing so, the NPC demonstrated an astounding lack of serious interest in the threat of runaway population growth; setting a target of 3.0% by 2010 is virtually equivalent to accepting no reduction in the growth rate" (Dewdney 1996).

> "While current policy sets ambitious targets for slowing the population growth rate, this sense of urgency is not reflected in the draft Population Policy as a whole, nor in the allocation of priorities and resources to achieve this end. It is not clear how such impressive reductions are going to be brought about." (Dewdney 1996)

7.8.2 Institutions and capacity to implement population policy

In addition to a policy that sets objectives and provides a strategy for achieving them, institutions with the capacity to implement the policy on the ground are needed. Such a capacity includes the provision of contraception and family planning services, population education, and adequate maternal and child health care. It can and should be integrated with the national HIV/AIDS prevention programme.

Basic education for girls and adult women is correlated with fertility reductions, and this should also be integrated into a national population programme. The "Namibia Demographic and Health Survey 1992" (MHSS 1993) found, for example, the following total fertility rates for those women with:

- no education — 6.6 live births per woman
- some primary — 6.1 live births per woman
- completed primary — 5.2 live births per woman
- secondary or higher — 4.1 live births per woman

It is important for environmentalists and policy makers to realize that reducing population growth can only be one component of a broader environmental strategy. Although population growth is an ultimate, root cause of environmental impact, the impact of people on the environment is influenced by a number of other factors. However, without urgent, immediate attention, population will continue to grow unsustainably, to the ultimate detriment of all Namibians and to their environment.

7.9 Northern central Namibia: A geographic area of special concern

An explicit charge for this Synthesis Report, as given in the Scope of Work for the assessment, is to "...identify areas — geographic and thematic — of environmental concern that are not being addressed by the GRN and donor community".

Northern communal areas, especially Owambo, are *the* main geographic areas of environmental concern. It is in the densely populated northern areas that all of the root causes and problems come together; there is the most need for biodiversity conservation outside of protected areas; the most need for sustainable water management and sustainable rangeland management; the most need to bring rapid population growth under control.

References

Amutenya, P. 1995. Fisheries in Namibia: Towards sustainable utilization. *SADC Report, Vol. 1*. pp.11–16.

Ashley, C. 1994. Population growth and renewable resource management: The challenge of sustaining people and environment. *Research Discussion Paper No. 1 (August 1994).* Directorate of Environmental Affairs, Ministry of Environment and Tourism, Windhoek.

Ashley, C. 1995. Population dynamics, the environment, and demand for water and energy, in Namibia. *Research Discussion Paper No. 7.* Directorate of Environmental Affairs, Ministry of Environment and Tourism, Windhoek. 28pp.

Ashley, C. 1996. Can population growth and environmental sustainability be reconciled? *In:* Tarr, Peter W., ed. 1996. *op. cit.* pp.178–183.

Bakun, A. 1995. Climate variability and regime shifts in eastern boundary upwelling current systems. Proceedings of a seminar on *The Benguela Current and comparable eastern boundary upwelling ecosystems*. Ministry of Fisheries and Marine Resources, June 1996.

Barnard, Phoebe, (Ed.) *Biological diversity in Namibia: A country study*. Namibian National Biodiversity Task Force. Directorate of Environmental Affairs, Ministry of Environment and Tourism, Windhoek. In prep.

Barnes, JI. 1995. The value of non-agricultural land use in some Namibian communal areas: a data base for planning. *Research Discussion Paper No. 6.* Directorate of Environmental Affairs, Ministry of Environment and Tourism. Windhoek.

Barnes, JI and de Jager, JLV. 1995. Economic and financial incentives for wildlife use on private land in Namibia and the implications for policy. *Research Discussion Paper No. 8.* Directorate of Environmental Affairs, MET. Windhoek. 21 pp.

BDDSA. 1996. *ODA's strategy of assistance to renewable natural resources sector in Namibia (draft for discussion).* British Development Division in Southern Africa (BDDSA). Pretoria. April 1996.

Berry, HH. 1972. Flamingo breeding on Etosha Pan, South West Africa, during 1971. *Madoqua* (I) **5**: 5–31.

Bester, FV. 1996. Bush encroachment — A thorny problem. In: Tarr, Peter W., ed. 1996. *op. cit.* pp. 175–177.

Bethune, S. 1996. Namibia's challenge: Sustainable water use. In: Tarr, Peter W., ed. 1996. *op. cit.* pp. 185–189

Brown, CJ., (ed). 1992. *Namibia's green plan (draft)*. Republic of Namibia, Ministry of Environment and Tourism. 174 pp.

Brown, CJ. 1993. Land as a factor in poverty alleviation: Environmental considerations. In: *Land as a Factor in Poverty Alleviation*. Ministry of Lands, Resettlement and Rehabilitation, Windhoek. 1993.

Brown, CJ. 1996. The outlook for the future. In: Tarr, Peter W., ed. 1996. *op. cit.* pp. 15–19.

Brown, CJ, MacDonald, IAW and Brown, SE. 1985. Invasive alien organisms of SWA/Namibia. *SANSP Report No. 119*, CSIR, Pretoria. 74 pp.

CATAD. 1993. *Participatory methods for situation analysis and planning of project activities: Experiences with women and youth in the communal areas of Namibia.* Berlin: Humboldt University.

Crawford, RJM, Shannon, LV and Pollock, DL. 1987. Fish and invertebrate resources. *Mar. Biol. Ann. Rev.* 25:353–505

DANCED. 1995. Danced programme formulation mission to Namibia: Part One — Institutional and organisational issues. Final Report, April 1995. T and B Consult.

de Klerk, JN. 1988. Strukturele Hindernisse in de Landbou. *Agricola* No. 6.

Dewdney, R. 1996. *Policy factors and desertification — Analysis and proposals.* A report prepared for NAPCOD, the Namibian Programme to Combat Desertification. April 1996.

du Toit, D, and Sguazzin, T. 1995. *Sink or swim... water and the Namibian environment*. Windhoek: Desert Research Foundation of Namibia. 230 pp.

EEAN. 1992. *Environmental assessment study and identification of pilot areas for Hereroland and Namaland. Sustainable Animal and Range Development Programme (SARDEP).* Ministry of Agriculture, Water and Rural Development, Windhoek, Namibia.

Ellis, JE, Coughenour, MB, and Swift, DM. 1993. Climatic variability, ecosystem stability and the implications for range and livestock development. In: Behnke, RH, Schoones, I and Kerven, C. Eds. 1993. *Range Ecology at Disequilibrium: New Models of Natural Variability and Pastoral Adaptation in African Savannas*. London: Overseas Development Institute.

Fisher, Wes. 1995. *Environmental review in support of preparation of USAID, Namibia's country program strategic plan for the period 1995–2000*. A report prepared for USAID, Namibia (August 1995).

Giess, W. 1971. A preliminary vegetation map of South West Africa. *Dineteria* 4: 5–115.

GTZ. 1991. *Sustainable livestock production in the less developed areas of Namibia. Vol. 1. Sector Analysis and Planning Study*. Eschborn, Germany.

Harrison, Paul. 1993. *The third wave: Population, environment, and a sustainable world*. New York: Viking Penguin.

Hay, CJ. 1995. *The development of a database for the assessment of the biotic integrity and sustainable utilisation of the Okavango River, Namibia.* Unpublished PhD thesis, Rand Afrikaans University, South Africa. 223pp.

Holm-Petersen, Erik. 1996. Tourism in Namibia. In: Tarr, Peter W., ed. 1996. *op. cit.* pp. 92–94

IFAD. 1992. *Northern Areas Livestock Development Project*. Preparation Mission Report. Windhoek, Namibia.

Jacobson PJ, Jacobson KM and Seely, MK. 1995. *Ephemeral rivers and their catchments: Sustaining people and development in western Namibia*. Windhoek: Desert Research Foundation of Namibia. 160pp.

Marsh, A, and Seely, M. Eds. 1992. *Oshanas: Sustaining people, environment and development in central Owambo, Namibia.* Windhoek: Desert Research Foundation of Namibia. 56 pp.

MAWRD. 1992. Socio-economic survey: Southern Communal areas. Directorate of Rural Development, Ministry of Agriculture, Water and Rural Development, Windhoek, Namibia.

MET. 1995. *Wildlife management, utilisation and tourism in communal areas*. Policy Document, June 1995. Ministry of Environment and Toursism, Windhoek.

MFMR. 1995. *The responsible management of the inland fisheries of Namibia*. White Paper: draft, December 1995. Ministry of Fisheries and Marine Resources, Windhoek. 52 + xvii pp.

MHSS. 1993. *Namibia demographic and health survey 1992*. Ministry of Health and Social Services. cited in Dewdney 1996, *op. cit.*

NOLIDEP. 1996. *Preliminary Site Surveys. Northern Region Livestock Development Programme, Ministry of Agriculture, Water and Rural Development, Windhoek, Namibia*.

Owen-Smith, G. 1996. The Kaokoveld: Southern Africa's Last Wilderness. In: Tarr, Peter W., ed. 1996. *op. cit.* pp. 62–65

Paskin, RD. 1995. *Ovahimba people of Kaokoland: Husbandry perceptions and practices*. MSc. Dissertation, Wye College, University of London, U.K.

Republic of Namibia. 1996. Outline of a National Land Policy. Draft dated 17 May 1996; photocopy, no additional source information.

Rogers, J, and Bremner, JM. 1991. The Benguela ecosystem. Part VIII. Marine geological aspects. *Oceanogr. mar. Biol. Ann. Rev*., 29: 1–85.

Shannon, LV, Crawford, RMJ, Pollock, DE, Hutchings, L, Boyd, AJ, Taunton-Clark, J, Badenhorst, A, Melville-Smith, R, Augustyn, CJ, Cochrane, KL, Hampton, I, Nelson, G, Japp, DW and Tarr, RJQ. 1992. The 1980's — a decade of change in the Benguela ecosystem. Payne, AIL, Brink, KH, Mann, KH and Hilbourn, R (Eds). Benguela trophic functioning. *S. Afr. J. Mar. Sci.* 12:271–296.

Skelton, PH. 1993. *A complete guide to the freshwater fishes of southern Africa*. Halfway House, South Africa: Southern Book Publishers. 388 pp.

Steiner, A, and Rihoy, E. 1995. The commons without the tragedy?: Strategies for community based natural resources management in Southern Africa. Background Paper for the 1995 Annual Regional Conference of the Natural Resources Management Programme. SADC Wildlife Technical Co-ordination Unit, Malawi; USAID Regional Natural Resources Management Programme.

Strohback-Fricke, M. 1996. Exciting world of Namibian flora. In: Tarr, Peter W., ed. 1996. *op. cit*. pp. 79–82

Stuttaford, M. 1994. Assistance by the international community: Focus on fisheries. *Namibia Brief* 18:94. (June 1994).

Tapscott, CPG. 1990. The social economy of livestock production in Ovambo and Kavango. Namibian Institute for Social and Economic Research, University of Namibia, Windhoek.

Tarr, Peter W. Ed. 1996. *Namibia Environment*, Vol. 1. Directorate of Environmental Affairs, Ministry of Environment and Tourism, Private Bag 13306, Windhoek, Namibia.

Tvedten, I, Girvan, L-A, Maasdorp, M, Pomuti, A and van Rooy, G. 1994. Freshwater fisheries and fish management in Namibia: a socio-economic background study. Social Sciences Research Division Report 12, Multidisciplinary Research Centre, University of Namibia, Windhoek. 164pp.

USAID. 1995. *USAID Mission to Namibia Country Strategic Plan (FY 1996–2000)*. December 30, 1995.

Van der Merwe, JH. (Ed.) 1983. *National Atlas of South West Africa (Namibia)*. National Book Printers. Pretoria.

Van der Waal, BCW. 1991. Fish life of the oshana delta in Owambo, Namibia, and the translocation of Cunene species. *Madoqua* **17**: 201-209.

Van Zyl, B.J., and C.J. Hay. 1994. Inland fisheries resources. *Namibia Brief*. **18**: 87–89.

Appendix 1: Biographical sketches of team members

Bruce Byers (Ph.D., M.A. Biology; B.A. (Hons) Human Biology) served as team leader and wrote the synthesis report. Currently an independent consultant in conservation and environmental management based in Washington, DC, he has more than 20 years of experience in research, education and management. Although his academic training was in ecology, over the last decade his work has shifted toward the social and human dimensions of conservation and natural resources management. After receiving his doctorate, Bruce taught at the University of Colorado for 12 years. From 1992–1994 he served as an environmental and conservation advisor in USAID's Global Bureau, Office of Environment and Natural Resources. His professional interests include conservation biology, community based natural resources management, environmental conflict resolution, common-property resource management, environmental education and communication and environmental ethics. He has worked in more than 20 countries in North America, Europe, Africa and Asia, and clients have included USAID, WWF, the U.S. Fish and Wildlife Service and The Nature Conservancy.

Jenny Day (Ph.D, B.Sc (Hons) Zoology) (Riparian habitats, freshwater systems) has considerable experience in freshwater ecosystems and is currently the Director of the Freshwater Research Unit at the University of Cape Town. She has worked extensively throughout the aquatic environments of Namibia and has published her findings in a wide range of scientific journals. Her work in Namibia is one of a number of major topics of research; from 1978 to 1984 the topic of the ecophysiology of primitive crustaceans from temporary habitats was completed, while work on the limnology of the Namib Desert is continuing. In addition she acted as advisor to R`ssing Uranium in 1984–1985 with an ecological survey and advice on the management of their water resources. Current research interests include, amongst others, temporary inland waters including salt pans, the effects of water chemistry on freshwater organisms and conservation and management of freshwater ecosystems.

Rod Davis has over 35 years experience in agricultural project development and management in the SADC region having completed assignments in Malawi, Namibia, Zambia and Zimbabwe. He is head of Namibia Resource Consultants and a Director and Resident Consultant of LVAN. Rod is a keen conservationist and a proponent of appropriate soil tillage practices, water conservation and erosion prevention. Since arriving in Namibia he has been involved in a wide range of agriculturally related activities which have brought him into contact with government ministries, NGOs and various development agencies and local organisations.

Tony Ferrar (B.Sc Agric, M.Sc Ecol) (terrestrial biodiversity conservation and forestry) is a wildlife ecologist of 30 years experience with extensive exposure to wildlife and nature reserve management in southern Africa, experienced in conservation policy and planning, EIA, ecotourism and hunting and conservation-based community development. He has edited and written many standard southern African texts on biodiversity including CSIR Red Data Species Book Series, Invasive Alien Biota, Coastal Dune Ecosystems and Environmental Education. He is the past Chief Executive Officer of the Wildlife Society of Southern Africa and is currently a free-lance consultant and an Associate of NRC. He has recently completed a USAID/IUCN funded project on the Park Planning Project to Develop Management Plans for the Makgadikgadi and Nxai Pan National Parks, North/Central Botswana.

Bertus Kruger (rangeland resources, pastoralism and agropastoralism) is a Namibian citizen and an expert in rangeland and livestock management techniques and applies these to the capacity building of Namibian farmers and community based organisations by enabling them to identify, and produce solutions to, their problems. In addition to original range research work and full time commercial ranching he has been the National Co-ordinator for SARDEP (Sustainable Animal and Range Development) since January 1993.

Mick O'Toole (coastal and marine resources) is an experienced marine Biologist currently engaged as Chief Fisheries Biologist for the Ministry of Fisheries and Marine Resources. He has headed the supportive fisheries and environmental divisions since 1992 having previously worked as Principal Fisheries Officer for the Sea Fisheries Research Institute at the University of Cape Town. His current activities cover fish stock assessment, management and TAC recommendations; coastal oceanography, remote sensing, environmental impact assessment on fisheries and water quality; monitoring programmes and pollution control. He is responsible for the preparation of the Draft National Oil Spill Contingency Plan or West Coast Plan and has published over fifty research papers and consultancy reports during his career on fisheries, aquaculture and environmental impact assessments.

Chris Schumann has contributed the essence of topical reports on donor activities and policy and institutional issues. He has recently launched Global Consultancy Services whose principle objective is to identify and enhance the capability and capacity of Namibia's development co-operation programme. Prior to this Chris was the head of the Bilateral development Co-operation Section in the National Planning Commission. His duties at the NPC included extensive dealings with the donor community and the Namibian government institutions. In addition his responsibilities included negotiations, co-ordination and advising on external assistance to Namibia from bilateral donor countries and agencies, international NGOs and the international banking community.

Appendix 2: List of persons contacted

Dr P Barnard, Directorate of Environmental Affairs, MET
Mr J Barnes, Directorate of Environmental Affairs, MET
Mr F Bester, MAWRD
Ms S Bethune, Department of Water Affairs, MAWRD
Mr B Beytell, Directorate of Resource Management, MET
Mr D Boyer, MFMR
Dr C Brown, Directorate of Environmental Affairs, MET
Mr L Clark, MFMR
Ms P Craven, National Botanical Research Institute (Herbarium)
Mr R Dewdney, Directorate of Environmental Affairs, MET
Dr J Fitter, GTZ
Dr C Geldenhuys, Directorate of Forestry, MET
Mr J Glazewski, Directorate of Environmental Affairs, MET
Ms E Griffin, Museums
Mr M Griffin, Directorate of Resource Management, MET
Dr C Hockett, Coastal Ecology Research Laboratory, University of Maryland Eastern Shore, Maryland, USA
Mr J Huesken, MLRR
Mr B Jones, Directorate of Environmental Affairs, MET
Dr W Knausenberger, USAID, Washington
Mr H Kolberg, Directorate of Resource Management, MET
Dr H Kojwany, Directorate of Forestry, MET
Mr R Kressirer, GTZ
Ms S Lane, De Beers Diamond Mining
Dr M Lindique, Directorate of Resource Management, MET
Mr R Loutit, Directorate of Resource Management, MET
Mr E Marais, Museums
Dr R Miller, National Petroleum Corporation of Namibia
Ms K Noll, MFMR
Dr G Otte, GTZ Marenpro Programme, MFMR
Mr E Reed, MAWRD
Mr T Resch, USAID, Washington
Dr J Roux, MFMR
Dr M Seely, DRFN
Dr B Strohback, National Botanical Research Institute (Herbarium)
Mr P Tarr, Directorate of Environmental Affairs, MET
Capt van der Meer, Namibian Port Authority
Dr B van Zyl, MFMR

Appendix 3: Synthesis workshop participants

NAME	ORGANISATION	CONTACT ADDRESS	TEL or FAX
Ashby, Auriol	NRC	PO Box 11513, Windhoek	233679
Barnard, Phoebe	DEA, MET	P/Bag 13306, Windhoek	249015
de Queiroz, Joao S	USAID/REDSO	PO Box 30261, Nairobi	254-2-751613 x2369 e-mail:jqueiroz@usaidgov
Dickerson, Nigel	British High Commission	PO Box 22202, Windhoek	228895
Fitter, Dr JC	Dir. Planning MAWRD-SARDEP	PO Box 40226, Windhoek	224550 or 222974
Goagoseb, Lakka M	USAID/LIFE Project	P/Bag 22028, Ausspannplatz	
Hay, Clinton	MFMR	PO Box 246, Mariental	0661-361
Heyns, P	DWA	P/Bag 13193	2963074 or 224512
Mhopjeni, K-K	MME	PO Box 3984, Windhoek	226571
Kambatuku, Jack R	DRFN	PO Box 20232, Windhoek	229855 or 230172
Kamwi, S	UNAM, SSD	P/Bag 13301, Windhoek	
Maass, Erika	UNAM, Faculty of Science	P/Bag 13301, Windhoek	2063890 or 2063013
Mbaeva, TN	Office of the Ombudsman	P/Bag 13211, Windhoek	225998
McArthur, Malcolm	NNF	PO Box 245, Windhoek	248345 or 248344
Mhone, Yambila	Africare	PO Box 9364, Eros	230930 or 229823
Mosimane, Alphons	UNAM, MRC, SSD	P/Bag 13301, Windhoek	
Motinga, JD	NEPRU/DEA		249015 or 240339
M`ller, Leon	MME		226571 or 238643
Mwandemele, Prof O	UNAM, Faculty of Agric and Natural Resources	P/Bag 13301, Windhoek	2063890 or 2063013
Schumann, Christoph	Global Consultancy Services	PO Box 22584, Windhoek	238298 or 236531
Stauffer, Donna	USAID/RCSA/Botswana	PO Box 2427, Gaborone	267-353382 or 324404
Strohbach, Ben	NBRI / MAWRD	P/Bag 13184, Windhoek	2022016 or 258153
Venter, Roelie	Namibia Agricultural Union	P/Bag 13255, Windhoek	237838

DIRECTORATE OF ENVIRONMENTAL AFFAIRS

Other Research Discussion Papers *available in this series*

Ashley, C. 1994. Population growth and renewable resource management: the challenge of sustaining people and the environment. *DEA Research Discussion Paper # 1*. 40pp

Ashley, C, Barnes, J and Healy, T. 1994. Profits, equity, growth and sustainability: the potential role of wildlife enterprises in Caprivi and other communal areas in Namibia. *DEA Research Discussion Paper # 2*. 25pp

Quan, J, Barton, D and Conroy, C (Ashley, C ed). 1994. A preliminary assessment of the economic impact of desertification in Namibia. *DEA Research Discussion Paper # 3.* 150pp
Northern commercial areas: Okahandja, Otjiwarongo and Grootfontein. 33pp
Communal and commercial areas of southern Namibia. 42pp
Northern communal areas: Uukwaluudhi. 35pp

Ashley, C and Garland, E. 1994. Promoting community-based tourism development: why, what and how? *DEA Research Discussion Paper # 4.* 37pp

Jones, BTB. 1995. Wildlife management, utilisation and tourism in communal areas: benefits to communities and improved resource management. *DEA Research Discussion Paper # 5.* 27pp

Barnes, JI. 1995. The value of non-agricultural resource use in some Namibian communal areas: a data-base for planning. *DEA Research Discussion Paper # 6.* 21pp

Ashley, C, Müller, H and Harris, M. 1995. Population dynamics, the environment and demand for water and energy in Namibia. *DEA Research Discussion Paper # 7.* 37pp

Barnes, JI and de Jager, JLV. 1995. Economic and financial incentives for wildlife use on private land in Namibia and the implications for policy. *DEA Research Discussion Paper # 8.* 21pp

Rodwell, TC, Tagg, J and Grobler, M. 1995. Wildlife resources in Caprivi, Namibia: the results of an aerial census in 1994 and comparisons with past surveys. *DEA Research Discussion Paper # 9.* 29pp

Ashley, C. 1995. Tourism, communities and the potential impacts on local incomes and conservation. *DEA Research Discussion Paper # 10.* 51pp

Jones, BTB. 1996. Institutional relationships, capacity and sustainability: lessons learned from a community-based conservation project, eastern Tsumkwe District, Namibia, 1991–96. *DEA Research Discussion Paper # 11.* 43pp

Ashley, C and Barnes, JI. 1996. Wildlife use for economic gain: the potential for wildlife to contribute to development in Namibia. *DEA Research Discussion Paper # 12.* 23pp

Ashley, C. 1996. Incentives affecting biodiversity conservation and sustainable use: the case of land use options in Namibia. *DEA Research Discussion Paper # 13.* 21pp

Jarvis, AM and Robertson, A. 1997. Endemic birds of Namibia: evaluating their status and mapping biodiversity hotspots. *DEA Research Discussion Paper # 14.* 103pp

Barnes, JI, Schier, C and van Rooy, G. 1997. Tourists' willingness to pay for wildlife viewing and wildlife conservation in Namibia. *DEA Research Discussion Paper # 15.* 24pp

Ashley, C, Barnes, JI, Brown, CJ and Jones, BTB. 1997. Using resource economics for natural resource management: Namibia's experience. *DEA Research Discussion Paper # 16.* 23pp

Lange, G, Barnes, JI and Motinga, DJ. 1997. Cattle numbers, biomass, productivity and land degradation in the commercial farming sector of Namibia, 1915 to 1995. *DEA Research Discussion Paper # 17.* 28pp

Lange, G. 1997. An approach to sustainable water management using natural resource accounts: the use of water, the economic value of water and implications for policy. *DEA Research Discussion Paper # 18.* 39pp

Lange, G and Motinga DJ. 1997. The contribution of resource rents from minerals and fisheries to sustainable economic development in Namibia. *DEA Research Discussion Paper # 19.* 32pp

Ashley, C and La Franchi, C. 1997. Livelihood strategies of rural households in Caprivi: Implications for conservancies and natural resource management. *DEA Research Discussion Paper # 20.* In press.