NAMIBIA

Initial National Communication to the United Nations Framework Convention on Climate Change

July 2002

Foreword

By the Hon. Minister of Environment and Tourism

It is with great pleasure that I have availed myself of the opportunity to present this foreword for the Initial National Communication (INC) of the Republic of Namibia to the United Nations Framework Convention on Climate Change (UNFCCC).

The Constitution of the Republic of Namibia requires the State to actively promote and adopt policies that maintain ecosystems, ecological processes and biological diversity for the benefit of the present and future populations. The anticipated effects of climate change could have potentially negative impacts on the ability of the State to fulfill its constitutional obligations. The State, through its various government agencies and departments and in full partnership with the private sectors and non-governmental organizations, seeks to develop and adopt pre-emptive and corrective actions and activities to address the predicted and actual impacts of climate change.

Climate change is considered one of the most serious threats to our environment, human health and well-being, and economic development. Our arid environment, recurrent drought and desertification have contributed to making Namibia one of the most vulnerable countries to climate change. Our natural resource-based economy and limited financial resources further increases our vulnerability to climate change. Climate change and its effects could potentially become one of the most significant and costly issues that affect national development in Namibia.

Agricultural production, food security, health and other development goals could be turned upside down. The projected rise in sea levels due to global warming could submerge some of our coastal islands and affect our entire marine industry and the coastal economy, as we know it. Fishing and tourism are vulnerable. Namibia as a nation needs to prepare itself to adapt to the effects of climate change.

The Ministry of Environment and Tourism, for administrative and technical reasons, has been designated lead ministry in the co-ordination of climate change activities in Namibia. The task of managing climate change is however national in scope and bigger than any one ministry. The Namibia Climate Change Committee (NCCC) was established as a multi-stakeholder committee to advise government on policies and strategies needed to prepare the country for climate change. The NCCC consists of representatives from government, NGOs, parastatals and the private sector working in a collaborative framework for the good of the country.

A country study on climate change in Namibia was completed in 1998 and was used as the foundation upon which the Initial National Communication was built. It is anticipated that as a direct result of the submission of the INC to the UNFCCC, action will commence to secure resources through the Convention mechanisms to establish a secretariat to provide support to the Ministry in the co-ordination of the climate change program in Namibia. The Republic of Namibia would, however, like to go on record by stating that any resources provided for such a secretariat should be used not only for direct climate change activities but for co-ordination and strengthening of synergies between the UNFCCC and the other United Nations based environmental conventions to which we are a Party, namely the Convention on Biological Diversity (CBD) and the Convention to Combat Desertification (CCD).

As a minor producer of greenhouse gases, Namibia will place more emphasis on our vulnerability and adaptation to climate change rather than mitigation. This approach will be used to prepare strategies and action plans that can be easily fitted into the national development planning processes such as our second National Development Plan (NDP 2), the National Biodiversity Strategy and Action Plan (NBSAP) and Vision 2030.

Despite its limited resources and technology, Namibia undertakes to continue to play its role in the protection of the global heritage of mankind from the effects of climate change. We are aware of our responsibilities under the Convention and we will position ourselves to benefit from the global resources that are available to assist us to live up to these responsibilities. We will work within the framework of the UNFCCC and protocols such as Kyoto. Climate change is a global issue that knows no national boundaries. It will only be solved within a global context and with full international co-operation among nations, both developed and developing.

Finally, on behalf of the Government of the Republic of Namibia and the Ministry of Environment and Tourism, I wish to express my sincere gratitude to all organisations, institutions and individuals who participated in the process towards the preparation of the Initial National Communication. Your active participation in the deliberations was vital to the success of this project. Thank you very much.

Hon. Philemon Malima, M.P.
Minister
Ministry of Environment and Tourism

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- An overview of Namibia's vulnerability to climate change by Jacquie Tarr.
- Mitigation study for the Namibian climate change study – economic scenarios, emission scenarios and mitigation options by Rob Blackie.

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Executive Summary

Purpose of the report

There is scientific evidence that the climate has changed and will continue to change during the next century, both globally and locally, due to increased concentrations of greenhouse gases in the atmosphere. The increase in these gases is due mainly to human activities, such as the use of fossil fuels and change in the land surface through agriculture.

The United Nations Framework Convention on Climate Change (UNFCCC) was adopted in New York on 9 May 1992. The objective of the Convention is to stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. The Republic of Namibia ratified the UNFCCC on 16 May 1995 and this decision came into effect on 14 August 1995. This initial national communication by Namibia to the Conference of Parties of the UNFCCC is delivered in accordance with Articles 4 and 12 of the Convention. The communication follows the guidelines laid out in the Decision 10 of the Second Conference of Parties. It includes the emissions of greenhouse gases from the territory of Namibia for the year 1994, the specified "base year" for signatory countries not listed in Annex 1 of the Convention. Summaries of the anticipated impacts of climate change, a statement of the actions taken and planned by Namibia to avoid and respond to climate change, and some of Namibia's initially identified needs in this regard are outlined.

National circumstances

Namibia is an arid country on the Atlantic coast of southern Africa. Its neighbouring countries are South Africa to the south, Botswana to the east, Angola and Zambia to the north. Namibia's climate is strongly influenced by the cold Benguela Current that flows north along the west coast. The altitude range in Namibia is from sea level to 2 606 m. Much of the interior basin has a mean altitude of 1000 m. Total land area is 824 268 km^2.

Much of the land surface is exposed bedrock, with deposits of sand in the Kalahari and Namib Deserts. Mineral and other resources include uranium, copper, gold, coal, diamonds, zinc and offshore oil and natural gas deposits.

Annual rainfall is low and highly variable between years, ranging from an average of 25 mm in the southwest to 700 mm in the northeast. Most rain falls in the summer months (November to April) in the form of thunderstorms and showers, except in the southwest where winter rains account for at least half of the annual total.

Water is scarce and droughts are frequent. Lack of water is the key limitation to Namibia's development. High solar radiation, low humidity and high temperatures lead to very high evaporation rates; thus only about 1% of rainfall ends up replenishing the groundwater aquifers that many Namibians depend on. The ground water resources require careful management if they are to be sustainable. The main perennial river courses flow along the national borders and include the Orange, Zambezi, Kwando-Linyanti-Chobe, Okavango and Kunene Rivers. Rivers, springs, pans and wetlands within the territory of Namibia are generally not permanent. In the north central area, temporary water bodies called *oshanas* form after rainfall.

The natural resource base comprises mineral deposits, a largely intact biodiversity (including wildlife and woodlands), a large area of arid rangeland, and a small area (2%) of arable land. Three main vegetation types predominate – desert, savanna and woodlands. There are 687 known endemic plant species (17% of the total flora), located particularly on the escarpment and the southwest winter rainfall area. Tourism contributes about a third of the foreign exchange earnings of Namibia. Scenery and wildlife are the major tourist attractions. Protected areas comprise 13% of the land surface. About 41% of the land is State-owned communal land, on which over two-thirds of the population rely for subsistence farming. Commercial farmers own about 44% of the land.

Agriculture is dominated by livestock production and dry-land crop production. Agriculture contributed 5.6% of the GDP in 2000, of which almost 90% was from the production of cattle and small stock. The majority of Namibians depend on subsistence agriculture, farming pearl millet, sorghum, livestock and fruit. Commercial crop production includes maize, pearl millet, sunflowers, and wheat. Grapes, vegetables and dates are grown under irrigation where water from rivers, dams or artesian water sources is available. Forest and wood resources are used under permit control.

The fisheries and fish processing sector of Namibia is an increasingly important, though variable, contributor to the national economy. Most of the catch is bottom-living (demersal) species such as hake and horse mackerel, rock lobster and crab. Strict catch allocations are in force to protect the fish stocks since severe over-fishing of several species in the pre-Independence era caused the collapse or near-collapse of some stocks.

Mining, particularly diamond mining, is the traditional backbone of the Namibian economy, contributing 13% to GDP in 2000. Uranium, gold, copper, lead and salt are also mined. New developments include a zinc mine and refinery and the development of offshore natural gas fields.

The manufacturing sector relies mostly on agricultural and fishery products, although there are developments in metallurgy and textiles. Diamond polishing is undertaken at Okahandja.

Energy is generated locally using hydropower, and coal- and diesel-burning power stations. Local supply is insufficient so the demand is met by importing electricity from the Southern African Power Pool. Imports accounted for 42.5% of total electricity in 1999. Domestic electricity supply may be increased in the future by the use of natural gas and possibly more hydro-power stations. In the rural areas, energy needs are met with diesel generators, paraffin, candles and fuelwood. A wind farm is planned for the high-energy Lüderitz coastline. Use of solar energy is not widespread.

The widely dispersed population and great distances make transportation an important sector. The infrastructure is well developed with 43 000 km of gravel roads, 5 400 km of tarred roads and 2 400 km of railway lines. There are currently about 170 000 motor vehicles registered in Namibia.

Namibia's earliest inhabitants lived as hunter-gatherers and left a legacy of rock paintings from 29 000 years ago. Bantu-speaking pastoralists and crop-farmers moved into Namibia more than 1 500 years ago, followed by European settlers in the 19th and 20th centuries. After the First World War Namibia was governed by the Union of South Africa, later the Republic of South Africa. Namibia gained its independence in 1990 and is now a parliamentary democracy with general elections held every five years. The judiciary is independent of the executive and legislative bodies (Cabinet and Parliament respectively).

Namibia is home to a variety of ethnic groups of which the Ovambo form the largest. Other ethnic groups include the Coloureds, Damara, Herero, Himba, Lozi, Mafwe, Basters, Tswana, Mbukusha, Nama, San, Subiya and citizens of European descent. The official language is English.

The population of Namibia is estimated at 1 826 854 for 2001, of which 51.3% are women. The population growth rate declined from 3.1% in 1991 to 2.6% in 2001. The spread of HIV/AIDS is a major factor contributing to this decline. Life expectancy dropped from 56 years in 1995 to 43 years in 2000. Average population density is two people per square km, although it rises to 100 per square km in the Khomas region and in the north where rainfall is higher.

Namibia is a lower middle-income country with a real per capita income of about N$8 300[1]in 2001. There are considerable disparities in income as reflected by the Gini-coefficient of 0.7. About 38% of households live in poverty. Government is the single largest employer in the country (about 80,000 people). Unemployment is currently at 35%.

Namibia is highly dependent on its natural resource base of minerals, fisheries, agriculture and wildlife. The variable rainfall, frequent droughts and reliance on subsistence agriculture combine to make Namibia highly vulnerable to climate change.

Inventory of greenhouse gases

Namibia contributes little to global greenhouse gas (GHG) emissions. Instead, Namibia is estimated to be a net sink for carbon dioxide in 1994, as a result of increasing woody biomass in the rangelands, due to the process of bush encroachment. There is a large degree of uncertainty on the extent and rate of bush encroachment and hence the magnitude of CO_2 uptake for 1994.

In 1994, the greenhouse gas emissions from Namibia were 5 614 Gg CO_2 equivalent, excluding the sink described above. The transport sector is the greatest emitter of CO_2 (about 50% of total national CO_2 emissions) because of the great distances travelled in order to distribute goods and services. Enteric fermentation in cattle and sheep contributes 98% of the CH_4 emissions. Emissions of NO_2 are small and mostly derived from the burning of savannas.

[1] The Namibian dollar (N$) has parity with the South African Rand. N$=0.1 US$ in May 2002.

Summary of greenhouse gas emissions (positive) and removals (negative) in 1994

Greenhouse gas source and sink categories	CO_2 (Gg/year)	CH_4 (Gg/year)	N_2O (Gg/year)	CO_2 equivalent (Gg/year)
All energy	1821	4	0	1920
Industrial processes	5			5
Agriculture		162	1	3712
Land use change and forestry	-5716			-5716
Waste		3		63
Total (net national emission/removal)	**-3890**	**169**	**1**	**-16**

Notes: One Gg is equal to a billion ($1x10^9$) grams, or a thousand tons. Methane and nitrous oxide have been converted to their equivalent climate effect, expressed as CO_2. Values have been rounded to the nearest Gg.

The industrial sector is small. Cement manufacturing was the only industry for which CO_2 emissions were calculated in 1994.

The Namibian economy is not energy-intensive, as it relies primarily on agriculture, fisheries and mining of minerals, without much secondary processing. The bulk of the energy needs are currently imported as petroleum products, electricity and coal. Electricity related emissions of carbon dioxide in Namibia are low (1 800 Gg of CO_2 in 1994) compared to other countries. Most of Namibia's electricity is imported from South Africa. The two thermal power plants in Namibia are mainly used when there are problems with the national grid. In times of drought, electricity generation from the hydro-electric plant cannot always be provided.

Future updates of the inventory require several areas of uncertainty to be addressed. Research should be directed to improve estimates of emissions or sinks resulting from land use, validated emission factors for enteric fermentation, better estimates of emissions from the waste sector, and improved information on crop residue and savanna burning. In many cases, these data were not available for the 1994 inventory, but are now being collected.

Projected impacts and vulnerability

Projected impacts for Namibia were based on the global IS92a climate change scenario. The IS92a scenario was used because it offers a mid-range estimate of future emissions and assumes only a modest degree of policy intervention to limit emissions of GHG. Under this global scenario, anthropogenic CO_2 emissions will triple, and CH_4 and NO_2 emissions will double by 2100.

The climate models reviewed in this study project that mean annual temperature, and minimum and maximum monthly temperatures will increase by 2 to 6°C by 2100 in Namibia. Predictions of rainfall are highly uncertain, ranging from a small increase of 30 mm per year to severe decreases of 200 mm below the current annual average. The greatest impact is predicted for the central inland areas. Evaporation is also anticipated to rise by 5% per degree of warming, so even if rainfall is unchanged, the availability of water is likely to decrease. Sea level rises of 30 to 100 cm are anticipated by 2100.

The water sector is the most vulnerable to climate change. Even without the threat of climate change, Namibia faces absolute water scarcity by the year 2020. The combined flow of the rivers Namibia shares with its neighbouring countries is 66 500 million m^3 per year.

Groundwater and ephemeral water bodies supply the rest of Namibia's water needs. The assured annual yield of water is about 500 million m^3. The per capita water supply is thus below 300 m^3 per person per year, making Namibia a nation of absolute water scarcity. Even in the case of a moderate increase in evaporation of 15% and no change in rainfall, the additional stress on the water sector due to climate change would be severe. If rainfall decreased by 30% and coincided with an increase in evaporation of 30%, as projected by some models, then the impact on the water sector and human development in Namibia would be extreme.

Water supply for irrigation of crops and livestock watering amounts to about 120 million and 6 million m^3 per year respectively, while mining activities require about 8 million m^3 per year. Water flow in the Kunene River is essential to ensure the continued functioning of the Ruacana Hydropower plant, which supplies almost half of Namibia's electricity needs. Water supply and seasonal flow patterns are also essential for ecosystem maintenance – particularly the wetlands which are identified as Namibia's most threatened category of ecosystem.

Climate factors already have a great influence on agricultural productivity. Periodic droughts are responsible for stock losses and reduced grain production. Indeed aridity is regarded as an expected state of the environment, although agricultural systems are not always adapted to this reality. In times of drought, livestock production is reduced because the availability of forage is reduced, milk production declines, health status deteriorates and growth rates decline. The agricultural sector is particularly vulnerable to climate change because it is crucial to national food security. Over two-thirds of the population practise subsistence cropping with staple crops such as millet. Impacts of climate change on household food security in the subsistence farming area could be dramatic. In the extreme, climate change could lead to social disruptions and displacement amongst rural communities. Maize is the principal commercial crop but only half of the country's needs are met locally. Maize yield is likely to decrease under climate change scenarios of increased temperatures and less rainfall.

The marine fisheries are threatened by possible changes to the ocean current on Namibia's west coast. The fisheries rely on nutrient-rich upwellings of the cold Benguela Current. Any change in the frequency, timing or distribution of the upwelling would influence production, with significant economic impacts due to the prominence of marine resource industries in Namibia. Over the last decade, a trend of warmer sea surface temperatures has been noted over the northern Benguela region. This warming trend may be one of several environmental factors that have contributed to declining fish stocks in recent years.

Changes in rainfall and temperature would impact on biodiversity and ecosystems in Namibia. Endemic species, such as those found on the escarpment and in the winter rainfall area of the southwest, and wetland ecosystems, are particularly vulnerable. In particular, the Succulent Karoo biome is vulnerable to ecosystem boundary shifts and local species extinctions due to climate change. Marine biodiversity may also be impacted if there are shifts in the Benguela Current system. Impacts on the natural resource base, on which the tourism, agriculture, inland and marine fisheries, craft, wildlife and many subsistence sectors rely, are difficult to predict but may be substantial.

The predicted rise of 0.3 m or more in sea level would certainly inundate significant parts of Walvis Bay, the main port of Namibia. The coastal towns of Swakopmund and Henties Bay are also vulnerable, to a lesser degree.

Diarrhoea, under-nutrition, malaria and acute respiratory infections are responsible for most deaths of children under five years of age in Namibia. These causes of death are all strongly linked to climate. Drought and the shortage of clean water for drinking and washing increase susceptibility to respiratory and gastro-intestinal infections. Malaria is an important cause of adult mortality. Projected changes in climate could extend the area at risk from malaria southwards into the centre of the country, a trend that is already apparent.

Most of Namibia's electricity is imported. The balance is generated locally by the Ruacana hydroelectric plant on the Kunene River or the two thermal power stations at Windhoek and Walvis Bay. During periods of drought and low river flow; electricity production at Ruacana is severely curtailed. Under climate change scenarios of increased evaporation and reduced rainfall, electricity generation would be adversely affected. Under some scenarios, rainfall is predicted to increase in the southern parts of Angola, in which case the catchments of the Kunene River could receive more rain.

Energy needs in rural areas are largely met by biomass fuel. The supply of wood for fuel is increasing because of bush encroachment in some parts of the country, but these are often remote from the areas of fuelwood scarcity. The high sunshine hours in Namibia make the country ideally suited to exploit solar power, but this renewable energy source is currently under-utilised.

The direct effects of climate change on the economic sectors described above would be felt throughout the economy, ultimately reducing productivity, influencing sustainable development options and affecting social stability. If, as some models predict, the climate of Namibia becomes hotter, drier and more variable over most of the country, marginalized rural populations and the urban poor will be most severely affected.

Policies and measures

Namibia does not yet have a national policy that specifically addresses climate change. The need for such a policy has been recognised. A wide range of policies, plans and programmes are already in place that put natural resource management in the context of Namibia's existing harsh climatic conditions. Natural resources are recognised as crucial for the future growth of Namibia. Considerable effort has been spent on formulating policies that address sustainable environmental development within the context of social and economic development. A Climate Change Strategy and Action Plan is needed to integrate policies across sectors and to consultatively identify priority activities to address climate change issues.

The Namibian Climate Change Committee (NCCC) was established in 2001. Its main function is to advise and make recommendations to government on climate change including how to meet its obligations to the UNFCCC. The NCCC membership is made up of representatives from government, NGO's, parastatals and the private sector.

Namibia is a signatory to most of the important regional and international environmental agreements and conventions and ensures that activities and obligations are coordinated as synergistically as possible. Integration ensures technical links and improved economic efficiency between programmes as well as better development outcomes.

Although Namibia is a net sink of GHG, several mitigation options have nevertheless been considered. For example, the use of natural gas from the Kudu gas field as an energy source would increase GHG emissions from Namibia, but would reduce the emissions from the southern African region.

Research and systematic observations

Namibia contributes to the global observations of the climate system. Weather data is provided on an hourly basis from six synoptic stations, supplemented by eight stations where records are taken three times a day. There is a network of about 300 active rainfall stations. About 100 stations provide full year-round records.

Other relevant environmental parameters that are regularly measured include river flow, depth of water table, vegetation change, wildlife and livestock numbers, crop production, sea temperature, fisheries statistics and health statistics. The Ministry of Environment and Tourism has a range of relevant environmental information-related programmes, including a State of the Environment Reporting (SoER) programme, a small but expanding Environmental Observatories Network looking at environmental change in an integrated manner, and national programmes on desertification, woody resources, biodiversity loss, wetland management, and regional land use planning.

Namibia has participated in regional global change research initiatives such as SAFARI-92, SAFARI 2000, BENEFIT, BCLME and others and contributes to global change monitoring through ozone observations and Long Term Ecological Research observatories.

Environmental observations and monitoring networks are well established but generally need to improve spatial or temporal coverage. Specific research needs relating to climate change are identified in the following section. In addition to support for these identified research needs, there is a need for interpretative capacity to be developed within Namibia.

Public awareness and training

Some effort has been directed towards increasing awareness of climate change issues. The Regional Awareness Programme of the Desert Research Foundation of Namibia is focused on the sensitivity of arid environments, and as the increase of aridity would be the major impact of climate change in Namibia, public education is thus in its initial stages. Information dissemination and awareness of environmental issues have received general attention in school curricula, with some attention specifically paid to climate change.

Training in environmental management has been undertaken with most recipients comprising staff at national institutions, or local communities and NGOs. The need for greater awareness of climate change in both the public sector and government is recognised by the Ministry of Environment and Tourism, NCCC and partner organisations.

Financial and technology needs

As a non-Annex 1 party, Namibia is eligible for support in order to meet the obligations of the UNFCCC.

Namibia requests financial and technology support in the following areas:

- The establishment of a National Climate Change Office to coordinate activities in this sphere. This office would coordinate the compilation of databases, inventories and technical information documents, as well as promote public awareness, on climate change. The office would also contribute to policy development on climate change.
- The development of a Climate Change Strategy and Action plan. A consultative process is needed to ensure that climate change is further integrated into policies at a national level. Important activities must be identified and prioritised in an implementation plan with appropriate budgets.
- Research and modelling to reduce uncertainty in a number of areas. These include future climate change trends, improved observation systems, agricultural production models, dynamics of the Benguela Current ecosystem, carbon balance of woodlands and land-use change, improved GHG estimates from the waste sector, impacts on water resources and understanding threats to biodiversity and likely impacts on terrestrial and freshwater ecosystems.
- Adaptation projects such as control of malaria and other climate-related diseases, dealing with sea level rise, testing of drought tolerant crops and heat resistant livestock breeds (focusing on locally adapted landraces), public education programmes and water use efficiency measures.
- Mitigation projects such as improved energy systems, appropriate afforestation and agroforestry projects, improved stoves and charcoal kilns, efficient lighting and solar water heating schemes and expanded rail infrastructure/s.

Conclusion

As an extremely arid country, Namibia is highly vulnerable to the effect of climate change. Namibia has a relatively small economy with few options for economic development, marginal agriculture, highly specialised biodiversity, and limited capacity to adapt to climate change impacts.

Namibia and climate change

- Namibia's contribution of greenhouse gases to the global atmosphere is minimal.
- Namibia is more likely to be a sink of greenhouse gases although there is considerable uncertainty around the size estimates of sinks such as woodlands and forests.
- Water is a scarce resource in Namibia so climate change, especially changes in rainfall, will have the greatest effect on its economic growth.
- Namibia is vulnerable in sectors such as human health, crop and livestock production, coastal flooding and impacts on biodiversity and ecosystems.
- Likely impacts, vulnerable sectors and opportunities for adaptation and mitigation to climate change have been identified. Financial and technical support to address these is required from the UNFCCC mechanisms.

Abbreviations, acronyms and glossary

AIACC	Assessment, Impacts and Adaptation to Climate Change
BCLME	Benguela Current Large Marine Ecosystem Programme
BENEFIT	Benguela Environment Fisheries Interaction and Training Programme
BIOTA	Biodiversity Monitoring Transect Analysis in Africa Programme
CBS	Central Bureau of Statistics
CC	climate change
CCAC	Climate Change Advisory Committee
CDM	Clean Development Mechanism
CGCC	Contact Group on Climate Change
CH_4	methane, a greenhouse gas
CO_2	carbon dioxide, the principle anthropogenic greenhouse gas
COP2/10	Decision 10 of the Second Conference of the Parties to the UNFCCC
DEA	Directorate of Environmental Affairs
dm	Dry matter (the weight of plant material after drying)
DMC	Drought Monitoring Center
DOC	Degradable organic matter
DRFN	Desert Research Foundation of Namibia
DWA	Department of Water Affairs
ELTOSA	Environmental Long-Term Observatories for Southern Africa
EMIN	Environmental Monitoring and Indicators Network of Namibia
ENSO	El-Niño Southern Oscillation, a global climate phenomenon caused by large difference in temperature in the eastern Pacific Ocean. During ENSO events summer rainfall areas are abnormally dry. A similar effect occurs in the south Atlantic, known as the Benguela Niño, which has a direct effect on Namibia's climate
EONN	Environmental Observatory Network Namibia
FAO	Food and Agriculture Organisation
Gg	gigagram or 1 kiloton (equals $1x10^9$ grams)
GDP	gross domestic product
GEF	Global Environment Facility
GHG	greenhouse gas
GRN	Government of the Republic of Namibia
GTZ	Gesellschaft für Technische Zusammenarbeit
GWh	gigaWatt hour (equals $1x10^9$ watt hour)
GWP	global warming potential
ha	hectare (equivalent to 10 $000m^2$)
HIV/AIDS	human immune virus/ acquired immune deficiency syndrome
IGBP	International Geosphere-Biosphere Programme
IPCC	Intergovernmental Panel on Climate Change
ITCZ	inter tropical convergence zone
kha	kilohectare (equals 1 000 hectares)
km	kilometre
kt	kiloton or one thousand tons (equals $1x10^9$ grams)
kV	kilovolt
LUCF	land use change and forestry
LPG	liquid petroleum gas
LTER	long-term ecological research
m^3	cubic metres
mamsl	metres above mean sea level
Mg	megagram ($1x10^6$ g) also known as a metric ton
mm	millimeter
Mm^3	million cubic metres

MAWRD	Ministry of Agriculture, Water and Rural Development
MET	Ministry of Environment and Tourism
MFMR	Ministry of Fisheries and Marine Resources
MME	Ministry of Mines and Energy
Mt	megaton or $1x10^6$ tons (equals $1x10^{12}$ grams)
MW	megawatts (equals $1x10^6$ watts or $1x10^6$ J/s)
MWTC	Ministry of Works, Trade and Communication
N_2O	nitrous oxide, a greenhouse gas
NBSAP	Namibian biodiversity strategy and action plan
NCRST	National Commission on Research, Science and Technology
NCCC	Namibian Committee on Climate Change
NDP 1	National Development Plan 1 (in two parts)
NDP 2	National Development Plan 2
NEEN	Namibian Environmental Education Network
NEPRU	Namibian Economic Policy Research Unit
NGO	Non-governmental organization
NMS	Namibian Meteorological Service
NMVOC	Non-methane volatile organic compounds
non-Annex 1	Countries not listed in Annex 1 at the UNFCCC i.e. developing countries
N$	Namibian Dollar (about 0.1 US$ in May 2002)
oshana	A temporary water body formed when shallow depressions are filled by floods or rainwater. Oshanas are common in the north central part of Namibia.
PV	photo voltaic
RAP	Regional Awareness Program
RRSU	Regional Remote Sensing Unit
SADC	Southern African Development Community
SAFARI-92	Southern African Fire-Atmosphere Research Initiative which took place in 1992 and aimed to quantify the effect of vegetation burning in southern Africa on the atmosphere
SAFARI2000	Southern African Regional Science Initiative, an international science initiative aimed at developing a better understanding of the southern African land-atmosphere-human system in 2000
t	ton (one metric ton, $1x10^6$ grams)
TJ	terajoules ($1x10^{12}$ joules), a measure of energy
TAC	total allowable catch
TAR	Third Assessment Report
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America
US$	United States Dollar
VOC	volatile organic compound

Chapter 1: National circumstances

The purpose of this section is to establish the context in which Namibia exists, especially as it relates to the country's vulnerability to climate change and capacity to respond to likely impacts.

1.1 Geography and geology

Namibia is situated in southwestern Africa, between 17° and 29° S and 11° and 26° E. It has a 1 500 km long coastline on the south Atlantic Ocean (Sakko, 1998). Its neighbours are Angola, Zambia, Botswana and South Africa. The total land area is 824 268 km^2. The physical-geographic context of Namibia is determined by its position at the border of the continental shelf of the southern African subcontinent in the climatic sphere of influence of the Tropic of Capricorn and the cold Benguela Current. The land surface ascends from the Namib Desert to the mountains of the continental border range with peaks of up to 2 606 metres above mean sea level (mamsl). To the east and north the country then descends into the Kalahari basin with a mean altitude of 1 000 mamsl. Nearly half of the county's surface is exposed bedrock, while young surficial deposits of the Kalahari and Namib deserts cover the remainder. Namibia is underlain by many geological formations, including mineral-bearing metamorphic complexes, as well as Meso- to Neoproterozoic rocks containing copper, gold, zinc and uranium and Permian rocks of the Karoo sequence with coal deposits. Following the discovery of the offshore Kudu gas field of Cretaceous age, recent hydrocarbon exploration also intersected potential oil-producing rocks. Tertiary to Quartenary diamondiferous deposits are currently exploited along the southwestern coast of the country (Pers. Comm. Dr G Schneider, Ministry of Mines and Energy, 2002).

1.2 Climate

Namibia is semi-arid to hyper-arid with highly erratic rainfall. The mean annual rainfall ranges from over 700 mm in the northeast to less than 25 mm in the southwest and west of the country. The Ministry of Agriculture, Water and Rural Development (MAWRD) classifies Namibia into four climate zones (Table 1.1; MWARD, 1995).

The cold Benguela Current along the west coast, and Namibia's position straddling the subtropical high-pressure belt determines the main features of the climate. During the summer months, the Inter-tropical Convergence Zone (ITCZ) moves southwards to about 20° S, bringing moisture to the northeastern parts of the country. A thermal low-pressure cell influences the rest of the country. Moist air associated with the ITCZ is warmed by intense radiation and leads to convective storms. The air becomes progressively drier over the central and southern parts of the country as most of the moisture is shed over the northeastern parts of the country. Between April and October, the stable high-pressure cell displaces the ITCZ and its associated thermal lows to the north, resulting in dry conditions in winter. Sometimes during this dry season, southwesterly waves displace the cell northwards, drawing in moisture-bearing air from the southwest and causing some winter rain up to 23° S (Pers. Comm. Mr Franz Uirab and Dr AL Du Pisani, 2002; Preston-White and Tyson, 1988).

Table 1.1 The average annual rainfall by zone (MAWRD, 1995)

Zone	Annual rainfall in mm	Percent of Namibia
Desert	<100	22
Arid	100-300	33
Semi-arid	301-500	37
Semi-humid and sub-tropical	501-700	8

Most rain occurs in the summer months from November to April in the form of localised showers and thunderstorms. In the extreme southwest, winter rain and even snow can be expected in the months from June to August. The inter-annual coefficient of variation of rainfall is very high, ranging from 25% in the northeast to >80% in the southwest. At some places in the southern parts of the country, winter rains account for up to 50% of annual rainfall. The percentage of total annual rainfall for the summer months (October to April) is shown in Figure 1.1. In the western part of the Namib Desert, coastal fog is an important source of water for the desert fauna and flora. Fog precipitation is fives times greater than that of rain and is far more predictable (Henschel *et al.*, 1998).

Daytime air temperatures are generally warm to hot due to high insolation, but because of low humidity and outgoing long wave radiation at night, minimum temperatures can drop to below freezing point in winter. In the coastal areas, temperature extremes are rare. Mean temperatures are shown in Table 1.2.

Table 1.2 Mean monthly minimum and maximum temperatures in Namibia

Location		Mean monthly maximum temperatures	Mean monthly minimum temperatures
Coastal areas	Throughout the year	16-22° C	10-17° C
Inland areas	Summer	28-37° C	13-20° C
	Winter	20-30° C	2-12.5° C

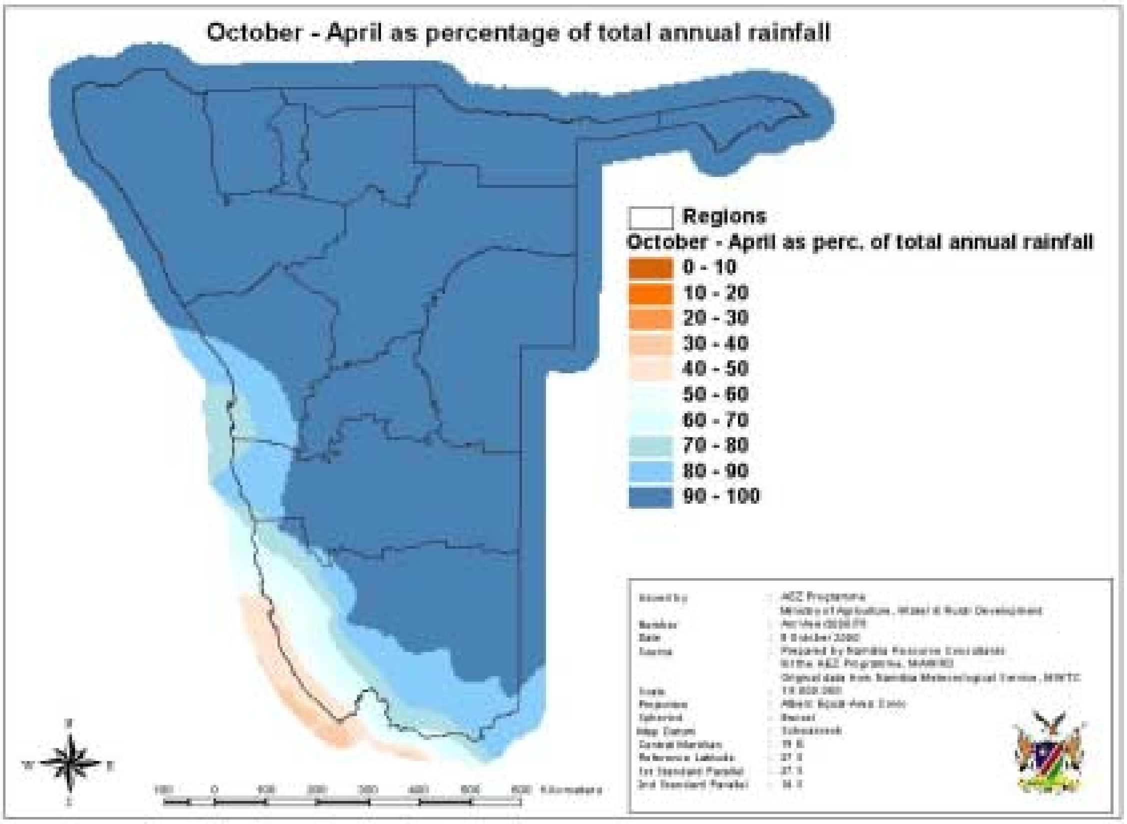


Figure 1.1 The percent of the total annual rainfall occurring in the summer months (October to April)

High solar radiation, low humidity and high temperature lead to very high evaporation rates, ranging from 1.5 to 3.0 metres annually for surface water. The effect of the sparse and highly variable rainfall, high evaporation rate and virtual absence of permanent surface water, other than in a few dams and perennial streams, make water an extremely scarce resource in Namibia. Drought is a recurring feature of the climate and desertification is a serious national concern.

1.3 Vegetation

Namibia is conveniently described as a land between two deserts, the Namib and the Kalahari. Annual rainfall determines the three main vegetation zones: deserts, savannas and woodlands. Savanna covers 37% of Namibia, dry woodlands and forests 17%, while desert (Namib and Karoo biome) vegetation is distributed over 46%.

Fourteen more-detailed vegetation types have traditionally been recognised (Table 1.3) (Giess, 1971), although a new and more accurate vegetation classification system for the 2002 Atlas of Namibia rests on 101 vegetation types.

Table 1.3 Types of vegetation recognised in Namibia by Giess (1971)

Vegetation Type	Vegetation Type (cont.)
1 Northern Namib	8 Mountain savanna and Karstfeld
2 Central Namib	9 Thorn bush savanna
3 Southern Namib	10 Highland savanna
4 Desert and succulent steppe	11 Dwarf shrub savanna
5 Saline desert with dwarf shrub savanna fringe	12 Camelthorn savanna
6 Semi-desert and savanna transition	13 Mixed tree and shrub savanna
7 Mopane savanna	14 Forest savanna and woodland

In Namibia, 4 138 plant species have been recorded, of which 687 (17%) are endemic and occur in the escarpment and southwest winter rainfall area. The National Herbarium of Namibia, part of the National Botanical Research Institute of Namibia, houses over 65 000 vascular plant specimens. A synopsis of the Namibian flora is shown in Table 1.4.

Table 1.4 Synopsis of Namibian plant taxa including recognized infra-specific taxa

Taxon	Family	Genera	Species	Naturalised species	Total, incl. naturalised species
Mosses/liverworts	22	49	97	-	97
Ferns	12	20	60	2	62
Gymnosperms	1	1	1	-	1
Monocots	35	236	978	28	1006
Dicots	123	722	2971	205	3176
Totals	**192**	**927**	**4 107**	**235**	**4 342**

Source: National Herbarium of Namibia, 2002

Namibia is known for its fungal diversity. Of 189 species recorded for Namibia, two edible species are fairly well known. *Terfezia pfeilii*, or the Kalahari truffle, occurs mainly in the Kalahari sands of south and central eastern Namibia. *Termitomyces schimperi* is found on termite mounds throughout the north-central region after rains. Both fungi contribute substantially to the diet of Namibians living in these regions (Barnard, 1998).

1.4 Water resources

Water sources in Namibia can be divided into three major categories: perennial surface water, ephemeral surface water and ground water. About 43% of the water demand in the country is supplied from surface water sources and 57% from groundwater sources (Table 1.5). Water conservation and demand management are key priorities in the soon to be promulgated Water Act of Namibia. There is a concern that groundwater resources are declining and fossil water is being extracted in some areas. Careful management is necessary if the reserves are to be maintained. Figure 1.2 illustrates Namibia’s ground water resources.

Table 1.5 Use of water by source and sector in 1993 (millions of cubic metres). Bulk refers to bulk users such as mines or local authorities. Rural refers to water supplied to farmers and rural settlements

	Groundwater			**Perennial surface water**			**Ephemeral surface water**		
	Total	**Bulk**	**Rural**	**Total**	**Bulk**	**Rural**	**Total**	**Bulk**	**Rural**
Agriculture	69.1	5.6	63.4	48.9	1.9	47.1	28.3	27.7	0.6
Fisheries	0	0	0	0	0	0	0	0	0
Mining	20.3	3.0	17.3	0.9	0.9	0	0.5	0.5	0
- Diamond	*13.6*	*0*	*13.6*	*0*	*0*	*0*	*0*	*0*	*0*
-Other mining	*6.7*	*3.0*	*3.7*	*0.9*	*0.9*	*0*	*0.5*	*0.5*	*0*
Manufacturing	3.5	6.5	0	0.2	0.2	0	1.3	1.3	0
Services	3.6	3.4	0.2	0.2	0.2	0	1.5	1.4	0.1
Households	28.2	22.6	5.7	5.3	1.7	3.6	11.2	10.4	0.7
Government	1.5	1.5	0	0.1	0.1	0	0.7	0.7	0
Total	**126.2**	**39.6**	**86.6**	**55.7**	**5.0**	**50.7**	**43.3**	**42.0**	**1.4**

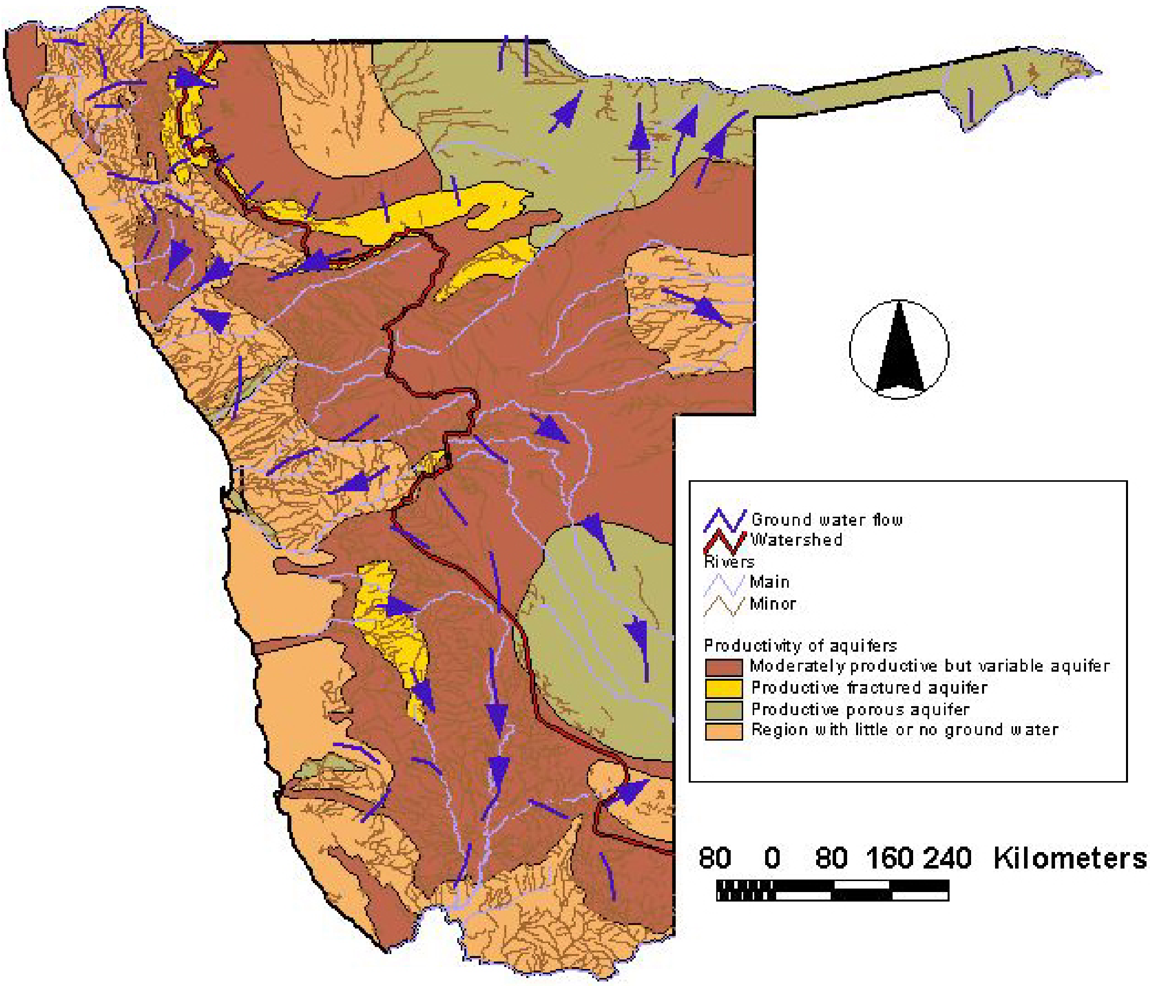


Figure 1.2 Ground water resources in Namibia (Ministry of Environment and Tourism, 2002).

Although access to water has improved tremendously since Independence through the development of new pipelines and dams, water supply is extremely limited. The municipality of Windhoek recycles about 36% of the water it consumes, and operates the largest re-cycling plant in the southern hemisphere. A large desalination plant at either of the coastal towns of Swakopmund or Walvis Bay is under consideration. The ephemeral nature of surface water supplies and Namibia's increasing dependence on these sources increases the county's vulnerability to drought and to climate change (NDP 1, 1995; NDP 2, 2001). Table 1.6 shows water availability and use in Namibia (Lange, 1997).

Table 1.6 Stocks of ground water, perennial surface water and ephemeral surface water for 1990 to 1993 (millions of cubic metres)

Year	**Ground water**	**Perennial Surface Water Annual Runoff of Major Rivers**					**Ephemeral Surface Water**	
		Orange	Zambezi	Kwando	Okavango	Kunene	Annual Runoff	Annual Dam Storage
1990	NA	3 534	31 483	795	3 882	3 863	275	303
1991	NA	2 800	17 613	661	6 607	7 404	58	184
1992	938	600	34 941	785	3 228	1 840	222	252
1993	NA	1 298	24 011	844	2 998	2 516	286	293

Note: NA = not available

1.5 Rivers and wetlands

There are few rivers in Namibia. Most are ephemeral, flowing only after intensive rains. The perennial rivers lie on the southern and northern borders, with the Orange River in the south and the Kunene, Kavango, Kwando-Linyanti-Chobe and Zambezi Rivers in the north.

Ephemeral waters include rivers that run for short periods after rain has fallen upstream in the catchments, the pools they leave behind after flow has stopped, and pools formed as a result of rain falling in inward-draining basins. Some near-permanent pools, streams and lakelets are relatively fresh and others are hyper-saline (Day, 1997). The *oshanas* are ephemeral rivers formed in the shallow depressions of the Cuvelai system which originate in Angola and flow into the Etosha Pan during years of very high rainfall (Figure 1.3). *Oshanas* are in the north-central region, which is the most densely populated area of Namibia.

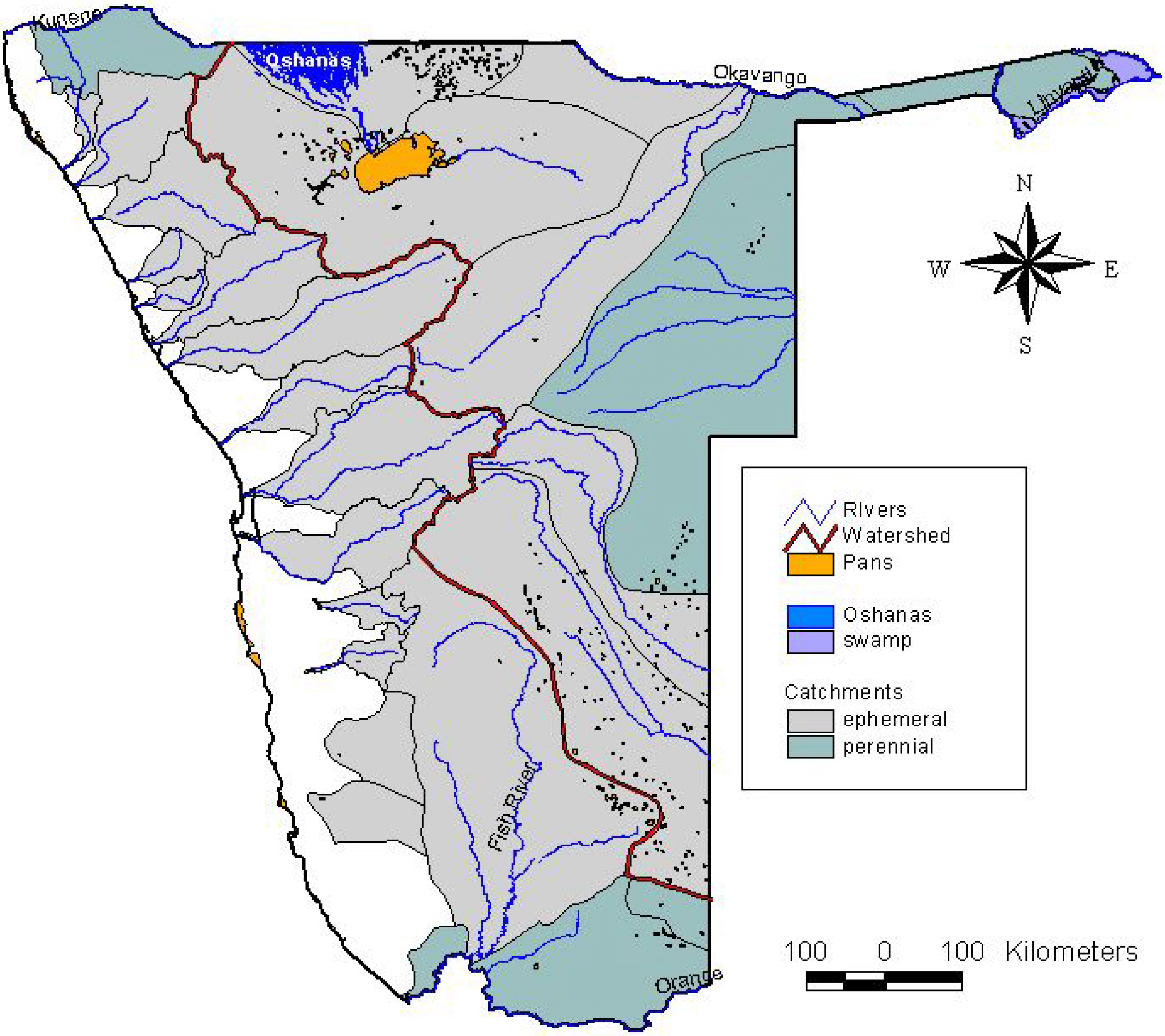


Figure 1.3 Surface water resources in Namibia (Ministry of Environment and Tourism, 2002).

1.6 Natural resources

Namibia's natural resource base includes range and arable land, woodlands, high-value mineral deposits and a large and diverse community of wildlife. Savanna covers 37% of Namibia, dry woodlands and forests 17% while desert vegetation (Namib and Karoo biomes) is distributed over 46% (Barnard, 1998). Less than 2% of the land is arable, because rainfall is limited. Beef and small stock (sheep and goats) production is the most common land use, although game farming and mixed wildlife/livestock production is a fast-growing industry. State controlled protected areas comprise 114 079 km^2, or 13.8% of the land surface (Barnard, 1998). The total above ground woody standing stock is estimated as 1 618.80 million ton and the mean annual increment is 34 million tons (Errlikä and Siiskonen, 1992). For the 1994 inventory the annual biomass increment calculated for dry forest was 1 250 000 ton and for other forest and woody biomass stock it was 3 300 000 ton, to give a total of

4 550 000 ton of dry matter. These figures are considered conservative. It must be noted that the estimates of forest and woody biomass differ according to the definitions used to categorise different vegetation types.

1.7 Land use

Current and past land use patterns in Namibia are determined by Namibia's political history, ecology and climate. Nomadic pastoralism, dictated by the availability of grazing and water, was practised extensively during the pre-colonial period. The following land use pattern is reported for Namibia (Tarr, 1998):

- Close to 70% of Namibia's population practise subsistence crop farming and agro-pastoralism on communal land (non-free-hold land). Communal land belongs to the State and constitutes approximately 41% of the total land area of the country.
- Commercial farmers (less than 1% of the population) own approximately 44% of the land. For commercial livestock farming an economic unit or farm is sized between 3 000 – 20 000 hectares (Pers. Comm. Mr R Venter).
- 2% of the total land area is reserved for diamond mining.
- 13.8% has been proclaimed as state-controlled protected conservation areas.

Figure 1.4 presents the way in which Namibia's land is currently divided and used.

1.8 Agriculture

The agricultural sector consists of two sub-sectors. More than half (52%) of the agricultural land is occupied by some 4 500 commercial farmers with freehold land title (Werner, 2000) who employ about 35 000 labourers. The communal sub-sector consists of about 150 000 small-scale subsistence farmers that obtain land through customary land tenure regimes. The sector's contribution to GDP (5.6% in 2000) was shared by both sub-sectors equally (Central Bureau of Statistics, 2001). Namibia's semi-arid to arid climate does not allow for much intensive agricultural production. Extensive livestock ranching thus dominates, with cattle farming in the northern and central regions and small-stock and ostrich farming in the more arid western, southern and south-western regions (Werner, 2000). Dryland crop production is common in the north and north-eastern parts of the country. While pearl millet is the staple crop in the communal areas, maize is grown in the commercial areas. Wheat production is only possible under irrigation.

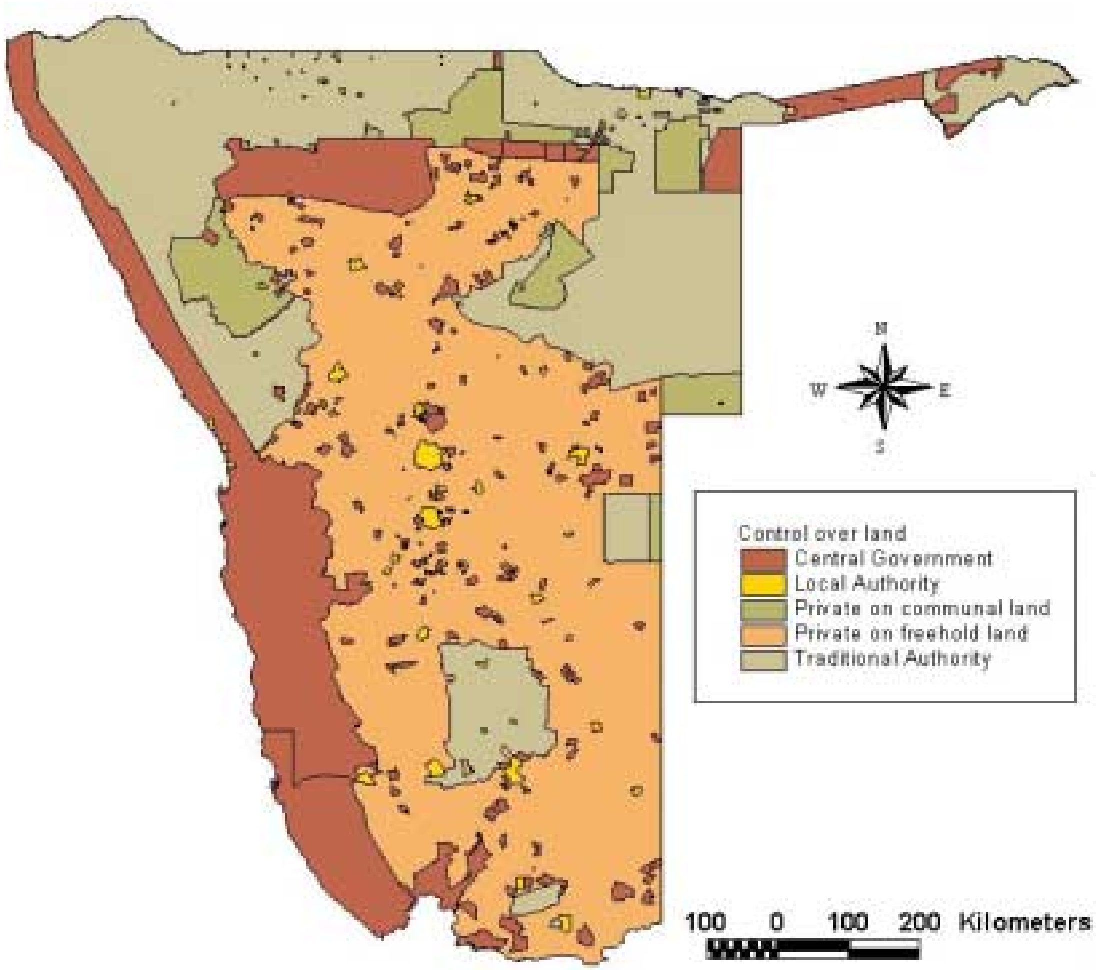


Figure 1.4 Land tenure in Namibia (Ministry of Environment and Tourism, 2002).

Agricultural activities have diversified over the past years with cotton and tobacco production in the north. In a pilot project, rice is grown in some of the *oshanas* – flat pans in the Cuvelai Basin of north-central Namibia that fill with water during the rainy season. Horticulture plays an increasingly important role, since favourable climatic conditions along the Orange River on South Africa's border have attracted considerable investment in grape production. Dates, vegetables and other products are grown where dams supply irrigation water. Though the agricultural sector is, to a certain extent, adapted to the prevailing climatic conditions, the continued reliance on imported paradigms and genetic resources mean that it is vulnerable to climate change. Rangeland resources in particular would be under threat in the country, as human communities have become settled in areas where they previously practised an adaptive form of extensive and nomadic pastoralism.

1.9 Fisheries

Namibia's fisheries sector is based on the cold Benguela Current. The associated up-welling cells carry nutrients that support fish stocks in Namibian waters. The commercial fishery is based on about 20 different species. Small pelagic (open-water) species (pilchard, anchovy and juvenile mackerel) and lobster are fished along the shallower onshore waters on the continental shelf. Large pelagic species including adult mackerel, demersal (bottom-dwelling) hake and other deep-sea species, such as monkfish, sole and crab, are fished in the waters further offshore (DIT, 1999).

Uncontrolled fishing before Independence dramatically reduced the stocks of many fish species and the new government embarked on a policy to rebuild fish stocks and to manage fish stocks on a sustainable basis. Fishing rights are allocated to fishing companies for a specific period of time, up to 20 years. Total Allowable Catches (TACs) based on the fishable biomass of the stocks are set every year by the Ministry of Fisheries and Marine Resources (MFMR), based on the advice from the Directorate of Resource Management, and the Marine Resources Advisory Council. In May 2002, for the first time, a zero TAC for pelagic fish resources was announced by the MFMR.

The fisheries and fish processing sectors have contributed over 10% to GDP since 1998, up from 5% in 1991 (Boyer and Hampton, 2001). The combined fisheries and fish processing sector is the third largest of the Namibian economy, behind agriculture and mining, and the second largest export earner, after mining. The demersal fishery, which focusses on bottom-dwelling fish, is the most valuable, with a landed value of N$593 million in 1996 (Boyer and Hampton, 2001). It is estimated that over 85% of Namibia's fish output is for export (DIT, 1999).

The Total Allowable Catch (TAC) for rock lobster and crab is low, but due to stringent protection measures, there seems to be a recovery in stocks. Statistics from the Fisheries Statistic Division in the Directorate of Policy, Planning and Economics in the MFMR show that the quantity of fish harvested in Namibian waters appears to be reaching a limit. The challenge for Namibia is now to add further value to the resource by more on-shore processing. In addition, aquaculture has been identified as a key development focus for the next 30 years.

The impact of climate change on Namibian fish stocks could be quite dramatic. Seawater temperature changes have a definite influence on fish stocks in Namibian waters. The Directorate of Policy Planning and Economics carefully monitors all environmental factors influencing the availability of fish in Namibian waters to harmonize the TAC with the environment. The warming-up (tropicalisation) of the northern Benguela system is already seen as an indication of climatic changes, since it exceeds the normal oscillation. The recent decline in pilchard stocks can probably be explained in part by this warming.

In northern Namibia people fish in the *oshanas* during the rainy season and in the perennial Okavango, Zambezi and Kwando Rivers. The fish is mainly for own consumption and small-scale local trade. It is national policy not to encourage the commercialisation of inland fisheries, especially in the rivers, but to allow only subsistence fisheries.

1.10 Tourism

Tourism is the third largest contributor to foreign exchange earnings, after mining and fisheries. Most tourists expect an environment-centred experience such as game-viewing, bird-watching, hiking, sport-fishing or trophy-hunting (Figure 1.5). The growth of car hire companies indicates the trend towards independently conducted tours instead of group tours in buses. Since the most scenic sites are scattered across the vast country, tourism is quite transport-intensive. As well as being energy demanding most tourism also relies heavily on scarce water resources in arid areas. While Namibia's variety of animals attracts tourists, free roaming animals such as elephants compete with humans, in particular subsistence-farmers, for land and water. The declaration of community conservancies tries to reconcile the basic needs of subsistence farmers with the conservation of nature. Communities now benefit from game in their area through tourism promotion, in particular hunting concessions.

(Photo: Klaus Schade)

Figure 1.5 Namibia's wildlife is the country's third most significant source of foreign currency income, and the fastest growing economic sector.

1.11 Mining

Mining can still be regarded as the backbone of the Namibian economy. The sector contributed 13% to GDP in 2000, mostly through diamond-mining (11.7%). Only the government sector contributed more at 20.5% (CBS, 2001). For the financial year 2001/02, diamond-mining companies are expected to contribute 5.5% to total government revenue in form of company taxes and an additional 3.8% through diamond royalties. Furthermore, diamonds accounted for 48% of the total export value in 2000 (Bank of Namibia, 2001). The mining sector's significance is not reflected in its contribution to employment creation. Total employment in this sector declined from around 20 000 in the early 1980s to about 6 000 in 2000. Capital-intensive production techniques, in particular in off-shore diamond mining that contributes more than 50% to the total diamond production, has made much labour redundant.

Besides diamonds, uranium, copper, lead, gold, zinc and salt are further important products, while other minerals play only a minor role. The Skorpion zinc mine is under development in the south of the country. Production is expected to commence during the first quarter of 2003. A large copper deposit has also been demonstrated in the south, but currently cannot be economically exploited, because of low copper prices on the world-market.

Gas explorations are promising and it is expected that the development of the Kudu Gas Field in the south of Namibia – about 170 km offshore of Oranjemund – could commence in 2003.

Development would include a gas-fuelled power plant at Oranjemund (400 MW) – and perhaps a larger one at Cape Town – and the establishment of a floating Liquefied Natural Gas facility. Production would not start before the year 2006.

1.12 Manufacturing

The manufacturing sector largely depends on the processing of agricultural (grain and meat processing) products, food and beverages, and fishery products. Mining output is processed to a lesser extent in the country. Diamonds are now being cut and polished at Okahandja and the same is planned for gemstones. A lead smelter is operated at Tsumeb and a zinc refinery is under construction at the Skorpion Mine. A large textile plant is under construction in Windhoek that will employ up to 5 000 workers and consume considerable amounts of water and electricity. Despite the large number of cattle in the country, a leather industry is emerging slowly with an additional tannery to be opened in the north soon. There is no significant chemical and metal-working industry in the country. Charcoal production has increased over the past years. Klaboe and Omwami (1997) reported that 7 000 tons of charcoal were produced in 1996. The felling of mature indigenous plants (for charcoal production) speeds up the process of bush encroachment by smaller, less valuable shrubs. Exact figures are hard to obtain but estimates of wood used range between 15 000 tons and 50 000 tons per year.

Namibia's Industrial Policy aims to increase manufacturing activities to reduce dependency on the primary sector and add value to raw materials.

1.13 Energy

Additional economic activities and increased domestic consumption supported by the extension of the rural grid after Independence have led to a natural growth in peak power demand of about 5% per annum. NamPower is the bulk supplier while municipalities supply individual households. Total units sold increased from 1 612 GWh in 1990 to 2 050 GWh in 2001 (NamPower, 2001). Bulk electricity sales are gradually increasing, with local authorities becoming the most significant consumers of bulk electricity, since they overtook the mining sector in the early 1990s. The decline in mining electricity consumption is primarily due to closure of mines rather than energy efficiency measures. The increase in sales to rural areas is a result of the growth in rural consumer numbers (DEA, 1999).

Namibia currently has three electricity-generating plants: a hydroelectric plant at Ruacana (249 MW capacity) which depends on the rainfall in Angola, the coal-fired Van Eck station at Windhoek (120 MW capacity) which imports coal from South Africa, and the stand-by Paratus station at Walvis Bay (46 MW), which burns diesel. In addition, diesel generators and solar panels are used to provide electricity in remote areas in particular.

The local supply does not meet the demand. The maximum demand increased from 280 MW in 1995 to 320 MW in 1998. To cover the demand that cannot be met by local supply, electricity is imported through a 400 kiloVolt (kV) and a 220 kV power line from the South African utility Eskom, and to a much lesser extent, from the Zambian utility Zesco to supply the Caprivi Strip. South Africa generates electricity primarily from coal-fired power plants. Imports accounted for 42.5% of total electricity in 1999, down from 67.7% in 1997. The value of electricity imports hovered around N$80m at current prices between 1993 and 1998 with the exception of 1997 when it peaked at N$139m, accounting for between 0.7% and

1.6% of total imports of goods and services. Transmission losses amounted to 10% in 2001, but will be lower with the completion of the new power line (NamPower, 2001).

The main electricity consumer used to be the mining sector, but its demand has decreased since the early nineties and is now exceeded by that of municipalities. During the year 2000, electricity demand from the mining sector increased substantially due to the resumption of mining operations at Tsumeb by Ongopolo Mining and Processing Limited, particularly the operation of the lead smelter there. A demand increase of over 30% is expected once the Ramatex textile factory in Windhoek and the Skorpion mine in the south start operating. This is expected to be in the second quarter of 2002 and beginning of 2003 respectively.

In the commercial farming areas, diesel generators are used to provide electricity for lighting and pumping water, while subsistence households use firewood to prepare food and candles and paraffin lamps for lighting. Energy-saving ovens are being introduced that reduce the use of firewood by up to 30%. The Rural Electrification Master Plan makes provision for the extension of the grid to rural areas. Electrification would replace the current forms of energy supply with electricity currently generated at coal-fired power plants in South Africa.

Marine fisheries are a major consumer of diesel in the country. While the number of vessels licensed to fish in Namibian waters decreased from 332 (1995) to 260 (1998), it increased again to 293 in 1999 – the year for which the latest figure is available. The number of vessels does not give a sufficient indication of the trend in diesel consumption, since other factors such as age and size of vessels have to be taken into account (Figure 1.6).

(Photo: J-O Krakstad)

Figure 1.6 The Namibian fishing fleet, as represented by this mid-water trawler, is the greatest consumer of diesel in the country.

The Energy White Paper makes provision for the exploitation of renewable energies such as solar energy and wind energy. The Ministry of Mines and Energy, together with the National Development Corporation, embarked on a project to enable rural households to purchase solar panels. Construction of a pilot plant is scheduled to commence shortly. By the end of December 2001, 570 systems had been installed – mainly in the north central regions. A feasibility study was also conducted to generate electricity from wind energy - up to 20 MW - to supply the harbour town of Lüderitz in the south. In the short term, the high costs compared to current electricity prices put constraints on the wider use of this energy source. Two hydroelectric power plants are being considered at the Kunene River in the northwest and at the Kavango River in the northeast, but no final decisions have been taken yet.

1.14 Transport

Namibia’s transport infrastructure is well developed and highly rated. Gravel roads cover almost 43 000 km, tarred roads 5 400 km and railway lines stretch over some 2 400 km (Namibia Trade Directory, 2002). Railway engines are powered by diesel engines. Two highways were constructed to connect Namibia’s deep-sea port of Walvis Bay to neighbouring countries in the north-east such as Zambia, Zimbabwe and northern Botswana through the Trans-Caprivi Highway, and Botswana and South Africa’s industrial heartland through the Trans-Kalahari Highway. The railway line extension from Tsumeb to the densely populated north-central regions and the Angolan border is currently underway. Intensive investment in the two Namibian ports – Walvis Bay and Lüderitz – has increased the capacity to handle additional cargo substantially and has improved competitiveness with South African ports such as Cape Town and Durban. Thus it is expected that transport activities in the country will increase in the medium term.

Passenger transport is on the increase and mainly carried out by minibuses and sedans. For business people and tourists, air travel has become a more important means of transport to bridge the long distances. Aircraft movements have increased by 29% between 1997 and 1999 while the number of passengers rose by 12%. The increasing mobility of people is reflected in the number of cars registered in Namibia. Between May 1999 and February 2002 the number more than doubled from some 82 000 to about 170 000.

Since Namibia introduced unleaded petrol in 1997 it has gained a market share of 25% without being subsidised by government. It is expected that leaded petrol will be phased out over a period of up to 15 years. Diesel with a lower environmental impact will be introduced in 2002. There are deliberations to use gas-fuelled cars for the government fleet, which would reduce vehicle emissions by up to 60%.

1.15 Other economic sectors

Government services are the main single contributor to GDP at about 20% in 2000. Government has become the major single employer in the country – employing almost 80 000 people – while agriculture is the sector that provides most jobs. Large numbers of ex-combatants have been absorbed into government and the security forces after Independence in 1990. Other import sectors, in terms of contribution to GDP, are wholesale and retail trade and real estate and business services. The construction business contributes significantly to job creation in particular for unskilled workers, but its direct contribution to GDP has decreased over the past years to 2%.

1.16 Economic outlook and development

GDP grew by 4.1% on average during the period 1994 to 2000, with some fluctuations mainly caused by the economy's dependence on world commodity prices and climatic conditions. Namibia's inflation rate declined from double-digit figures in 1994 – annual average 10.8% - to a low of 6.2% in 1998. The devaluation of the South African Rand, to which the Namibia Dollar (N$) is linked on a one-to-one basis, as well as oil price increases, have resulted in higher inflation rates in the following years – up to 9.3% in 2001. Since October 2001 inflation has risen from 7.6% (September, 2001) to 10.3% (April, 2002). The devaluation affects imports traded in US$ such as oil and oil products, but also staple foodstuffs such as maize which are priced on import parity prices. On the other hand, exporters gained substantially from higher income and increased competitiveness.

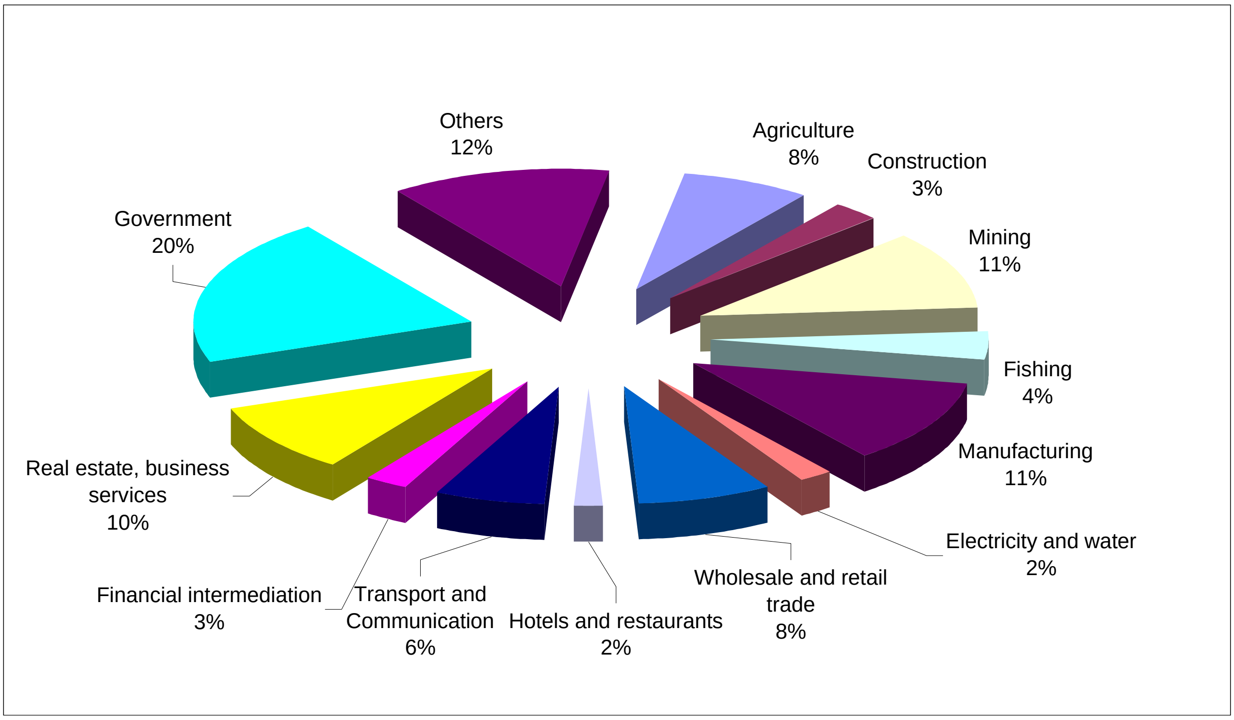


Figure 1.7 GDP composition in 1994 in % (Source: Central Bureau of Statistics, 2001)

It is expected that economic growth will pick up over the next few years because of new, significant economic developments in the country. These include the textile industry, the Skorpion Zinc Mine, and the development of the Kudu Gas field. The manufacturing sector could benefit further from new export opportunities to the USA opened by the provisions of the Africa Growth and Opportunity Act. The diversification of the agricultural sector is expected to continue, with higher demand for cotton by the newly established textile industry, an expansion of tobacco plantations, and further investment in horticulture. Further investment in labour-intensive industries such as the textile industry will help to reduce unemployment in the country and could alleviate poverty as mainly low-skilled labour would be demanded. Expected investment in the manufacturing sector is not likely to change the GDP composition significantly towards the secondary sector since the primary sector will grow due to developments in the mining and gas industry (Pers. Comm. K Schade, 2002).

1.17 Culture and history

Namibia is characterised by a variety of ethnic groups. The Ovambo form the largest group – about 50% of the total population - living mainly in the north-central regions. Other major ethnic groups include the Coloureds, Damara, Herero, Himba, Lozi, Mafwe, Baster, Tswana, Mbukushu, Nama, San, Subiya, and citizens of European descent with Afrikaans, English and/or German as their mother tongue. English is the official language of Namibia.

Rock paintings of early inhabitants date back as far as 29 000 years (Katzao *et al.*, 1995). The early inhabitants were the Nama and San people that lived as hunters and gatherers. Bantu groups started moving into Namibia from East and North East Africa more than 1 500 years ago. The first Europeans reportedly arrived in 1486 as seafarers, but colonisation started only towards the end of the nineteenth century once Africa had been divided between European countries at the Berlin Conference. Namibia was allocated to Germany and became a settler colony in the late 19^{th} century. During the colonial period, the Germans fought against the Herero and Nama people, almost destroying these groups completely. The German colonial period came to an end during World War I. The League of Nations asked Great Britain to govern the country as a 'C-Mandate' on its behalf, but Great Britain handed it over to what was then the South African Union in 1920. After winning the national election in the South African Union in 1948, the National Party also introduced its apartheid ideology to Namibia and created the so-called homelands for the different ethnic, non-white groups. Pressure from the United Nations, among others, through Resolution 435 in 1978 which spelled the way for Namibia's Independence - and from the liberation struggle that started in 1966, eventually led to the Independence of Namibia in 1990. General elections included all political parties and led to the first democratically elected independent government in March 1990.

The new Constitution has been acclaimed for its far-reaching civil rights and democratic spirit. Namibia is a parliamentary democracy with national and regional elections held every five years. The power is separated between three organs: the executive (cabinet), the legislative (parliament) and the judiciary (courts). The President, Prime Minister, Deputy Prime Minister, the 19 Ministers and the Director General of National Planning Commission form the Cabinet. The parliament consists of two bodies – the National Assembly and the National Council. Five political parties are represented in the National Assembly, which consists of 72 elected members and an additional six members appointed by the President. The National Council is the representative body for the 13 regions that send two members each. The courts are independent in Namibia.

1.18 Population

According to preliminary figures from the latest population census in August 2001, Namibia's population grew by 2.6% per annum between 1991 and 2001 to 1,826,854 (National Planning Commission, 2002). Women (51.3%) still outnumber men. The population growth rate declined from 3.1% in 1991 to 2.6% in 2001. A factor contributing to the decline is the spread of HIV/AIDS, as 19.3% of pregnant women are infected with the virus. While only four cases of HIV infection were diagnosed in 1986, AIDS has become the leading cause of death ten years later (Ministry of Health and Social Services, 2001). The impact is already felt by the decline in life expectancy from 56 years in 1995 to 43 years in 2000 (UNDP, 2001). The population is relatively young. In 1997, 42% was under the age of 15 years (UNDP, 1998).

Urbanisation is increasing. In 1991 about 32% of the population lived in urban areas (UNDP, 2001). This share has probably increased over the past ten years since cities such as Windhoek, Oshakati, and Ondangwa have grown considerably. Despite the fact that Namibia is sparsely populated by international standards – the average population density is less than two people per square kilometre - population pressure is already considerable in the northern regions. Most (47%) of the population lives in the north-central and north-eastern regions (National Planning Commission, 2002), where the population density is as high as 100 people per square kilometre. Rainfall in these areas is higher than elsewhere in the country, making it possible for the mainly rural population to survive from subsistence agriculture. Poverty is widespread in these areas and people are vulnerable to climatic changes.

Namibia is classified as a lower middle-income country with a real per-capita income of approximately N$8 300 in 2001. The Gross National Income in Purchasing Power Parity Prices is estimated at US$6 440 for the year 2000 (World Bank, 2002). The average income, however, conceals considerable differences in individual income, which is reflected in the Gini-coefficient of 0.7 (UNDP, 2001). The Gini-coefficient measures the equality in income distribution with 0 representing a totally equal income and 1 an income distribution skewed towards high-income individuals. It is estimated that 38% of households are living in poverty. The Human Development Index was calculated at 0.648 in 2000, placing Namibia 114th out of 171 countries worldwide. The considerable achievements after Independence in school enrolment and literacy have been offset by the declining life expectancy due to HIV/AIDS. The unemployment rate is still 35% according to the latest available National Labour Force Survey of 1997 (Ministry of Labour, 2001).

Table 1.7 National Circumstances of Namibia

Criteria	Units	Absolute values 1994	Absolute values (most recent year)	Source
Population (estimated from1991 census with average growth rate of 2.5%)	Number	1 526 000	1 826 854 (2001)	4,2
Land area	km^2	824 268	824 268	
GDP	N$	12 204	15 074 (2000)	1
GDP per capita (1995 constant prices)	N$	7 894	8 154 (2000)	4
Share of informal sector in GDP	%	Not available	Not available	1
Share of agriculture in GDP	%	7.6	5.6 (2000)	1
Share of fishing in GDP	%	3.8	4.9 (2000)	1
Share of mining in GDP	%	10.8	13.0 (2000)	1
Share of manufacturing in GPD	%	11.8	10.2 (2000)	1
Share of water and electricity in GDP	%	2.0	2.4 (2000)	1
Share of construction in GDP	%	2.7	2.0 (2000)	1
Share of trade, hotels and restaurants in GDP	%	9.3	10.4 (2000)	1
Share of transport and communication in GDP	%	6.4	5.8 (2000)	1
Share of banks, insurance and business services in GDP	%	12.3	12.7 (2000)	1
Share of general Government in GDP	%	20.6	20.5 (2000)	1
Share of social and personal services in GDP	%	0.9	0.8 (2000)	1
Share of taxes (less subsidies) in GDP	%	10.5	11 (2000)	1
Land area used for agriculture	km^2	320 000	Not available	
Beef production (Million N$)	N$	412.1	793.8 (1999)	3
Other livestock productions (milk, hides and skins) in Million N$	N$	48.8	168.4 (1999)	3
Other animal and animal products	N$	83.1	48.5 (1999)	3
Major cereals (million N$)	N$	30.20	15.60 (1999)	3
Horticulture Production	N$	4 392 010	92 375 315	3
Urban population as percentage of total population (urban area defined as settlements of > 5000 people in which < 25% indulge in agricultural activities	%	36.0	43.0 (2000)	4
Livestock population (1993 data)	Number			3
• *Cattle*		2 035 794	2 278 569 (1999)	3
• *Goats*		1 639 212	1 689 770 (1999)	3
• *Chickens*		473 310	450 513 (1999)	3
• *Sheep*		2 619 525	2 160 651 (1999)	3
• *Donkeys and Horses*		Not available	Not available	
• *Pigs*		17 843	18 731 (1999)	3
Forest area (dry forest and other woody biomass, includes bush encroached area)	%	22 - 26	Not available	5
Population in absolute poverty (households)	%	38	24.7 (2000)	4
Life expectancy at birth	Years	55.6	43.1 (2000)	4
Literacy rate (adult)	%	50.0	81 (2000)	4

Note: GDP shares are based on current prices of the respective years.
Sources: 1) CBS, 2001; 2) NPC, 2002; 3) MAWRD, 2000; 4) UNDP, 2001; 5) Chapter 2:GHG inventory

Chapter 2: Emissions of anthropogenic greenhouse gases

The quantity of greenhouse gases (GHGs) that were produced by anthropogenic activities or taken-up by human-induced changes in the vegetation of Namibia in 1994 are reported in this section. Under the UNFCCC process for non-Annex 1 countries, 1994 was adopted as the agreed base year for which initial greenhouse gas emissions inventories have to be reported. Details of the calculations are provided in Appendix A.

2.1 Introduction

Article 4.1 (a) of the UNFCCC requires Parties to periodically share information about the emissions from defined sources, and uptakes by sinks, of the gases believed to contribute to global climate change. Article 12.1(a) of the convention provides that the communication should include a national inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol. Information should be provided on carbon dioxide (CO_2) and, to the extent permitted by the capacity of the Party, on methane (CH_4) and nitrous oxide (N_2O). Parties may also provide information on ozone (O_3) precursors, such as carbon monoxide (CO), nitrogen oxides (NO_x) and volatile organic compounds (VOCs), as well as on other greenhouse gases, including, *inter alia*, perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), and sulphur hexafluoride (SF_6). Namibia has chosen to report CO_2, CH_4 and N_2O; the data on other gases are insufficient for reliable reporting.

To ensure international comparability and transparency, these national 'inventories' are conducted according to a methodology developed by the Intergovernmental Panel on Climate Change (IPCC) (see Box 2.1). The IPCC Guidelines recommend the simplest default calculations of emissions of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) as a minimum, but Parties are encouraged to use more detailed methods, where applicable and appropriate. Parties that have already developed and are using an established and comparable methodology, emission factors or activity data may use that data for compiling their national GHG inventories, provided that sufficient documentation to substantiate the data is presented. The guidelines require Parties to discuss the level of uncertainty associated with default emission factors, activity data and underlying assumptions adopted and, where possible, provide quantification in the instances where nationally generated data are used.

In the compilation of Namibia's national GHG inventory, the requirements relevant to the inventory section as described in Decision 10 made by the Conference of Parties 2 (CoP 2) in 1996, were taken into account and followed.

The revised 1996 IPCC methodology (IPCC, 1997) together with the accompanying software was used to calculate the values reported in this section. IPCC default values (i.e. default values for conversion and emission factors) have been used in the compilation of the inventory unless stated otherwise. The information source for this chapter is the First Greenhouse Gas Inventory: A Report on Sources and Sinks of Greenhouse Gases in Namibia in 1994 (Du Plessis, 1999).

Box 2.1 The IPCC guidelines for national greenhouse gas inventories

The guidelines are designed to estimate and report on national-level inventories of anthropogenic greenhouse gas emissions and removals. The term 'anthropogenic' refers to emissions and removals that are a direct result of human activities, or are the result of natural processes that have been affected by human activities in a way which differs in type or degree from the human effects prior to the Industrial Era (i.e. since 1750). The 'Revised Guidelines' (IPCC 1997) were used for the Namibia 1994 inventory.

National inventories include all emissions and removals taking place within the national territory. They do not include the emissions associated with energy or goods that are imported. Emissions from fuel sold to aircraft departing on international flights are listed separately ('international bunker fuels').

The Guidelines provide step-by-step instructions for calculating CO_2, CH_4, N_2O and some other trace gas emissions. For CO_2 emissions from the energy sector, two calculation methods are used, which act as a check on one another. The *Reference Approach,* also known as the 'top down' approach, multiplies the total quantity of energy used in the country by the carbon content per unit energy for each fuel type. The *Sectoral Approach*, also known as the 'bottom-up' approach, adds up the emissions for each individual emission-generating process. The emissions for each process are calculated by multiplying an 'activity level' (i.e. how much of that process occurs) by an 'emission factor' (the gas emitted per unit of activity). For gases other than CO_2, only a sectoral approach is possible. Within the sectoral approach, three levels of increasing detail and accuracy are offered (Tier 1, 2 and 3). Countries are expected to choose the level that matches the availability of data in their country. Namibia used Tier 1 methods in its 1994 inventory.

A single year estimate is required for most source and sink sectors, except for agriculture and land use change and forestry. For these, three-year averages (with the base year in the middle) are preferred. This is to compensate for cases where the reference year was an 'abnormal' year for a specific activity, for instance a drought year.

Emissions and removals of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) for the base year 1994 are included in Namibia's Initial National Communications Report. Emissions of carbon monoxide (CO), oxides of nitrogen (NOx), sulphur dioxide (SO_2) and non-methane volatile organic carbon (NMVOC) were included, where data were available, in the 1994 Namibia inventory but are not reported as part of the Initial National Communication.

Standard Global Warming Potentials (GWP) are used to convert the different greenhouse gases into CO_2 equivalents (Table 2.1) in order to assess the combined global warming effect of the different gases. The GWP is the ability of each greenhouse gas to trap heat in the atmosphere relative to CO_2. The different radiation absorption properties of the gases together with the different lifetimes of the gases in the atmosphere are taken into account. By convention, the standard GWPs are integrated over a 100-year period.

Table 2.1 Global warming potentials of the three main greenhouse gases, calculated over a 100-year period.

Greenhouse Gas		**Global Warming Potential**
Carbon dioxide	CO_2	1
Methane	CH_4	21
Nitrous oxide	N_2O	310

2.2 Overview of Namibia's carbon balance

Namibia was estimated to be a net sink for carbon dioxide in 1994 due to the large uptake of carbon dioxide by trees into their woody tissues. The woody biomass in Namibia's vast areas of rangeland is believed to be increasing. Namibia has a relatively small economy with little impact on global emissions (i.e. it contributed less than 0.05% to global CO_2 equivalent emissions in 1994, even when the carbon sink is excluded). The amount of carbon estimated to be taken up by the natural vegetation in Namibia in 1994 constitutes about 0.1% of the total net uptake by land ecosystems throughout the world (IPCC, 2000).

Due to the relative size of the Land Use Change and Forestry (LUCF) category compared with the other source categories in the national GHG inventory, the overall uncertainty of the national GHG inventory is highly influenced by the level of uncertainty associated with the LUCF category. The sources and approximate levels of uncertainty associated with the national carbon sink are discussed in the section on Land Use Change and Forestry. No uncertainty levels were quantitatively estimated for any of the source or sink categories in the inventory due to the lack of data. Emission estimates are based, to a large extent, on estimates and anecdotal evidence. The relative uncertainty is therefore high in many categories (>± 20%), but the absolute uncertainty is small in global terms because the activity levels are low.

Box 2.2 Estimating uncertainty

A rigorous statistical analysis of uncertainty is not supportable by the data. Expert opinion, however, is that the emissions based on the consumption of fossil fuels are accurate within about 10% (standard deviation), most of which is due to uncertainties surrounding the appropriate emission factors, rather than uncertain activity levels. Uncertainty with respect to the agricultural sector, in particular methane emissions from ruminants, is high (>20%). This is also principally due to uncertain emission factors rather than poor livestock data. Uncertainty regarding the net carbon sink due to land cover change is very high, perhaps in excess of 100%.

The Land Use Change and Forestry sector was estimated to be a net sink of carbon dioxide emissions in 1994, and was therefore excluded when calculating the relative percentage contributions by different sources to the total emissions of greenhouse gases from Namibian territory. The relative percentage contributions by different sources to the inventory exclude the Land Use Change and Forestry sink.

The contribution by the main economic sectors in Namibia to CO_2, CH_4 and N_2O emissions in 1994 (excluding the removals by the Land Use Change and Forestry sector) are given in

Table 2.2. The total greenhouse gas emissions from Namibia according to the IPCC sectors are given in Table 2.3. Methane is the largest contributor to this total (63%), followed by carbon dioxide (33%) and nitrous oxide (4%). The total emissions are equivalent to about 5 614 kt CO_2, or 3.7 t CO_2 equivalents per person in 1994.

Table 2.2 Percentage contribution to national emissions by various economic sectors

Economic Sector[a]	CO_2	CH_4	N_2O	All gases GWP	Main sources of emissions
Electricity and water	12	<<1	<1	4	Coal and residual fuel oil
Transport and communication	49	<1	1	16	Petrol and diesel
Mining	6	<<1	<1	2	Diesel and residual fuel oil
Agriculture/fisheries/forestry (mainly agricultural contributions to CH_4)	19	98	97	72	Enteric fermentation, savanna burning, diesel and residual fuel oil
Manufacturing and construction	11	<<1	<1	4	Coal, diesel and residual fuel oil

Note a) The IPCC sector categorisation (Table 2.3) is different. In this table, the emissions associated with various economic sectors as defined in Namibia have been grouped together. The columns do not total 100% due to minor contributions from other sectors (Du Plessis, 1999). The government, business, financial services, trade, hotels and restaurants as a group contributed more than 40% to Namibia's GDP in 1994. Detailed data on the amount of fossil fuels used in this sector are not available. The transport related emissions from this sector are accounted for in the Transport and Communication sector. Emissions from the use of fuels other than those used for transport purposes, are considered very small on a national level and are omitted.

Table 2.3 National greenhouse gas emissions and removals in Gg for 1994, according to IPCC defined sources and sink categories. Negative CO_2 values indicate a sink of CO_2. Values are rounded to nearest Gg. The net CO_2 emissions from the burning of savannas and agricultural residues are assumed to be zero and are therefore not reported. (The IPCC category, *Module 3: Solvents and Other Product Use* is excluded from this table because it contributes mainly to NMVOC emissions which are not reported in the Initial National Communications. No IPCC methodology or emission factors are available to estimate any other possible emissions. The amount of solvents used in Namibia is considered insignificant.)

GREENHOUSE GAS SOURCES AND SINKS	CO_2	CH_4	N_2O
Total National Emissions	**1 827**	**169**	**1**
Total National Removals	**- 5716**		
1 Energy	**1 821**	**4**	**0**
A Fuel Combustion (Sectoral Approach)	1 821	4	0
1 Energy Industries	217	0	0
2 Manufacturing Industries and Construction	207	0	0
3 Transport	899	0	0
4 Other Sectors	381	3	0
5 Other (please specify)	117	0	0
B Fugitive Emissions from Fuels		0	
1 Solid Fuels		0	
2 Oil and Natural Gas		0	
2 Industrial Processes	**5**	**0**	**0**
A Mineral Products (cement production)	5		

GREENHOUSE GAS SOURCES AND SINKS	CO_2	CH_4	N_2O
B Chemical Industry	NA	NA	NA
C Metal Production	NAV	NAV	NAV
D Other Production			
4 Agriculture		**162**	**1**
A Enteric Fermentation		112	
B Manure Management		3	0
C Rice Cultivation		NA	
D Agricultural Soils			0
E Prescribed Burning of Savannas		47	1
F Field Burning of Agricultural Residues		0	0
G Other (please specify)		0	0
5 Land-Use Change & Forestry	**-5 716**	**0**	**0**
A Changes in Forest and Other Woody Biomass Stocks	-6 370		
B Forest and Grassland Conversion	655	0	0
C Abandonment of Managed Lands	NAV		
D CO_2 Emissions and Removals from soil	NAV		
E Other (please specify)	NA	NA	NA
6 Waste		**3**	**NAV**
A Solid Waste Disposal on Land		3	
B Wastewater Handling		NAV	NAV
C Waste Incineration			
D Other (please specify)		NA	NA
Memo Items			
International Bunkers	**111**	**0**	**0**
Aviation	76	0	0
Marine	35	0	0
CO_2 Emissions from Biomass	**1 135**		

Note: Zeros indicate values less than 0.5. Empty cells indicate that no emissions occur for a specific gas from a particular source (following IPCC methodology). Cells marked 'NAV' indicate that emissions occur from a particular source but no data were available to estimate emissions. Cells marked 'NA' indicate the emission is not applicable to the Namibian situation.

2.3 Energy

Namibia did not produce any solid, liquid or gaseous fossil fuels in 1994. Only the emissions from the combustion of fossil fuels are therefore considered. No fugitive emissions, i.e. unintentional gas leaks from processes during the mining and production of coal and the refining of crude oil, natural gas or petroleum, are included.

Namibia's electricity demand is met mainly from three sources: electricity imported from South Africa; a hydro-electric power plant; and two thermal power plants (one plant burns both heavy fuel oil and diesel, and the other one coal). The thermal power stations are mainly used to supply electricity when problems are experienced with the national grid. The Namibian coal consumption was unusually high in 1994 to compensate for the loss in hydro-electricity generation as a result of the severe drought of 1992/93. Nevertheless, the energy-related CO_2 emissions in Namibia in 1994 are low compared to other countries, i.e. in absolute terms (1 821 Gg (or 1.8 Mt) CO_2 in 1994) as well as on a per capita basis (1.2 Mg (or 1.2 t) CO_2 per person in 1994). This is because the Namibian economy is not highly energy intensive and the country imports most of its electricity from South Africa. The emissions associated with the generation of electricity are included as part of the inventory of the country where it is generated and so are reflected in the South African GHG inventory. The use of petrol and diesel for road transport purposes is the single largest source of national CO_2 emissions, (i.e. nearly 50% of the total national CO_2 emissions). This is due to the large distances between towns and settlements that are travelled mainly by road when transporting goods and people. The marine fishing and fish processing sectors are major consumers of fossil fuels, especially diesel (about 27% of the total national diesel consumption in 1994). Unpublished statistics from the Ministry of Mines and Energy (Pers. Comm. P du Plessis, 1999) were the main source of data used to estimate emissions from the combustion of liquid fuels.

The IPCC Tier 1 methodology and default emission factors were used for all emissions estimated from the energy sector. Fuel consumption per sector was indirectly derived using sectoral fuel-use analyses (Du Plessis, 1999). Energy consumption and activity data were not available for each of the different sectors to calculate CO_2 emissions with the *Sectoral Approach*. The same average emissions factor per gas species per fuel type was applied to all the different demand sectors.

The carbon contained in bitumen and half the carbon in lubricants is assumed to enter long-term storage when calculating CO_2 emissions with the *Reference Approach*.

It is normal that the CO_2 emissions calculated using the two approaches can differ. For Namibia, the *Reference Approach* estimates 1 760 Gg of CO_2, while the *Sectoral Approach* derives an estimate of 1 821 Gg of CO_2. These estimates are very similar (differ by less than 4%).

The CO_2 emitted when burning wood for energy purposes is not considered to add to the atmospheric burden when the wood is harvested sustainably (i.e. it is taken up again by regrowing trees). Non-CO_2 emissions are included in the energy category and added to the national totals for these gases. The total fuel wood consumption of about 661 kt in 1994 is made up of fuel wood used for household, industrial and charcoal making purposes (Klaeboe and Omwami, 1997). No liquid biomass is burned in Namibia and a very small amount of biogas (340 t per year) is recovered from a waste treatment plant in Windhoek. Most of the charcoal produced in Namibia is exported (more than 85%) and not used locally. Animal dung and agricultural wastes are used to a certain extent for energy purposes by rural people but are not included in the inventory as no data are available.

Reliable disaggregated data for the amount of fuel used for national and international marine and aircraft bunkers are not available. Following the IPCC Guidelines, international bunkers must not be included in the national inventories but reported separately.

Although Namibia, as a non-Annex 1 party to the UNFCCC, is not required to report emissions other than CO_2 resulting from fuel use, non-CO_2 emissions were estimated. A high level of uncertainty is associated with these emissions due to the low reliability of the sectoral fuel use data and the use of IPCC default emission factors that may not be applicable to operating conditions in the different sectors in Namibia.

2.4 Industry

Namibia has a small industrial sector. Cement manufacturing is the only industry for which data were available to calculate CO_2 emissions in 1994. Emissions of NMVOC and SO_2 from industrial processes such as the use of bitumen for road surfaces, production of metals, food processing and animal feed production, beer brewing and alcoholic beverage production are not included in this report as Namibia is not required to report on these gases in its Initial National Communication.

Only the emissions from the chemical or physical transformation of materials, and not the energy related emissions are reported in this category. The IPCC default CO_2 emission factor for the amount of cement (not clinker) produced, was used. Due to the lack of detailed industrial consumption data, the total amount of fuel used as a reducing agent during metal refining to produce copper and lead from sulphide ores is reported under the energy sector and not as part of the specific industrial process as recommended by the IPCC Guidelines.

2.5 Agriculture

Namibian agriculture is characterised by extensive livestock ranching, an agronomic sector of low per-hectare productivity by the standards of less-arid countries. There are fundamental differences between the production methods and intensities of the commercial and subsistence farming sectors. Only emissions from domestic livestock, prescribed burning of savannas, field burning of agricultural residues and agricultural soils are estimated as no extensive rice cultivation in flooded fields took place in Namibia in 1994. Rice cultivation has recently been considered for the eastern Caprivi, and trials are currently in progress.

(Photo: Klaus Schade)

Figure 2.1 Livestock ranching is highly dependent on rainfall, with great numbers of livestock lost during drought periods.

Changes in livestock numbers in Namibia are closely linked to changes in rainfall patterns. Animal populations in arid environments decline drastically during major droughts and then grow gradually until the next drought. This periodicity in Namibia is believed to be considerably longer than the three-year average for agricultural statistics recommended by the IPCC. A three-year average (1993-1995) based on statistics provided by the Directorate of Agricultural Planning for livestock numbers was used. There is a reported trend towards lower livestock numbers in the commercial farming sector because animals are marketed at a younger age and farmers are changing from beef or lamb production to game farming. Livestock numbers in the communal farming areas are reported to increase mainly due to the increased availability of water in areas that were not ranched before. Due to limited data availability, neither of the trends can be quantified.

The simplified IPCC Tier 1 method and default emission factors for the amount of CH_4 emissions from enteric fermentation were used, except for cattle, where IPCC default values were adapted as follows to reflect Namibian conditions more realistically. An interpolated CH_4 emission factor of 43 kg CH_4/head/year, based on IPCC values reported for Africa and Oceania was used for non-dairy cattle, and an emission factor of 72 kg CH_4/head/year (double the IPCC default value) for dairy cattle. This value, which is half-way between the emission factors for high and low milk production cattle, was chosen to reflect the Namibian conditions where half the dairy cattle herd falls in the high milk production category (i.e. on average 26 litres/head/day) and the rest in the low production category (i.e. less than 10 litres/head/day). The CH_4 emissions from the enteric fermentation in livestock, mainly cattle and sheep, are the dominant source of CH_4 emissions from the agricultural sector, contributing about 70% to the total national CH_4 emissions.

Most animal manures are deposited directly on rangelands in Namibia. The two main manure handling systems used in Namibia are pasture range and paddock, and solid storage and drylot systems. About 75% of the manure produced by non-dairy cattle is deposited in a pasture range and paddock system whereas 100% of the manure produced by diary cattle is deposited in a solid storage and drylot system. The manure is collected for fertiliser use in the areas where a solid storage and drylot system is used. The manure produced by other livestock types, such as sheep is mainly deposited in a pasture range and paddock system.

Very small amounts of methane are released from manures due to the very dry climatic conditions.

The frequency and extent of savanna burning in Namibia is believed to have been reduced in the central commercial areas over the past century mainly because, in commercial areas, dry grass is valued as insurance fodder against a failure of rains. In some communal areas, such as in the Kunene province, less dry matter accumulates due to higher animal stocking rates and the use of grass for thatching. Roads and cultivated fields, together with purpose-built fire-breaks, also reduce the extent of area burned in fires. In the north-east, fires may increase because of the larger number of people in the area.

The deliberate burning of savannas occurs almost exclusively in the north-eastern regions, whereas accidental and/or natural fires which are larger and more spectacular, occur mainly in the eastern regions in some years. Data to quantify the extent and intensity of the areas burned are not readily available. The burning of savannas is estimated to be the single largest source of N_2O emissions in Namibia, contributing about 77% to the national N_2O emissions. The total national emissions of N_2O are very small, i.e. less than 1 Gg in 1994.

The following statistics, provided by the Etosha Ecological Institute, were used to determine the area burned in Namibia. An average biomass density of 6 t dm/ha is used (Du Plessis, 1999). This value may still be too high for the conditions occurring in Namibia and may be nearer to 2 t dm/ha. A factor of 0.8 for the fraction of biomass burned (lowest IPCC value due to the ‘cool’ fires and occurrence of fire-resistant woody species) is assumed. About 20% living above-ground biomass is assumed to burn because fires generally occur after a long dry season (Pers Comm L Du Pisani, M Coetzee and A Calitz).

Table 2.4 Area burned in three regions of Namibia

Region	**Biomass density** (tdm/ha)	**Area burned (in thousands of hectares, kha)**									
		1993		**1994**		**1995**		**1996**		**1997**	
		kha	% of region	kha	% of region	kha	% of region	kha	% of region	kha	% of region
Caprivi	4-9	1515	90	1347	80	1515	90	1515	90	1515	90
Kavango	4-8	2739	60	3424	75	2511	55	2283	50	3652	80
Etosha National Park	2-5	100	4.4	340	14.8	0	0	2.5	0.1	450	19.6
Total	**6**	**4354**		**5111**		**4026**		**3800**		**5617**	

* tdm/ha = ton of dry matter (i.e. less than 5% water content) per ha

The amounts estimated for the three regions are most probably an overestimate. However, the overestimate compensates for the unknown quantity of biomass burned in other regions of the country.

Agricultural soils are potential sources of CH_4 and N_2O emissions. The potential CH_4 emissions from agricultural soils in Namibia are insignificant as they are mainly sandy and arid, and anaerobic conditions that can lead to CH_4 emissions occur very rarely. A fraction of the nitrogen contained in nitrogen-based fertilisers is lost to the atmosphere as N_2O when applied to soils. The IPCC methodology is based on the annual usage of nitrogen-containing fertilisers of all forms (including fertiliser, crop residues, biological nitrogen fixation and manure). It was assumed that all of the synthetic fertiliser used in Namibia is urea-based (i.e.

containing 43% N), due to the lack of disaggregated fertiliser data. Only a small area is planted with N-fixing crops in Namibia and no significant amounts of nitrogen are fixed by pulses and beans as a result of the constant moisture stress (Pers. Comm. J Hoffmann).

Agricultural residues are not routinely burned in Namibia and very little or no data are available. Emissions from this source are considered to be negligible. Agricultural residues are mainly eaten by livestock, used as thatching, ploughed back into the soil or burned to a lesser extent as a lighting fuel. Termites often consume the residues left on the fields and produce methane. These emissions are generally not considered to be of anthropogenic origin and are therefore not included in the IPCC method.

2.6 Land use change and forestry

Namibia was estimated to be a net sink of carbon in 1994 because carbon-based emissions from the use of wood products were less than the estimated amount of carbon taken up by regrowing trees. It was estimated that 52.5 kt of wood are used to manufacture 10.5 kt of charcoal (i.e. a conversion ratio of 5) and about 12 kt and 597 kt of wood are used for energy purposes in the industry and household sectors respectively.

The large amount of uncertainty associated with the Land Use Change and Forestry (LUCF) section is mainly due to the following reasons:

1) The LUCF IPCC category, compared to the other IPCC categories, has the highest level of uncertainty associated with the default methodology and values provided. A team of experts from different countries has been appointed to update the methodology and default values and to reduce the amount of uncertainty associated with this category. An updated IPCC version of this category will be ready for the next Conference of the Parties (CoP 7) to take place in 2003.
2) Very limited country-specific data on the following are available:
   - The magnitude of biomass increases and decreases, e.g. the amount of bush-encroached land cleared, and the extent of recurrence of bush encroachment after clearing. The amount of dry forest and other woody biomass area was assumed to be 5 000 kha and 16 500 kha [of which 10 000 kha are assumed to be bush-encroached land and 6 500 kha (half of the estimated 13000 kha of savanna) are assumed to be ‘forest-like’] respectively.
   - The mean annual growth rates of different Namibian vegetation types. The annual biomass growing rate for dry forest and other woody biomass was assumed to be 0.25 and 0.2 t dm/ha respectively. These values are conservative as they are nearly half the average rate quoted for Namibian vegetation by Erkkilä and Siiskonen (1992).
   - The soil carbon content and changes in the carbon content over the last 100 years.

Most of the available data are out of date or, in their present format, cannot be reconciled with the IPCC reporting categories. Forest statistics available from the Food and Agricultural Organisation (FAO), anecdotal evidence and estimates were used to complete the relevant IPCC worksheets.

The following two major opposing trends in the changes in woody biomass amounts in Namibia can be discerned:

- Deforestation in certain parts of the northern communal areas.
- Bush encroachment in the north central and eastern cattle farming areas.

a)

b)

(Photos: Nico de Klerk)

Figure 2.2 Bush encroachment near Gobabis, east-central Namibia. Photo a represents what is believed to be the natural density of trees and shrubs within this savanna type. Photo b represents a bush encroached condition, with about 7 500 bushes per hectare. The two photographs were taken at the same location, facing in opposite directions, and represent a treatment and control respectively.

Due to the level of uncertainty associated with the available data, it was decided to use the upper limits of ranges suggested in the IPCC guidelines, literature reviews and expert opinions, for factors that lead to biomass loss, and lower limits of ranges suggested for biomass increases. The current IPCC methodology does not consider the amount of carbon sequestered in the underground biomass. Arid conditions in Namibia encourage extensive rooting. The extent of riverine forests occurring in Namibia was not quantified for 1994. This could potentially be an important sink of carbon dioxide emissions that need to be considered in future updates of the inventory as a large number of trees occur along river courses, even in the driest parts of Namibia (Brown *et al*., 1985 cited in Erkkilä and Siiskonen, 1992). Considering the above, it is, therefore, likely that the size of the Namibian carbon sink is underestimated.

About 20% of the country (mainly in the north eastern parts) is covered by tree savanna and woodland (Erkkilä and Siiskonen, 1992). A further 64% of Namibia is covered by various types of savannas of which about 25% can be classified as open forest according to the IPCC definition (IPCC, 1997). Barnard (1998) estimates that savanna covers 37% of Namibia, dry woodlands and forests 17% while desert vegetation (Namib and Karoo biome) is distributed over 46%.

No significant areas of plantation occur in Namibia, due to the unfavourable climatic and biophysical conditions.

It was assumed that about 60% of the total woody biomass cleared is burned off-site and 10% is burned on-site of which 90% of the carbon is oxidised to CO_2. About 10% is left to decay on site over ten years. The balance of 20% was assumed to enter long-term storage as durable, termite-resistant construction poles and other durable goods.

A clearance rate of 17.2 kha per year is used to calculate the amount of CO_2 emitted from biomass due to forest and grassland conversion. This value is double the FAO default forest conversion rate of 8.6 kha per year since the FAO-estimated forest area had been doubled (i.e. according to FAO and assuming an unchanged conversion rate of 8.6 kha/year, dry forests covered about 2 500 kha in 1994). A value of 5 000 kha was used based on a combination of expert opinions and other sources.

About 5 t dm/ha (i.e. half the IPCC default value for cropland) is left after burning. This 'conservative' value is based on an average biomass of 25 t dm/ha for the entire area (i.e. 19 t dm/ha for above-ground biomass of long-dry-season mixed tree savanna in neighbouring Botswana (IPCC/OECD/IEA Reference manual, 1996); 23 t dm/ha (Rutherford cited in Erkkilä and Siiskonen, 1992) reported for woodland near Otjiwarongo; 6-10 t dm/ha for woodlands on sandy soils and 20-25 t dm/ha for woodlands on heavier clay soils (Reed, pers. comm.).

An additional 14 kha per year is converted from savanna/grassland to cultivated area, human settlements and overgrazed land. Due to clearing, the amount of biomass on this land is assumed to be reduced from 10 t dm/ha to 1 t dm/ha. Although these values are based on anecdotal evidence, as no data are available, they were included in the inventory to account for the gradual land degradation known to be taking place over a large area.

Abandonment of managed lands is excluded from the calculations as no data are available, only anecdotal reports. The total amount (including the portion that may be considered in this section) of carbon sequestered by bush-encroached land is accounted for in the section on 'Changes in Forest and Other Woody Biomass'.

Very limited or no data are available to estimate the CO_2-C emissions from agriculturally impacted soils. This section is, however, not considered a significant source of CO_2 emissions in Namibia, as cultivated Namibian soils are very sandy with a low organic content. No intensively managed organic soils occur in Namibia and liming is not a common practice.

2.7 Waste

Namibia, as a non-Annex 1 country, is not required to report emissions from waste (Decision 10 of COP 2). Only methane emissions from solid waste disposal sites were calculated as part of this category. IPCC default values and methodologies were used to estimate these emissions.

A waste generation figure of 0.4 kg/capita/day was used for the total urban population in Namibia. This figure is based on estimates made for Windhoek (Tarr, 1997) and Walvis Bay which are similar to the IPCC default value for Egypt and Nigeria. The degradable organic carbon content was assumed to be 0.21 based on the IPCC default value for Egypt.

The emission estimates from this source category are incomplete and have a high level of uncertainty associated with them. There is a lack of data on local conditions, e.g. information on the Degradable Organic Content (DOC) of solid waste disposed of in arid landfills as well as a lack of data on the amounts of domestic and commercial wastewater generated and treated in sewerage treatment plants per annum. Although some information on the amount of industrial wastewater is available, no data are available on the organic content of the different wastewater streams, the amount of organic content removed as sludge and the type of treatment systems used.

The methane emissions from the waste streams generated by the fish processing and meat-packing industries, breweries and tanneries could be significant on a national level and need to be included in future updates of the national GHG inventory.

2.8 Recommendations

Several areas of investigation have been identified to deal with the uncertainties associated with the GHG emission inventory. These research needs will provide improved information for future updates of the emission inventory and will contribute to subsequent communications. Research areas are given below in no order of priority:

- The extent of area covered and growth rates of different vegetation types as well as the amount of woody biomass removed in Namibia for direct energy consumption or charcoal production purposes, or long-term storage products such as furniture, need to be accurately quantified. A study on the changes in woody biomass stocks could be linked to the existing bush encroachment study. The amount of underground biomass growth and the nitrogen flux associated with growth and clearance of legume species also needs to be quantified.
- Emission factors for the methane emissions from domestic livestock need to be determined that are applicable to conditions in Namibia. Namibian grazing is generally of relatively poor quality and cattle graze over large areas so the IPCC default emission factors for African cattle may underestimate the Namibian situation. The amount of manure deposited per manure management system needs to be quantified.
- Data and information on the amount of wastewater generated from domestic, commercial and industrial processes such as the fish processing and meat packing industries and breweries and tanneries, the amounts treated, the types of treatment systems used and organic contents of the different waste streams need to be

investigated, collected and/or updated for future inclusion in the national GHG inventory.

- The data on the amount of savanna burning in Namibia needs to be refined. The National Botanical Research Institute in the MAWRD is currently quantifying the amount of area of savanna burning by making use of satellite imagery. The results of this study should be combined with the biomass densities reported in the Department of Forestry’s National Forest Inventory.
- Emissions from the substantial burning of cotton residues for pest control purposes need to be quantified for future updates of the inventory as cotton production is likely to increase in Namibia.
- The nitrous oxide emissions from the application of crop residue and sewage sludge to agricultural soils in Namibia need to be quantified as these practices are known to occur but no data are available on the actual amounts.
- The amount of N-based fertiliser used in Namibia needs to be quantified in order to estimate nitrous oxide emissions from the use of synthetic fertiliser.
- Due to hot climatic conditions in Namibia, a relatively large amount of halocarbons with high global warming effects are used for refrigeration and air conditioning purposes. If Namibia is required to, or elects to include these gases in future updates of the inventory, data on the amount of gases emitted into the atmosphere will need to be collected.
- The sectoral-energy use and activity data need to be improved in order to reduce the amount of uncertainty associated with the CO_2 emissions from the different source categories.

Chapter 3: Projected impacts and vulnerability assessment

This chapter summarises the studies that have been done on climate change in Namibia. It focuses on the potential vulnerability of people, economic sectors and ecosystems in Namibia, and how they may adapt to the projected changes. Namibia's Country Study on Climate Change: An Overview of Namibia's Vulnerability to Climate Change, compiled in 1998, was the primary source of information for this chapter.

3.1 Projections of climate change in Namibia

3.1.1 Magnitude of climate change: scenarios

The climate change scenarios that were used for the Namibian Country Study (1998) were based on the IS92a emission scenario, as translated by global climate models in the early 1990s. The IS92a GHG emission scenario offers a mid-range estimate of future emissions and assumes only a modest degree of policy intervention to limit emissions of GHG.

In this Initial National Communication for Namibia, the more recent IPCC scenarios and model simulations from the IPCC Data Distribution Centre (DDC) and the Third Assessment Report (TAR) were also considered. The full set of IPCC scenarios consists of about thirty distinct futures, which fall into four broad clusters. The 'A' scenarios represent a high-growth, highly globalised world, whereas the 'B' scenarios represent a more regionally-organised future, with a lower overall growth rate. Globalisation would be expected to result in a larger fraction of emission-intensive activities taking place in the developing world. The '1' scenarios (ie A1 and B1) represent a world in which environmental considerations are secondary to growth considerations, whereas the '2' scenarios (A2 and B2) have environmental consciousness as an important component. The IS92a and the A1 scenarios are broadly similar projections of the future, and both can be considered as tending towards the 'worst case' scenarios with respect to the impact on climate, whereas the B1 scenarios result in a lower degree of climate change. All scenarios are considered up until the year 2100, by which stage only a portion of the eventual climate change and sea level rise will actually have been realised.

3.1.2 Models

All models for which adequate data were available were considered in the updated IPCC scenarios (Table 3.1). None of these models have any specifically Namibian or southern African involvement, and all the models should be considered equally valid.

Table 3.1 Some models used in the development of the different IPCC scenarios for climate change

Model	Origin	Characteristics
HADCM2	Hadley Centre, UK	Detailed land surface coupling
ECHAM	European Community (Hamburg)	Detailed and sophisticated treatment of oceans
CSIRO	Australia	CSIRO are the only group specialising in southern hemisphere climate change models

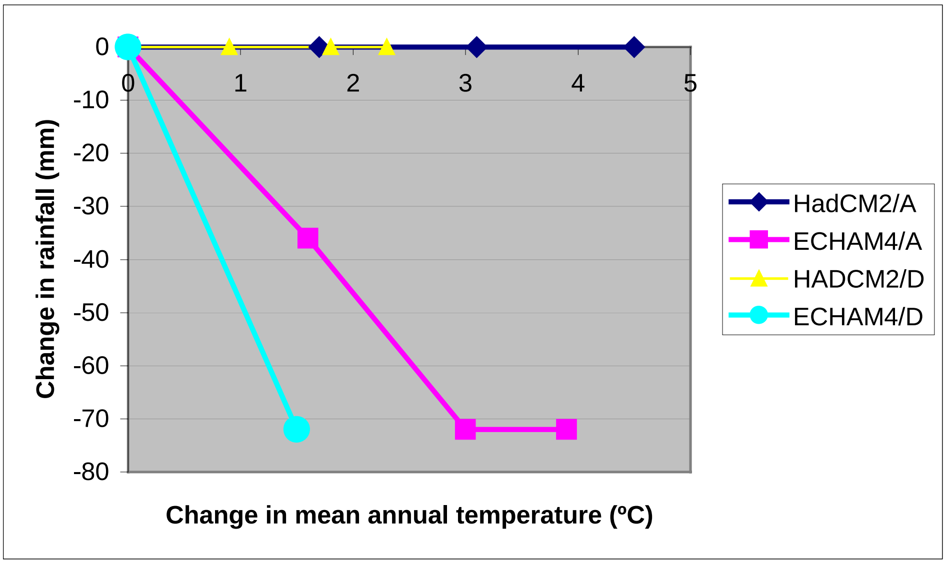


Figure 3.1 Projections of climate change in the vicinity of Windhoek, from several models and for various scenarios. The graph shows the changes relative to the mean climate 1961 to 1990, and the successive dots on each line are for the year 1990 (at the origin), 2020, 2050 and 2080. Note that all the models, under all scenarios, show warming, and most show drying out.

3.1.3 Future temperatures

All the models that were considered show an increase in mean annual temperature (and in both the minimum and maximum monthly temperatures), under all scenarios. For the year 2100 the A1 scenario predicts the range of mean annual temperature increase for the central plateau region of Namibia to be 4.5-6˚C above the 1961-1990 mean temperature, and 2-3˚C for the B1 scenario. Temperature increases are lower to the west (nearer the ocean).

The rate of temperature increase is projected to reach a maximum in the middle of the twenty-first century.

The historical observed temperature record is consistent with a warming trend although the station at Windhoek is the only one with a sufficient period of observation to support an analysis of historical temperature trends. Over the period 1950 to 2000 there has been an upward trend of 0.023˚C per year, some of which may be an urban heat island effect (Figure 3.2). Seven weather stations, distributed all over Namibia, recorded their highest temperatures in the year 1998.

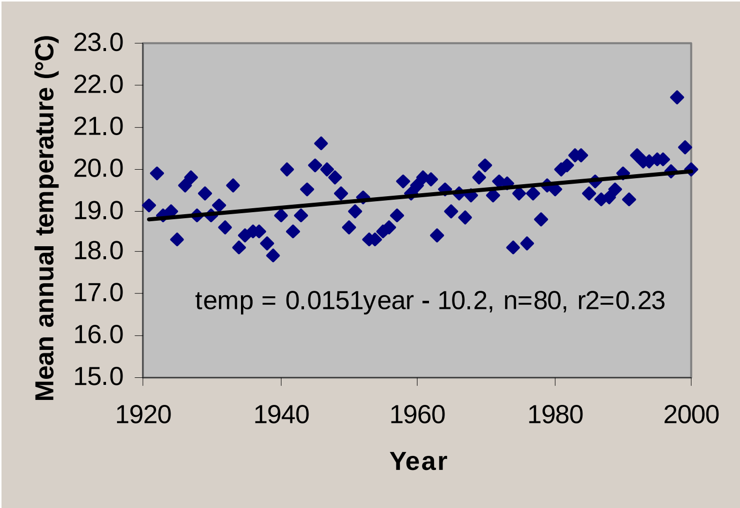


Figure 3.2 Mean temperatures recorded for Windhoek for the period 1950 to 2000 (Namibia Meteorological Service, 2002).

3.1.4 Future rainfall

There is less agreement amongst the various models regarding future rainfall in the Namibian region. The projections range from small increases of less than 30 mm per year to severe decreases in annual rainfall (200 mm per year less than the current average). The largest projected changes are associated with the highest projected temperature changes. The greatest impact is projected to occur in the central, inland areas.

The long-term rainfall record for Namibia (1915 to 1997) suggests an overall national mean of 272 mm. In the period from 1981 to 1996 only two of these sixteen years had rainfall above this mean. The variation in rainfall from year to year is extremely high (in excess of 30% everywhere in the country, rising to 70% in southern Namibia and 100% in the Namib Desert). Figure 3.3 shows the mean annual rainfall recorded for Windhoek. Both the rainfall and temperature in Namibia are sensitive to the El-Niño Southern Oscillation (ENSO) effect, showing periods of below-average rainfall and above-average temperature during El Niño conditions. Rainfall in the future is projected to become even more variable than at present.

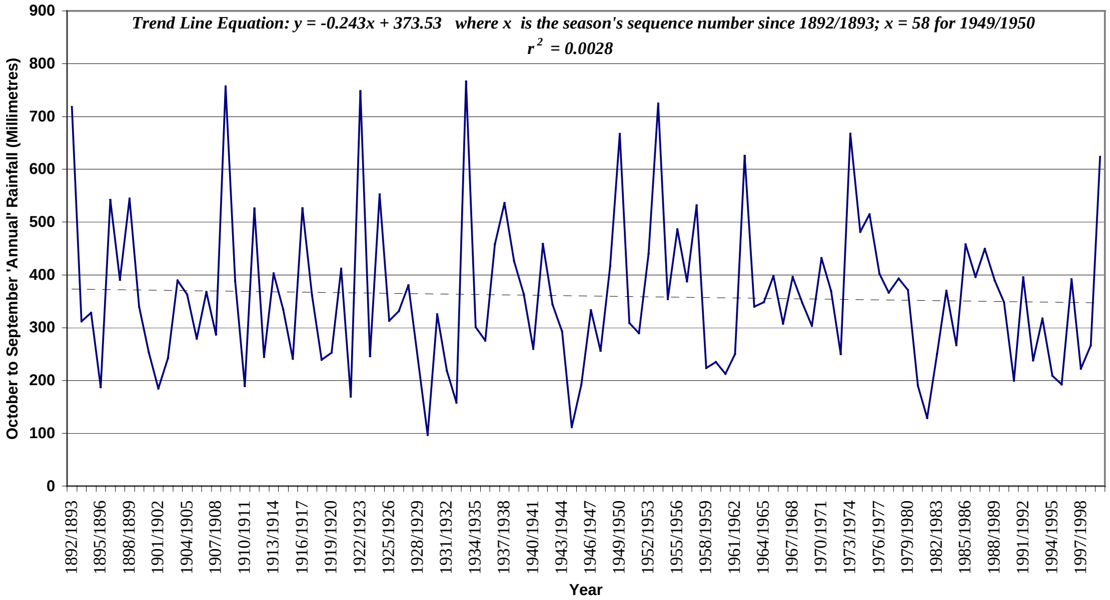


Figure 3.3 Mean annual rainfall (October to September) recorded for Windhoek for the period 1892/1893 to 1999/2000 (Namibia Meteorological Service).

3.1.5 Future evaporation

An increase in temperature will be associated with an increase in the potential evaporation rate of around 5% per degree of warming. Thus, the Namibian water balance is anticipated to become drier, even if the rainfall remains the same as it is at present. This projection is very slightly offset by possible small increases in plant water use efficiency that will result from the increasing carbon dioxide concentration of the atmosphere.

3.2 Vulnerability of the Water Sector

The whole of Namibia experiences a net water deficit (mean annual rainfall minus potential evaporation), ranging from - 4000 mm in the south east, to -1600 mm in the northeast.

There are no perennial rivers arising in Namibia. Perennial rivers are found only on the southern boundary (the Orange, which is shared with South Africa and Lesotho) and the northern boundary (the Kunene, Okavango, Kwando, Linyanti and Zambezi which are shared with Angola, Botswana and several other countries). Their combined flow is around 66 500 million m^3 per year. Less than 2% of the rain falling on Namibia becomes runoff. Most of this discharge is in the form of ephemeral pans (Figure 3.4), rivers and shallow water bodies, called *oshanas*, in the north. Less than 1% of the rainfall, on average, becomes groundwater recharge (DWA 1991). The assured annual yield of water is about 500 million m^3 (Day 1997). An estimated 226 million m^3 of this is used directly or indirectly by Namibia as rural and bulk water supply.

(Photo: Klaus Schade)

Figure 3.4 An ephemeral pan in the Namib Dune Sea.

Unusually low flow conditions have prevailed in Namibian rivers since 1980. This is partly attributable to a period of low rainfall, but changes in land use and land cover may also have contributed.

Total water consumption has grown in Namibia at a rate of 3.5% per annum. Even in the absence of climate change, Namibia, along with most of the other countries of southern Africa that share its rivers, faces absolute water scarcity (i.e. less than 1 000 m^3 of available water per capita per year) by 2020.

Even in the case of a moderate increase in evaporation of 15% and no change in rainfall, the additional stress on the Namibian water sector due to climate change would be severe. In the case of the largest projected decrease in rainfall (30%), coinciding with an increase in evaporation of 30%, the impact on Namibia's water sector, and all the aspects of human development that depend on it, would be extreme.

3.2.1 Water supply

Half of Namibia's population lives in the northern region in the proximity of the perennial rivers, but do not necessarily have direct access to them. Approximately 116 000 rural households are dependent on ephemeral rivers for domestic water and livestock. Just over half of Namibia's total water demand is supplied from groundwater (Lange, 1997). The domestic bulk water supply is around 43 million m^3 per year, and is increasing at about 8% per year. Declining water quality, which is a result of reduced flow rates, salt incursion in coastal areas, and rising water temperature, is likely to be a key constraint to urban water supply in the future.

3.2.2 Mining and manufacturing

Mines consume about 8 million m^3 of water per year, although the fraction of the total bulk water supply used by mines is declining. Some consumption by light manufacturing industries is included in the urban water supply total given above. There is significant further scope for water conservation in all these industrial sectors, following the lead of several prominent mines in Namibia, such as Rössing Uranium.

3.2.3 Hydroelectric power

The 240 MW installed capacity hydropower plant at Ruacana could supply nearly half of the electricity needs in 1994 of Namibia. The amount of power generated varies with the strength of water flow and so depends on climate. There are possibilities for further hydropower projects on the Lower Kunene River. The magnitude and reliability of power supply from such projects will be impacted by climate change to a degree that is currently poorly quantified.

3.2.4 Irrigation and agriculture

Irrigation is estimated to use over half of the bulk water supply in Namibia (i.e. around 120 million m^3 per year). Watering of livestock consumes around 6 million m^3 per year. The allocations to irrigation are likely to come under heavy pressure in the future, as the demands from the domestic and other sectors with a higher economic return on water use increase. Despite this consideration, modest expansion of irrigated agricultural projects is planned in certain areas.

3.2.5 Water for ecosystem maintenance

The formation of coastal fog depends on the Benguela Current and is an important source of water for fauna and flora in the western part of the Namib Desert. Changes in fog patterns, possibly caused by Benguela El Niño events or climate change, could have major implications on the availability of this water source, and therefore on the biodiversity of the Namib Desert and the Succulent Karoo biome, one of the world's top 25 biodiversity hotspots (Henschel *et al*., 1998).

Natural wetlands have been identified as Namibia's most threatened category of ecosystem. The flow of water in *oshanas* has been declining since the end of the 1970s. Riparian and floodplain vegetation is considered to be in decline due to grazing pressure and removal of trees for fuelwood. Freshwater fish populations are under stress from over-fishing, especially in recent years as more efficient but less sustainable methods for catching fish have been adopted by rural subsistence fishers. Desiccation due to a combination of climate change and human demand for water is likely to accelerate these trends. Higher water temperatures, changes in flow regimes and water levels and a decrease in water quality are also damaging to aquatic ecosystems and their endemic and indigenous biodiversity.

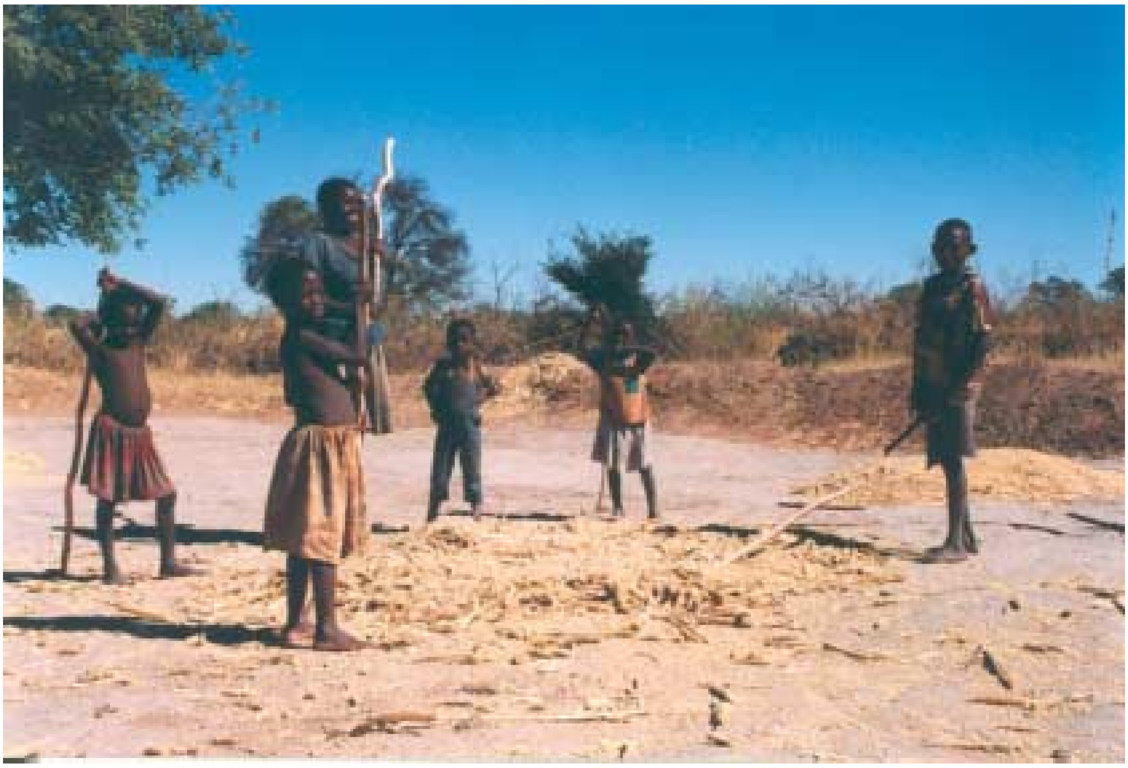
3.3 Vulnerability of the agriculture sector

Over two-thirds of Namibians practise subsistence cropping and pastoralism, mostly on communally-held land. Less than 10% of the land surface is used for cropping, while nearly 75% is used for grazing. Nearly half of the land is owned and managed by commercial farmers (1% of the population), and commercial agriculture employs nearly half of the total workforce.

Agricultural output from Namibia is extremely sensitive to climatic conditions. Periodic droughts cause considerable stock losses and reduced grain production. The uncertainty in future rainfall trends make projection of agricultural impacts very difficult, but certain projections under increased temperatures can be made with confidence.

3.3.1 Subsistence cropping

There are 274 000 ha under rain-fed cereal cropping, consisting mostly of millet (Tarr, 1999). Millet is vital to the food security of most rural households in the north of the country (Figure 3.5). In times of climatic hardship, it is supplemented by use of wild natural resources, known as *veldkos*. Millet is relatively drought resistant, particularly indigenous and improved regional varieties, but if effective soil moisture decreases in the future, then decreases in yield, and a greater inter-annual variability in yield, are likely.



(Photo: Klaus Schade)

Figure 3.5 Millet (known locally as omahangu) is the staple diet for subsistence farmers in the north.

3.3.2 Commercial cropping

The vulnerability of this sub-sector to competition for irrigation water has already been noted. Maize is the principal commercial crop. Namibia has not been self-sufficient for grain since 1964 and currently only half of the country's domestic needs are supplied locally. One study (Hulme *et al*., 1996) predicts a small increase in maize yield under future climate change scenarios, although yield quality would be reduced because of shortened growing seasons. Given the projected increase in air temperature, already close to the maximum for maize, a probable decrease in rainfall and increased evaporation, a decrease in maize yield is more likely.

3.3.3 Livestock farming

Export of livestock products makes up 8.2% of GDP (average for period from 1988 to 1996) and 16% of all exports. Cattle-ranching is practised in the north and east, and small stock (sheep, ostriches and goats) are mainly ranched in the south. Farming with both domestic livestock and game is common. A trend towards greater aridity would be associated with a shift towards farming with more small stock and game. Droughts are associated with a greater incidence of stock poisoning as stock animals are forced to eat unpalatable or toxic plants that are the first to emerge on overgrazed rangelands. Drought lowers the availability of forage, reduces milk production, growth rates and the health status of livestock. With increased temperatures the incidence of tick-borne diseases may increase, but diseases borne by the tsetse fly may decrease. The expanded use of indigenous livestock breeds may help mitigate this trend.

Impacts on household food security in the subsistence farming areas could be dramatic and climate change has the potential to cause significant social disruption and population displacement in these communities.

3.4 Vulnerability of the fisheries sector

Natural environmental variability is already the main factor causing variations in fish stocks in Namibian waters. The highly-productive marine ecosystem on the west coast of southern Africa is driven by the upwelling of the cold, nutrient-rich Benguela current. The upwelling is caused by the interaction of south-easterly winds with the north-flowing current and the topography of the seabed. When upwelling is suppressed by northerly or easterly winds, oxygen-poor water can accumulate near the sea-bed and suffocate marine life. There is a possible connection between the frequency of such events and large-scale climate phenomena such as ENSO. Future changes in the distribution and intensity of winds could therefore have an effect on the fisheries sector.

Currently there are no reliable scientific projections to suggest either an increase or decrease in the Benguela fisheries yield as a result of climate change, but marine ecosystems must continue to be regarded as vulnerable pending more conclusive studies. Recent studies have shown that sea surface temperatures over the northern Benguela region appear to have become persistently warmer since 1993. This may be one of several factors reducing the pilchard stock (MFMR, 2002).

The reduction in pelagic fish stocks, largely induced by overfishing, may also cause an increase in the oceanic carbon sink. Plankton that is not consumed by pelagic fish stocks may make a considerable contribution to the carbon sink. This phenomenon may be unique to Namibia's Benguela current system. Some degree of change, of unknown sign, magnitude and location, is to be expected. In the event of major changes in the global oceanic circulation pattern, a situation not anticipated to occur in the 21st century, but possible under some scenarios after that time, there could be substantial changes to the marine ecosystems off the Namibian coast.

Marine ecosystems around the world are showing signs of damage due to overexploitation and pollution. The Benguela fishery, shared with South Africa and Angola (and with other nations outside the Exclusive Economic Zone) is currently relatively healthy, but some stocks have not recovered fully from past over-exploitation. The Benguela System is certainly not immune to future over-exploitation in the face of rising regional and global demand, and national expectations for employment. Potential climate change is another important source of uncertainty to be considered in this context.

3.5 Vulnerability of ecosystems, biodiversity and the tourism sector

Many organisms of the hyperarid Namib Desert are highly adapted to hot, dry conditions, and are partly buffered against climate change by the proximity of the Atlantic Ocean. The Succulent Karroo biome in the southwest, one of the world's 25 top 'global biodiversity hotspots,' is regarded as under high risk of ecosystem boundary shifts and local extinctions under climate change scenarios. It is a diverse and unique biome occurring in an area of winter rainfall, and hence is vulnerable to changes in the seasonality of rainfall projected by some of the climate change models. There are also many endemic plants with very restricted distributions along the escarpment that are regarded as highly vulnerable to climate change. The escarpment separates the arid deserts from the semi-arid savannas.

Wetlands (including coastal lagoons and seasonal *oshanas*) occupy less than 5% of Namibia and are highly vulnerable to a decrease in water flow, whether caused by climate change or human development or both. The savannas and woodlands that occupy up to 84% of Namibia are inhabited by species with mainly wider distributions that are unlikely to be badly threatened with extinction by climate change, although their distributions and productivity could change. Marine biodiversity off the Namibian coast declines from south to north, an anomaly, as generally biodiversity increases as one moves from the poles to the tropics. A southward movement of warm tropical waters would thus reduce marine biodiversity in Namibia. The large flocks of palaearctic and resident sea- and shorebirds would be susceptible to changes in either climate or other marine resources through changes in food supply and availability of breeding sites. The impact would be compounded further by water flow reduction at river mouths (including the coastal Ramsar sites) under the combined pressure of increased human water demand and increased temperature and evaporation.

Tourism has been identified as one of the fastest growth sectors within the Namibian economy. Since Namibian tourism relies solely on its natural resource base, any impacts to biodiversity and natural ecosystems will impact on tourism. There is increasing protection of these assets through State Protected Areas, communal and freehold conservancies, cross-boundary conservation zones and commercial mixed livestock and game farms, but most of these efforts need to be financially viable. Climate change may cause a loss of species and shifts in distribution, but limiting activities that alter, fragment, isolate or stress existing ecosystems can enhance ecosystem resilience. Conservation of biodiversity and ecological complexity is recognised as a priority, especially in Namibia's wetlands, vulnerable western escarpment and southwestern Succulent Karoo.

3.6 Vulnerability of the coastal zone

Sea level is projected to rise by 30 to 100 cm by the year 2100, relative to the 1990 level. The rate of rise is projected to be relatively steady, accelerating slightly over time, although storm surges are expected to be the main source of damage to coastal infrastructure. In the scenarios considered, the largest rises in sea level are associated with the highest projected temperature rises.

The coastline of Namibia is 1 500 km long, and consists of 78% sandy beaches, 16% rocky shores and 4% mixed sand and rock shores. Only 2% of the shore is backed by lagoons. There are four significant towns on the coast: Lüderitz, Walvis Bay (the only deep water port), Swakopmund and Henties Bay. The coastline is an important tourism and recreation asset hosting attractions such as angling, sport fishing, seal colonies, bird watching and historical sites.

Walvis Bay is located between 1 and 3 m above sea level, in a small semi-sheltered bay surrounded by an erodible coastline. Walvis Bay is an important deep water port providing trade access to landlocked countries such as Botswana. The mean annual rainfall is 20 mm, and the town relies on coastal aquifers which are already susceptible to salt intrusion. This intrusion would be further exacerbated by sea level rise. A desalination plant is planned which would assist the town to adapt to a more saline water supply reducing the demand for groundwater thus making the aquifers less susceptible to salt water ingress. In the past, flooding of the Kuiseb River has caused inundation of parts of the town. A sea level rise of 0.3 m, now regarded as virtually certain, will flood significant areas, and a 1 m rise would inundate most of the town during high tide. During storm events inundation would be even greater.

Swakopmund and Henties Bay are less vulnerable to rising sea levels, and Lüderitz, located on a steep, rocky shore, is relatively invulnerable.

3.7 Vulnerability of the health sector

Infant mortality rates in Namibia have declined, from 65 per 1000 in 1990 to 57 per 1000 in 1995. Infant mortality is higher in rural areas and in the wetter north, compared with urban areas and the more arid south. The main causes of deaths in children under five-years old are diarrhoea (42%), under-nutrition (40%), malaria (32%) and acute respiratory infections (30%), although it must be noted that multiple causes of death are frequent. All of these causes of death have a strong environmental component linked to climate. The main causes of adult mortality are AIDS, tuberculosis and malaria, and since these diseases often co-occur, it is difficult to establish the exact cause of death. The increasing effect of AIDS is likely to place a strain on Namibia’s health and social services in the future.

Drought decreases the nutritional status, particularly of the rural population, and reduces the availability of clean water. Susceptibility to respiratory and gastrointestinal infections and other water-borne diseases such as bilharzia increases, possibly in part due to vitamin A deficiencies that increase in frequency during drought periods. Increased drought in the future, in the absence of safe water provision and secure nutrition, would exacerbate these problems.

Higher temperatures in an area that already experiences very high temperatures are likely to increase mortality among the elderly, infants and others whose health is already poor.

About 60% of the population live in areas where malaria is prevalent. An increase in the area exposed to malaria is predicted in Namibia under climate change scenarios. Such a shift may already be occurring. The southern and central health directorates show an increase in malaria incidence over the past few decades (Figure 3.6). Human trypanosomiasis (sleeping sickness, carried by the tsetse fly) is currently not present in Namibia, although the cattle version, nagana, occurs in eastern Caprivi. The occurrence of both forms is projected to decrease under future climate projections, because of a reduction in habitat availability. There is a possibility of incursion of lymphatic filiariasis (*elephantiasis*), dengue fever and yellow fever from countries to the north under some climate change scenarios.

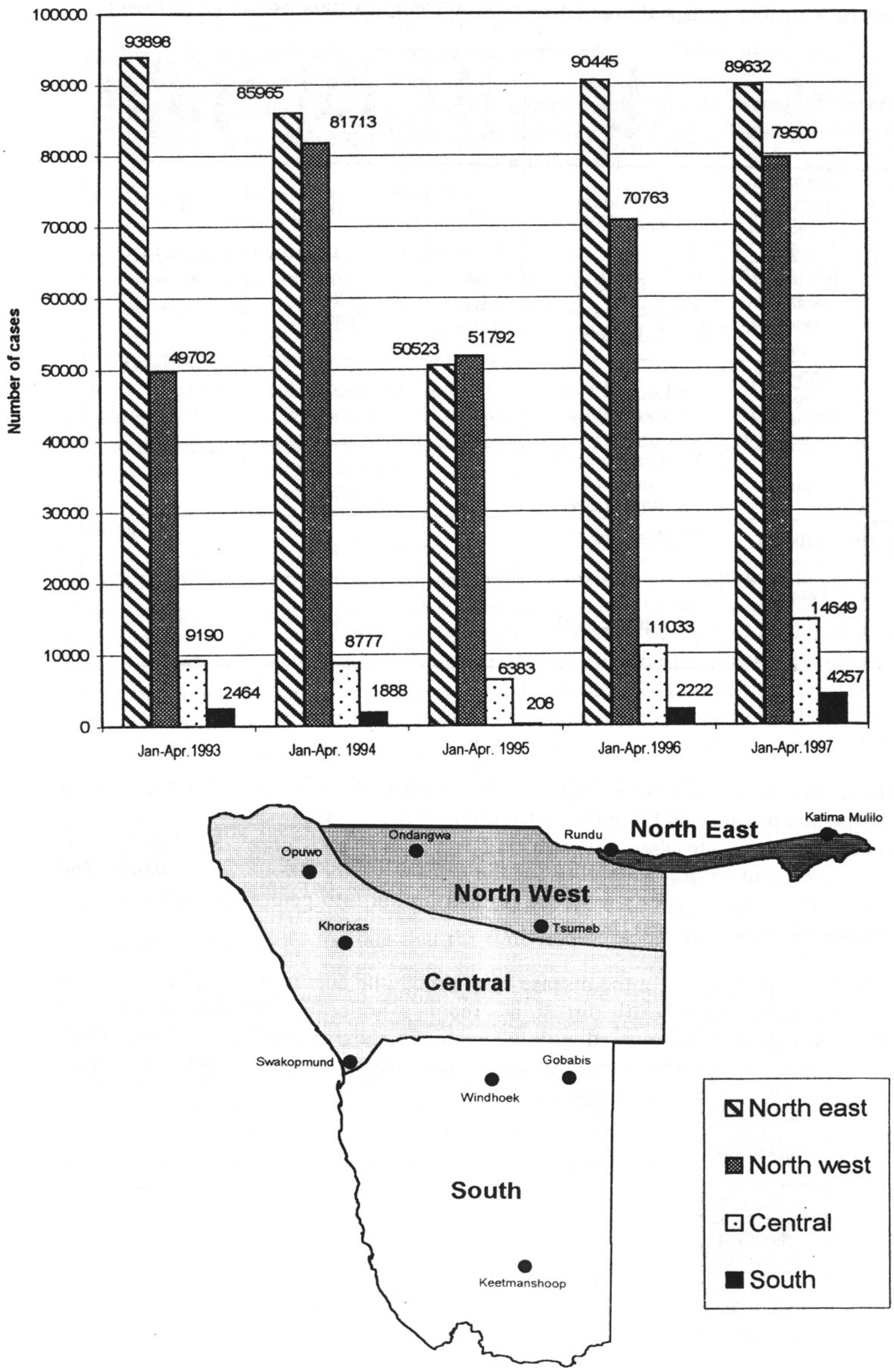


Figure 3.6 Malaria cases reported for the period 1993 to 1997 (January to April) as per health directorate (adapted from Tarr, 1998).

3.8 Vulnerability of the energy sector

Total energy consumption in Namibia was estimated in 1993 at 46 621 TJ (terajoules). About 78% of this energy was imported as petroleum products, electricity and coal. The balance (22%) is made up by biomass fuel (mostly wood), which is the primary energy source for 60% of the population. The transport sector is the major consumer of energy in Namibia. Petroleum consumption has grown at about 7% per annum since 1990. Currently there are about 125 000 vehicles in Namibia.

With its high number of sunshine hours, Namibia is very well suited to use solar power, but this renewable energy source is currently under-utilised.

Electricity consumption by sector is as follows: urban households 52%, mining 39%, agriculture and water supply 3% and industry and commerce 6%. Most of Namibia's electricity is imported, but local generation capacity is available at the Van Eck coal-fired power station in Windhoek, the Paratus diesel-powered station at Walvis Bay and the Ruacana hydroelectric power station on the Kunene River. Of these, the hydroelectric plant (capacity of 240 MW) generates most of Namibia's locally produced electricity.

Electricity production from the Ruacana plant is already severely curtailed during periods of drought and low flow. Under the climate change scenarios of reduced rainfall or increased evaporation, the impact would become worse. However, under some scenarios, rainfall is anticipated to increase in the tropical regions of southern Africa, so although Namibia may become drier, the catchments of the Kunene River (which lie in southern Angola) could receive more rain. It must be emphasised that this possibility is very uncertain.

Bush encroachment in vulnerable parts of the country may increase as a result of climate change, and so total fuel wood supply may be enhanced. Distribution of fuel wood to the remote areas where it is needed would require transportation and so remains a problem.

3.9 Conclusions

The Namibian people, economy and environment are extremely sensitive to climate change effects and, due to institutional and financial constraints, are considered highly vulnerable to these effects. Direct effects on the various economic sectors described above could potentially be felt throughout the economy, ultimately reducing productivity, influencing sustainable development options, and affecting social stability. If, as some models suggest, the climate becomes hotter, drier and more variable over most of Namibia, it is clear that marginalized rural and urban populations will be the most dramatically affected.

Chapter 4: Policies and measures

Article 12.1 (b) of the United Nations Convention on Climate Change requires parties to report on the "general description of steps taken or envisaged by the Party to implement the Convention". Such steps include policies and measures adopted by the country to reduce the impact of climate change, as well as actions that may reduce greenhouse gas emissions.

As discussed in previous chapters, Namibia is estimated to be a net sink of carbon dioxide, but is also extremely vulnerable to climatic changes. Greenhouse gas emissions from Namibia account for only a minute fraction of the global emissions, and, as a consequence, most policies and measures deal with adaptation to climate change. Although no national climate change policy has yet been formulated, the already harsh climatic conditions in Namibia have resulted in the explicit or implicit inclusion of climate considerations in a wide range of existing policies on economic and social development and on natural and environmental resources. In addition, explicit strategic aims and prioritised activities on climate change have been included in a section of the National Biodiversity Strategy and Action Plan (NBSAP) in the context of the vulnerability of Namibian ecosystems, species and rural livelihoods to climate change.

4.1 Policy context

A planning programme called Vision 2030 is currently in progress in Namibia. Vision 2030 describes in general terms the overall level of development the country wants to achieve over the course of the coming three decades. Among the priority sectors targeted are education, health, natural resources and macro-economic aspects. Vision 2030 guides plans and policies that specifically address national development, regional development, poverty eradication, natural resources and environmental resources.

Due to the complex nature of climate change, responsive policies will be a combination of various different policy areas. Policies need to address adaptation to adverse impacts of climate change on terrestrial, freshwater and marine ecosystems, hydrology and water resources, food and fibre, human infrastructure and human health or mitigation options in all economic sectors. The steps taken towards addressing a changing climate system will therefore be integrated in many other sustainable development policies and work programmes, for example the NBSAP.

4.2 Co-ordination of climate change activities

Following Namibia's ratification of the UNFCCC on 16 May 1995, which took effect on 14 August 1995, an interim Climate Change Advisory Committee (CCAC) was established by the Ministry of Environment and Tourism (MET). The CCAC comprised of senior scientists and policy makers from different ministries and organisations concerned with climate change. The CCAC was responsible for overseeing the production of Namibia's country study on climate change, funded by the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ).

The Namibian Climate Change Committee (NCCC) was established early in 2001 by the MET to direct and oversee further obligations to the UNFCCC. The NCCC included the

members of the old CCAC, but included expanded representation from ministries and other experts from civil society (Figure 4.1).
The mandate of the NCCC is to:

- Develop national positions on climate change issues through intersectoral dialogue to feed into all relevant international fora, including Conference of the Parties to the UNFCCC, meetings of the Subsidiary Body on Scientific and Technical Advice, and other international and regional meetings;

- Oversee the development of Namibia's ongoing national communications to the UNFCCC, including programme and project proposals to be included therein;

- Define Namibia's climate change capacity building needs and institutional requirements, and devise an effective strategy for meeting these;

- Devise a national strategy for adapting to climate change with emphasis on Namibia's extreme vulnerability as an arid African nation;

- Oversee the implementation of the Clean Development Mechanism (CDM) and other bilateral and multilateral mechanisms; and

- Carry out work as needed by way of subcommittees, through the co-option of additional members or advisors as appropriate.

A technical advisor was appointed to provide advice and administrative/policy support to the National Coordinator for climate change and the NCCC in their operations. This position was funded by GEF through the UNDP. The NCCC is chaired by the Ministry of Environment and Tourism, Directorate of Environmental Affairs (MET DEA). The deputy chair is the National Meteorological Service in the Ministry of Works, Transport and Communication (MWTC NMS). The NCCC reports to the Permanent Secretary of the Ministry of Environment and Tourism (MET) via the head of the Directorate of Environmental Affairs (DEA). The NCCC has the powers to establish working groups and subcommittees as needed.

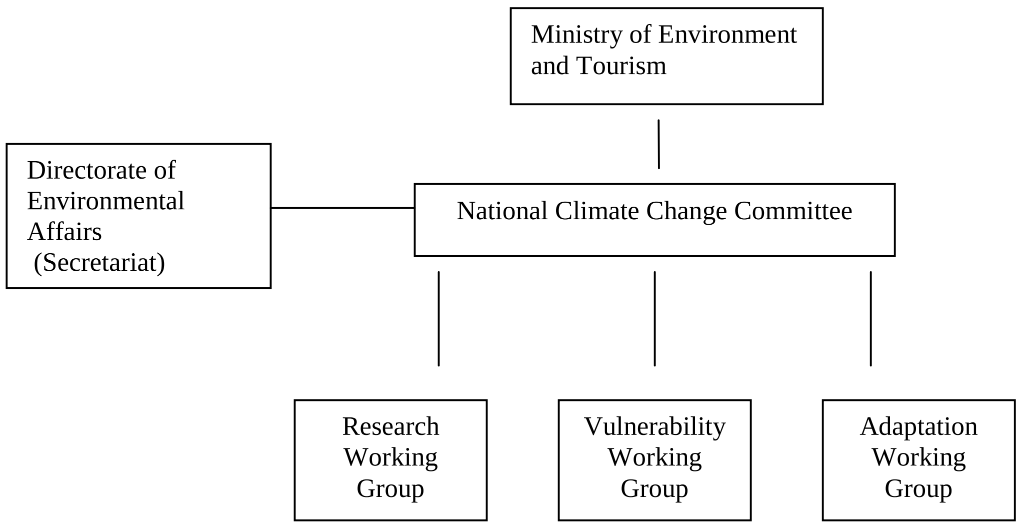


Figure 4.1 The Namibian Committee on Climate Change (April 2002).

The National Climate Change Programme has also begun to build a broader civil society forum on climate change known as the Contact Group on Climate Change (CGCC). The forum is a voluntary and open-ended group consisting of interested members of civil society, industry, local government, NGOs, educational institutions and others. It thus has an important role to play in supplementing the relatively government-focused and more formally constituted Namibian Climate Change Committee, in terms of public awareness, public debate, and focus on local and thematic issues.

4.3 International environmental conventions and policy

Namibia has committed to a number of Multilateral Environmental Agreements (see Box 4.1). The Office of the Chief Development Planner: Conventions and Related Programs coordinates the functions and activities within these conventions. Integration ensures technical links and improved economic efficiency between programs as well as better development outcomes for Namibia. Namibia has a highly collaborative and synergistic approach to dealing with the convention programmes but needs support for detailed implementation of joint activities.

Box 4.1 Namibia's commitment to international environmental conventions

- Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention, 1971)
- Convention on the International Trade in Endangered Species of Wild Flora and Fauna (CITES, 1973)
- Vienna Convention on the Protection of the Ozone Layer (1985)
- Montreal Protocol on Substances that Deplete the Ozone Layer (1987)
- Basel Convention on Transboundary Movements of Hazardous Wastes and their Disposal (1989)
- Convention on Biological Diversity (CBD, 1992)
- UN Framework Convention on Climate Change (UNFCCC, 1992)
- Convention to Combat Desertification (CCD, 1994)
- Convention for the Protection of World Cultural and Natural Heritage (1998)

Although Namibia has not taken a very active part in the international negotiations on climate change, Namibia did commit to positions articulated in the Africa Group and G77+ China. Most important for Namibia were the provisions of financial resources to adapt to climate change impacts under Articles 4.8 and 4.9 of the UNFCCC.

Namibia (through the Namibian National Biodiversity Programme) has also initiated national-level joint planning discussions, and contributed to international-level joint workplan discussions within the framework of the CBD, UNFCCC, CCD and Ramsar Conventions, in an attempt to streamline and integrate implementation of these conventions to make effective use of limited resources. Financial support is needed for detailed implementation of identified joint activities. For example, in the NBSAP, a number of activities have already been prioritised so synergistic planning for joint implementation of these with activities from other convention programmes would be of great benefit.

4.4 Regional co-operation

Namibia is a member of the Southern African Development Community (SADC) and participates in a number of relevant regional treaties and policies. Namibia collaborates with SADC climate monitoring initiatives, especially the Drought Monitoring Centre (DMC) and the Regional Remote Sensing Unit (RRSU) both situated in Harare, Zimbabwe.

Namibia shares all of its major perennial rivers with its neighbours, and controls none of their major catchments. The SADC Protocol on shared watercourses outlines the guidelines for the usage of water from shared watercourses in the SADC countries. The guidelines cover issues ranging from equitable and reasonable usage of water to the responsibilities to inform basin states about environmental and other changes in water usage. This protocol has been one of the main reference points for Namibia's negotiations with other basin states on the usage of water from shared rivers. Several agreements have been made between Namibia and her neighbours to co-ordinate transboundary water issues (MAWRD, 2002; Tarr, 1998):

- Permanent Joint Technical Commission on the Kunene River (JPTC) between Angola and Namibia (1990);
- Permanent Joint Water Commission (JPWC) between Namibia and Botswana which deals with the utilisation of water resources from the Kwando-Linyanti-Chobe, the Zambezi and the Okavango rivers (1990);
- Permanent Water Commission on the Orange River between Namibia and South Africa (with a specific agreement on the Vioolsdrift and Noordoewer Joint Irrigation Scheme) (1992); and
- Permanent Okavango River Basin Water Commission (OKAKOM) between Angola, Botswana and Namibia (1994).

Namibia has also established its first transboundary conservation area with South Africa in the Ai-Ais Richtersveld region, and is also investigating the establishment of further transboundary conservation areas in the Skeleton Coast Park / Parque Nacionale do Iona (with Angola) and the Caprivi Region (with Botswana, Zambia and Zimbabwe). The Orange River Mouth is a Ramsar site shared with South Africa.

4.5 Overview of relevant national policy and other regulatory mechanisms

Namibia does not have a specific climate change policy, although the need for one has been agreed and the NCCC has started to formulate policy recommendations. Several socio-economic and natural resource policies provide an indirect framework for adaptation to climate change or, to a lesser extent, mitigation against the emissions of greenhouse gases. These policies are described here.

The UNFCCC recognises the first priority of economic and social development as poverty eradication in developing countries (UNFCCC, Art 4.7). It is also explicitly required that policies and measures to protect the climate system should be integrated with national development plans, as economic development is essential for adopting measures to address climate change in the first place (UNFCCC Art 3.4).

The National Preparatory Committee for the World Summit on Sustainable Development in Johannesburg is currently reviving a policy discussion on environmental issues in Namibia. So far, Namibia's only strategic planning document which explicitly refers to climate change is the draft National Biodiversity Strategy and Action Plan (NBSAP), formally known as *Biodiversity and Development: Namibia's ten-year strategic plan of action for sustainable development through biodiversity conservation 2001-2010.* In particular, Chapter 3 of this document deals with monitoring, predicting and coping with environmental change, through ten prioritised strategic aims given in Box 4.2.

Box 4.2 Ten prioritised strategic aims of the NBSAP

1. Strengthen national capacity for reliable decision-making on the environment and development
2. Improve national and local capacity to monitor, detect and predict environmental change
3. Develop reliable indicators and monitoring systems of biodiversity and ecosystem function
4. Enhance national capacity in biosystematics to support biodiversity management
5. Identify and monitor main environmental threats
6. **Raise awareness and strengthen capacity to adapt to climate change**
7. Manage and mitigate desertification, land degradation and land conversion
8. Reduce the threat to biological diversity from alien invasive species
9. Strengthen national and local capacity to manage and reduce pollution
10. Develop and apply rehabilitation and restoration methods to degraded ecosystems

Each of these strategic aims has a number of prioritised activities, with datebound targets for implementation. Those for Strategic Aim 6 on climate change (focusing on biodiversity and ecosystem impacts) are shown in Table 4.1.

Table 4.1 Strategic aim 6 of the Namibian Biodiversity Strategy and Action Plan (NBSAP)

Climate change activities	**Target**
a. Synthesize relevant regional and national information and scenarios from other sources	Namibia's Initial National Communication to the UNFCCC is submitted by July 2002
b. Commission analyses of biodiversity impacts in Namibia with appropriate partners	Namibia's first national communication identifies main areas of impact by July 2002; Climate change impacts on Namibian terrestrial ecosystem boundaries and species distributions are preliminarily analysed by December 2002
c. Design and implement appropriate awareness programme based on summary information for target audiences in consultation with stakeholders	An information brochure on the vulnerability of Namibia to CC and potential mitigation strategies is available to key decision-makers by 2003
d. Integrate climate change monitoring and research needs in the design and planning of environmental observatories (EONN sites – Environmental Observatories Network of Namibia)	Indicators of CC are monitored at five EONN sites by 2005
e. Focus research and management planning on climate change impacts on vulnerable species and areas	A map of biodiversity priority areas is produced, with at least three relevant CC monitoring and research programmes implemented at these sites, by 2006
f. Make results and recommendations regularly available to stakeholders and decision-makers through appropriate media	Environmental briefing sheets focusing on CC and biodiversity issues are distributed to Parliament at least once yearly by 2003; A pamphlet on strategies to mitigate the effects of CC is distributed to natural resource users by 2004

Other chapters of the NBSAP make broader reference to sustainable land management, water management and economic and social mechanisms for buffering rural people from environmental change, such as livelihood diversification.

The NBSAP was participatively developed by a number of thematic working groups and national workshops of the National Biodiversity Task Force. It was formally presented by the

Task Force to the Minister of Environment and Tourism in April 2002 and will be submitted to Cabinet by the end of the second quarter of 2002.

Namibia's *First National Development Plan* (NDP 1) (Republic of Namibia 1995a) covered the period 1995/1996 to 1999/2000. During this period, the Namibian economy was particularly dependent on primary production, which in turn is vulnerable to climatic factors. In Namibia's draft *Second National Development Plan* (NDP 2), (Republic of Namibia 2001a) for the period 2000/01 to 2005/06, strategies have been adopted for increased diversification of the economy. Furthermore, in response to the heavy reliance on natural resources for the country's economic activities, the promotion of environmental and ecological sustainability has become one of the key national strategies. It is recognised that the arid and fragile environment places a limit on economic development. Response strategies on a national level include: full-cost pricing of consumptive use of natural resources, especially water; adequate institutional arrangements to promote integrated approaches to sustainable development; community participation in natural resource management and; the continued establishment of reserves to protect Namibia's unique flora and fauna.

Within Namibia's NDP 2 a separate document addresses *Issues and threats to sustainable development in Namibia* (Tarr 2000). This document highlights Namibia's already harsh climatic conditions, fragile lands and the additional potential negative impacts of climate change on scarce water resources, food production and human health (e.g. malaria).

The review paper, *Government policies on sustainable development in Namibia* (Blackie and Tarr, 1999) focuses on the effectiveness of institutional responses to achieve sustainable development. Notwithstanding plans for diversification wherever possible, natural resources will remain the key to the future growth of the economy and any pressure on these resources needs supportive institutional frameworks that have impacts on decision making. It is advised that economic policies need to be broadened to include a wider range of issues related to sustainable development.

An inter-ministerial Sustainable Development Commission is being established under the draft Environmental Management Bill (2002) to deal with issues on the sustainable utilisation of the environment that cut across government departments, including procedures and institutional structures for environmental assessments of projects and policies.

In the *Regional Planning and Development Policy* of Namibia, the management of environmental resources is seen as a major preoccupation of the government (Republic of Namibia, undated). Agricultural lands, pastures, rangelands, forests and other vegetation types are increasingly facing degradation. The government has responded through a strategy of decentralisation of management for soil, water and forests to regional and local councils. Tourism is also promoted as a means by which rural development can take place through the extension of wildlife rights to benefit people living on communal lands through conservancies (Republic of Namibia 1995d, 1995e, 1994b).

(Photo: Bob Scholes)

Figure 4.2 Wildlife resources are important assets for tourism and rural development

The *National Population Policy for Sustainable Human Development* emphasises the links between the changes within Namibia's population and the productivity of the agricultural and natural resources (Republic of Namibia 1997b). Rural areas support up to 70% of the people, most of whom are directly dependent on agriculture and ecosystems for their livelihoods. A growing population and economy need to be supported within Namibia's environmental constraints. The link between poverty eradication and the management of natural resources is explicitly made in the *Poverty Reduction Strategy for Namibia* (Republic of Namibia 1998a). Most of the country's poor people depend on livestock and crop production for a significant part of their livelihood. Several strategies are aimed at raising subsistence farm production and incomes. Another area identified for poverty reduction is community-based tourism programmes (Figure 4.2).

The *National Drought Policy and Strategy* (Republic of Namibia, 1997c) does not make any explicit reference to climate change, although a key objective of the policy is to "minimise the degradation of the natural resource base during droughts". A key feature of the policy is to reduce vulnerability to drought in the long-term.

A *National Policy and Strategy for Malaria Control* is already in place (Republic of Namibia, 1995b) emphasising disease management and disease prevention through personal protection, chemoprophylaxis for special risk groups and vector control.

The *National Policy on Research, Science and Technology* (Republic of Namibia, 1999) provides the structure wherein sector-specific science and technology (S&T) strategies are carried out. A National Commission on Research, Science and Technology (NCRST) integrates inputs from various key science and technology institutions and reports directly to the Ministry of Higher Education, Science, Technology and Employment Creation (which has jurisdiction over science and technology).

Namibia's Green Plan (Republic of Namibia, 1993) recognises Namibia's negligible contribution to the enhanced greenhouse effect, but at the same time the country's vulnerability to the predicted changes of warming and increased aridity. Several measures to increase Namibia's contribution as a sink for greenhouse gases, to increase energy efficiency through the increased use of solar and wind resources, to improve the national rail transport system and to participate in international agreements, research and the transfer of information, were proposed.

In *Environmental threats and opportunities in Namibia: a comprehensive assessment* (Byers, 1997) Namibia's environmental vulnerability is further emphasised. The Government of Namibia has responded through a set of new policies for natural and environmental resources. The *National Water Policy White Paper* (Republic of Namibia, 2000) recognises the threats to water resources, and proposes a set of measures and approaches on the assessment of water resources, management of shared watercourses, the economic pricing of water, water demand management, a new legislative framework with ownership vested in the State, and institutional strengthening. Water is to be managed on a catchment-basis, and is to include all stakeholders. Economic development will be constrained by the inadequate supply of water, necessitating a pro-active and integrative approach to water resource management. On a regional level, several shared water schemes are in the process of being researched and further developed (Pallet, 1997). The National Water Act strongly supports this demand management and efficient pricing approach, although it regards water purely as a commodity, and not as an environment or ecosystem requirement.

The *National Land Policy* (Republic of Namibia, 1998b) proposes a reform of land rights (including customary grants, leasehold, freehold, licences, certificates or permits and state ownership), to provide the means for more sustainable management of these resources. The land policy will at all times promote environmentally sustainable land use, and failure will lead to the termination or denial to award any land title. This commitment to sustainable resource use is echoed in the *National Agricultural Policy* (Republic of Namibia, 1995c), particularly through the empowerment of local people and the implementation of agricultural policies that are compatible with the country's fragile ecosystems. The opening up of new agricultural areas and land uses are, for instance, subject to an environmental impact assessment. Vulnerability to drought is reduced through the institution of emergency management systems with an emphasis on relief and rehabilitation mechanisms.

The *Namibia Biodiversity Policy Analysis* (McGann, 2000), which preceded publication of the National Biodiversity Strategy and Action Plan 2001-2010, is based on the premise that biodiversity, like climate change, is an issue that needs to be addressed through a holistic policy approach. Several recommendations have been made to various ministries and policy makers to make their policies more sensitive to biodiversity issues. Several policy documents and research discussion papers have highlighted the need for an incentives-based approach to biodiversity conservation (Ashley, 1996; Barnes *et al.*, 2002) and community-based tourism (Republic of Namibia, 1995d). The first draft of the *Access to Biological Resources and Associated Traditional Knowledge Act* (2000) emphasises the rights of local communities over crop varieties and biological resources and the need for grassroots conservation of biodiversity, which should facilitate increased self-reliance among rural communities and perhaps reduce energy-intensive livelihood changes. A national policy, *The Safe Use of Biotechnology in Namibia*, was approved by Cabinet in 1999 and provides detailed guidelines and procedures for evaluating biotechnology applications in the light of sustainable environmental management, human health and ecosystem impacts. It is supported by a draft *Biosafety Bill* which will probably be tabled in Cabinet in late 2002 or 2003.

Namibia's new *Forest Act* (Republic of Namibia, 2001b) requests the preparation of management plans for each classified forest. In addition, in order to protect the forest's primary role as "protector and enhancer of the environment", strict rules control the cutting, destruction or removal of vegetation, trees, bushes or shrubs. Rural households are encouraged to seek alternatives to wood fencing and to utilise agro-forestry measures. In addition, afforestation is encouraged through the distribution of low-cost seedlings and a working group is currently assessing the feasibility of a national afforestation programme. In addition, a Strategic Forests Task Force has identified specific forest areas regarded as nationally or internationally important for biodiversity, watershed management or carbon sequestration. The revised *Development Forestry Policy for Namibia* (Republic of Namibia, 2001c) specifically welcomes international supplements to compensate for the global benefits of sustainable forestry management (e.g. carbon sequestration and regulation of climate change).

The *White Paper on Energy Policy* (Ministry of Mines and Energy, 1998c) emphasises the diversification of energy resources, with emphasis on natural gas and on renewable energy in development applications. It is estimated that available gas, hydro-power, wind and solar energy resources are in excess of Namibian domestic demand, but it is recognised that the economic costs and benefits of these options should be examined against the alternative of importing electricity. Nevertheless, rural households rely mostly on biomass fuels to meet their energy needs as only 8-9% of these households have electricity connections. In response to this situation, the Government plans to introduce measures for more sustainable biomass use and an institutional and planning framework to implement decentralised solar photovoltaic and wind energy systems. Namibia introduced unleaded petrol in 1997, and latest available figures show that it already accounts for 25% of demand.

Currently there are no national policies for air pollution. Legislation to mitigate adverse environmental impacts of development, such as pollution and waste, is currently receiving attention in the Ministry of Health and Social Services through the review of the existing Waste Management Act. Transport policies contain no mention of climate change issues even though transport is a significant sector in terms of emissions of greenhouse gases in Namibia. Although there are National White Papers on Marine Fisheries, Inland Fisheries and Aquaculture, these do not address issues of climate change nor its impacts.

4.6 Mitigation and reduction strategies

Namibia's contribution of greenhouse gases on both a regional and global scale is negligible, and the greenhouse gas inventory estimates that Namibia is a net sink of carbon dioxide. Nevertheless, some cost-efficient and environmentally effective reduction options can still be achieved. Namibia's energy production is dominated by hydropower while the shortfall to meet energy demand is imported from the southern African Power Pool. There are plans to meet the projected growth in energy demand through the development of the Kudu natural gas field and possibly additional hydropower plants in the lower Kunene and Kayango Rivers. These developments would displace the need to import more coal-derived power from South Africa. The Kudu gas option, which includes the possibility of export of gas to South Africa, would increase greenhouse gas emissions in Namibia itself. On a regional basis, however, it would lead to savings of greenhouse gas emissions. Emissions in the transport sector are already significant and are projected to grow in the future. The forestry, land use changes, agriculture and waste sectors in Namibia do not contribute in a major way to global growth in greenhouse gas emissions (Blackie 1998). Land use changes, including savanna burning and land-use change, have locally significant GHG consequences. Table 4.2 provides an overview of mitigation options, and where possible their incremental costs, that have been considered in the country study. Many of these options, however, have not been quantified yet.

Table 4.2 Mitigation options for Namibia (from Blackie, 1998).

Mitigation option	Potential Gg CO_2 saved	Incremental cost (N$m)	N$m/Gg CO_2
Kudu Gas only	45574	negative	negative
Lower Kunene hydro only	11691	-195.8	-0.0167
Commercial borehole conversion to PV	39	4.4	0.113
Communal borehole conversion to PV	12	1.5	0.13
Solar water heaters	na	na	na
Solar ovens	33	0.6	0.18
1000 catalytic convertors: 50 000km version	97	10	0.1
1000 catalytic convertors: 25 000km version	49	10	0.2
1000 catalytic convertors: 10 000km version	19	10	0.53
Address loss of energy due to transmission	na	na	na
Increase urban household energy efficiency	na	na	na
Reduce pumping requirements for desalinisation	na	na	na
Purse seiners and longliners instead of trawlers	na	na	na
Freezing and processing fish on shore	na	na	na
Concentrate on fishing when close to harbour	na	na	na
Higher catch rates per day	na	na	na
Modernisation of horse mackerel fleet	na	na	na
Incentives for fuel efficient cars	na	na	na
Reduce rangeland expansion	na	na	na
Windfarm generation at Lüderitz	na	na	na

Note: na = not available

Namibia is still in a process of selecting feasible alternatives as further research on these and other options are still required (Blackie, 1998). Alternative ways in which to make use of the opportunities under the Clean Development Mechanism are currently under discussion in the NCCC. Namibia has not introduced regulations or market-based incentives intentionally targeted at the emissions of greenhouse gases or the vulnerability to climate change.

4.7 Actions taken in support of the Convention

Several activities have been undertaken in support of the Convention and are listed in Table 4.3.

Table 4.3 Budgets for climate change activities already undertaken in Namibia

Activity	Budget	Funding agent
Country Studies	No data	GTZ
Ongoing activities of NCCC (e.g. meetings, international negotiations)	No data	GRN, UNDP, GEF
National Communication	US$ 120 000	UNDP/GEF
Permanent Secretariat Office	US$ 10 000	UNDP/GEF
Implementation of adaptation policies		To be sourced

A focussed workshop was held in March 2002 to discuss policies and measures to deal with climate change in Namibia. A number of measures relating to vulnerability and adaptation to climate change were identified and prioritised. Apart from identifying several technical and research needs, it was recognized that capacity-building was fundamental to Namibia's future implementation of the UNFCCC and to Namibia's freedom from adverse climate change impacts. A climate change strategy and action plan, similar to the NBSAP, is needed to integrate policies across sectors and to identify priority activities. Such a planning process would need to be highly consultative. Proactive integrated natural resources policy and implementation to deal with expected impacts from climate change is also necessary. Namibia is relatively well served by conducive policy frameworks in this respect, but still lacks sufficient implementation capacity.

4.8 Recommendations

The sustainable development measures discussed above need to be developed and implemented across sectors to ensure their benefits for human and economic health and well-being, and to ensure a positive development trajectory for Namibia.

The following steps are recommended:

- The integration of existing information on the vulnerability to climate change and measures to adapt to these changes into existing economic, social, and natural and environmental resource policies.

- In parallel, further research is needed on Namibia's socioeconomic and ecosystem vulnerability to climate change, and measures to adapt to such changes. This research should emphasize impacts on economic development and implications for poverty eradication, and be financed through the mechanisms of the UNFCCC.

- Exploitation of cost-effective opportunities for the reduction of greenhouse gases on a regional and global level through the Clean Development Mechanism and other bilateral and multilateral agreements.

- A consultative planning process to develop a strategic framework to deal with climate change issues within the existing policies and legislation is needed.

Chapter 5: Research and systematic observations

5.1 Climate observation system

Climate observations have been made in Namibia since 1892, but earlier observations were limited to measurement of rainfall at a few missionary settlements. Namibia's Meteorological Services currently operates a network of about 300 active rainfall stations. About 100 stations provide full year-round records. Historical rainfall figures are available, for various periods, from 900 stations.

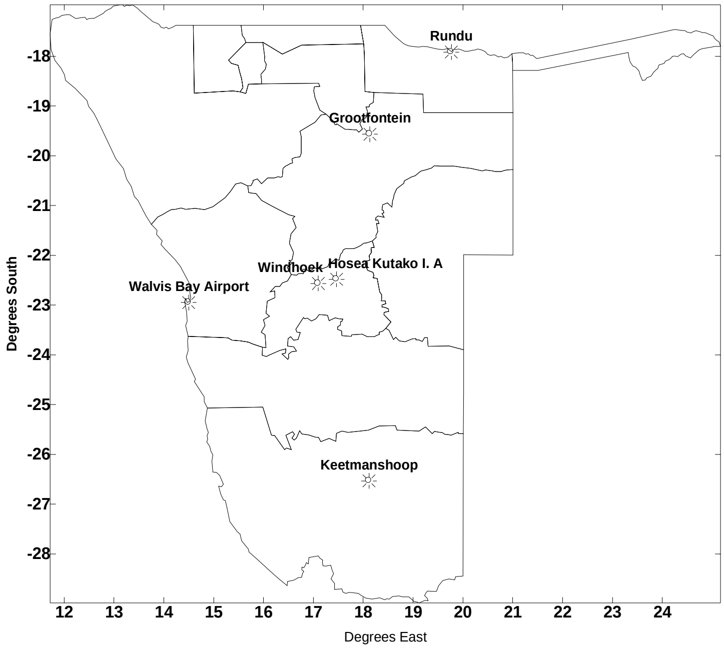
The Namibian Meteorological Services make use of six synoptic weather stations, recording most of the standard meteorological parameters on an hourly basis. In addition there are eight stations recording three times per day, which are operated by volunteers (Figure 5.1). The stations are not evenly distributed across the country. For instance, there is only one full time station, Rundu, in the northern parts of the country, which is obviously not representative of the entire northern area. The Caprivi Region with Katima Mulilo in the far northeast often relies on data from Botswana or Zambia. To increase the accuracy of forecasts, a representative network across the country is needed. Daily upper air observations are conducted at one station and these data, together with selected data from the hourly and thrice-daily synoptic stations, are exchanged regionally and globally for weather forecasting purposes. The Namibia Meteorological Services plans to increase its number of fulltime stations to ensure a reasonable level of support to all user sectors and research needs, including environmental monitoring and climate change detection and attribution studies.

Weather parameters are also available from the marine environment monitoring performed at full time stations on the coast (Möwe Bay, Meob Bay and Kerbuhunk). A weather buoy at Swakopmund measures seawater salinity, O_2 content and sea temperature. Sea surface temperatures are collected daily through satellite remote sensing, together with measures of primary production (Pers. Comm. B. Oelofsen, 2002).

During ship-based marine surveys, parameters such as temperature salinity and biological parameters are recorded.

Namibia collaborates with the SADC Early Warning initiative and has a National Early Warning System and an Emergency Management Unit, both of which rely on climate observations for reactive interventions. Namibia collaborates with SADC climate monitoring initiatives such as the Drought Monitoring Centre (DMC) and the Regional Remote Sensing Unit (RRSU) both situated in Harare, Zimbabwe.

a)



b)

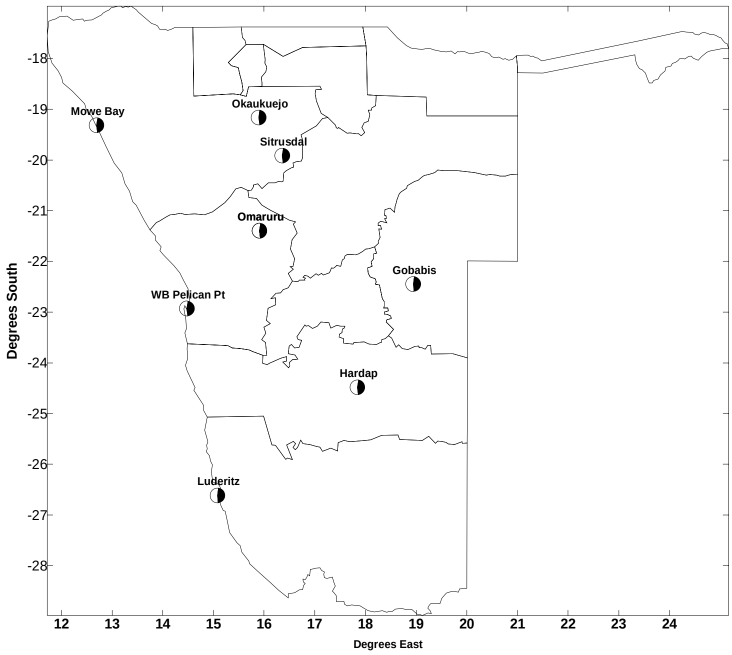


Figure 5.1 **Namibia network of a) full-time and b) part-time meteorological stations as at 31st July 2001. The part time stations are operated by volunteer personnel (individuals and organizations) and make at most three observations per day (08h00, 14h00 and 20h00 hours). All are in the synoptic and principal climate station category, albeit with deficiencies in most cases (Namibian Meteorological Service, 25 March 2002).**

5.2 Environmental observations

Rate of river flow is recorded at several points along major river courses. One hundred and twenty monitoring stations are operative of which four are linked in real time, via satellite, to the WHYCOS Southern African network.

The depth of the water table is monitored at about 900 borehole stations, of which 90 are automatically linked to the Department of Water Affairs in Windhoek.

The vegetation of Namibia has been mapped and is monitored through the Agro-Ecological Zoning and Vegetation Survey Projects of the Ministry of Agriculture, Water and Rural Development (MAWRD); by the National Atlas of Namibia Project (which drew on the Vegetation Survey and other data); by the Tree Atlas Project of the National Biodiversity Programme, and by the National Forest Inventory of the Ministry of Environmental Affairs and Tourism (MET)'s Directorate of Forestry.

The MET, by way of selected yearly strip counting and aerial surveys since 1983, counts large game mammals on an ongoing basis. Freehold and communal conservancy committees also conduct detailed regular game censuses, with MET and NGO technical support. Bird research and survey projects are also regularly conducted.

Livestock numbers are physically established on a yearly basis by the Directorate of Veterinary Services in the MAWRD and the Farm Assured Namibian Meat Scheme (FANMEAT) of the Meat Board of Namibia. The Health Statistics Unit in the Ministry of Health and Social Services Health collect statistics and incidence of human diseases. The Namibian Agronomic Board and the National Early Warning System in the MAWRD survey crop and horticultural production data on an annual basis. The Directorate of Policy Planning and Economics of the Ministry of Fisheries and Marine Resources monitor pelagic and deep-sea fish stocks and inventories.

There is no operational air quality monitoring system underway anywhere in Namibia.

5.3 Global change research

Namibia has participated in regional research activities aimed at better understanding global change and its impacts. Namibia hosted a site of the Kalahari Transect (at Sandveld). During the SAFARI-92 study of biomass burning it hosted researchers at Etosha, and during the SAFARI 2000 study of regional aerosols and ozone precursors one of the airborne campaigns was based in Walvis Bay. Namibian scientists were investigators in both studies.

Namibia presently operates three atmospheric ozone-monitoring stations which are used to help calibrate the satellite-derived estimates of ozone and aerosols in the atmosphere. The sites are named Etosha (335), Okaukuejo (312) and Khomas (782). The numbers of the stations are the official NASA allocated numbers.

5.4 Need for enhanced interpretative capacity

A framework for environmental observations in several important spheres exists in Namibia. Taking into account the large surface and the diverse environments of the country, much better physical coverage is needed for most of the observations in order to generate spatially and temporally reliable information. Greater capacity to capture, process and interpret these data is needed. Capacity building initiatives should involve Namibian educational institutions such as the University of Namibia and the Polytechnic.

With a view on policy inputs, there is a need to enhance capacity to interpret the collected information. This is explicitly called for (with financial, institutional and timeframe details) in the National Biodiversity Strategy and Action Plan's chapter 3 on monitoring, predicting and coping with environmental change and should receive additional attention within the climate change context.

5.5 Key research issues

A number of research needs have been identified and are comprehensively described in the section on financial and technological needs. These initial research priorities were determined during a stakeholder workshop (March 2002) on policies and measures, through the process of compiling the country study report and the Initial National Communication, and through the process of joint identification of synergies between the CBD, UNFCCC and CCD within Namibia initiated by MET.

The research topics identified thus far have not been prioritised, nor have they been determined through a widely consultative process. They are neither comprehensive nor definitive. A strategic planning process is needed to reaffirm these needs, identify others, prioritise activities and initiate implementation of these activities.

Chapter 6: Public awareness and training

Public awareness and training that deals specifically with climate change issues has been limited in Namibia. There are efforts underway to improve general awareness of environmental issues such as desertification. In the past, Namibia has had to deal with lengthy periods of drought and water scarcity so these environmental impacts of climate have already received attention.

6.1 Information dissemination to decision-makers and the general public

The Desert Research Foundation of Namibia coordinates a German government funded Regional Awareness Programme (RAP) in northern Namibia - the most populous part of Namibia. RAP is a component of the National Programme to Combat Desertification and uses the following platforms to create environmental awareness among the general public: workshops and discussions, posters, booklets, brochures, and radio-programmes.

The programme raises awareness and understanding amongst regional and local decision-makers about the sensitivity of arid environments. Furthermore, the programme creates awareness and increases understanding about the importance and use of rainfall data; the value of floods in the *oshanas*; the protection and value of trees; use of modern fuel efficient stoves; and alternative materials for fencing and home construction. RAP gathers information on these issues and makes it available to decision-makers. Collaborators include governors, regional councillors, traditional leaders, Non-governmental Organisations (NGOs), Community-Based Organisations, the Ministry of Environment and Tourism, and the Department of Rural Water Supply.

The use of indigenous languages in public awareness campaigns is encouraged.

6.2 Education of the general public and students

According to the second National Development Plan, a considerable amount of information on the environment was published and disseminated for public use by various ministries and programmes. The Namibian Environmental Education Network was established to help co-ordinate environmental education activities in Namibia. Environmental issues such as climate change were introduced into grade 10 and 12 national curricula to specifically target high school students. Climate change issues were included in the Natural Economy course (Unit on Atmosphere in Crisis) and broadly disseminated into the Geography stream (Ecosystems and Soil Unit). Appropriate teaching materials were developed to assist teachers in integrating environmental issues into everyday teaching across all subjects. This information is distributed through teacher resource centres.

6.3 Training of Namibians and the strengthening of national institutions

The Ministry of Environment and Tourism has developed a conscious human resource development strategy that will provide targeted and focused training on environmental management. For example, the Directorate of Environmental Affairs is training Namibians in environmental economics, toxic waste management, geographic information system skills and biodiversity planning. Training in wildlife and tourism management, and in aspects of combating desertification is provided to local communities by government and NGOs.

Substantial further capacity building is required across ministries to assist the implementation of inter/intra-sectoral co-ordination for sustainable development. The need for greater awareness of climate change in both the public sector and government is also recognised.

Chapter 7: Financial and technology needs

7.1 Support to date

The Namibian government has received financial and technical assistance from various national and multi-national organizations. For instance, the MET received funding from the Government of Germany's Ministry for Economic Cooperation and Development via the GTZ (Gesellschaft für Technische Zusammenarbeit) to compile the country study on Climate Change. This Initial Communication is funded by the UNDP/GEF. Future assistance which the Republic of Namibia requires, in terms of UNFCCC Article 4.3 (obligation of developed countries to meet the full costs of satisfying Article 12, the provision of inventories and national communications) is described in more detail in the following sections.

7.2 Support for a national climate change office

A single institutionalized point of responsibility and coordination is required to ensure the optimal provision of information from Namibia to the UNFCCC, in accordance with obligations. The office would aid the flow of information in the reverse direction, from the international community to decision-makers and the public in Namibia. In addition the office could strengthen links with international research bodies such as the International Geosphere-Biosphere Programme, the World Climate Research Programme and the Intergovernmental Panel on Climate Change. Such an office should have a permanent staff of three, consisting of a senior professional, a junior professional and a secretarial position, and should be located close to the Ministry of Environment and Tourism (MET). The office would have the following responsibilities:

- Develop and maintain the databases needed to conduct regular emissions inventories and prepare statements regarding the impact of climate change in Namibia; including collecting and curating a library of relevant documents;
- Manage the process by which repeated national communications, and any other technical information requests from the UNFCCC, are written and delivered to the MET for submission to the UNFCCC;
- Provide management support for the process of climate change policy and action plan development in Namibia; and
- Act as a point of information access for parties interested in climate change in Namibia, and actively promote the dissemination of information to decision-makers, schools and tertiary education institutions.

7.3 Support for joint implementation of activities

Namibia has a strongly synergistic and collaborative approach to coordinating the functions and activities relating to international environmental conventions. The coordination of Namibia's programmes under the UNFCCC, CBD and CCD is exercised by the Office of the Chief Development Planner: Conventions and Related Programmes. Financial support is needed for the detailed implementation of joint activities, e.g. integrated environmental change monitoring and research; and modeling of climate change impacts on Namibian ecosystems and species. Several activities identified under the NBSAP would simply require synergistic planning to ensure their practical implementation is efficient and cost-effective.

7.4 Support for a Namibian climate change strategy and action plan

There is an urgent need for financial resources to support a strategic planning process on climate change in Namibia. Climate change, like biodiversity conservation, is a cross-cutting issue that requires an integrated approach at the national level. An analysis of national and regional policies is needed to focus on climate change issues and to identify areas of possible policy conflict. In the course of defining a strategic framework for consideration of climate change issues, priority issues for an action plan can be reaffirmed or redefined more clearly. A number of preliminary projects and associated budget figures have already been identified and are listed in the following sections. These projects and budgets need to be modified and updated as part of an adaptive planning process.

Further detail on the preliminary research needs, adaptation and mitigation projects are outlined in the following sections.

7.5 Research needs to improve key elements of the Initial National Communication

The Namibian Climate Change Country Study and this Initial National Communication have highlighted the major areas of significant uncertainty relating to climate change in Namibia. Funds, and in most cases, technical support and partnerships are required to reduce these uncertainties and to allow for adaptive environmental management and national development in this very arid country.

7.5.1 The climate observation system

As with most developing countries, and many developed countries, Namibia is struggling to keep its climate observation system adequate for the needs of climate change detection and adaptation. The Namibia Meteorological Service has received assistance through the World Meteorological Organization in form of technical equipment and staff training. Support is needed, in terms of Article 5 (b) and (c) of the UNFCCC, to expand the replacement of the current manual system with automated systems, in line with the Global Climate Observing System needs. A representative network across the country is needed. The expansion of the network would require more well-trained staff to service the stations properly and to analyze the data.

Currently, the research capacity of the Meteorological Service is limited and more posts should be created. There is no institution in the country that can provide training in this specific area so staff are sent to South Africa and other countries to attend training courses. External funding is necessary to enhance the capacity within the institution. Support is also essential to get the key long-term archival stations into available digital form (Pers. Comm. Mr. S. Mwangala, March 2002).

7.5.2 Future climate in Namibia

The reduction of uncertainties regarding the direction and magnitude of change in future rainfall is of central planning importance to Namibia. More certain projections of future climate trends are essential if the major impact sectors in Namibia are to be more clearly defined, and mitigation or adaptation measures introduced. In particular, more detailed climate change scenarios are important for Namibia.

The task of global climate modeling cannot be tackled by Namibia alone, but collaboration between southern African research groups, including Namibia, and leading international global climate modeling groups could achieve two objectives:

- Downscaled projections for the Namibian region; and
- Better representation of tropical and subtropical precipitation processes.

National Climate Change Detection and Attribution Studies (NCCDAS) should include Climate Change Indices and Characterization of the Changing Climate Extremes (CCI&CCCE) focusing on:

- Patterns in daily rainfall extremes events – are extreme rainfall events getting larger and less frequent, against a general decline in annual rainfall totals;
- Trends in onset, duration and length of rainy seasons;
- Teleconnections of significance to Namibia's seasonal rainfall performance- besides the El Niño/Southern Oscillation (ENSO) index; and
- Patterns in daily temperature extremes and runs (sequences of days when the temperature exceeds or remains lower than predetermined thresholds).

The need for a sophisticated monitoring framework and equipment for weather observations to be established was echoed at the policy and measures workshop held in March 2002. In addition, further strengthening of the Environmental Long-Term Observatories of Southern Africa (ELTOSA) and early warning systems was called for. The Environmental Observatories Network of Namibia (EONN), the founding member of ELTOSA, needs considerable institutional strengthening of its national network in order to achieve this. EONN is co-ordinated under the National Biodiversity Programme and implemented by the DRFN. The Namibia Meteorological Services would then be in a better position to convert improved climate predictions into impact assessments that can be fed into policy decisions.

7.5.3 Agricultural production models for arid-land crops (millet) and for small and large stock in hot and arid environments

Investment in human resource development is crucial. The Ministry of Agriculture, Water and Rural Development currently employs only one agricultural meteorologist. The research section of the Ministry is facing financial constraints that limit crop and climate change modelling. Namibia has the capacity to use such models, but not to develop them. There is a need for model acquisition, a modest amount of hardware to run the models, and capacity building in the application of models and the preparation of the necessary datasets. Other institutions, such as the University of Namibia could be involved in addressing the issue of capacity building. Extension services are in place to inform farmers - in particular communal, subsistence farmers - on how to cope with varying rainfall patterns and climate change in general. New crops have been introduced such as cotton, more drought-resistant millet (o*mahangu*) and tobacco. It is, however, necessary to breed better varieties (Pers. Comm. Dr AL du Pisani, March 2002). Research into alternative salt-tolerant crops is also required.

The MAWRD supports a FAO-funded project on indigenous livestock breeds that have superior tolerance to hot and arid conditions, and require low agricultural inputs.

7.5.4 Dynamics of the Benguela marine ecosystem under future climate scenarios

The dynamics of the Benguela marine ecosystem is currently a major uncertainty with large potential impacts on Namibia. A substantial oceanographic modelling exercise, possibly supported by a research effort to quantify and validate parts of the model, is needed to reduce this uncertainty. South Africa and Angola would also be direct beneficiaries through their collaboration with Namibia in the Benguela Current Large Marine Ecosystem (BCLME) and Benguela Environment Fisheries Interaction and Training (BENEFIT) Programmes. Since the southern tip of Africa is a major control point on the global ocean circulation system, an improved understanding here would have global benefits. Such a research programme would need to be funded and implemented largely from developed country institutions, but the research campaign should be hosted within the region and make use of the substantial implementation capacity in the region. Specifically, it should aim to quantify the changes in upwelling location and intensity along the coast of southwestern Africa, under future climate scenarios, including those resulting in a substantial change in the Atlantic thermohaline circulation. The BCLME and BENEFIT programs should contribute greatly to these research needs and capacity-building efforts. South Africa and Angola participate in the trilateral BENEFIT programme. The BCLME programme includes assessments of environmental variability, ecosystem impacts and improvements of predictions. The five-year project was launched in March 2002 with funding from the UNDP/GEF. These programmes should cover some aspects of the research suggested above.

(Photo:Klaus Schade)

Figure 7.1 Namibia’s marine ecosystems are very vulnerable to climate change impacts.

The Ministry of Fisheries and Marine Resources has received assistance from the development and technical cooperation agencies of the Governments of Norway (Norad) and Germany (GTZ) to monitor the environment, set up a database and to train staff. Continuous capacity building is needed since there is still a shortage of experienced staff in Namibia and the ministry relies on inexperienced graduates.

Funds would also be needed to expand the existing marine environmental database. A substantial amount of data exists in Kaliningrad, Russia that was collected by the then Soviet fleet in the 1970s and 1980s. This data exists only on paper, not in electronic form, and would need to be entered into a database once its quality has been assessed and verified.

7.5.5 The carbon balance of Namibia in relation to land cover, land use and forestry

A clearer understanding of the carbon balance of the woodlands and savannas of Namibia under various forms and intensities of use, including savanna burning and land clearing, is necessary to reduce uncertainties of the greenhouse gas emission inventory. It should also allow for changes in climate parameters and CO_2 concentrations to be determined. The uptake of carbon due to 'bush encroachment' is believed to make Namibia a net carbon sink. The uncertainty associated with this estimate, and its future dynamics, is large and should be calculated for both above ground and below ground biomass. Clearing of bush-encroached land may result in higher nitrogen emissions. A more detailed study is needed on the rate of woody biomass change in Namibia, and how it will evolve in the future under various management options and climate scenarios. Such a study could be executed by Namibia with financial and technical support. Technology such as remote sensing would serve in the assessment and monitoring of carbon sinks. The contribution of ruminants (including wild mammals) and other herbivores on rangelands to greenhouse gas emissions also has to be investigated in more detail. Other areas of research necessary to improve the inventory are the extent of savanna burning, the burning of cotton residues and estimates of emissions of nitrous oxide from crop residue, sewage sludge and synthetic fertilizer. More detailed research needs are outlined in Chapter 2, which deals with the calculation of the GHG inventory.

7.5.6 Threats to biodiversity

The unique floral, invertebrate, reptilian, avian and other biodiversity, particularly in the southwestern part of the country, in the pro-Namib, and along the northwestern escarpment is significantly threatened by climate change. Namibia's centres of endemism are extremely ancient, as the area has been one of relative climatic stability and aridity over millions of years. Namibia also has three of the very few internationally recognized wetlands on the Atlantic coast of Africa, a fourth in the halophytic pans of Etosha National Park, and huge wetlands covering over 18 000 km^2 are in the Caprivi-Zambezi-Linyanti basin. Since these wetlands are of vital importance to the biodiversity of Namibia and the region, the effect of climate change on these sites has to be investigated. Furthermore, as local extinction of some species (including restricted-range endemics) is possible, a study covering the whole of Namibia identifying indicator species and addressing the effects of climate change on biota and ecosystems is required. This is being undertaken by the Environmental Monitoring and Indicators Network of Namibia (EMIN), a collaborative network of the MET/DEA's Environmental Information Service, National Biodiversity Programme, EONN, and other institutions undertaking environmental monitoring and indicator development in Namibia. A more detailed analysis of the threat to biodiversity and suitable response measures is needed.

Experts from the Climate Change Modelling Unit of the National Botanical Institute in South Africa are working with Namibian experts to identify vulnerable ecosystems and biodiversity. Funds of N$241 000 in 2002/03 are initially needed to develop these preliminary models of ecosystem and biodiversity impacts.

7.5.7 Emissions from the waste sector

The emissions of CH_4 and N_2O from the waste sector in Namibia are currently poorly quantified. A research effort is needed to rectify this gap.

7.5.8 The water sector

Climate change will exacerbate droughts and floods in Namibia. Namibia is fundamentally a water-limited country, and therefore prone to droughts. When rain falls, it is generally in the form of intense showers and thunderstorms that can result in flash floods. The floods are generally not life threatening as, with a few exceptions, people do not live in ephemeral riverbeds and flood warnings in the perennial rivers are received in time from neighbouring countries. Floods do pose a threat to assets (Figure 7.2).

To date, the Namibian government has received support from the German government in investigating ephemeral rivers and groundwater resources. This assistance is, however, coming to an end owing to a reprioritization of Germany's development co-operation. To secure a sustainable water supply, groundwater and surface water levels need to be monitored more comprehensively than at present. Moreover, the capital investment to increase security of supply is considerable in an arid country such as Namibia. Namibia needs assistance to not only maintain the current standard of monitoring but to further investigate, and increase the security of supply (Pers. Comm. Mr. P. Heyns, 2002).

(Photo: Joe McGann)

Figure 7.2 Flooding near Oranjemund

7.6 Adaptation projects

In terms of Article 4.4 of the UNFCCC (the obligation of developed countries to assist developing countries that are particularly vulnerable to the adverse effects of climate change in meeting costs of adaptation to those adverse effects), the preliminary identified needs of Namibia are given below. As with the suggested research projects, it must be noted that these needs must be confirmed by wider consultation with stakeholders through a strategic planning process.

7.6.1 Control of malaria and water-borne diseases

Nearly three-quarters of the population of Namibia lives in a high-risk malaria area. Research on mosquito control, predictive malaria models and potential vaccines is proposed as part of an adaptation strategy. There is a need for preventative measures (control of the mosquito vector, provision of safe drinking water and sanitation in rural areas, and public education), affordable and accessible prophylactic drugs against malaria, and prompt and effective treatment for malaria and diarrhoea. The incremental cost, due to climate change, of providing these services is requested.

7.6.2 Sea level rise in Walvis Bay and Swakopmund and coastal wetlands

There is a need for a detailed engineering and environmental study of the options for protecting these low-lying coastal towns against sea level rise and to consider impacts on low-lying coastal wetlands.

7.6.3 Testing and dissemination of heat, drought and salt tolerant crop cultivars and livestock breeds

Systems must be developed to match crop species and cultivars to environmental conditions, including climate, soils and farming systems. Support is needed for the selection and testing of genetic material suited for the temperature and rainfall conditions which are projected to occur in the future. The expertise and indigenous germplasm collections of the National Plant Genetic Resources Centre, and possibly the SADC Plant Genetic Resources Centre, will be essential here. The Ministry of Agriculture, Water and Rural Development participates in an indigenous livestock breeds project funded by FAO, which promotes the superior tolerance of local livestock breeds in hot and dry conditions with low agricultural inputs.

7.6.4 Public education programmes

A major effort is required to inform the Namibian public about climate issues in a responsible and effective way. This would take the form of extension to educational institutions, and programmes on radio and television. The need is for financial support to prepare and deliver the education and outreach materials. The expertise and networks of the Namibian Environmental Education Network and its member institutions (including the Desert Research Foundation of Namibia and the Regional Awareness Programme) can be cost-effectively used here.

7.6.5 Water use efficiency measures

The key interventions to ensure efficient water use are most likely to apply to the water allocation policy. There may be technical and/or policy interventions in agriculture, domestic and industrial water use as well. An example is use of water storage methods that are less sensitive to evaporation, including aquifer-recharge dams such as the Omdel Dam in western Namibia.

There is a need for support to develop the options mentioned, and for development funding on favourable terms to implement them. A further need facing Namibia, which has extra urgency in the context of projected climate change impacts on ecosystem water stress, is the need for technical assistance to calculate ecosystem requirements for water in Namibia's major river systems. These ecosystem requirements must then be strictly respected in water allocation decisions.

7.7 Mitigation projects

The greenhouse gas emissions from Namibia are a tiny fraction of the global total. In terms of the UNFCCC, Namibia has no quantitative commitment to reduce these emissions. Nevertheless, in the spirit of contributing to the solution of a global problem and in the context of the Kyoto Protocol and its Clean Development Mechanism, Namibia can offer the following opportunities to reduce emissions:

7.7.1 Energy system projects

The energy sector depends on imports of petroleum products and electricity generated by mainly coal-fired power plants in South Africa. The presence of large natural gas reserves off the coast of Namibia offers possibilities of generating energy with a lower greenhouse gas emission per unit energy than the existing supplies. Furthermore, the climatic conditions in the country are very favourable for alternative sources of energy such solar energy, and in some locations, wind energy. The costs of these technologies are high so promotion efforts would need initial grants to mobilise the industries. More research would also be needed to identify the most suitable technology and location for such industries. The introduction of environmentally friendlier fuel such as natural gas for cars would depend on financial assistance to cover the initial investment in cars and fuelling stations (Pers. Comm. Mr. M. von Jeney, March 2002).

7.7.2 Afforestation and agroforestry projects

The reforestation of degraded areas, particularly in the wetter northern part of the country, could simultaneously address issues of sustainable development, rural poverty, desertification and biodiversity loss, while providing a modest net carbon uptake. Afforestation programmes should be initiated in appropriate areas and utilise appropriate species. Agroforestry has potential applications in northern Namibia, such as the commercial cultivation of the *marula* fruit (*Sclerocarya birrea*) and *mangetti* nut (*Schinziophyton rautenii)*. Where agroforestry replaces annual crops or degraded land with mixed indigenous tree plantings it leads to carbon storage.

7.7.3 Promotion of improved stoves and charcoal kilns

The emission of CH_4 and ozone precursor gases from charcoal kilns and inefficient domestic stoves could be substantially reduced with known technology. This would simultaneously reduce the deforestation caused by unsustainable fuel wood harvesting and prolong the life of the Namibian carbon sink. It would also provide health and air quality benefits.

Fire management systems could substantially reduce the net emission of CH_4 and ozone precursors, increase the net carbon sink, and have biodiversity benefits. The Directorate of Forestry and its partners are developing a National Fire Management Policy, but this is in its early stages.

7.7.4 Efficient lighting and alternative energy sources

Known technology could substantially improve the energy use efficiency in Namibia, but international support would help to make this technology available to more people, especially in rural areas.

7.7.5 Rail infrastructure

The vast distances and low population density in Namibia result in a large proportion of its emissions being associated with the transport sector. The construction of a rail link to the populous north of the country will provide an emissions-efficient way of improving public transport, if this were done consultatively and cost-effectively for consumers.

7.8 Summary of needs

A number of research needs have been identified to reduce the uncertainty surrounding the size of the emission sources and sinks in Namibia. Projects to permit adaptation to climate change impacts have also been identified, together with opportunities to reduce emissions. These projects are summarized in the Table 7.1. It must be noted that the projects and suggested budget figures need to be updated and confirmed in a broad consultative and adaptive process. The confirmation of the identified activities could be part of Namibia's policy development for climate change.

Table 7.1 Provisional initial estimates of the costs to Namibia of reducing uncertainties, adapting to and mitigating climate change in the period 2002 to 2007. These proposal items are only preliminarily identified and are not the result of a prioritised strategic planning process. Estimated budgets would be prepared after a prioritisation process.

Element	**Total cost**	**Note:**
Climate Change office and Climate Change Strategy and Action Plan	US$ 80 000 – 100 000/yr (N$ 1 000 000/yr)	
Uncertainty reduction		
Climate observation system	Estimated total cost US$ 660 000 (N$ 6 600 000)	US$ 132 000/y (N$ 1 320 000/y) for 5 years
Future climate and rainfall	Estimated total cost US$ 2-5 million (N$ 20-50 million) over 5 years	Required by Namibia: US$ 4 000/yr (N$ 40 000/y) for 4 years
Agricultural production models		Required by Namibia: US$ 12 000/y (N$ 120,000/y) for 5 years
Benguela Current dynamics and impacts	US$ 3 million (N$ 30 million) over 3 years	US$ 50 000/y (N$ 500 000/y) for 3 years
Carbon balance and land use		US$ 20 000/y (N$ 200,000/y) for 3 years
Threats to biodiversity and ecosystems (supporting human livelihood studies)		US$ 12 000/y (N$ 120,000/y) for 3 years There is an immediate need for US$ 24 100 (N$241 000) for a 6 month biodiversity impact study
Waste sector emissions		US$ 5 000 (N$ 50 000) over 1 year
Water security and supply		US$ 50 000/y (N$ 500 000/y) for 3 years
Adaptation projects		
Combating climate-linked diseases (malaria)	US$ 500 000 (N$ 5 000 000)	Based on incremental cost of prevention
Planning for sea level rise – engineering studies	US$ 60 000 (N$ 600 000) for one year	
Crop and livestock adaptation	USD 40 0000 (N$ 400 000)	
Public education and awareness	USD 100 000 (N$ 1 000 000)	
Water use efficiency and ecological requirements of river systems	N$2.2 m over 2 years for modelling and capacity building of Namibian students and hydrologists	US$ 80 000 (N$ 800 000)
Mitigation projects		
Energy system projects		
Afforestation and agroforestry projects		
Promotion of improved stoves and charcoal kilns		
Efficient lighting and heating systems		
Rail infrastructure		

Chapter 8: Conclusions

8.1 Namibia’s contribution to climate change

The contribution of greenhouse gases from Namibia is negligible. Namibia was estimated to be a net sink of GHG’s in the year 1994, although there is still a large degree of uncertainty around the magnitude of uptake of carbon by savannas in Namibia.

8.2 Namibia’s vulnerability to climate change

As an arid country with a high reliance on natural resources, Namibia is highly vulnerable to climate change. Climate change, especially changes in rainfall distribution, will have the greatest effect on Namibia. Water scarcity is already the major constraint to development and this is likely to be exacerbated under the existing climate change scenarios. Namibia is also very vulnerable in sectors such as human health, crop and livestock production, coastal flooding and impacts on ecosystems and biodiversity.

8.3 Actions taken in support of the Convention

A Namibian Climate Change Committee has been established; a three-volume country study has been produced to improve understanding of impacts, vulnerable sectors and possible mitigation options and in the form of this report, the Initial National Communication has been submitted to the UNFCCC.

8.4 Identification of priority needs

Numerous research needs have been identified as well as opportunities for cost-effective technological and financial support in adapting to the impacts of climate change. Namibia has also identified opportunities for mitigation or reduction of greenhouse gas emissions. All of these proposals must be prioritized and implemented in consideration of climate change and other global environmental commitments.

8.5 Conclusion

As an arid, agriculturally marginal country with a low economic growth and flexibility, and a high dependence on natural resource based industries, including subsistence agriculture and tourism, Namibia currently has limited capacity to adapt to climate change impacts. Namibia is therefore considered to be among the highly vulnerable African countries with regard to climate change.

References

Ashley C. 1996. *Incentives affecting biodiversity conservation and sustainable use: the case of land use options in Namibia*. DEA Research Discussion Paper no. 13.

Ashley C, Müller H and Harris M. 1995. *Population dynamics, the environment, and demand for water and energy in Namibia*. DEA Research Discussion Paper no. 7.

Bank of Namibia. 2001. Annual Report 2000, March.

Barnard P (Ed). 1998. Biological diversity in Namibia: a country study. Windhoek, Namibian National Biodiversity Task Force, Directorate of Environmental Affairs. ISBN 0 86976 436 5. 332pp.

Barnes JI, MacGregor J, Weaver LC. 2002. Economic efficiency and incentives for change within Namibia's community wildlife use initiatives. World Development 30(4):667-681, Pergamon Press.

Blackie R. 1998. Emission scenarios and mitigation options for Namibia: A preliminary overview. Mitigation study for the Namibian climate change study – Economic scenarios, emission scenarios and mitigation options. Volume 3. Prepared for the Desert Research Foundation of Namibia as part of the Namibia Country Study on Climate Change. 51pp.

Blackie R and Tarr P. 1999. *Government policies on sustainable development in Namibia*. DEA Research Discussion Paper no. 28.

Boyer and Hampton. 2001. An overview of the living marine resources of Namibia, S. Afr. J. mar. Sci. 23:5-35.

Byers BA. 1997. *Environmental threats and opportunities in Namibia: A comprehensive assessment*. DEA Research Discussion Paper no. 21.

Central Bureau of Statistics. 2001. National Accounts 1993 – 2000, August.

Day JA. 1997. The status of freshwater resources in Namibia, DEA Research Discussion Paper no. 22.

DEA, 1999. State of the environment report on Namibia's industrialisation environment. Final report: 4 August 1999. http://www.dea.met.gov.na/data/publications/reports/soeind5.pdf

DIT, 1999. Fisheries sector report. Directorate of International Trade in co-operation with the International Trade Centre (ITC) /UNCTAD / WTO. http://www.intracen.org/iatp/surveys/fish/fishnam.html)

Du Plessis P. 1999. Republic of Namibia: First Greenhouse Gas Inventory. A report on sources and sinks of greenhouse gases in Namibia in 1994. Volume 1. Prepared for the Desert Research Foundation of Namibia (DRFN) as part of the Namibia Country Study on Climate Change. 37 pp plus appendix.

Erkkilä A and Siiskonen H. 1992. Forestry in Namibia 1850-1990. Silva Carelica. University of Joensuu, Finland.

Giess W. 1971. *A Preliminary Vegetation Map of South West Africa*, Dienteria 4:1-114. SWA Scientific Society, Windhoek.

Hall AE, GH Cannel and HW Lawton. 1979. Agriculture in semi-arid environments. University of California, Springer Verlag, New York, ISBN 0 387 09414 8

Henschel J, V Mtuleni, N Gruntkowski, M Seely and E Shanyengana. 1998. NAMFOG: Namibian application of fog-collecting systems. Phase 1:Evaluation of fog water harvesting. Occasional paper 8 Desert Research Foundation of Namibia (DRFN). ISBN 99916-43-31-1

Hulme M (Ed). 1996. Climate Change and Southern Africa: an exploration of some potential impacts and implications for the SADC Region. Climatic Research Unit, University of East Anglia, Norwich, UK and WWF International, Gland, Switzerland 1996, ISBN 2 88085-193-9

IPCC/UNEP/OECD/IEA. 1997. Revised 1996 Guidelines for National Greenhouse Gas Inventories: Reporting Instructions; Workbook; Reference Manual), Parys.

IPCC. 1996. Climate Change 1995: the Science of Climate Change. Summary for policymakers. Intergovernmental Panel on Climate Change, Geneva.

Klaeboe J and Omwami R. 1997. Forest Policy for sustainable utilisation of the woodlands and savannas of Namibia. Namibian Directorate of Forestry, Windhoek.

Katzao JJ, Nangolo Mbumba, Helgard Patemann, Eddie I van Staden, Davy H A Tait. 1995. Understanding History 8, Namibian Junior Secondary Textbook, Early History of Namibia, Africa and the World, Windhoek.

Lange G-M. 1997. An approach to sustainable water management using natural resource accounts in Namibia: the use of water, the economic value of water, and implications for policy. DEA Research Discussion Paper no. 18, MET.

McGann, J. 2000. Namibia Biodiversity Policy Analysis. Directorate of Environmental Affairs, Ministry of Environment and Tourism.

Ministry of Agriculture, Water and Rural Development. 1995. Namibia Agricultural Policy, Windhoek.

Ministry of Agriculture, Water and Rural Development. 2000. Agricultural Statistical Bulletin, Windhoek.

Ministry of Fisheries and Marine Resources. 2002. Management recommendations for pilchard based on the biological state of the stock. Report for the Marine Resources Advisory Council. Directorate of Resource Management Report no 2/2002.

Ministry of Health and Social Services. 2001. Report of the 2000 HIV Sentinel Sero Survey, March.

Ministry of Labour. 2001. The Namibia Labour Force Survey 1997, Final Report of Analysis, June.

Moorsom R, Jutta Franz and Moono Mupotola (Eds). 1995. Coping with Aridity: drought impacts and preparedness in Namibia. Brandes & Apsel/NEPRU.

Moyo S, Phil O'Keefe and Michael Sill. 1993. The Southern African Environment: profiles of the SADC Countries, Earthscan Publishers, London.

NAPCOD. 1996. *Policy Factors and Desertification – Analysis and Proposals*. Namibian Programme to Combat Desertification.

NamPower, 2001. Annual Report 2001.

Namibia Trade Directory. 2002.

National Herbarium of Namibia (WIND). 2002. Flora database. National Botanical Research Institute. Windhoek.

National Planning Commission. 1996. First National Development Plan. Government Printing Office: Windhoek, Namibia.

National Planning Commission. 2001. Second National Development Plan. National Workshop on the 2nd NDP. Volume 2.

National Planning Commission. 2002. Census Preliminary Results, March.

Olszewski, J. and Richard Moorsom. 1995. Rainfall Records and the Analysis of Drought, Chapter 3 in Moorsom R, Jutta Franz and Moono Mupotola (Eds). 1995. Coping with Aridity: drought impacts and preparedness in Namibia. Brandes & Apsel/NEPRU.

Pallet J (Ed). 1997. *Sharing water in Southern Africa*. Desert Research Foundation of Namibia.

Preston-White RA and PD Tyson. 1988. The Atmosphere and Weather of Southern Africa, Oxford University Press, Cape Town. ISBN 0 19 570496 7

Quan J, Barton D and C Conroy. 1994. *A Preliminary assessment of the Economic Impact of Desertification in Namibia*. DEA Research Discussion Paper no. 3.

Republic of Namibia (Brown, C.J.- ed.) 1993. *Namibia's Green Plan*. Ministry of Wildlife, Conservation and Tourism.

Republic of Namibia, 1994a. *Land-use Planning: Toward Sustainable Development*. Ministry of Environment and Tourism.

Republic of Namibia, 1994b. *White Paper on Tourism*. Namibia Brief no. 19, September 1994.

Republic of Namibia, 1995a. *First National Development Plan, 1995/96-1999/2000*. National Planning Commission.

Republic of Namibia, 1995b. *National Policy and Strategy for Malaria Control*. Ministry of Health and Social Services.

Republic of Namibia, 1995c. *National Agriculture Policy*. Ministry of Agriculture, Water and Rural Development.

Republic of Namibia, 1995d. *Promotion of Community Based Tourism*. Ministry of Environment and Tourism.

Republic of Namibia, 1995e. *Wildlife Management, Utilisation and Tourism in Communal Areas*. Ministry of Agriculture, Water and Rural Development.

Republic of Namibia, 1997a. *National Land Policy: White Paper*. Ministry of Lands, Resettlement and Rehabilitation.

Republic of Namibia, 1997b. *National Population Policy for Sustainable Human Development*. National Planning Commission.

Republic of Namibia, 1997c. *National Drought Policy and Strategy*. National Drought Task Force, Windhoek. MAWDR.

Republic of Namibia, 1998a. *Poverty Reduction Strategy for Namibia*. National Planning Commission.

Republic of Namibia, 1998b. *National Land Policy*. Ministry of Lands, Resettlement and Rehabilitation.

Republic of Namibia, 1998c. *White Paper on Energy Policy*. Directorate of Energy. Ministry of Mines and Energy.

Republic of Namibia, 1999. *National Policy on Research, Science and Technology*. Directorate of Research, Science and Technology, Ministry of Higher Education, Vocational Training, Science and Technology.

Republic of Namibia, 1999b. *National Policy Document: Enabling the Safe Use of Biotechnology*. Ministry of Higher Education, Vocational Training, Science and Technology.

Republic of Namibia, 2000. *Access to Biological Resources and Associated Traditional Knowledge Act*. First Draft.

Republic of Namibia, 2000. *National Water Policy White Paper*. Ministry of Agriculture, Water and Rural Development.

Republic of Namibia, 2001a. *Second National Development Plan (NDP2), 2001/02-2005/06*. National Planning Commission (NPC).

Republic of Namibia, 2001b. *Forest Act*. National Council.

Republic of Namibia, 2001c. *Development Forestry Policy for Namibia*. Ministry of Environment and Tourism.

Republic of Namibia, 2001d. *Estimate of Revenue and Expenditure for the Financial Year 1 April 2001 to 31 March 2002*.

Republic of Namibia, no date. *Regional Planning and Development Policy*. National Planning Commission.

Republic of Namibia, 2002. Environmental Management Act of 2002.

Sakko AS. 1998. The influence of the Benguela upwelling system on Namibia's marine biodiversity. Biodiversity & conservation 7(4):419-433.

Tarr J. 1998. An overview of Namibia's vulnerability to climate change. Volume 2. Prepared for the Desert Research Foundation of Namibia as part of the Namibia Country Study on Climate Change. 150pp.

Tarr J. 1997. Desktop survey on waste management in Namibia1996-1997. NNF/Norad, Windhoek

Tarr J. 2000. *Issues and Threats to Sustainable Development in Namibia*.

UNDP, 1998, Namibia Human Development Report 1998, December.

UNDP, 2001. Namibia Human Development Report 2000, May.

United Nations Framework Convention on Climate Change (UNFCCC), 1992.

Werner W, 2000. Agriculture and Land, in Melber, H. (Ed.) Namibia A Decade of Independence 1990 – 2000, pp. 29 to 48, NEPRU Publication No. 7.

World Bank, 2002. World Development Report 2002.

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Useful web pages:
http://www.dea.met.gov.na
http://www.drfn.org/RAP.html.
http://www.ipcc.ch
http://www.whrc.org/pubaffair/pdf/ALA-12-APPENDIX.pdf
http://www.iisd.ca/climate/cop6bis/indexpronkoutline
http://cop6.unfccc.int/issues/94.html

APPENDICES

APPENDIX A - GREEN HOUSE GAS INVENTORY

Sectoral summaries: Energy

TABLE 1: SECTORAL REPORT FOR ENERGY

SECTORAL REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg)			
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O
Total Energy	**1,821**	**4**	**0**
A Fuel Combustion Activities (Sectoral Approach)	**1,821**	**4**	**0**
1 Energy Industries	**217**	**0**	**0**
a Public Electricity and Heat Production			
b Petroleum Refining			
c Manufacture of Solid Fuels and Other Energy Industries			
2 Manufacturing Industries and Construction	**207**	**0**	**0**
a Iron and Steel			
b Non-Ferrous Metals			
c Chemicals			
d Pulp, Paper and Print			
e Food Processing, Beverages and Tobacco			
f Other (please specify)			
3 Transport	**899**	**0**	**0**
a Civil Aviation	99	0	0
b Road Transportation	757	0	0
c Railways	44	0	0
d Navigation	0	0	0
e Other (please specify)	0		
Pipeline Transport	0		
4 Other Sectors	**381**	**3**	**0**
a Commercial/Institutional	0	0	0
b Residential	28	3	0
c Agriculture/Forestry/Fishing	352	0	0
5 Other (please specify)	**117**	**0**	**0**
B Fugitive Emissions from Fuels	**0**	**0**	**0**
1 Solid Fuels	**0**	**0**	**0**
a Coal Mining		0	
b Solid Fuel Transformation			
c Other (please specify)			
2 Oil and Natural Gas	**0**	**0**	**0**
a Oil		0	
b Natural Gas		0	
c Venting and Flaring		0	
Memo Items (1)			
International Bunkers	**111**	**0**	**0**
Aviation	76	0	0
Marine	35	0	0
CO_2 Emissions from Biomass	**1 135**		

TABLE 2: SECTORAL REPORT FOR INDUSTRIAL PROCESSES

SECTORAL REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg)			
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O
Total Industrial Processes	**5**	**0**	**0**
A Mineral Products	**5**	**0**	**0**
1 Cement Production	5		
2 Lime Production	0		
3 Limestone and Dolomite Use	0		
4 Soda Ash Production and Use	0		
5 Asphalt Roofing			
6 Road Paving with Asphalt			
7 Other (please specify)	0	0	0
Glass Production			
Concrete Pumice Stone			
B Chemical Industry	**0**	**0**	**0**
1 Ammonia Production	0		
2 Nitric Acid Production			0
3 Adipic Acid Production			0
4 Carbide Production	0	0	
5 Other (please specify)		0	
C Metal Production	**0**	**0**	**0**
1 Iron and Steel Production	0		
2 Ferroalloys Production	0		
3 Aluminium Production	0		
4 SF_6 Used in Aluminium and Magnesium Foundries			
5 Other (please specify)	0		
D Other Production	**0**	**0**	**0**
1 Pulp and Paper			
2 Food and Drink			
E Production of Halocarbons and Sulphur Hexafluoride	**0**	**0**	**0**
1 By-product Emissions			
2 Fugitive Emissions			
3 Other (please specify)			
F Consumption of Halocarbons and Sulphur Hexafluoride	**0**	**0**	**0**
1 Refrigeration and Air Conditioning Equipment			
2 Foam Blowing			
3 Fire Extinguishers			
4 Aerosols			
5 Solvents			
6 Other (please specify)			
G Other (please specify)			

TABLE 4: SECTORAL REPORT FOR AGRICULTURE

SECTORAL REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES(Gg)		
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CH_4	N_2O
Total Agriculture	**162**	**1**
A Enteric Fermentation	**112**	
1 Cattle	88	
2 Buffalo	0	
3 Sheep	13	
4 Goats	8	
5 Camels and Llamas	0	
6 Horses	1	
7 Mules and Asses	2	
8 Swine	0	
9 Poultry	0	
10 Other (please specify)		
B Manure Management	**3**	**0**
1 Cattle	2	
2 Buffalo	0	
3 Sheep	0	
4 Goats	0	
5 Camels and Llamas	0	
6 Horses	0	
7 Mules and Asses	0	
8 Swine	0	
9 Poultry	0	
B Manure Management (cont...)		
10 Anaerobic		0
11 Liquid Systems		0
12 Solid Storage and Dry Lot		0
13 Other (please specify)		0
C Rice Cultivation	**0**	
1 Irrigated	0	
2 Rainfed	0	
3 Deep Water	0	
4 Other (please specify)		
D Agricultural Soils		**0**
E Prescribed Burning of Savannas	**47**	**1**
F Field Burning of Agricultural Residues [(1)]	**0**	**0**
1 Cereals		
2 Pulse		
3 Tuber and Root		
4 Sugar Cane		
5 Other (please specify)		
G Other (please specify)		

TABLE 5: SECTORAL REPORT FOR LAND-USE CHANGE AND FORESTRY

SECTORAL REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 Emissions	CO_2 Removals	CH_4	N_2O
Total Land-Use Change and Forestry	**0**	**-5 716**	**0**	**0**
A Changes in Forest and Other Woody Biomass Stocks	**0**	**-6 370**		
1 Tropical Forests				
2 Temperate Forests				
3 Boreal Forests				
4 Grasslands/Tundra				
5 Other (please specify)				
B Forest and Grassland Conversion	**655**		**0**	**0**
1 Tropical Forests	479			
2 Temperate Forests	0			
3 Boreal Forests	0			
4 Grasslands/Tundra	176			
5 Other (please specify)	0			
C Abandonment of Managed Lands		**0**		
1 Tropical Forests		0		
2 Temperate Forests		0		
3 Boreal Forests		0		
4 Grasslands/Tundra		0		
5 Other (please specify)		0		
D CO_2 Emissions and Removals from Soil	**0**	**0**		
E Other (please specify)				

TABLE 6: SECTORAL REPORT FOR WASTE

SECTORAL REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O
Total Waste	**0**	**3**	**0**
A Solid Waste Disposal on Land	**0**	**3**	**0**
1 Managed Waste Disposal on Land			
2 Unmanaged Waste Disposal Sites			
3 Other (please specify)			
B Wastewater Handling	**0**	**0**	**0**
1 Industrial Wastewater		0	
2 Domestic and Commercial Wastewater		0	0
3 Other (please specify)			
C Waste Incineration			
D Other (please specify)			

TABLE 7A: SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES

SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg)				
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 Emissions	CO_2 Removals	CH_4	N_2O
Total National Emissions and Removals	**1 827**	**-5 716**	**169**	**1**
1 Energy	**1 821**	**0**	**4**	**0**
A Fuel Combustion (Sectoral Approach)	1 821		4	0
1 Energy Industries	217		0	0
2 Manufacturing Industries and Construction	207		0	0
3 Transport	899		0	0
4 Other Sectors	381		3	0
5 Other (please specify)	117		0	0
B Fugitive Emissions from Fuels	0		0	
1 Solid Fuels			0	
2 Oil and Natural Gas			0	
2 Industrial Processes	**5**	**0**	**0**	**0**
A Mineral Products	5			
B Chemical Industry	0		0	0
C Metal Production	0		0	0
D Other Production	0			
E Production of Halocarbons and Sulphur hexafluoride				
F Consumption of Halocarbons and Sulphur hexafluoride				
G Other (please specify)	0		0	0
3 Solvent and Other Product Use	**0**			**0**
4 Agriculture			**162**	**1**
A Enteric Fermentation			112	
B Manure Management			3	0
C Rice Cultivation			0	
D Agricultural Soils				0
E Prescribed Burning of Savannas			47	1
F Field Burning of Agricultural Residues			0	0
G Other (please specify)			0	0
5 Land-Use Change & Forestry	**0**	**-5 716**	**0**	**0**
A Changes in Forest and Other Woody biomass stocks	0	-6 370		
B Forest and Grassland Conversion	655		0	0
C Abandonment of Managed Lands		0		
D CO_2 Emissions and Removals from soil	0	0		
E Other (please specify)	0	0	0	0
6 Waste			**3**	**0**
A Solid Waste Disposal on Land			3	
B Wastewater Handling			0	0
C Waste Incineration				
D Other (please specify)			0	0
7 Other (please specify)				
CATEGORIES	Emissions	Removals		
Memo Items				
International Bunkers	**111**		**0**	**0**
Aviation	76		0	0
Marine	35		0	0
CO_2 Emissions from Biomass	**1 135**			

Summary Report

SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg)					
GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2 Emissions	CO_2 Removals	CH_4	N_2O
Total National Emissions and Removals		**1 827**	**-5 716**	**169**	**1**
1 Energy	Reference Approach[1]	**1 760**			
	Sectoral Approach[1]	**1 821**		**4**	**0**
A Fuel Combustion		1 821		4	0
B Fugitive Emissions from Fuels		0		0	
2 Industrial Processes		**5**		**0**	**0**
3 Solvent and Other Product Use		**0**			**0**
4 Agriculture				**162**	**1**
5 Land-Use Change & Forestry		**0**	**-5 716**	**0**	**0**
6 Waste				**3**	**0**
7 Other (please specify)		**0**	**0**	**0**	**0**
Memo Items:					
International Bunkers		**111**		**0**	**0**
Aviation		76		0	0
Marine		35		0	0
CO_2 Emissions from Biomass		**1 135**			

Energy sector

		MODULE	**ENERGY**					
		SUBMODULE	**CO_2 FROM ENERGY SOURCES (REFERENCE APPROACH)**					
		WORKSHEET	**1-1**					
		SHEETS	**1 OF 5**					
		COUNTRY	**Namibia**					
		YEAR	**1994**					
			A Production	B Imports kt	C Exports	D International Bunkers	E Stock Change	F Apparent Consumption
FUEL TYPES								F=(A+B -C-D-E)
Liquid Fossil	Primary Fuels	Crude Oil	0	0	0		0	0.00
		Orimulsion	0	0	0		0	0.00
		Natural Gas Liquids	0	0	0		0	0.00
	Secondary Fuels	Gasoline		165.93	0	0	0	165.93
		Jet Kerosene		52.95	0	23.96	0	28.99
		Other Kerosene		8.07	0	0	0	8.07
		Shale Oil		0	0		0	0.00
		Gas / Diesel Oil		218.88	0	10.94	0	207.94
		Residual Fuel Oil		20.17	0	0	0	20.17
		LPG		6.05	0		0	6.05
		Ethane		0	0		0	0.00
		Naphtha		0	0		0	0.00
		Bitumen		7.05	0		0	7.05
		Lubricants		10	0	0.5	0	9.50
		Petroleum Coke		0	0		0	0.00
		Refinery Feedstocks		0	0		0	0.00
		Other Oil		0	0		0	0.00
Liquid Fossil Totals			0	489.1	0	35.35	0	
Solid Fossil	Primary Fuels	Anthracite [(a)]	0	0	0		0	0.00
		Coking Coal	0	16.81	0		0	16.81
		Other Bit. Coal	0	162.53	0	0	0	162.53
		Sub-bit. Coal	0	0	0	0	0	0.00
		Lignite	0	0	0		0	0.00
		Oil Shale	0	0	0		0	0.00
		Peat	0	0	0		0	0.00
	Secondary Fuels	BKB & Patent Fuel		0	0		0	0.00
		Coke Oven/Gas Coke		0	0		0	0.00
Solid Fuel Totals			0	179.34	0	0	0	
Gaseous Fossil		Natural Gas (Dry)	0	0	0		0	0.00
Total								
Biomass total								
		Solid Biomass	660.58	0	7		0	653.58
		Liquid Biomass	0	0	0		0	0.00
		Gas Biomass	0	0	0		0	0.34

		MODULE	**ENERGY**				
		SUBMODULE	**CO_2 FROM ENERGY SOURCES (REFERENCE APPROACH)**				
		WORKSHEET	**1-1**				
		SHEETS	**2 OF 5**				
		COUNTRY	**Namibia**				
		YEAR	**1994**				
			G [b] Conversion Factor (TJ/kt)	H Apparent Consumption (TJ)	I Carbon Emission Factor (t C/TJ)	J Carbon Content (t C)	K Carbon Content (Gg C)
FUEL TYPES				H=(FxG)		J=(HxI)	K=(J/1000)
Liquid Fossil	Primary Fuels	Crude Oil		0.00		0.00	0.00
		Orimulsion		0.00		0.00	0.00
		Natural Gas Liquids		0.00		0.00	0.00
	Secondary Fuels	Gasoline	44.8	7,433.66	18.9	140,496.25	140.50
		Jet Kerosene	44.59	1,292.66	19.5	25,206.95	25.21
		Other Kerosene	44.75	361.13	19.6	7,078.20	7.08
		Shale Oil		0.00		0.00	0.00
		Gas / Diesel Oil	43.33	9,010.04	20.2	182,002.81	182.00
		Residual Fuel Oil	40.19	810.63	21.1	17,104.34	17.10
		LPG	47.32	286.29	17.2	4,924.12	4.92
		Ethane		0.00		0.00	0.00
		Naphtha		0.00		0.00	0.00
		Bitumen	40.19	283.34	22	6,233.47	6.23
		Lubricants	40.19	381.81	20	7,636.10	7.64
		Petroleum Coke		0.00		0.00	0.00
		Refinery Feedstocks		0.00		0.00	0.00
		Other Oil		0.00		0.00	0.00
Liquid Fossil Totals				19,859.56		390,682.24	390.68
Solid Fossil	Primary Fuels	Anthracite [a]		0.00		0.00	0.00
		Coking Coal	25.75	432.86	25.8	11,167.72	11.17
		Other Bit. Coal	25.09	4,077.88	25.8	105,209.24	105.21
		Sub-bit. Coal		0.00		0.00	0.00
		Lignite		0.00		0.00	0.00
		Oil Shale		0.00		0.00	0.00
		Peat		0.00		0.00	0.00
	Secondary Fuels	BKB & Patent Fuel		0.00		0.00	0.00
		Coke Oven/Gas Coke		0.00		0.00	0.00
Solid Fuel Totals				4,510.74		116,376.97	116.38
Gaseous Fossil		Natural Gas (Dry)		0.00		0.00	0.00
Total				**24,370.30**		**507,059.21**	**507.06**
Biomass total				11,668.76		348,902.09	348.90
		Solid Biomass	17.84	11,659.87	29.9	348,630.03	348.63
		Liquid Biomass	0	0.00		0.00	0.00
		Gas Biomass	26.15	8.89	30.6	272.06	0.27

		MODULE	**ENERGY**				
		SUBMODULE	**CO_2 FROM ENERGY SOURCES (REFERENCE APPROACH)**				
		WORKSHEET	**1-1**				
		SHEETS	**3 OF 5**				
		COUNTRY	**Namibia**				
		YEAR	**1994**				
			L	M	N	O	P
			Carbon Stored (Gg C)	Net Carbon Emissions (Gg C)	Fraction of Carbon Oxidised	Actual Carbon Emissions (Gg C)	Actual CO_2 Emissions (Gg CO_2)
FUEL TYPES				M=(K-L)		O=(MxN)	P=(Ox[44/12])
Liquid Fossil	Primary Fuels	Crude Oil		0.00		0.00	0.00
		Orimulsion		0.00		0.00	0.00
		Natural Gas Liquids		0.00		0.00	0.00
	Secondary Fuels	Gasoline	0	140.50	0.99	139.09	510.00
		Jet Kerosene	0	25.21	0.99	24.95	91.50
		Other Kerosene	0	7.08	0.99	7.01	25.69
		Shale Oil	0	0.00		0.00	0.00
		Gas / Diesel Oil	0.00	182.00	0.99	180.18	660.67
		Residual Fuel Oil	0	17.10	0.99	16.93	62.09
		LPG	0.00	4.92	0.995	4.90	17.96
		Ethane	0.00	0.00		0.00	0.00
		Naphtha	0.00	0.00		0.00	0.00
		Bitumen	6.23	0.00		0.00	0.00
		Lubricants	3.82	3.82	0.99	3.78	13.85
		Petroleum Coke	0	0.00		0.00	0.00
		Refinery Feedstocks	0	0.00		0.00	0.00
		Other Oil	0	0.00		0.00	0.00
Liquid Fossil Totals			10.05	380.63		376.85	1,381.77
Solid Fossil	Primary Fuels	Anthracite [(a)]		0.00		0.00	0.00
		Coking Coal	0.50	10.66	0.98	10.45	38.32
		Other Bit. Coal	10.52	94.69	0.98	92.80	340.25
		Sub-bit. Coal		0.00		0.00	0.00
		Lignite		0.00		0.00	0.00
		Oil Shale		0.00		0.00	0.00
		Peat		0.00		0.00	0.00
	Secondary Fuels	BKB & Patent Fuel		0.00		0.00	0.00
		Coke Oven/Gas Coke		0.00		0.00	0.00
Solid Fuel Totals			11.02	105.35		103.25	378.57
Gaseous Fossil		Natural Gas (Dry)	0.00	0.00		0.00	0.00
Total			**21.07**	**485.99**		**480.09**	**1,760.34**
Biomass total			0.00	348.90		331.47	1,215.38
		Solid Biomass	0	348.63	0.95	331.20	1,214.39
		Liquid Biomass		0.00		0.00	0.00
		Gas Biomass	0	0.27	0.99	0.27	0.99

MODULE		ENERGY
SUBMODULE		CO_2 FROM ENERGY SOURCES (REFERENCE APPROACH)
WORKSHEET		1-1
SHEETS		4 OF 5 EMISSIONS FROM INTERNATIONAL BUNKERS (INTERNATIONAL MARINE AND AIR TRANSPORT)
COUNTRY		Namibia
YEAR		1994

		STEP 1	STEP 2		STEP 3		
		A Quantities Delivered[a]	B Conversion Factor (TJ/Unit)	C Quantities Delivered (TJ)	D Carbon Emission Factor (t C/TJ)	E Carbon Content (t C)	F Carbon Content (Gg C)
FUEL TYPES				C=(AxB)		E=(CxD)	F=(E/1000)
Solid Fossil	Other Bituminous Coal	0.00	25.09	0.00	25.80	0.00	0.00
	Sub-Bituminous Coal	0.00	0.00	0.00	0.00	0.00	0.00
Liquid Fossil	Gasoline	0.00	44.80	0.00	18.90	0.00	0.00
	Jet Kerosene	23.96	44.59	1 068.38	19.50	20 833.34	20.83
	Gas / Diesel Oil	10.94	43.33	474.03	20.20	9 575.41	9.58
	Residual Fuel Oil	0.00	40.19	0.00	21.10	0.00	0.00
	Lubricants	0.50	40.19	20.10	20.00	401.90	0.40
			Total	**1 562.50**			

	MODULE	ENERGY
	SUBMODULE	CO_2 FROM ENERGY SOURCES (REFERENCE APPROACH)
	WORKSHEET	1-1
	SHEETS	5 OF 5 EMISSIONS FROM INTERNATIONAL BUNKERS (INTERNATIONAL MARINE AND AIR TRANSPORT)
	COUNTRY	Namibia
	YEAR	1994

		G Fraction of Carbon Stored	H Carbon Stored (Gg C)	I Net Carbon Emissions (Gg C)	J Fraction of Carbon Oxidised	K Actual Carbon Emissions (Gg C)	L Actual CO_2 Emissions (Gg CO_2)
FUEL TYPES			H=(FxG)	I=(F-H)		K=(IxJ)	L=(Kx[44/12])
Solid Fossil	Other Bituminous Coal		0.00	0.00		0.00	0.00
	Sub-Bituminous Coal		0.00	0.00		0.00	0.00
Liquid Fossil	Gasoline		0.00	0.00		0.00	0.00
	Jet Kerosene	0	0.00	20.83	0.99	20.63	75.63
	Gas / Diesel Oil	0	0.00	9.58	0.99	9.48	34.76
	Residual Fuel Oil		0.00	0.00		0.00	0.00
	Lubricants	0.5	0.20	0.20	0.99	0.20	0.73
						Total	**111.11**

MODULE	ENERGY							
SUBMODULE	CO_2 FROM ENERGY							
WORKSHEET	AUXILIARY WORKSHEET 1-1: ESTIMATING CARBON STORED IN PRODUCTS.							
SHEETS	1 OF 1							
COUNTRY	Namibia							
YEAR	1994							
	A	B	C	D	E	F	G	H
	Estimated Fuel Quantities	Conversion Factor (TJ/Unit)	Estimated Fuel Quantities (TJ)	Carbon Emission Factor (t C/TJ)	Carbon Content (t C)	Carbon Content (Gg C)	Fraction of Carbon Stored	Carbon Stored (Gg C)
FUEL TYPES			C=(AxB)		E=(CxD)	F=(E/1000)		H=(FxG)
Naphtha [(a)]	0		0.00		0.00	0.00	0.8	0.00
Lubricants	9.5	40.19	381.81	20	7 636.10	7.64	0.5	3.82
Bitumen	7.05	40.19	283.34	22	6 233.47	6.23	1	6.23
Coal Oils and Tars (from Coking Coal)	1.01	25.75	26.01	25.8	670.99	0.67	0.75	0.50
Natural Gas [(a)]			0.00		0.00	0.00	0.33	0.00
Gas/Diesel Oil [(a)]			0.00		0.00	0.00	0.5	0.00
LPG [(a)]			0.00		0.00	0.00	0.8	0.00
Ethane [(a)]			0.00		0.00	0.00	0.8	0.00
Other Fuels [(b)]			0.00		0.00	0.00		0.00
Coal Ash	162.53	25.09	4 077.88	25.8	105 209.24	105.21	0.1	10.52
			0.00		0.00	0.00		0.00

MODULE	**ENERGY**					
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**					
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**					
SHEETS	**1 OF 16 ENERGY INDUSTRIES**					
COUNTRY	**Namibia**					
YEAR	**1994**					
	STEP 1	**STEP 2**		**STEP 3**		
ENERGY INDUSTRIES	A Consumption	B Conversion Factor (TJ/Unit)	C Consumption (TJ)	D Carbon Emission Factor (t C/TJ)	E Carbon Content (t C)	F Carbon Content (Gg C)
			C=(AxB)		E=(CxD)	F=(E/1000)
Crude Oil [a]	0		0.00		0.00	0.00
Natural Gas Liquids	0		0.00		0.00	0.00
Gasoline	0		0.00		0.00	0.00
Jet Kerosene	0		0.00		0.00	0.00
Other Kerosene	0		0.00		0.00	0.00
Gas/Diesel Oil	0.17	43.33	7.37	20.2	148.80	0.15
Residual Fuel Oil	1.91	40.19	76.76	21.1	1 619.70	1.62
LPG	0		0.00		0.00	0.00
Ethane	0		0.00		0.00	0.00
Naphtha	0		0.00		0.00	0.00
Lubricants	0.1	40.19	4.02	20	80.38	0.08
Petroleum Coke	0		0.00		0.00	0.00
Refinery Gas	0		0.00		0.00	0.00
Anthracite	0		0.00		0.00	0.00
Coking Coal	0		0.00		0.00	0.00
Other Bituminous Coal	100.44	25.09	2 520.04	25.8	65 017.02	65.02
Sub-Bituminous Coal	0		0.00		0.00	0.00
Lignite	0		0.00		0.00	0.00
Peat	0		0.00		0.00	0.00
Patent Fuel	0		0.00		0.00	0.00
Brown Coal Briquettes	0		0.00		0.00	0.00
Coke Oven Coke	0		0.00		0.00	0.00
Gas Coke	0		0.00		0.00	0.00
Gas Works Gas	0		0.00		0.00	0.00
Coke Oven Gas	0		0.00		0.00	0.00
Blast Furnace Gas	0		0.00		0.00	0.00
Natural gas	0		0.00		0.00	0.00
Municipal Solid Waste	0		0.00		0.00	0.00
Industrial Waste	0		0.00		0.00	0.00
		Total	**2 608.19**			
Memo items:						
Wood/Wood Waste	0		0.00		0.00	0.00
Charcoal	0		0.00		0.00	0.00
Other Solid Biomass	0		0.00		0.00	0.00
Liquid Biomass	0		0.00		0.00	0.00
Gaseous Biomass	0.34		0.00		0.00	0.00
		Total Biomass	**0.00**			

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**
SHEETS	**2 OF 16 ENERGY INDUSTRIES**
COUNTRY	**Namibia**
YEAR	**1994**

	STEP 4			**STEP 5**		**STEP 6**
	G	H	I	J	K	L
ENERGY INDUSTRIES	Fraction of Carbon Stored	Carbon Stored (Gg C)	Net Carbon Emissions (Gg C)	Fraction of Carbon Oxidised	Actual Carbon Emissions (Gg C)	Actual CO_2 Emissions (Gg CO_2)
		H=(FxG)	I=(F-H)		K=(IxJ)	L=(Kx[44/12])
Crude Oil [a]		0.00	0.00		0.00	0.00
Natural Gas Liquids		0.00	0.00		0.00	0.00
Gasoline		0.00	0.00		0.00	0.00
Jet Kerosene		0.00	0.00		0.00	0.00
Other Kerosene		0.00	0.00		0.00	0.00
Gas/Diesel Oil	0	0.00	0.15	0.99	0.15	0.54
Residual Fuel Oil	0	0.00	1.62	0.99	1.60	5.88
LPG		0.00	0.00		0.00	0.00
Ethane		0.00	0.00		0.00	0.00
Naphtha		0.00	0.00		0.00	0.00
Lubricants	[b] 0.5	0.04	0.04	0.99	0.04	0.15
Petroleum Coke		0.00	0.00		0.00	0.00
Refinery Gas		0.00	0.00		0.00	0.00
Anthracite		0.00	0.00		0.00	0.00
Coking Coal		0.00	0.00		0.00	0.00
Other Bituminous Coal	0.1	6.50	58.52	0.98	57.35	210.27
Sub-Bituminous Coal		0.00	0.00		0.00	0.00
Lignite		0.00	0.00		0.00	0.00
Peat		0.00	0.00		0.00	0.00
Patent Fuel		0.00	0.00		0.00	0.00
Brown Coal Briquettes		0.00	0.00		0.00	0.00
Coke Oven Coke		0.00	0.00		0.00	0.00
Gas Coke		0.00	0.00		0.00	0.00
Gas Works Gas		0.00	0.00		0.00	0.00
Coke Oven Gas		0.00	0.00		0.00	0.00
Blast Furnace Gas		0.00	0.00		0.00	0.00
Natural gas		0.00	0.00		0.00	0.00
Municipal Solid Waste		0.00	0.00		0.00	0.00
Industrial Waste		0.00	0.00		0.00	0.00
					Total	**216.83**
Memo items:						
Wood/Wood Waste		0.00	0.00		0.00	0.00
Charcoal		0.00	0.00		0.00	0.00
Other Solid Biomass		0.00	0.00		0.00	0.00
Liquid Biomass		0.00	0.00		0.00	0.00
Gaseous Biomass		0.00	0.00		0.00	0.00
					Total Biomass	**0.00**

MODULE	**ENERGY**					
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**					
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**					
SHEETS	**3 OF 16 MANUFACTURING INDUSTRIES AND CONSTRUCTION**					
COUNTRY	**Namibia**					
YEAR	**1994**					
	STEP 1	**STEP 2**		**STEP 3**		
	A	B	C	D	E	F
MANUFACTURING INDUSTRIES AND CONSTRUCTION	Consumption kt	Conversion Factor (TJ/kt)	Consumption (TJ)	Carbon Emission Factor (t C/TJ)	Carbon Content (t C)	Carbon Content (Gg C)
			C=(AxB)		E=(CxD)	F=(E/1000)
Crude Oil [(a)]	0		0.00		0.00	0.00
Natural Gas Liquids	0		0.00		0.00	0.00
Gasoline	0.35	44.8	15.68	18.9	296.35	0.30
Jet Kerosene	0		0.00		0.00	0.00
Other Kerosene	0.2	44.75	8.95	19.6	175.42	0.18
Gas/Diesel Oil	9.33	43.33	404.27	20.2	8 166.23	8.17
Residual Fuel Oil	4.4	40.19	176.84	21.1	3 731.24	3.73
LPG	0		0.00		0.00	0.00
Ethane	0		0.00		0.00	0.00
Naphtha	0		0.00		0.00	0.00
Lubricants	0.33	40.19	13.26	20	265.25	0.27
Petroleum Coke	0		0.00		0.00	0.00
Refinery Gas	0		0.00		0.00	0.00
Anthracite	0		0.00		0.00	0.00
Coking Coal	16.81	25.75	432.86	25.8	11 167.72	11.17
Other Bituminous Coal	52.53	25.09	1 317.98	25.8	34 003.82	34.00
Sub-Bituminous Coal	0		0.00		0.00	0.00
Lignite	0		0.00		0.00	0.00
Peat	0		0.00		0.00	0.00
Patent Fuel	0		0.00		0.00	0.00
Brown Coal Briquettes	0		0.00		0.00	0.00
Coke Oven Coke	0		0.00		0.00	0.00
Gas Coke	0		0.00		0.00	0.00
Gas Works Gas	0		0.00		0.00	0.00
Coke Oven Gas	0		0.00		0.00	0.00
Blast Furnace Gas	0		0.00		0.00	0.00
Natural gas	0		0.00		0.00	0.00
Municipal Solid Waste	0		0.00		0.00	0.00
Industrial Waste	0		0.00		0.00	0.00
		Total	**2 369.83**			
Memo items:						
Wood/Wood Waste	11.18	18.5	206.83	29.9	6 184.22	6.18
Charcoal	3.5	30	105.00	28.3	2 971.50	2.97
Other Solid Biomass	0		0.00		0.00	0.00
Liquid Biomass	0		0.00		0.00	0.00
Gaseous Biomass	0		0.00		0.00	0.00
		Total Biomass	**311.83**			

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**
SHEETS	**4 OF 16 MANUFACTURING INDUSTRIES AND CONSTRUCTION**
COUNTRY	= **Namibia**
YEAR	**1994**

	STEP 4			**STEP 5**		**STEP 6**
	G	H	I	J	K	L
MANUFACTURING INDUSTRIES AND CONSTRUCTION	Fraction of Carbon Stored[a]	Carbon Stored (Gg C)[a]	Net Carbon Emissions (Gg C)	Fraction of Carbon Oxidised	Actual Carbon Emissions (Gg C)	Actual CO_2 Emissions (Gg CO_2)
		H=(FxG)	I=(F-H)		K=(IxJ)	L=(Kx[44/12])
Crude Oil [a]		0.00	0.00		0.00	0.00
Natural Gas Liquids		0.00	0.00		0.00	0.00
Gasoline	0	0.00	0.30	0.99	0.29	1.08
Jet Kerosene		0.00	0.00		0.00	0.00
Other Kerosene	0	0.00	0.18	0.99	0.17	0.64
Gas/Diesel Oil	0	(b) 0.00	8.17	0.99	8.08	29.64
Residual Fuel Oil	0	0.00	3.73	0.99	3.69	13.54
LPG		(b) 0.00	0.00		0.00	0.00
Ethane		(b) 0.00	0.00		0.00	0.00
Naphtha		(b) 0.00	0.00		0.00	0.00
Lubricants	(c) 0.5	0.13	0.13	0.5	0.07	0.24
Petroleum Coke		0.00	0.00		0.00	0.00
Refinery Gas		0.00	0.00		0.00	0.00
Anthracite		0.00	0.00		0.00	0.00
Coking Coal	0	0.00	11.17	0.98	10.94	40.13
Other Bituminous Coal	0	0.00	34.00	0.98	33.32	122.19
Sub-Bituminous Coal		0.00	0.00		0.00	0.00
Lignite		0.00	0.00		0.00	0.00
Peat		0.00	0.00		0.00	0.00
Patent Fuel		0.00	0.00		0.00	0.00
Brown Coal Briquettes		0.00	0.00		0.00	0.00
Coke Oven Coke		0.00	0.00		0.00	0.00
Gas Coke		0.00	0.00		0.00	0.00
Gas Works Gas		0.00	0.00		0.00	0.00
Coke Oven Gas		0.00	0.00		0.00	0.00
Blast Furnace Gas		0.00	0.00		0.00	0.00
Natural gas		(b) 0.00	0.00		0.00	0.00
Municipal Solid Waste		0.00	0.00		0.00	0.00
Industrial Waste		0.00	0.00		0.00	0.00
					Total	**207.46**
Memo items:						
Wood/Wood Waste	0	0.00	6.18	0.95	5.88	21.54
Charcoal	0	0.00	2.97	0.95	2.82	10.35
Other Solid Biomass		0.00	0.00		0.00	0.00
Liquid Biomass		0.00	0.00		0.00	0.00
Gaseous Biomass		0.00	0.00		0.00	0.00
					Total Biomass	**31.89**

MODULE	**ENERGY**					
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**					
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**					
SHEETS	**5 OF 16 TRANSPORT**					
COUNTRY	**Namibia**					
YEAR	**1994**					
	STEP 1	**STEP 2**		**STEP 3**		
	A	B	C	D	E	F
TRANSPORT	Consumption kt	Conversion Factor (TJ/Unit)	Consumption (TJ)	Carbon Emission Factor (t C/TJ)	Carbon Content (t C)	Carbon Content (Gg C)
			C=(AxB)		E=(CxD)	F=(E/1000)
Domestic Aviation [(a)]						
Gasoline	2.39	44.8	107.07	18.9	2 023.66	2.02
Jet Kerosene	28.99	44.59	1 292.66	19.5	25 206.95	25.21
			0.00		0.00	0.00
		Subtotal	**1 399.74**			
Road Transport						
Natural Gas	0		0.00		0.00	0.00
LPG	0		0.00		0.00	0.00
Gasoline	159.39	44.8	7 140.67	18.9	134 958.70	134.96
Gas/Diesel Oil	81.63	43.33	3 537.03	20.2	71 447.96	71.45
Lubricants	5.07	40.19	203.76	20	4 075.27	4.08
		Subtotal	**10 881.46**			
Rail Transport						
Gas/Diesel Oil	13.75	43.33	595.79	20.2	12 034.91	12.03
Residual Fuel Oil	0		0.00		0.00	0.00
Anthracite	0		0.00		0.00	0.00
Other Bituminous Coal	0		0.00		0.00	0.00
Coke Oven Coke	0		0.00		0.00	0.00
			0.00		0.00	0.00
		Subtotal	**595.79**			
National Navigation [(a)]						
Gasoline	0		0.00		0.00	0.00
Gas/Diesel Oil	0		0.00		0.00	0.00
Residual Fuel Oil	0		0.00		0.00	0.00
Lubricants	0		0.00		0.00	0.00
Sub-Bituminous Coal	0		0.00		0.00	0.00
			0.00		0.00	0.00
		Subtotal	**0.00**			
Pipeline Transport						
Natural Gas	0		0.00		0.00	0.00
		Subtotal	**0.00**			
		Total Transport [(a)]	**12 876.99**			
Memo items:						
Liquid Biomass	0		0.00		0.00	0.00
			0.00		0.00	0.00
		Total Biomass	**0.00**			

MODULE	**ENERGY**					
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**					
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**					
SHEETS	**6 OF 16 TRANSPORT**					
COUNTRY	= **Namibia**					
YEAR	**1994**					
	STEP 4			**STEP 5**		**STEP 6**
	G	H	I	J	K	L
TRANSPORT	Fraction of Carbon Stored	Carbon Stored (Gg C)	Net Carbon Emissions (Gg C)	Fraction of Carbon Oxidised	Actual Carbon Emissions (Gg C)	Actual CO_2 Emissions (Gg CO_2)
		H=(FxG)	I=(F-H)		K=(IxJ)	L=(Kx[44/12])
Domestic Aviation [(a)]						
Gasoline	0	0.00	2.02	0.99	2.00	7.35
Jet Kerosene	0	0.00	25.21	0.99	24.95	91.50
		0.00	0.00		0.00	0.00
					Subtotal	**98.85**
Road Transport						
Natural Gas		0.00	0.00		0.00	0.00
LPG		0.00	0.00		0.00	0.00
Gasoline	0	0.00	134.96	0.99	133.61	489.90
Gas/Diesel Oil	0	0.00	71.45	0.99	70.73	259.36
Lubricants	0.5	2.04	2.04	0.99	2.02	7.40
					Subtotal	**756.65**
Rail Transport						
Gas/Diesel Oil	0	0.00	12.03	0.99	11.91	43.69
Residual Fuel Oil		0.00	0.00		0.00	0.00
Anthracite		0.00	0.00		0.00	0.00
Other Bituminous Coal		0.00	0.00		0.00	0.00
Coke Oven Coke		0.00	0.00		0.00	0.00
		0.00	0.00		0.00	0.00
					Subtotal	**43.69**
National Navigation [(a)]						
Gasoline		0.00	0.00		0.00	0.00
Gas/Diesel Oil		0.00	0.00		0.00	0.00
Residual Fuel Oil		0.00	0.00		0.00	0.00
Lubricants	(b)	0.00	0.00		0.00	0.00
Sub-Bituminous Coal		0.00	0.00		0.00	0.00
		0.00	0.00		0.00	0.00
					Subtotal	**0.00**
Pipeline Transport						
Natural Gas		0.00	0.00		0.00	0.00
					Subtotal	**0.00**
					Total Transport [(a)]	**899.19**
Memo items:						
Liquid Biomass		0.00	0.00		0.00	0.00
		0.00	0.00		0.00	0.00
					Total Biomass	**0.00**

MODULE	ENERGY					
SUBMODULE	CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)					
WORKSHEET	1-2 STEP BY STEP CALCULATIONS					
SHEETS	7 OF 16 MEMO ITEMS: INTERNATIONAL BUNKERS					
COUNTRY	Namibia					
YEAR	1994					
	STEP 1	**STEP 2**		**STEP 3**		
MEMO ITEMS: INTERNATIONAL BUNKERS	A Consumption kt	B Conversion Factor (TJ/Unit)	C Consumption (TJ)	D Carbon Emission Factor (t C/TJ)	E Carbon Content (t C)	F Carbon Content (Gg C)
			C=(AxB)		E=(CxD)	F=(E/1000)
Intl. Marine Bunkers						
Gasoline	0		0.00		0.00	0.00
Gas/Diesel Oil	10.94	43.33	474.03	20.2	9 575.41	9.58
Residual Fuel Oil	0		0.00		0.00	0.00
Lubricants	0.5	40.19	20.10	20	401.90	0.40
Sub-Bituminous Coal	0		0.00		0.00	0.00
			0.00		0.00	0.00
		Total	**494.13**			
Intl. Aviation Bunkers						
Gasoline	0		0.00		0.00	0.00
Jet Kerosene	23.96	44.59	1 068.38	19.5	20 833.34	20.83
			0.00		0.00	0.00
		Total	**1 068.38**			

MODULE	ENERGY					
SUBMODULE	CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)					
WORKSHEET	1-2 STEP BY STEP CALCULATIONS					
SHEETS	8 OF 16 MEMO ITEMS: INTERNATIONAL BUNKERS					
COUNTRY	= Namibia					
YEAR	1994					
	STEP 4			**STEP 5**		**STEP 6**
MEMO ITEMS: INTERNATIONAL BUNKERS	G Fraction of Carbon Stored	H Carbon Stored (Gg C)	I Net Carbon Emissions (Gg C)	J Fraction of Carbon Oxidised	K Actual Carbon Emissions (Gg C)	L Actual CO_2 Emissions (Gg CO_2)
		H=(FxG)	I=(F-H)		K=(IxJ)	L=(Kx[44/12])
Intl. Marine Bunkers						
Gasoline		0.00	0.00		0.00	0.00
Gas/Diesel Oil	0	0.00	9.58	0.99	9.48	34.76
Residual Fuel Oil		0.00	0.00		0.00	0.00
Lubricants	(a) 0.5	0.20	0.20	0.99	0.20	0.73
Sub-Bituminous Coal		0.00	0.00		0.00	0.00
		0.00	0.00		0.00	0.00
					Total	**35.49**
Intl. Aviation Bunkers						
Gasoline		0.00	0.00		0.00	0.00
Jet Kerosene	0	0.00	20.83	0.99	20.63	75.63
		0.00	0.00		0.00	0.00
					Total	**75.63**

MODULE	ENERGY					
SUBMODULE	CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)					
WORKSHEET	1-2 STEP BY STEP CALCULATIONS					
SHEETS	9 OF 16 COMMERCIAL / INSTITUTIONAL SECTOR					
COUNTRY	Namibia					
YEAR	1994					
	STEP 1	STEP 2		STEP 3		
	A	B	C	D	E	F
COMMERCIAL / INSTITUTIONAL SECTOR	Consumption	Conversion Factor (TJ/Unit)	Consumption (TJ)	Carbon Emission Factor (t C/TJ)	Carbon Content (t C)	Carbon Content (Gg C)
			C=(AxB)		E=(CxD)	F=(E/1000)
Gasoline			0.00		0.00	0.00
Jet Kerosene			0.00		0.00	0.00
Other Kerosene			0.00		0.00	0.00
Gas/Diesel Oil			0.00		0.00	0.00
Residual Fuel Oil			0.00		0.00	0.00
LPG			0.00		0.00	0.00
Anthracite			0.00		0.00	0.00
Other Bituminous Coal			0.00		0.00	0.00
Lignite			0.00		0.00	0.00
Brown Coal Briquettes			0.00		0.00	0.00
Coke Oven Coke			0.00		0.00	0.00
Gas Works Gas			0.00		0.00	0.00
Coke Oven Gas			0.00		0.00	0.00
Natural gas			0.00		0.00	0.00
			0.00		0.00	0.00
			0.00		0.00	0.00
		Total	**0.00**			
Memo items:						
Wood/Wood Waste	52.5	16.6	871.50	29.9	26 057.85	26.06
Charcoal			0.00		0.00	0.00
Other Solid Biomass			0.00		0.00	0.00
Liquid Biomass			0.00		0.00	0.00
Gaseous Biomass			0.00		0.00	0.00
		Total Biomass	**871.50**			

MODULE	ENERGY					
SUBMODULE	CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)					
WORKSHEET	1-2 STEP BY STEP CALCULATIONS					
SHEETS	10 OF 16 COMMERCIAL / INSTITUTIONAL SECTOR					
COUNTRY	Namibia					
YEAR	1994					
	STEP 4			STEP 5		STEP 6
	G	H	I	J	K	L
COMMERCIAL / INSTITUTIONAL SECTOR	Fraction of Carbon Stored	Carbon Stored (Gg C)	Net Carbon Emissions (Gg C)	Fraction of Carbon Oxidised	Actual Carbon Emissions (Gg C)	Actual CO_2 Emissions (Gg CO_2)
		H=(FxG)	I=(F-H)		K=(IxJ)	L=(Kx[44/12])
Gasoline		0.00	0.00		0.00	0.00
Jet Kerosene		0.00	0.00		0.00	0.00
Other Kerosene		0.00	0.00		0.00	0.00
Gas/Diesel Oil		0.00	0.00		0.00	0.00
Residual Fuel Oil		0.00	0.00		0.00	0.00
LPG		0.00	0.00		0.00	0.00
Anthracite		0.00	0.00		0.00	0.00
Other Bituminous Coal		0.00	0.00		0.00	0.00
Lignite		0.00	0.00		0.00	0.00
Brown Coal Briquettes		0.00	0.00		0.00	0.00
Coke Oven Coke		0.00	0.00		0.00	0.00
Gas Works Gas		0.00	0.00		0.00	0.00
Coke Oven Gas		0.00	0.00		0.00	0.00
Natural gas		0.00	0.00		0.00	0.00
		0.00	0.00		0.00	0.00
		0.00	0.00		0.00	0.00
					Total	**0.00**
Memo items:						
Wood/Wood Waste	0.25	6.51	19.54	0.95	18.57	68.08
Charcoal		0.00	0.00		0.00	0.00
Other Solid Biomass		0.00	0.00		0.00	0.00
Liquid Biomass		0.00	0.00		0.00	0.00
Gaseous Biomass		0.00	0.00		0.00	0.00
					Total Biomass	**68.08**

MODULE	**ENERGY**					
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**					
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**					
SHEETS	**11 OF 16 RESIDENTIAL SECTOR**					
COUNTRY	**Namibia**					
YEAR	**1994**					
	STEP 1	**STEP 2**		**STEP 3**		
	A	B	C	D	E	F
RESIDENTIAL SECTOR	Consumption kt	Conversion Factor (TJ/Unit)	Consumption (TJ)	Carbon Emission Factor (t C/TJ)	Carbon Content (t C)	Carbon Content (Gg C)
			C=(AxB)		E=(CxD)	F=(E/1000)
Gasoline	0		0.00		0.00	0.00
Other Kerosene	3.29	44.75	147.23	19.6	2 885.66	2.89
Gas/Diesel Oil	0		0.00		0.00	0.00
Residual Fuel Oil	0		0.00		0.00	0.00
LPG	6.05	47.32	286.29	17.2	4 924.12	4.92
Anthracite	0		0.00		0.00	0.00
Other Bituminous Coal	0		0.00		0.00	0.00
Sub-Bituminous Coal	0		0.00		0.00	0.00
Lignite	0		0.00		0.00	0.00
Peat	0		0.00		0.00	0.00
Patent Fuel	0		0.00		0.00	0.00
Brown Coal Briquettes	0		0.00		0.00	0.00
Coke Oven Coke	0		0.00		0.00	0.00
Gas Works Gas	0		0.00		0.00	0.00
Coke Oven Gas	0		0.00		0.00	0.00
Natural gas	0		0.00		0.00	0.00
			0.00		0.00	0.00
			0.00		0.00	0.00
			0.00		0.00	0.00
			0.00		0.00	0.00
		Total	**433.51**			
Memo items:						
Wood/Wood Waste	596.9	16.6	9 908.54	29.9	296 265.35	296.27
Charcoal	1	30	30.00	28.3	849.00	0.85
Other Solid Biomass			0.00		0.00	0.00
Liquid Biomass	0		0.00		0.00	0.00
Gaseous Biomass	0		0.00		0.00	0.00
		Total Biomass	**9 938.54**			

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**
SHEETS	**12 OF 16 RESIDENTIAL SECTOR**
COUNTRY	**Namibia**
YEAR	**1994**

	STEP 4			**STEP 5**		**STEP 6**
	G	H	I	J	K	L
RESIDENTIAL SECTOR	Fraction of Carbon Stored	Carbon Stored (Gg C)	Net Carbon Emissions (Gg C)	Fraction of Carbon Oxidised	Actual Carbon Emissions (Gg C)	Actual CO_2 Emissions (Gg CO_2)
		H=(FxG)	I=(F-H)		K=(IxJ)	L=(Kx[44/12])
Gasoline		0.00	0.00		0.00	0.00
Other Kerosene	0	0.00	2.89	0.99	2.86	10.47
Gas/Diesel Oil		0.00	0.00		0.00	0.00
Residual Fuel Oil		0.00	0.00		0.00	0.00
LPG	0	0.00	4.92	0.99	4.87	17.87
Anthracite		0.00	0.00		0.00	0.00
Other Bituminous Coal		0.00	0.00		0.00	0.00
Sub-Bituminous Coal		0.00	0.00		0.00	0.00
Lignite		0.00	0.00		0.00	0.00
Peat		0.00	0.00		0.00	0.00
Patent Fuel		0.00	0.00		0.00	0.00
Brown Coal Briquettes		0.00	0.00		0.00	0.00
Coke Oven Coke		0.00	0.00		0.00	0.00
Gas Works Gas		0.00	0.00		0.00	0.00
Coke Oven Gas		0.00	0.00		0.00	0.00
Natural gas		0.00	0.00		0.00	0.00
		0.00	0.00		0.00	0.00
		0.00	0.00		0.00	0.00
		0.00	0.00		0.00	0.00
		0.00	0.00		0.00	0.00
					Total	**28.35**
Memo items:						
Wood/Wood Waste	0	0.00	296.27	0.95	281.45	1 031.99
Charcoal	0	0.00	0.85	0.95	0.81	2.96
Other Solid Biomass		0.00	0.00		0.00	0.00
Liquid Biomass		0.00	0.00		0.00	0.00
Gaseous Biomass		0.00	0.00		0.00	0.00
					Total Biomass	**1 034.95**

MODULE	**ENERGY**					
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**					
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**					
SHEETS	**13 OF 16 AGRICULTURE / FORESTRY / FISHING**					
COUNTRY	**Namibia**					
YEAR	**1994**					
	STEP 1	**STEP 2**		**STEP 3**		
AGRICULTURE / FORESTRY / FISHING	A Consumption kt	B Conversion Factor (TJ/Unit)	C Consumption (TJ)	D Carbon Emission Factor (t C/TJ)	E Carbon Content (t C)	F Carbon Content (Gg C)
			C=(AxB)		E=(CxD)	F=(E/1000)
Mobile						
Gasoline	0		0.00		0.00	0.00
Jet Kerosene	0		0.00		0.00	0.00
Other Kerosene	0		0.00		0.00	0.00
Gas/Diesel Oil	93.89	43.33	4 068.25	20.2	82 178.72	82.18
Residual Fuel Oil	0		0.00		0.00	0.00
LPG	0		0.00		0.00	0.00
		Total Mobile	**4 068.25**			
Stationary						
Gasoline	0		0.00		0.00	0.00
Other Kerosene	0		0.00		0.00	0.00
Gas/Diesel Oil	0		0.00		0.00	0.00
Residual Fuel Oil	11.34	40.19	455.75	21.1	9 616.42	9.62
LPG	0		0.00		0.00	0.00
Anthracite	0		0.00		0.00	0.00
Coking Coal	0		0.00		0.00	0.00
Other Bituminous Coal	8.41	25.09	211.01	25.8	5 443.98	5.44
Lignite	0		0.00		0.00	0.00
Patent Fuel	0		0.00		0.00	0.00
Brown Coal Briquettes	0		0.00		0.00	0.00
Coke Oven Coke	0		0.00		0.00	0.00
Gas Works Gas	0		0.00		0.00	0.00
Natural gas	0		0.00		0.00	0.00
		Total Stationary	**666.76**			
Memo items:						
Mobile						
Liquid Biomass			0.00		0.00	0.00
Stationary						
Wood/Wood Waste			0.00		0.00	0.00
Charcoal			0.00		0.00	0.00
Other Solid Biomass			0.00		0.00	0.00
Liquid Biomass			0.00		0.00	0.00
Gaseous Biomass			0.00		0.00	0.00
		Total Biomass	**0.00**			

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**
SHEETS	**14 OF 16 AGRICULTURE / FORESTRY / FISHING**
COUNTRY	**Namibia**
YEAR	**1994**

AGRICULTURE / FORESTRY / FISHING	G Fraction of Carbon Stored [(a)]	H Carbon Stored (Gg C)	I Net Carbon Emissions (Gg C)	J Fraction of Carbon Oxidised	K Actual Carbon Emissions (Gg C)	L Actual CO_2 Emissions (Gg CO_2)
		H=(FxG)	I=(F-H)		K=(IxJ)	L=(Kx[44/12])
Mobile						
Gasoline		0.00	0.00		0.00	0.00
Jet Kerosene		0.00	0.00		0.00	0.00
Other Kerosene		0.00	0.00		0.00	0.00
Gas/Diesel Oil	0	0.00	82.18	0.99	81.36	298.31
Residual Fuel Oil		0.00	0.00		0.00	0.00
LPG		0.00	0.00		0.00	0.00
					Total Mobile	**298.31**
Stationary						
Gasoline		0.00	0.00		0.00	0.00
Other Kerosene		0.00	0.00		0.00	0.00
Gas/Diesel Oil		0.00	0.00		0.00	0.00
Residual Fuel Oil	0	0.00	9.62	0.99	9.52	34.91
LPG		0.00	0.00		0.00	0.00
Anthracite		0.00	0.00		0.00	0.00
Coking Coal		0.00	0.00		0.00	0.00
Other Bituminous Coal	0	0.00	5.44	0.95	5.17	18.96
Lignite		0.00	0.00		0.00	0.00
Patent Fuel		0.00	0.00		0.00	0.00
Brown Coal Briquettes		0.00	0.00		0.00	0.00
Coke Oven Coke		0.00	0.00		0.00	0.00
Gas Works Gas		0.00	0.00		0.00	0.00
Natural gas		0.00	0.00		0.00	0.00
					Total Stationary	**53.87**
Memo items:						
Mobile						
Liquid Biomass		0.00	0.00		0.00	0.00
Stationary						
Wood/Wood Waste		0.00	0.00		0.00	0.00
Charcoal		0.00	0.00		0.00	0.00
Other Solid Biomass		0.00	0.00		0.00	0.00
Liquid Biomass		0.00	0.00		0.00	0.00
Gaseous Biomass		0.00	0.00		0.00	0.00
					Total Biomass	**0.00**

MODULE	**ENERGY**					
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**					
WORKSHEET	**1-2 STEP BY STEP CALCULATIONS**					
SHEETS	**15 OF 16 OTHER (NOT ELSEWHERE SPECIFIED)**					
COUNTRY	= **Namibia**					
YEAR	**1994**					
	STEP 1	**STEP 2**		**STEP 3**		
MINING	A Consumption kt	B Conversion Factor (TJ/Unit)	C Consumption (TJ)	D Carbon Emission Factor (t C/TJ)	E Carbon Content (t C)	F Carbon Content (Gg C)
			C=(AxB)		E=(CxD)	F=(E/1000)
Crude Oil	(a) 0		0.00		0.00	0.00
Natural Gas Liquids	0		0.00		0.00	0.00
Gasoline	6.19	44.8	277.31	18.9	5 241.20	5.24
Jet Kerosene	0		0.00		0.00	0.00
Other Kerosene	4.58	44.75	204.96	19.6	4 017.12	4.02
Gas/Diesel Oil	22.92	43.33	993.12	20.2	20 061.10	20.06
Residual Fuel Oil	1.59	40.19	63.90	21.1	1 348.33	1.35
LPG	0		0.00		0.00	0.00
Ethane	0		0.00		0.00	0.00
Naphtha	0		0.00		0.00	0.00
Lubricants	4	40.19	160.76	20	3 215.20	3.22
Petroleum Coke	0		0.00		0.00	0.00
Refinery Gas	0		0.00		0.00	0.00
Anthracite	0		0.00		0.00	0.00
Coking Coal	0		0.00		0.00	0.00
Other Bituminous Coal	0		0.00		0.00	0.00
Sub-Bituminous Coal	0		0.00		0.00	0.00
Lignite	0		0.00		0.00	0.00
Peat	0		0.00		0.00	0.00
Patent Fuel	0		0.00		0.00	0.00
Brown Coal Briquettes	0		0.00		0.00	0.00
Coke Oven Coke	0		0.00		0.00	0.00
Gas Coke	0		0.00		0.00	0.00
Gas Works Gas	0		0.00		0.00	0.00
Coke Oven Gas	0		0.00		0.00	0.00
Blast Furnace Gas	0		0.00		0.00	0.00
Natural gas	0		0.00		0.00	0.00
Municipal Solid Waste	0		0.00		0.00	0.00
Industrial Waste	0		0.00		0.00	0.00
		Total	**1 700.05**			
Memo items:						
Wood/Wood Waste	0		0.00		0.00	0.00
Charcoal	0		0.00		0.00	0.00
Other Solid Biomass	0		0.00		0.00	0.00
Liquid Biomass	0		0.00		0.00	0.00
Gaseous Biomass	0		0.00		0.00	0.00
		Total Biomass	**0.00**			

MODULE	ENERGY					
SUBMODULE	CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)					
WORKSHEET	1-2 STEP BY STEP CALCULATIONS					
SHEETS	16 OF 16 OTHER (NOT ELSEWHERE SPECIFIED)					
COUNTRY	= Namibia					
YEAR	1994					
	STEP 4			STEP 5		STEP 6
	G	H	I	J	K	L
MINING	Fraction of Carbon Stored	Carbon Stored (Gg C)	Net Carbon Emissions (Gg C)	Fraction of Carbon Oxidised	Actual Carbon Emissions (Gg C)	Actual CO_2 Emissions (Gg CO_2)
		H=(FxG)	I=(F-H)		K=(IxJ)	L=(Kx[44/12])
Crude Oil		0.00	0.00		0.00	0.00
Natural Gas Liquids		0.00	0.00		0.00	0.00
Gasoline	0	0.00	5.24	0.99	5.19	19.03
Jet Kerosene		0.00	0.00		0.00	0.00
Other Kerosene	0	0.00	4.02	0.99	3.98	14.58
Gas/Diesel Oil	0	0.00	20.06	0.99	19.86	72.82
Residual Fuel Oil	0	0.00	1.35	0.99	1.33	4.89
LPG		0.00	0.00		0.00	0.00
Ethane		0.00	0.00		0.00	0.00
Naphtha		0.00	0.00		0.00	0.00
Lubricants	(a) 0.5	1.61	1.61	0.99	1.59	5.84
Petroleum Coke		0.00	0.00		0.00	0.00
Refinery Gas		0.00	0.00		0.00	0.00
Anthracite		0.00	0.00		0.00	0.00
Coking Coal		0.00	0.00		0.00	0.00
Other Bituminous Coal		0.00	0.00		0.00	0.00
Sub-Bituminous Coal		0.00	0.00		0.00	0.00
Lignite		0.00	0.00		0.00	0.00
Peat		0.00	0.00		0.00	0.00
Patent Fuel		0.00	0.00		0.00	0.00
Brown Coal Briquettes		0.00	0.00		0.00	0.00
Coke Oven Coke		0.00	0.00		0.00	0.00
Gas Coke		0.00	0.00		0.00	0.00
Gas Works Gas		0.00	0.00		0.00	0.00
Coke Oven Gas		0.00	0.00		0.00	0.00
Blast Furnace Gas		0.00	0.00		0.00	0.00
Natural gas		0.00	0.00		0.00	0.00
Municipal Solid Waste		0.00	0.00		0.00	0.00
Industrial Waste		0.00	0.00		0.00	0.00
					Total	**117.16**
Memo items:						
Wood/Wood Waste		0.00	0.00		0.00	0.00
Charcoal		0.00	0.00		0.00	0.00
Other Solid Biomass		0.00	0.00		0.00	0.00
Liquid Biomass		0.00	0.00		0.00	0.00
Gaseous Biomass		0.00	0.00		0.00	0.00
					Total Biomass	**0.00**

		MODULE	**ENERGY**				
		SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**				
		WORKSHEET	**1-2 OVERVIEW**				
		SHEET	**1 OF 8**				
		COUNTRY	**Namibia**				
		YEAR	**1994**				

			A	B	C	D	E	F
			Crude Oil	Orimulsion	Natural Gas Liquids	Gasoline	Jet Kerosene	Other Kerosene
FUEL CONSUMPTION (TJ)								
Energy Industries			0.00		0.00	0.00	0.00	0.00
Manufacturing Industries and Construction			0.00		0.00	15.68	0.00	8.95
Transport	Domestic Aviation [a]					107.07	1 292.66	
	Road					7 140.67		
	Railways							
	National Navigation [a]					0.00		
	Pipeline Transport							
Other Sectors	Commercial/Institutional					0.00	0.00	0.00
	Residential					0.00		147.23
	Agriculture / Forestry / Fishing	Stationary				0.00		0.00
		Mobile				0.00	0.00	0.00
Other (not elsewhere specified)			0.00		0.00	277.31	0.00	204.96
Total [a]			**0.00**	**0.00**	**0.00**	**7 540.74**	**1 292.66**	**361.13**
Memo: International Marine Bunkers						0.00		
Memo: International Aviation Bunkers						0.00	1 068.38	
CO_2 EMISSIONS (Gg)								
Energy Industries			0.00		0.00	0.00	0.00	0.00
Manufacturing Industries and Construction			0.00		0.00	1.08	0.00	0.64
Transport	Domestic Aviation [a]					7.35	91.50	
	Road					489.90		
	Railways							
	National Navigation [a]					0.00		
	Pipeline Transport							
Other Sectors	Commercial/Institutional					0.00	0.00	0.00
	Residential					0.00		10.47
	Agriculture / Forestry / Fishing	Stationary				0.00		0.00
		Mobile				0.00	0.00	0.00
Other (not elsewhere specified)			0.00		0.00	19.03	0.00	14.58
Total [a]			**0.00**	**0.00**	**0.00**	**517.35**	**91.50**	**25.69**
Memo: International Marine Bunkers						0.00		
Memo: International Aviation Bunkers						0.00	75.63	

		MODULE	**ENERGY**					
		SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**					
		WORKSHEET	**1-2 OVERVIEW**					
		SHEET	**2 OF 8**					
		COUNTRY	**Namibia**					
		YEAR	**1994**					
			G	H	I	J	K	L
			Shale Oil	Gas / Diesel Oil	Residual Fuel Oil	LPG	Ethane	Naphtha
FUEL CONSUMPTION (TJ)								
Energy Industries				7.37	76.76	0.00	0.00	0.00
Manufacturing Industries and Construction				404.27	176.84	0.00	0.00	0.00
Transport	Domestic Aviation (a)							
	Road			3 537.03		0.00		
	Railways			595.79	0.00			
	National Navigation (a)			0.00	0.00			
	Pipeline Transport							
Other Sectors	Commercial/Institutional			0.00	0.00	0.00		
	Residential			0.00	0.00	286.29		
	Agriculture / Forestry / Fishing	Stationary		0.00	455.75	0.00		
		Mobile		4 068.25	0.00	0.00		
Other (not elsewhere specified)				993.12	63.90	0.00	0.00	0.00
Total (a)			**0.00**	**9 605.83**	**773.26**	**286.29**	**0.00**	**0.00**
Memo: International Marine Bunkers				474.03	0.00			
Memo: International Aviation Bunkers								
CO_2 EMISSIONS (Gg)								
Energy Industries				0.54	5.88	0.00	0.00	0.00
Manufacturing Industries and Construction				29.64	13.54	0.00	0.00	0.00
Transport	Domestic Aviation (a)							
	Road			259.36		0.00		
	Railways			43.69	0.00			
	National Navigation (a)			0.00	0.00			
	Pipeline Transport							
Other Sectors	Commercial/Institutional			0.00	0.00	0.00		
	Residential			0.00	0.00	17.87		
	Agriculture / Forestry / Fishing	Stationary		0.00	34.91	0.00		
		Mobile		298.31	0.00	0.00		
Other (not elsewhere specified)				72.82	4.89	0.00	0.00	0.00
Total (a)			**0.00**	**704.36**	**59.23**	**17.87**	**0.00**	**0.00**
Memo: International Marine Bunkers				34.76	0.00			
Memo: International Aviation Bunkers								

	MODULE	**ENERGY**					
	SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**					
	WORKSHEET	**1-2 OVERVIEW**					
	SHEET	**3 OF 8**					
	COUNTRY	**Namibia**					
	YEAR	**1994**					
		M	N	O	P	Q	R
		Lubricants	Petroleum Coke	Refinery Gas	Anthracite	Coking Coal	Other Bituminous Coal
FUEL CONSUMPTION (TJ)							
Energy Industries		4.02	0.00	0.00	0.00	0.00	2 520.04
Manufacturing Industries and Construction		13.26	0.00	0.00	0.00	432.86	1 317.98
Transport	Domestic Aviation (a)						
	Road						
	Railways				0.00		0.00
	National Navigation (a)	0.00					
	Pipeline Transport						
Other Sectors	Commercial/Institutional				0.00		0.00
	Residential				0.00		0.00
	Agriculture / Forestry / Fishing – Stationary				0.00	0.00	211.01
	Agriculture / Forestry / Fishing – Mobile						
Other (not elsewhere specified)		160.76	0.00	0.00	0.00	0.00	0.00
Total (a)		**178.04**	**0.00**	**0.00**	**0.00**	**432.86**	**4 049.02**
Memo: International Marine Bunkers		20.10					
Memo: International Aviation Bunkers							
CO_2 EMISSIONS (Gg)							
Energy Industries		0.15	0.00	0.00	0.00	0.00	210.27
Manufacturing Industries and Construction		0.24	0.00	0.00	0.00	40.13	122.19
Transport	Domestic Aviation (a)						
	Road						
	Railways				0.00		0.00
	National Navigation (a)	0.00					
	Pipeline Transport						
Other Sectors	Commercial/Institutional				0.00		0.00
	Residential				0.00		0.00
	Agriculture / Forestry / Fishing – Stationary				0.00	0.00	18.96
	Agriculture / Forestry / Fishing – Mobile						
Other (not elsewhere specified)		5.84	0.00	0.00	0.00	0.00	0.00
Total (a)		**6.22**	**0.00**	**0.00**	**0.00**	**40.13**	**351.42**
Memo: International Marine Bunkers		0.73					
Memo: International Aviation Bunkers							

			S	T	U	V	W	X
		MODULE	**ENERGY**					
		SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**					
		WORKSHEET	**1-2 OVERVIEW**					
		SHEET	**4 OF 8**					
		COUNTRY	**Namibia**					
		YEAR	**1994**					
			Sub-Bituminous Coal	Lignite	Oil Shale	Peat	Patent Fuel	Brown Coal Briquettes
FUEL CONSUMPTION (TJ)								
Energy Industries			0.00	0.00		0.00	0.00	0.00
Manufacturing Industries and Construction			0.00	0.00		0.00	0.00	0.00
Transport	Domestic Aviation (a)							
	Road							
	Railways							
	National Navigation (a)		0.00					
	Pipeline Transport							
Other Sectors	Commercial/Institutional			0.00				0.00
	Residential		0.00	0.00		0.00	0.00	0.00
	Agriculture / Forestry / Fishing	Stationary		0.00			0.00	0.00
		Mobile						
Other (not elsewhere specified)			0.00	0.00		0.00	0.00	0.00
Total (a)			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Memo: International Marine Bunkers			0.00					
Memo: International Aviation Bunkers								
CO_2 EMISSIONS (Gg)								
Energy Industries			0.00	0.00		0.00	0.00	0.00
Manufacturing Industries and Construction			0.00	0.00		0.00	0.00	0.00
Transport	Domestic Aviation (a)							
	Road							
	Railways							
	National Navigation (a)		0.00					
	Pipeline Transport							
Other Sectors	Commercial/Institutional			0.00				0.00
	Residential		0.00	0.00		0.00	0.00	0.00
	Agriculture / Forestry / Fishing	Stationary		0.00			0.00	0.00
		Mobile						
Other (not elsewhere specified)			0.00	0.00		0.00	0.00	0.00
Total (a)			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Memo: International Marine Bunkers			0.00					
Memo: International Aviation Bunkers								

		MODULE	ENERGY					
		SUBMODULE	CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)					
		WORKSHEET	1-2 OVERVIEW					
		SHEET	5 OF 8					
		COUNTRY	Namibia					
		YEAR	1994					
			Y	Z	AA	AB	AC	AD
			Coke Oven Coke	Gas Coke	Works Gas	Coke Oven Gas	Blast Furnace Gas	Natural Gas
FUEL CONSUMPTION (TJ)								
Energy Industries			0.00	0.00	0.00	0.00	0.00	0.00
Manufacturing Industries and Construction			0.00	0.00	0.00	0.00	0.00	0.00
Transport	Domestic Aviation (a)							
	Road							0.00
	Railways		0.00					
	National Navigation (a)							
	Pipeline Transport							0.00
Other Sectors	Commercial/Institutional		0.00		0.00	0.00		0.00
	Residential		0.00		0.00	0.00		0.00
	Agriculture / Forestry / Fishing	Stationary	0.00		0.00			0.00
		Mobile						
Other (not elsewhere specified)			0.00	0.00	0.00	0.00	0.00	0.00
Total (a)			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Memo: International Marine Bunkers								
Memo: International Aviation Bunkers								
CO_2 EMISSIONS (Gg)								
Energy Industries			0.00	0.00	0.00	0.00	0.00	0.00
Manufacturing Industries and Construction			0.00	0.00	0.00	0.00	0.00	0.00
Transport	Domestic Aviation (a)							
	Road							0.00
	Railways		0.00					
	National Navigation (a)							
	Pipeline Transport							0.00
Other Sectors	Commercial/Institutional		0.00		0.00	0.00		0.00
	Residential		0.00		0.00	0.00		0.00
	Agriculture / Forestry / Fishing	Stationary	0.00		0.00			0.00
		Mobile						
Other (not elsewhere specified)			0.00	0.00	0.00	0.00	0.00	0.00
Total (a)			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Memo: International Marine Bunkers								
Memo: International Aviation Bunkers								

		MODULE	**ENERGY**					
		SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**					
		WORKSHEET	**1-2 OVERVIEW**					
		SHEET	**6 OF 8**					
		COUNTRY	**Namibia**					
		YEAR	**1994**					
			AE	AF	AG (b)	AH(b)	AI(b)	AJ(b)
			Municipal Solid Waste	Industrial Waste	(additional fuels)			
FUEL CONSUMPTION (TJ)								
Energy Industries			0.00	0.00	0.00	0.00		
Manufacturing Industries and Construction			0.00	0.00	0.00	0.00		
Transport	Domestic Aviation (a)				0.00			
	Road				203.76			
	Railways				0.00			
	National Navigation (a)				0.00			
	Pipeline Transport				0.00	0.00		
Other Sectors	Commercial/Institutional				0.00	0.00		
	Residential				0.00	0.00	0.00	0.00
	Agriculture / Forestry / Fishing	Stationary			0.00	0.00		
		Mobile			0.00	0.00		
Other (not elsewhere specified)			0.00	0.00	0.00	0.00	0.00	
Total (a)			**0.00**	**0.00**	**203.76**	**0.00**	**0.00**	**0.00**
Memo: International Marine Bunkers					0.00			
Memo: International Aviation Bunkers					0.00			
CO_2 EMISSIONS (Gg)								
Energy Industries			0.00	0.00	0.00	0.00		
Manufacturing Industries and Construction			0.00	0.00	0.00	0.00		
Transport	Domestic Aviation (a)				0.00			
	Road				7.40			
	Railways				0.00			
	National Navigation (a)				0.00			
	Pipeline Transport				0.00	0.00		
Other Sectors	Commercial/Institutional				0.00	0.00		
	Residential				0.00	0.00	0.00	0.00
	Agriculture / Forestry / Fishing	Stationary			0.00	0.00		
		Mobile			0.00	0.00		
Other (not elsewhere specified)			0.00	0.00	0.00	0.00	0.00	
Total (a)			**0.00**	**0.00**	**7.40**	**0.00**	**0.00**	**0.00**
Memo: International Marine Bunkers					0.00			
Memo: International Aviation Bunkers					0.00			

		MODULE	**ENERGY**					
		SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**					
		WORKSHEET	**1-2 OVERVIEW**					
		SHEET	**7 OF 8**					
		COUNTRY	**Namibia**					
		YEAR	**1994**					
			AK(b)	AL	AM	AN	AO	AP
				Total Liquid Fossil (c)	Total Solid Fossil (c)	Total Gaseous Fossil (c)	Total Other Fuels (c)	Total (d)
FUEL CONSUMPTION (TJ)								
Energy Industries				88.15	2 520.04	0.00	0.00	2 608.19
Manufacturing Industries and Construction				619.00	1 750.84	0.00	0.00	2 369.83
Transport	Domestic Aviation (a)			1 399.74	0.00		0.00	1 399.74
	Road			10 677.70	0.00	0.00	203.76	10 881.46
	Railways			595.79	0.00		0.00	595.79
	National Navigation (a)			0.00	0.00		0.00	0.00
	Pipeline Transport			0.00	0.00	0.00	0.00	0.00
Other Sectors	Commercial/Institutional			0.00	0.00	0.00	0.00	0.00
	Residential			433.51	0.00	0.00	0.00	433.51
	Agriculture / Forestry / Fishing	Stationary		455.75	211.01	0.00	0.00	666.76
		Mobile		4 068.25	0.00		0.00	4 068.25
Other (not elsewhere specified)				1 700.05	0.00	0.00	0.00	1 700.05
Total (a)			**0.00**	**20 037.94**	**4 481.88**	**0.00**	**203.76**	**24 723.59**
Memo: International Marine Bunkers				494.13	4 481.88			494.13
Memo: International Aviation Bunkers				1 068.38	0.00			1 068.38
CO_2 EMISSIONS (Gg)								
Energy Industries				6.57	210.27	0.00	0.00	216.83
Manufacturing Industries and Construction				45.14	162.32	0.00	0.00	207.46
Transport	Domestic Aviation (a)			98.85	0.00		0.00	98.85
	Road			749.26	0.00	0.00	7.40	756.65
	Railways			43.69	0.00		0.00	43.69
	National Navigation (a)			0.00	0.00		0.00	0.00
	Pipeline Transport			0.00	0.00	0.00	0.00	0.00
Other Sectors	Commercial/Institutional			0.00	0.00	0.00	0.00	0.00
	Residential			28.35	0.00	0.00	0.00	28.35
	Agriculture / Forestry / Fishing	Stationary		34.91	18.96	0.00	0.00	53.87
		Mobile		298.31	0.00		0.00	298.31
Other (not elsewhere specified)				117.16	0.00	0.00	0.00	117.16
Total (a)			**0.00**	**1 422.22**	**391.54**	**0.00**	**7.40**	**1 821.17**
Memo: International Marine Bunkers				35.49	0.00			35.49
Memo: International Aviation Bunkers				75.63	0.00			75.63

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-2 OVERVIEW**
SHEET	**8 OF 8**
COUNTRY	**Namibia**
YEAR	**1994**

			AQ	AR	AS	AT	AU	AV
			Wood / Wood Waste	Charcoal	Other Solid Biomass	Liquid Biomass	Gaseous Biomass	Total Biomass
FUEL CONSUMPTION (TJ)								
Energy Industries			0.00	0.00	0.00	0.00	0.00	0.00
Manufacturing Industries and Construction			206.83	105.00	0.00	0.00	0.00	311.83
Transport	Domestic Aviation (a)							0.00
	Road					(b) 0.00		0.00
	Railways							0.00
	National Navigation (a)							0.00
	Pipeline Transport							
Other Sectors	Commercial/Institutional		871.50	0.00	0.00	0.00	0.00	871.50
	Residential		9 908.54	30.00	0.00	0.00	0.00	9 938.54
	Agriculture / Forestry / Fishing	Stationary	0.00	0.00	0.00	0.00	0.00	0.00
		Mobile				0.00		0.00
Other (not elsewhere specified)			0.00	0.00	0.00	0.00	0.00	0.00
Total (a)			**10 986.87**	**135.00**	**0.00**	**0.00**	**0.00**	**11 121.87**
Memo: International Marine Bunkers								0.00
Memo: International Aviation Bunkers								0.00
CO_2 EMISSIONS (Gg)								
Energy Industries			0.00	0.00	0.00	0.00	0.00	0.00
Manufacturing Industries and Construction			21.54	10.35	0.00	0.00	0.00	31.89
Transport	Domestic Aviation (a)							0.00
	Road					(b) 0.00		0.00
	Railways							0.00
	National Navigation (a)							0.00
	Pipeline Transport							
Other Sectors	Commercial/Institutional		68.08	0.00	0.00	0.00	0.00	68.08
	Residential		1 031.99	2.96	0.00	0.00	0.00	1 034.95
	Agriculture / Forestry / Fishing	Stationary	0.00	0.00	0.00	0.00	0.00	0.00
		Mobile				0.00		0.00
Other (not elsewhere specified)			0.00	0.00	0.00	0.00	0.00	0.00
Total (a)			**1 121.61**	**13.31**	**0.00**	**0.00**	**0.00**	**1 134.92**
Memo: International Marine Bunkers								0.00
Memo: International Aviation Bunkers								0.00

		MODULE	**ENERGY**						
		SUBMODULE	**NON-CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**						
		WORKSHEET	**1-3**						
		SHEETS	**1 OF 3**						
		COUNTRY	**Namibia**						
		YEAR	**1994**						
			STEP 1						
			A Fuel Consumption (TJ)						
ACTIVITY			A1 Coal	A2 Natural Gas	A3 Oil		A4 Wood / Wood Waste	A5 Charcoal	A6 Other Biomass and Wastes
Energy Industries			2520.04			84.99			
Manufacturing Industries and Construction			1262.28			582.83	206.83	105	
Transport	Domestic Aviation[a]					1399.74			
					Gasoline	Diesel			
	Road				7417.98	3536.16			
	Railways					595.79			
	National Navigation[a]								
Other Sectors	Commercial/Institutional								
	Residential				638.47		11540.67	30	
	Agriculture / Forestry / Fishing	Stationary				455.75			
		Mobile				4068.25			
Other (not elsewhere specified)						1422.72			
Total [a]			**3 782.32**	**0.00**		**20 117.69**	**11 747.50**	**135.00**	**0.00**
Memo: International Marine Bunkers						494.13			
Memo: International Aviation Bunkers					1068.38				

MODULE		**ENERGY**						
SUBMODULE		**NON-CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**						
WORKSHEET		**1-3**						
SHEETS		**2 OF 3 CH_4**						
COUNTRY		**Namibia**						
YEAR		**1994**						
		STEP 2						
		B **Emission Factors (kg/TJ)**						
ACTIVITY		B1 Coal	B2 Natural Gas	B3 Oil		B4 Wood / Wood Waste	B5 Charcoal	B6 Other Biomass and Wastes
Energy Industries		1			3			
Manufacturing Industries and Construction		10			2	30	200	
Transport	Domestic Aviation[(a)]				0.5			
	Road			Gasoline	Diesel			
				20	5			
	Railways				5			
	National Navigation[(a)]				5			
Other Sectors	Commercial/Institutional				10	300	200	
	Residential				10	300	200	
	Agriculture / Forestry / Fishing — Stationary				10			
	Agriculture / Forestry / Fishing — Mobile				5			
Other (not elsewhere specified)					5			
Total [(a)]								
Memo: International Marine Bunkers					5			
Memo: International Aviation Bunkers					0.5			

MODULE	**ENERGY**
SUBMODULE	**NON-CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-3**
SHEETS	**3 OF 3 CH_4**
COUNTRY	**Namibia**
YEAR	**1994**

ACTIVITY			**STEP 3**							
			C Emissions by Fuel (kg)							**D** Total Emissions (Gg)
			C=(AxB)							
			C1 Coal	C2 Natural Gas	C3 Oil		C4 Wood / Wood Waste	C5 Charcoal	C6 Other Biomass and Wastes	D= sum (C1..C6) / 1 000 000
Energy Industries			2 520.04	0.00		254.97	0.00	0.00	0.00	0.00
Manufacturing Industries and Construction			12 622.80	0.00		1 165.66	6 204.90	21 000.00	0.00	0.04
Transport	Domestic Aviation(a)					699.87				0.00
	Road				Gasoline	Diesel				
				0.00	148 359.60	17 680.80				0.17
	Railways		0.00			2 978.95				0.00
	National Navigation(a)		0.00			0.00				0.00
Other Sectors	Commercial/Institutional		0.00	0.00		0.00	0.00	0.00	0.00	0.00
	Residential		0.00	0.00		0.00	3 462 201.00	6 000.00	0.00	3.47
	Agriculture / Forestry / Fishing	Stationary	0.00	0.00		4 557.50	0.00	0.00	0.00	0.00
		Mobile		0.00		20 341.25				0.02
Other (not elsewhere specified)			0.00	0.00		7 113.60	0.00	0.00	0.00	0.01
Total (a)			**15 142.84**	**0.00**		**203 152.20**	**3 468 405.90**	**27 000.00**	**0.00**	**3.71**
Memo: International Marine Bunkers			0.00		0.00	2 470.65				0.00
Memo: International Aviation Bunkers					0.00	0.00				0.00

MODULE	**ENERGY**
SUBMODULE	**NON-CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-3**
SHEETS	**2 OF 3 N_2O**
COUNTRY	**Namibia**
YEAR	**1994**

STEP 2

B

Emission Factors (kg/TJ)

ACTIVITY			B1 Coal	B2 Natural Gas	B3 Oil (Gasoline)	B3 Oil (Diesel)	B4 Wood / Wood Waste	B5 Charcoal	B6 Other Biomass and Wastes
Energy Industries			1.4		0.6				
Manufacturing Industries and Construction			1.4			0.6	4	4	
Transport	Domestic Aviation(a)					2			
	Road				0.6	0.6			
	Railways				0.6				
	National Navigation(a)				0.6				
Other Sectors	Commercial/Institutional				0.6				
	Residential				0.6		4	1	
	Agriculture / Forestry / Fishing	Stationary			0.6				
		Mobile			0.6	0.6			
Other (not elsewhere specified)					0.6				
Total (a)									
Memo: International Marine Bunkers					0.6				
Memo: International Aviation Bunkers					2				

MODULE	**ENERGY**
SUBMODULE	**NON-CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)**
WORKSHEET	**1-3**
SHEETS	**3 OF 3 N_2O**
COUNTRY	**Namibia**
YEAR	**1994**

ACTIVITY			**STEP 3**							
			C Emissions by Fuel (kg)							**D Total Emissions (Gg)**
			C=(AxB)							
			C1	C2	C3		C4	C5	C6	D= sum
			Coal	Natural Gas	Oil		Wood / Wood Waste	Charcoal	Other Biomass and Wastes	(C1..C6) / 1 000 000
Energy Industries			3 528.06	0.00		50.99	0.00	0.00	0.00	0.00
Manufacturing Industries and Construction			1 767.19	0.00		349.70	827.32	420.00	0.00	0.00
Transport	Domestic Aviation(a)					2 799.48				0.00
	Road				Gasoline	Diesel				
				0.00	4 450.79	2 121.70				0.01
	Railways		0.00			357.47				0.00
	National Navigation(a)		0.00			0.00				0.00
Other Sectors	Commercial/Institutional		0.00	0.00		0.00	0.00	0.00	0.00	0.00
	Residential		0.00	0.00		0.00	46 162.68	30.00	0.00	0.05
	Agriculture / Forestry / Fishing	Stationary	0.00	0.00		273.45	0.00	0.00	0.00	0.00
		Mobile		0.00		2 440.95				0.00
Other (not elsewhere specified)			0.00	0.00		853.63	0.00	0.00	0.00	0.00
Total (a)			**5 295.25**	**0.00**		**13 698.16**	**46 990.00**	**450.00**	**0.00**	**0.07**
Memo: International Marine Bunkers			0.00		0.00	296.48				0.00
Memo: International Aviation Bunkers					2 136.76	0.00				0.00

Industry Sector

MODULE	**INDUSTRIAL PROCESSES**		
SUBMODULE	**CEMENT PRODUCTION**		
WORKSHEET	**2-1**		
SHEET	**1 OF 2 CO_2 EMISSIONS**		
COUNTRY	**Namibia**		
YEAR	**1994**		
STEP 1			
A Quantity of Clinker or Cement Produced (t)	B Emission Factor (t CO_2/t clinker or cement produced)	C CO_2 Emitted (t)	D CO_2 Emitted (Gg)
		C = (A x B)	D = C/1000
10957	0.4985	5,462.06	5.46

Agriculture sector

MODULE	**AGRICULTURE**					
SUBMODULE	**METHANE AND NITROUS OXIDE EMISSIONS FROM DOMESTIC LIVESTOCK ENTERIC FERMENTATION AND MANURE MANAGEMENT**					
WORKSHEET	**4-1**					
SHEET	**1 OF 2 METHANE EMISSIONS FROM DOMESTIC LIVESTOCK ENTERIC FERMENTATION AND MANURE MANAGEMENT**					
COUNTRY	**Namibia**					
YEAR	**1994**					
	STEP 1			**STEP 2**		**STEP 3**
Livestock Type	A Number of Animals (1000s)	B Emissions Factor for Enteric Fermentation (kg/head/yr)	C Emissions from Enteric Fermentation (t/yr)	D Emissions Factor for Manure Management (kg/head/yr)	E Emissions from Manure Management (t/yr)	F Total Annual Emissions from Domestic Livestock (Gg)
			C = (A x B)		E = (A x D)	F =(C + E)/1000
Dairy Cattle	2	72	144.00	1	2.00	0.15
Non-dairy Cattle	2045	43	87 935.00	1	2 045.00	89.98
Buffalo	0		0.00		0.00	0.00
Sheep	2560	5	12 800.00	0.16	409.60	13.21
Goats	1612	5	8 060.00	0.17	274.04	8.33
Camels	0.04	46	1.84	1.92	0.08	0.00
Horses	58	18	1 044.00	1.64	95.12	1.14
Mules & Asses	163	10	1 630.00	0.9	146.70	1.78
Swine	19	1.5	28.50	1	19.00	0.05
Poultry	474		0.00	0.018	8.53	0.01
Totals			111 643.34		3 000.07	114.64

MODULE	**AGRICULTURE**
SUBMODULE	**METHANE AND NITROUS OXIDE EMISSIONS FROM DOMESTIC LIVESTOCK ENTERIC FERMENTATION AND MANURE MANAGEMENT**
WORKSHEET	**4-1 (SUPPLEMENTAL)**
SPECIFY AWMS	**SOLID STORAGE AND DRYLOT**
SHEET	**NITROGEN EXCRETION FOR ANIMAL WASTE MANAGEMENT SYSTEM**
COUNTRY	**Namibia**
YEAR	**1994**

Livestock Type	A Number of Animals (1000s)	B Nitrogen Excretion Nex (kg//head/(yr)	C Fraction of Manure Nitrogen per AWMS (%/100) (fraction)	D Nitrogen Excretion per AWMS, Nex (kg N/yr)
				D = (A x B x C)
Non-dairy Cattle	2045	55	0.25	28 118.75
Dairy Cattle	2	80	1	160.00
Poultry	474	0.6	0.2	56.88
Sheep	4172	12	0.1	5 006.40
Swine	19	16	0.9	273.60
Others	229	40	0.2	1 832.00
			TOTAL	35 447.63

MODULE	**AGRICULTURE**
SUBMODULE	**METHANE AND NITROUS OXIDE EMISSIONS FROM DOMESTIC LIVESTOCK ENTERIC FERMENTATION AND MANURE MANAGEMENT**
WORKSHEET	**4-1 (SUPPLEMENTAL)**
SPECIFY AWMS	**PASTURE RANGE AND PADDOCK**
SHEET	**NITROGEN EXCRETION FOR ANIMAL WASTE MANAGEMENT SYSTEM**
COUNTRY	**Namibia**
YEAR	**1994**

Livestock Type	A Number of Animals (1000s)	B Nitrogen Excretion Nex (kg/head/(yr)	C Fraction of Manure Nitrogen per AWMS (%/100) (fraction)	D Nitrogen Excretion per AWMS, Nex (kg N/yr)
				D = (A x B x C)
Non-dairy Cattle	2045	55	0.75	84 356.25
Dairy Cattle	2	80	0	0.00
Poultry	474	0.6	0.8	227.52
Sheep	4172	12	0.9	45 057.60
Swine	19	16	0.1	30.40
Others	229	40	0.8	7 328.00
			TOTAL	136 999.77

MODULE	**AGRICULTURE**
SUBMODULE	**PRESCRIBED BURNING OF SAVANNAS**
WORKSHEET	**4-3**
SHEET	**1 OF 3**
COUNTRY	**Namibia**
YEAR	**1994**

STEP 1					**STEP 2**		
A Area Burned by Category (specify) (kha)	B Biomass Density of Savanna (t dm/ha)	C Total Biomass Exposed to Burning (Gg dm)	D Fraction Actually Burned	E Quantity Actually Burned (Gg dm)	F Fraction of Living Biomass Burned	G Quantity of Living Biomass Burned (Gg dm)	H Quantity of Dead Biomass Burned (Gg dm)
		C = (A x B)		E = (C x D)		G = (E x F)	H = (E - G)
5111	6	30 666.00	0.8	24 532.80	0.2	4 906.56	
							19 626.24

MODULE	**AGRICULTURE**
SUBMODULE	**PRESCRIBED BURNING OF SAVANNAS**
WORKSHEET	**4-3**
SHEET	**2 OF 3**
COUNTRY	**Namibia**
YEAR	**1994**

STEP 3				
Fraction living	I Oxidised of and dead biomass	J Total Biomass Oxidised (Gg dm)	K Carbon Fraction of Living & Dead Biomass	L Total Carbon Released (Gg C)
		Living: J = (G x I) *Dead:* J = (H x I)		L = (J x K)
Living	0.8	3 925.25	0.45	1 766.36
Dead	0.9	17 663.62	0.4	7 065.45
Total				8 831.81

MODULE	**AGRICULTURE**
SUBMODULE	**PRESCRIBED BURNING OF SAVANNAS**
WORKSHEET	**4-3**
SHEET	**3 OF 3**
COUNTRY	**Namibia**
YEAR	**1994**

STEP 4					**STEP 5**		
L Total Carbon Released (Gg C)	M Nitrogen-Carbon Ratio	N Total Nitrogen Content (Gg N)	O Emissions Ratio	P Emissions (Gg C **or** Gg N)	Q Conversion Ratio	R Emissions from Savanna Burning (Gg)	
		N = (L x M)		P = (L x O)		R = (P x Q)	
			0.004	35.33	16/12	*CH_4*	47.10
8 831.81	0.006	52.99		P = (N x O)		R = (P x Q)	
			0.007	0.37	44/28	*N_2O*	0.58

MODULE	**AGRICULTURE**

SUBMODULE	**AGRICULTURAL SOILS**		
WORKSHEET	**4-5**		
SHEET	**1 OF 5 DIRECT NITROUS OXIDE EMISSIONS FROM AGRICULTURAL FIELDS, EXCLUDING CULTIVATION OF HISTOSOLS**		
COUNTRY	**Namibia**		
YEAR	**1994**		
	STEP 1	**STEP 2**	
Type of N input to soil	A Amount of N Input (kg N/yr)	B Factor for Direct Emissions EF_1 (kg N_2O–N/kg N)	C Direct Soil Emissions (Gg N_2O-N/yr)
			C = (A x B)/1 000 000
Synthetic fertiliser (F_{SN})	2 709 000.00	0.0125	0.03
Animal waste (F_{AW})	125 886.60	0.0125	0.00
N-fixing crops (F_{BN})	0		0.00
Crop residue (F_{CR})	0.00		0.00
		Total	0.04

MODULE	**AGRICULTURE**				
SUBMODULE	**AGRICULTURAL SOILS**				
WORKSHEET	**4-5A (SUPPLEMENTAL)**				
SHEET	**1 OF 1 MANURE NITROGEN USED**				
COUNTRY	**Namibia**				
YEAR	**1994**				
A Total Nitrogen Excretion (kg N/yr)	B Fraction of Nitrogen Burned for Fuel (fraction)	C Fraction of Nitrogen Excreted During Grazing (fraction)	D Fraction of Nitrogen Excreted Emitted as NO_X and NH_3 (fraction)	E Sum (fraction)	F Manure Nitrogen Used (corrected for NO_X and NH_3 emissions), F_{AW} (kg N/yr)
				F = 1 - (B + C + D)	F = (A x E)
172 447.40	0.05	0.02	0.2	0.73	125 886.60

MODULE	**AGRICULTURE**			
SUBMODULE	**AGRICULTURAL SOILS**			
WORKSHEET	**4-5**			
SHEET	**2 OF 5 DIRECT NITROUS OXIDE EMISSIONS FROM CULTIVATION OF HISTOSOLS**			
COUNTRY	**Namibia**			
YEAR	**1994**			
	STEP 3			**STEP 4**
	D Area of Cultivated Organic Soils F_{OS} (ha)	E Emission Factor for Direct Soil Emissions EF_2 (kg N_2O–N/ha/yr)	F Direct Emissions from Histosols (Gg N_2O–N/yr)	G Total Direct Emissions of N_2O (Gg)
			F=(D x E)/1 000 000	G = (C+F)[44/28]
Subtotal	0		0.00	0.06

MODULE	**AGRICULTURE**		
SUBMODULE	**AGRICULTURAL SOILS**		
WORKSHEET	**4-5**		
SHEET	**3 OF 5 NITROUS OXIDE SOIL EMISSIONS FROM GRAZING ANIMALS - PASTURE RANGE AND PADDOCK**		
COUNTRY	**Namibia**		
YEAR	**1994**		
	STEP 5		
Animal Waste Management System (AWMS)	A Nitrogen Excretion $Nex_{(AWMS)}$ (kg N/yr)	B Emission Factor for AWMS EF_3 (kg N_2O–N/kg N)	C Emissions Of N_2O from Grazing Animals (Gg)
			C = (A x B)[44/28]/1 000 000
Pasture range & paddock	136 999.77	0.02	0.00

MODULE	**AGRICULTURE**
SUBMODULE	**AGRICULTURAL SOILS**
WORKSHEET	**4-5**
SHEET	**4 OF 5 INDIRECT NITROUS OXIDE EMISSIONS FROM ATMOSPHERIC DEPOSITION OF NH_3 AND NO_X**
COUNTRY	**Namibia**
YEAR	**1994**

STEP 6								
	A	B	C	D	E	F	G	H
Type of Deposition	Synthetic Fertiliser N Applied to Soil, N_{FERT} (kg N/yr)	Fraction of Synthetic Fertiliser N Applied that Volatilizes $Frac_{GASFS}$ (kg N/kg N)	Amount of Synthetic N Applied to Soil that Volatilizes (kg N/kg N)	Total N Excretion by Livestock N_{EX} (kg N/yr)	Fraction of Total Manure N Excreted that Volatilizes $Frac_{GASM}$ (kg N/kg N)	Total N Excretion by Livestock that Volatilizes (kg N/kg N)	Emission Factor EF_4 (kg N_2O–N/kg N)	Nitrous Oxide Emissions (Gg N_2O–N/yr)
			C = (A x B)			F = (D x E)		H = (C+F) x G/1 000 000
Total	3010000	0.1	301 000.00	172 447.40	0.2	34 489.48	0.01	0.00

MODULE	**AGRICULTURE**
SUBMODULE	**AGRICULTURAL SOILS**
WORKSHEET	**4-5**
SHEET	**5 OF 5 INDIRECT NITROUS OXIDE EMISSIONS FROM LEACHING**
COUNTRY	**Namibia**
YEAR	**1994**

	STEP 7					STEP 8	STEP 9
	I	J	K	L	M	N	O
	Synthetic Fertiliser Use N_{FERT} (kg N/yr)	Livestock N Excretion N_{EX} (kg N/yr)	Fraction of N That Leaches $Frac_{LEACH}$ (kg N/kg N)	Emission Factor EF_5	Nitrous Oxide Emissions From Leaching (Gg N_2O–N/yr)	Total Indirect Nitrous Oxide Emissions (Gg N_2O/yr)	Total Nitrous Oxide Emissions (Gg)
					M = (I + J) x K x L/1 000 000	N = (H + M)[44/28]	O = (G + C + N) (G from Worksheet 4 -5, sheet 2, Step 4; C from Worksheet 4-5, sheet 3, Step 5; N from Worksheet 4-5, sheet 5, Step 8).
Total	3 010 000.00	172 447.40	0.3	0.025	0.02	0.04	0.10

Land Use Change and Forestry sector

	MODULE	**LAND USE CHANGE AND FORESTRY**				
	SUBMODULE	**CHANGES IN FOREST AND OTHER WOODY BIOMASS STOCKS**				
	WORKSHEET	**5-1**				
	SHEET	**1 OF 3**				
	COUNTRY	**Namibia**				
	YEAR	**1994**				
		STEP 1				
		A Area of Forest/Biomass Stocks (kha)	B Annual Growth Rate (t dm/ha)	C Annual Biomass Increment (kt dm)	D Carbon Fraction of Dry Matter	E Total Carbon Uptake Increment (kt C)
				C=(A x B)		E=(C x D)
Plantations	*Acacia spp.*			0.00		0.00
	Eucalyptus spp.			0.00		0.00
	Tectona grandis			0.00		0.00
	Pinus spp			0.00		0.00
	Pinus caribaea			0.00		0.00
	Mixed Hardwoods			0.00		0.00
	Mixed Fast-Growing Hardwoods			0.00		0.00
	Mixed Softwoods			0.00		0.00
Other Forests	Moist			0.00		0.00
	Seasonal			0.00		0.00
	Dry	5000	0.25	1 250.00	0.5	625.00
Other: bush encroached land and 'forest-like' savanna		16500	0.2	3 300.00	0.5	1 650.00
Plantations	Douglas fir			0.00		0.00
	Loblolly pine			0.00		0.00
Commercial	Evergreen			0.00		0.00
	Deciduous			0.00		0.00
Other				0.00		0.00
				0.00		0.00
		A Number of Trees (1000s of trees)	B Annual Growth Rate (kt dm/1000 trees)			
				0.00		0.00
				0.00		0.00
					Total	2 275.00

MODULE	**LAND USE CHANGE AND FORESTRY**
SUBMODULE	**CHANGES IN FOREST AND OTHER WOODY BIOMASS STOCKS**
WORKSHEET	**5-1**
SHEET	**2 OF 3**
COUNTRY	**Namibia**
YEAR	**1994**

STEP 2

Harvest Categories (specify)	F Commercial Harvest (if applicable) (1000 m^3 roundwood)	G Biomass Conversion/ Expansion Ratio (if applicable) (t dm/m^3)	H Total Biomass Removed in Commercial Harvest (kt dm)	I Total Traditional Fuelwood Consumed (kt dm)	J Total Other Wood Use (kt dm)	K Total Biomass Consumption (kt dm)	L Wood Removed From Forest Clearing (kt dm)	M Total Biomass Consumption From Stocks (kt dm)
			H = (F x G)	FAO data		K = (H + I + J)	(From column M, Worksheet 5-2, sheet 3)	M = K - L
Firewood			0.00	596.9		596.90		
Wood for charcoal	64.3	1	64.30			64.30		
Poles			0.00		694	694.00		
Other			0.00		2	2.00		
Totals	64.30		64.30	596.90	696.00	1 357.20	282.00	1 075.20

MODULE	**LAND USE AND FORESTRY**
SUBMODULE	**CHANGES IN FOREST AND OTHER WOODY BIOMASS STOCKS**
WORKSHEET	**5-1**
SHEET	**3 OF 3**
COUNTRY	**Namibia**
YEAR	**1994**

STEP 3		**STEP 4**	
N Carbon Fraction	O Annual Carbon Release (kt C)	P Net Annual Carbon Uptake (+) or Release (-) (kt C)	Q Convert to CO_2 Annual Emission (-) or Removal (+) (Gg CO_2)
	O = (M x N)	P = (E - O)	Q = (P x [44/12])
0.5	537.60	1 737.40	6 370.47

	MODULE	**LAND-USE CHANGE AND FORESTRY**
	SUBMODULE	**FOREST AND GRASSLAND CONVERSION - CO_2 FROM BIOMASS**
	WORKSHEET	**5-2**
	SHEET	**1 OF 5 BIOMASS CLEARED**
	COUNTRY	**Namibia**
	YEAR	**1994**

Vegetation types		**STEP 1** A Area Converted Annually (kha)	B Biomass Before Conversion (t dm/ha)	C Biomass After Conversion (t dm/ha)	D Net Change in Biomass Density (t dm/ha)	E Annual Loss of Biomass (kt dm)
					D = (B - C)	E = (A x D)
Tropical	Wet/Very Moist				0.00	0.00
	Moist, short dry season				0.00	0.00
	Moist, long dry season				0.00	0.00
	Dry	17.2	25	5	20.00	344.00
	Montane Moist				0.00	0.00
	Montane Dry				0.00	0.00
Tropical Savanna/Grasslands		14	10	1	9.00	126.00
Temperate	Coniferous				0.00	0.00
	Broadleaf				0.00	0.00
Grasslands					0.00	0.00
Boreal	Mixed Broadleaf/ Coniferous				0.00	0.00
	Coniferous				0.00	0.00
	Forest-tundra				0.00	0.00
Grasslands/Tundra					0.00	0.00
Other					0.00	0.00
	Subtotals	31.20			29.00	470.00

	MODULE	**LAND-USE CHANGE AND FORESTRY**					
	SUBMODULE	**FOREST AND GRASSLAND CONVERSION - CO_2 FROM BIOMASS**					
	WORKSHEET	**5-2**					
	SHEET	**2 OF 5 CARBON RELEASED BY ON-SITE BURNING**					
	COUNTRY	**Namibia**					
	YEAR	**1994**					
		STEP 2					
Vegetation types		F Fraction of Biomass Burned on Site	G Quantity of Biomass Burned on Site (kt dm)	H Fraction of Biomass Oxidised on Site	I Quantity of Biomass Oxidised on Site (kt dm)	J Carbon Fraction of Above-ground Biomass (burned on site)	K Quantity of Carbon Released (from biomass burned) (kt C)
			G = (E x F)		I = (G x H)		K = (I x J)
Tropical	Wet/Very Moist		0.00		0.00		0.00
	Moist, short dry season		0.00		0.00		0.00
	Moist, long dry season		0.00		0.00		0.00
	Dry	0.1	34.40	0.9	30.96	0.5	15.48
	Montane Moist		0.00		0.00		0.00
	Montane Dry		0.00		0.00		0.00
Tropical Savanna/Grasslands		0.1	12.60	0.9	11.34	0.5	5.67
Temperate	Coniferous		0.00		0.00		0.00
	Broadleaf		0.00		0.00		0.00
Grasslands			0.00		0.00		0.00
Boreal	Mixed Broadleaf/Coniferous		0.00		0.00		0.00
	Coniferous		0.00		0.00		0.00
	Forest-tundra		0.00		0.00		0.00
Grasslands/Tundra			0.00		0.00		0.00
Other			0.00		0.00		0.00
						Subtotal	21.15

	MODULE	**LAND-USE CHANGE AND FORESTRY**								
	SUBMODULE	**FOREST AND GRASSLAND CONVERSION - CO_2 FROM BIOMASS**								
	WORKSHEET	**5-2**								
	SHEET	**4 OF 5 CARBON RELEASED BY DECAY OF BIOMASS**								
	COUNTRY	**Namibia**								
	YEAR	**1994**								
		STEP 5								
Vegetation types		A Average Area Converted (10 Year Average) (kha)	B Biomass Before Conversion (t dm/ha)	C Biomass After Conversion (t dm/ha)	D Net Change in Biomass Density (t dm/ha)	E Average Annual Loss of Biomass (kt dm)	F Fraction Left to Decay	G Quantity of Biomass Left to Decay (kt dm)	H Carbon Fraction in Above-ground Biomass	I Carbon Released from Decay of Above-ground Biomass (kt C)
					D = (B-C)	E = (A x D)		G = (E x F)		I = (G x H)
Tropical	Wet/Very Moist				0.00	0.00		0.00		0.00
	Moist, short dry season				0.00	0.00		0.00		0.00
	Moist, long dry season				0.00	0.00		0.00		0.00
	Dry	17.2	25	5	20.00	344.00	0.1	34.40	0.5	17.20
	Montane Moist				0.00	0.00		0.00		0.00
	Montane Dry				0.00	0.00		0.00		0.00
Tropical Savanna/Grasslands		14	10	1	9.00	126.00	0.1	12.60	0.5	6.30
Temperate	Coniferous				0.00	0.00		0.00		0.00
	Broadleaf				0.00	0.00		0.00		0.00
Grasslands					0.00	0.00		0.00		0.00
Boreal	Mixed Broadleaf/ Coniferous				0.00	0.00		0.00		0.00
	Coniferous				0.00	0.00		0.00		0.00
	Forest-tundra				0.00	0.00		0.00		0.00
Grasslands/Tundra					0.00	0.00		0.00		0.00
Other					0.00	0.00		0.00		0.00
									Subtotal	23.50

MODULE	**LAND-USE CHANGE AND FORESTRY**		
SUBMODULE	**FOREST AND GRASSLAND CONVERSION - CO_2 FROM BIOMASS**		
WORKSHEET	**5-2**		
SHEET	**5 OF 5 SUMMARY AND CONVERSION TO CO_2**		
COUNTRY	**Namibia**		
YEAR	**1994**		
STEP 6			
A Immediate Release From Burning (kt C)	B Delayed Emissions From Decay (kt C) (10-year average)	C Total Annual Carbon Release (kt C)	D Total Annual CO_2 Release (Gg CO_2)
		C = A + B	D = C x (44/12)
155.10	23.50	178.60	654.87

MODULE	**LAND-USE CHANGE AND FORESTRY**						
SUBMODULE	**ON-SITE BURNING OF FORESTS - NON-CO_2 TRACE GASES FROM BURNING BIOMASS**						
WORKSHEET	**5-3**						
SHEET	**1 OF 1 NON-CO_2 GAS EMISSIONS**						
COUNTRY	**Namibia**						
YEAR	**1994**						
STEP 1			**STEP 2**				
A Quantity of Carbon Released (kt C)	B Nitrogen-Carbon Ratio	C Total Nitrogen Released (kt N)		D Trace Gas Emissions Ratios	E Trace Gas Emissions (kt C)	F Conversion Ratio	G Trace Gas Emissions from Burning of Cleared Forests (Gg CH_4, CO)
(From column K, sheet 2 of Worksheet 5-2)		C = (A x B)			E = (A x D)		G = (E x F)
			CH_4	0.012	0.25	16/12	0.34
			CO	0.06	1.27	28/12	2.96
					(kt N)		(Gg N_2O, NO_x)
21.15	0.01	0.21			E = (C x D)		G = (E x F)
			N_2O	0.007	0.00	44/28	0.00
			NO_x	0.121	0.03	46/14	0.08

Waste sector

MODULE	**WASTE**											
SUBMODULE	**METHANE EMISSIONS FROM SOLID WASTE DISPOSAL SITES**											
WORKSHEET	**6-1**											
SHEET	**1 OF 1**											
COUNTRY	**Namibia**											
YEAR	**1994**											
STEP 1	**STEP 2**	**STEP 3**						**STEP 4**				
A Total Annual MSW Disposed to SWDSs (Gg MSW)	B Methane Correction Factor (MCF)	C Fraction of DOC in MSW	D Fraction of DOC which Actually Degrades	E Fraction of Carbon Released as Methane	F Conver-sion Ratio	G Potential Methane Generation Rate per Unit of Waste ($Gg\ CH_4$ /Gg MSW)	H Realised (Country-specific) Methane Generation Rate per Unit of Waste ($Gg\ CH_4$/ Gg MSW)	J Gross Annual Methane Generation ($Gg\ CH_4$)	K Recovered Methane per Year ($Gg\ CH_4$)	L Net Annual Methane Generation ($Gg\ CH_4$)	M One Minus Methane Oxidation Correction Factor	N Net Annual Methane Emissions ($Gg\ CH_4$)
						G= (C x D x E x F)	H= (B x G)	J= (H x A)		L= (J - K)		N= (L x M)
52.73	0.6	0.21	0.77	0.5	16/12	0.11	0.06	3.41		3.41	1	3.41

MODULE	**WASTE**			
SUBMODULE	**QUANTITY OF MSW DISPOSED OF IN SOLID WASTE DISPOSAL SITES USING COUNTRY DATA**			
WORKSHEET	**6-1A (SUPPLEMENTAL)**			
SHEET	**1 OF 1**			
COUNTRY	**Namibia**			
YEAR	**1994**			
A Population whose Waste goes to SWDSs (Urban or Total) (persons)	B MSW Generation Rate (kg/capita/day)	C Annual Amount of MSW Generated (Gg MSW)	D Fraction of MSW Disposed to SWDSs (Urban or Total)	E Total Annual MSW Disposed to SWDSs (Gg MSW)
		C = (A x B x 365)/1 000 000		E = (C x D)
401325	0.4	58.59	0.9	52.73

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