

DROUGHTS AND FLOODS IN SOUTHERN AFRICA

Environmental Change and
Human Vulnerability



Compiled by the Centre for Development Research and Information in
Southern Africa for the Division of Early Warning and Assessment of the

UNITED NATIONS ENVIRONMENT PROGRAMME

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ACRONYMS

AMCEN	African Ministerial Conference on the Environment
CBDPP	Community Based Disaster Preparedness Programme
CEDRISA	Centre for Development Research and Information in Southern Africa
DEAP	District Environmental Action Plan
DEWA	Division of Early Warning and Assessment
DMC	Drought Monitoring Centre
ENSO	El Niño Southern Oscillation
ESCOM	Electricity Supply Commission of Malawi
GDP	Gross Domestic Programme
GHG	Greenhouse Gases
GWIC	Global Warming International Centre
IPCC	Inter-Governmental Panel on Climate Change
ITCZ	Inter-Tropical Convergence Zone
IUCN	The World Conservation Union
LEAD	Leadership for Environment and Development
MRCS	Mozambique Red Cross Society
NEAP	National Environmental Action Plan
NEC	National Economic Council
NEPAD	New Economic Partnership for Africa's Development
NEWU	National Early Warning Unit
NGO	Non-Governmental Organisation
REWS	Regional Early Warning System
RWSC	Rural Water Supply Corporation
SADC	Southern African Development Community
SARCOF	Southern African Regional Climate Outlook Forum
SARDC	Southern African Research and Documentation Centre
SPI	Standardised Precipitation Index
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
UNSO	United Nations Office to Combat Desertification and Drought
WMO	World Meteorological Organisation
WRAP	Water Resources Action Programme
ZESA	Zimbabwe Electricity Supply Authority

Map of the Southern African Development Community



INTRODUCTION

This report outlines the impact of droughts and floods on the natural and human environment in southern Africa during the period 2000-2003, with a particular focus on Malawi, Mozambique, Swaziland, Zambia and Zimbabwe. The report is published in partial fulfilment of the outcome of the 9th session of the African Ministerial Conference on the Environment (AMCEN) which, recognised that the absence of adequate and relevant information and data is a major constraint to environmental management planning and implementation of global and sub-regional conventions in many African countries.

The Ministers further noted that success in achieving global sustainable development would ultimately depend on implementation of sound and cost effective national response policies and measures supported by the collection and exchange of quality data and information on the environment for use by decision makers.

National environmental outlook reports would therefore play a vital role in this respect if prepared in the framework of the Africa Environment Outlook report, which has been adopted by AMCEN as a tool for monitoring sustainable development in Africa.

Southern Africa has experienced and continues to experience a myriad of challenges including violent storms (GWIC 1999), droughts and floods. Socio-economic development in the sub-region has also been affected by the existence of HIV and AIDS. The social and economic impact of HIV and AIDS in all countries of the sub-region has been enormous resulting in illness among the productive members of society, deaths and an increase in the number of orphans. This situation has led governments to allocate more financial resources into the health sector for HIV and AIDS prevention strategies, resources which could otherwise have been allocated to other social and economic sectors such as education and transport were it not for this pandemic.

With more HIV and AIDS cases, it has not been possible for ill people to devote their energies to economic production. This has been worsened by the occurrence of extreme weather events such as droughts and floods, causing destruction of crops, homes and property, and slowing down economic growth.

This report examines the impact of extreme events that occurred in southern Africa during the period 2000-2003, and assesses the impact these events had on the natural and human

environment. It is a result of interviews, research and analysis of information collected from various institutions and organisations in five countries of the sub-region – Malawi, Mozambique, Swaziland, Zambia and Zimbabwe.

Water Resources in Southern Africa

Southern Africa's main freshwater resources are found in surface water bodies such as dams, rivers and wetlands, and in groundwater aquifers. The sub-region has 15 major internationally shared river basins, of which the four largest are the Zambezi, Congo, Orange, Okavango and Limpopo river basins. Major ground water resources are found in the Kalahari-Etoshia, Karoo, Cape Fold Belt, Eastern Kalahari Precambrian Belt and the coastal basins of Mozambique and Tanzania (UNEP 2006). Major wetlands in the sub-region include the Okavango Delta, the St Lucia Wetlands and Lake Malawi.

Unlike in other parts of the world where water availability is a collective contribution of glaciers, snow and rainfall, water resources availability in southern Africa is entirely dependent on rainfall which is seasonal.

Rainfall

Most parts of the sub-region receive a 5-7 month wet season during the October to April summer months (Conley 1996). The Western Cape in South Africa is an exception, as it has a winter rainfall regime from April to September. The Inter-Tropical Convergence Zone (ITCZ) and the Botswana Upper High are an important influence on the sub-region's rainfall patterns. While the ITCZ brings good rains to most parts of southern African, the Botswana Upper High creates unfavourable conditions for heavy or widespread rainfall and its frequent occurrence always results in drought in some countries in the region (SADC/IUCN/SARDC 1996).

Rainfall distribution is spatially and temporally uneven within countries and across southern Africa, resulting in unreliable water supplies. Surface runoff in the region is seasonal and this has an impact on water resources, as most of it is not harvestable. Seasonality of the rainfall is reflected in both biological and cultural processes such as ripening of indigenous fruits, migration of wild and domestic animals between dry and wet season's pastures (SADC/IUCN/SARDC 1996).

Many southern African countries are partially or largely semi-arid with low annual rainfall reliability. Rainfall ranges from 10mm in some parts of Namibia to about 2,800 mm in some parts of Angola, Malawi and Tanzania. In

most parts of the sub-region, potential evaporation is twice as high as rainfall totals (Hirji et al 2002). This has a dominant influence on the overall water balance, with the consequence that generally less than 15 percent of the rainfall contributes to runoff, river flow and infiltration to groundwater. Table 1 shows rainfall, evapotranspiration and surface runoff ranges in the sub-region.

Surface runoff in southern Africa is dependent on the sub-region's rainfall patterns. Surface runoff in the northern and eastern parts of southern Africa is available in sufficient quantities throughout the year. In the south-western parts, surface runoff only occurs with extreme episodic rainfall events. With such a rainfall scenario, the sub-region experiences floods mainly in the northeast, and episodes of severe and prolonged droughts.

Rivers

An important hydrological feature in southern Africa is the presence of 15 transboundary rivers, whose combined drainage area covers 78 percent of the sub-region's continental land

area (Hirji et al 2002). As shown in table 2, southern Africa's international rivers have a total catchment area of 6.76 million sq km (SADC/IUCN/SARDC 1996).

The Zambezi river, which is the most shared river basin wholly in SADC, has its source in the Kalene Hills of north-western Zambia and flows over a distance of nearly 3,000 km to its delta in the Indian Ocean. The river carries more than 75 percent of the mean annual runoff of southern Africa's interior and drains more than 40 percent of the land mass (Chenje 2000).

In the arid and semi-arid areas of the sub-region, rivers are non-perennial and only flow a few months a year, after the rains. As rainfall intensity decreases, transmission losses become an important component of the water balance. Groundwater becomes the main reliable source of water under these conditions.

Aquifers

Groundwater is available in variable quantities throughout the sub-region mainly in aquifers recharged through infiltration. It is

Table 1
Rainfall and Evaporation Statistics of some SADC Countries

Country	Rainfall range (mm)	Average rainfall (mm)	Potential evaporation range (mm)	Total surface runoff (mm)
Angola	25-1 600	800	1 300-2 600	104
Botswana	250-650	400	2 600-3 700	0.6
Malawi	700-2 800	1 000	1 800-2 000	60
Mozambique	350-2 000	1 100	1 100-2 000	275
Namibia	10-700	250	2 600-3 700	1.5
South Africa	50-3 000	500	1 100-3 000	39
Swaziland	500-1500	800	2 000-2 200	11
Tanzania	300-1600	750	1 100-2 000	78
Zambia	700-1200	800	2 000-2 500	133
Zimbabwe	350-1000	700	2 000-2 600	34

Source: Pallet 1997:14 in Hirji et al, *Defining and Mainstreaming Environmental Sustainability in Water Resource Management in Southern Africa*. SADC/IUCN/SARDC/World Bank: Maseru/Harare/Washington DC, 2002.

Table 2
Mean Annual Runoff of Selected River Basins in Southern Africa

River Basin	Basin area (sq km)	River length (km)	Mean Annual Runoff at mouth (10^6 cu m/ yr)	Unit runoff (mm)
Congo	2 942 700	4 700	1 260 000	330
Cunene	110 300	1 050	5 500	52
Limpopo	415 500	1 750	5 500	13
Okavango	708 600	1 100	11 000	19
Orange	947 700	2 300	11 500	13
Save	116 100	740	7 000	76
Zambezi	1 388 200	2 650	94 000	67

Source: Hirji et al, *Defining and Mainstreaming Environmental Sustainability in Water Resources Management in Southern Africa*. SADC/IUCN/SARDC/World Bank, Maseru/Harare/Washington DC, 2002.

an important source of water in the sub-region's rural areas, and to a lesser extent, for the supply of water to urban centres. It also supports base flows of perennial rivers during dry seasons and during periods of surface water drought.

In Botswana, 80 percent of water supplies is from groundwater sources. Most rural areas in Namibia also rely on groundwater. In the Limpopo river basin most farmers depend on groundwater for irrigation during the dry months. It is sourced from springs or pumped from drilled wells and boreholes (SADC Water Sector Coordination Unit 2003).

In Mozambique, groundwater is found in the young dune deposits along the coastal strip, the north-eastern region and the alluvial valleys of the Limpopo basin, where development of the aquifers is risky due to frequent flooding of the Limpopo River.

Although the environmental role of groundwater is not well-understood and recognised within much of SADC and sub-Saharan Africa (Envirotek 2003), it sustains ecosystems directly and indirectly through its interactions with surface water resources. Some ecosystems that depend on groundwater resources include aquifers, spring-type discharges associated with fault zones, dykes and sills, and floodplains (Envirotek 2003).

Studies in the region have suggested that aquifer recharge responds disproportionately to drought. The impact of drought is greater on aquifer recharge than the realised impact on the surface (Beekman et al 1996). The sustainability of groundwater resources depends on the balance between abstraction and recharge as over-abstraction can lead to the depletion of the resource.

Dams and Lakes

Freshwater in southern Africa is found in a number of artificial lakes or dams. Dams are built to store excess river run off and provide a secure long-term water supply. South Africa and Zimbabwe have the largest number of dams in the sub-region and are globally ranked number 11 and 20, respectively, in the top countries with large dams (World Commission on Dams 2000). These dams are needed because of the spatial and temporal variability of rainfall in the sub-region. They are built to store water during the rainy season for use during the dry season and they store water in order to convey it, often over long distances, to areas such as irrigation schemes, cities, industries and mines where water consumption is high and exceeds the capacity of nearby sources.

This is the case in the Gauteng Province of South Africa, which imports water from the Lesotho Highlands where the Katse and Mohale dams have been built for this purpose. The Zambezi river basin has more than 30 large dams including the Kariba and Cahora Bassa,

which have been built for domestic, industrial and mining water supply, irrigation and power generation. Other dams, built for hydropower generation in the region include Gariiep and Vanderkloof dams on the Orange River.

The major natural lakes in the sub-region include Lake Victoria, Lake Tanganyika and Lake Nyasa/Niassa/Malawi. Tanganyika and Malawi are the world's second and third deepest respectively, after Lake Baikal in Siberia, Russia.

Most lakes in the region are shallow, due to the landscape (SADC/IUCN/SARDC 1996). Lakes Malawi, Bangweulu, Chilwa, and Mweru are entirely within southern Africa, while some lakes are shared with countries outside the SADC region. These include Lake Victoria (Tanzania, Kenya and Uganda) and Lake Tanganyika (Tanzania, DRC, Zambia and Burundi). These lakes are sources of fisheries and provide an important source of livelihood for people living near the lakes.

Current environmental problems in the region's lakes include alien invasive species such as the water hyacinth, and the transfer of fish species from one lake to another. One example is the Nile perch, introduced into Lake Victoria in the 1970s. This has led to the extinction of around 200 fish species through its predatory activity. These include Cichlids (*Haplochromines*) species, of which more than 100 known species have disappeared since 1987 (SADC/IUCN/SARDC 1996).

Semi-arid and arid regions have limited freshwater in the form of non-perennial and ephemeral rivers, and are characterised by the absence of lakes. This is the case in the south-western part of southern Africa, including Namibia and parts of Botswana and South Africa.

Wetlands

Wetlands constitute an important source of freshwater in southern Africa. They have a great ecological value as they provide a habitat for various floral and faunal species. They also sustain the livelihoods of communities who depend on them for survival. Wetlands support river flow, ground water recharge, and are also important in flood regulation and drought mitigation.

They reduce the flood peaks and reduce flow velocity due to their ability to store large quantities of water. The release of stored water into streams and rivers as part of base-flow maintains dry season water supplies. Thus both people and wildlife converge on wetlands during drought periods. Examples of important wetlands in southern Africa include the Kafue Flats in Zambia; the Okavango Delta and the Makgadikgadi pans in Botswana; the Etosha pan in Namibia; and various dambos, pans and deltas scattered throughout the sub-region.

Estuaries

Estuaries are the interface for tidal exchanges between the saline waters from the sea and freshwater from rivers. They provide a unique and rich habitat for various species. In addition to the Zambezi, major estuaries in the region include the Limpopo, Rufiji and Cunene. The demand for freshwater that results in dams being built upstream of estuaries has the potential to adversely affect the delicate balance between marine and freshwater in estuaries.

The lower Zambezi valley, home to more than one million people is of economic, social

and ecological value to the local communities and Mozambique as a whole. Its fertile floodplains are important for recession agriculture, hunting, fishing and for the abundant natural resources. The delta and floodplain support abundant wildlife populations, including African Elephant, Cape Buffalo, Water Buck and the endangered Wattled Crane. They also provide spawning grounds for riverine and brackish water fish, and dry season grazing lands for livestock and wildlife. The extensive mangroves and estuary support production of prawn fishery.

DROUGHTS AND FLOODS IN SOUTHERN AFRICA

Several factors can be attributed to the occurrence of droughts and floods in southern Africa. These factors are both natural and human-induced. The incidences of droughts and floods in the sub-region not only cause great suffering among the people but also have a great impact on the economies of the countries that are affected from time to time. More than 80 per cent of natural disasters in the sub-region are hydro-meteorological in nature and result from relationships among natural hazards, climate, water management, the environment, land use and human behaviour (SADC/WMO, 2001).

Drought may be considered in general terms, as a consequence of a reduction in the amount of precipitation that is received, usually over a season. There are four types of drought as described in box 1.

Factors that Exacerbate the Impact of Droughts and Floods

The frequency and magnitude of droughts and floods vary from year to year, and from country to country. Droughts have a great impact on the socio-economic activities and production processes in southern Africa affecting people's welfare, employment, income and health. There are several factors that worsen the impact of droughts and floods. These factors are both natural and human-induced, and they include population pressure, poor land use practices, poverty and climate change.

Population pressure

About 63 percent of the people in southern Africa live in rural areas, depending heavily on agriculture for livelihood. Under conditions of relatively improved health care services, the population of the countries of the sub-region has been rising steadily at an annual growth rate of around 2.6 percent (SADC 2000). In some countries, the population growth rate has been higher than the economic growth rate.

The growth in population has meant that there has been increased demand for land on which to grow crops and carry out other economic activities. In this regard, many of the previously pristine and vegetated areas of the sub-region are now cleared for subsistence agriculture. Due to the relatively poor conditions in which most families residing on farms find themselves, they are unable to increase production through modern farming means and inputs.

The prices of farm inputs such as fertilisers in some of the countries in the sub-region are beyond the reach of subsistence farmers. As

Box 1

Types of Droughts

Meteorological drought refers to a reduction in rainfall supply compared with the average over a specified period.

Agricultural drought is a reduction in water availability below the optimal level required by a crop during its different growth stages, resulting in impaired growth and reduced yields. Agricultural drought relates to an imbalance in the water content of the soil during the growing season, which although influenced by other variables such as the crop water requirement, the soil water-holding capacity and degree of evaporation, is also largely dependent upon rainfall amount and distribution.

Hydrological drought is the impact of a reduction in precipitation on natural and artificial surface and subsurface water resources. It occurs when there is a substantial deficit in surface runoff below normal conditions or when there is a depletion of groundwater supplies. Hydrological drought reduces the supply of water for irrigation and hydroelectric power generation.

Socio-economic drought refers to the impact of drought on human activities. It relates to a meteorological anomaly or extreme event of intensity and/or duration outside the normal range of events taken into account by enterprises and public regulatory bodies in economic decision-making, thereby affecting production and the wider economy.

Wilhite, DA & Glantz, MH 1985

such, the subsistence farmers are forced to cultivate extensively in the hope that they will increase output from their fields. Under conditions of poor cultivation methods, large areas are exposed to wind and water erosion, causing land degradation. The impact of drought and floods is worse on degraded land than on fertile land.

Inappropriate land use

Management of land and associated resources is important for maintaining a healthy environment. Conversion of land use such as forests to agriculture and settlements opens up the land and results in the destruction of habitats for many species. Such land use changes increase the erosive force of wind, as well as decrease the porosity of the soil and its infiltration capacity.

In countries such as Malawi there has been a sharp rise in the number of burley and flue-cured tobacco farmers. Burley tobacco is cured with the sun's heat, while flue-cured tobacco is fire-processed, mainly from firewood.

According to Malawi's laws, burley growers are required to plant a portion of their farm with trees for their farm activities. This requirement

has hardly been heeded, with many farmers resorting to maximising production by opening up more land (Government of Malawi 2000). The resultant land degradation is often blamed for worsening the impact of drought and floods.

Lack of awareness

Apart from early warning systems, ineffective awareness in much of southern Africa contributes to the devastation with which floods and droughts are associated in the sub-region.

Information is a vital tool in development as it provides knowledge and awareness on critical issues affecting people and is essential for decision-making. However, lack of information due to absence of research on the causes of and impacts of droughts and floods on the environment can be one of the factors responsible for the deterioration of the ecosystems in the sub-region.



Land degradation – hill tops and slopes in Malawi



Sand deposition in rivers of Thyolo District-Malawi



Small-scale mining in Mozambique

Information regarding policies for environmental and natural resources management is not easily accessible by the majority of people in southern Africa. Lack of knowledge about what various laws say about agriculture and water resources management result in some people farming on fragile hilltops and along river banks. The situation is worsened by lack of enforcement of laws. In the case of Zimbabwe for instance, the law does not allow cultivation along river banks, but gold panning has instead brought the same environmental challenges that would have equally taken place if cultivation were extended to the river channels. Sand mining in Malawi and small-scale mining result in serious erosion of river banks and river catchment basins.

Poverty

The occurrence of droughts and floods in countries where people are already poor only exacerbates their suffering and forces them into a cycle of poverty.

Although poverty alleviation programmes have been established in the countries of the sub-region, it is essential that these programmes are adequately financed to avoid failure in some of their components. In Malawi for instance (Government of Malawi, 2003) the government started implementing the Malawi Poverty Reduction Strategy in April 2002 and most of the activities under the programme were referred to as the Priority Pro-Poor expenditures.

Poverty alleviation will also require increased food production which relies on, among other factors, reliable access to water resources at the community level (SADC, 1998). The provision of sufficient water can be accomplished by expanding irrigation systems, improving water harvesting techniques and implementing water and soil conservation practices (SADC, 1998).

Global warming and climate change

Many countries in southern Africa are prone to recurrent drought episodes, which are associated with the El Niño-Southern Oscillation (ENSO) phenomena. Africa is the most vulnerable region in the world to the impacts of the projected changes in climate.

A rise in global temperatures will amplify southern Africa's problems and further reduce economic growth, as resources will be diverted to deal with adapting to climate change rather than development. Climate change may also trigger weather patterns such as floods and severe droughts that are already frequent in the sub-region.

Climate change will also greatly alter habitats, resulting in devastating impacts on wildlife numbers and location. These changes would have an impact on the national parks and would affect the health of grazing species such as hartebeest, wildebeest and zebra.

It has been projected that there would be an average global temperature increase of 1.0-3.5°C, as a result of global warming induced by greenhouse gas (GHG) emissions by the year 2100 (IPCC, 2001). This rise in global temperatures is likely to influence a corresponding rise in mean sea level of about 0.09 mm/yr rising to 8.8 mm/yr in year 2100 (IPCC, 2001). The full extent of climate change impacts on the environment in southern Africa may not be clearly definitive due to varying global climate change scenarios, and the inadequate inventory of vul-

nerable assets and resources. However, expected consequences are likely to be related to:

- Changes in sea levels;
- Increased surface temperatures; and
- Modification of the hydrological cycle.

In the case of Mozambique which is one of the eight coastal countries in the SADC region, any sea level rise would cause displacement of people. The other coastal countries are Democratic Republic of Congo, Angola, Namibia, South Africa, Seychelles, Tanzania, Madagascar and Mauritius.

THE 2000-2003 DROUGHTS AND FLOODS

The period 2000-2003 was mainly a wet period interspaced with dry spells and droughts. Despite being spread across the period, the floods and droughts had significant impacts on the economies of southern African countries. Livestock, property and infrastructure were destroyed. Following research work carried out in December 2003 by CEDRISA the impacts that these events had on the environment in five southern African countries, Malawi, Mozambique, Swaziland, Zambia and Zimbabwe, are presented. These impacts call for a concerted effort and decisiveness in dealing with droughts and floods in the region even though they cannot be prevented. Mitigation measures need to be strengthened in order to reduce the suffering of people in the sub-region.

Malawi

During the period 2000-2003, Malawi faced one major drought in 2001-2002 and numerous flood events. The 2001-2002 drought affected the whole of southern Africa, and is considered one of the major drought seasons in living memory.

During the 2001-2002 drought season, Malawi's national food security situation worsened, forcing the country to declare a food-disaster in February 2002. In July 2001, the Government of Malawi recognised the national supply of maize was short by 400,000 metric tonnes and decided to buy 700,000 tonnes from local sources and import a further 150,000 tonnes (Government of Malawi, 2002).

While floods occur anywhere in Malawi depending on weather conditions, there are five basin systems in the country that experience severe flooding on a regular basis. These river basins are the Shire-Ruo River system, the Lake Chilwa Basin, the Lake Malawi littoral, the SW Lakeshore and the Songwe Basin.

The Shire-Ruo River system is the only one that has a flood forecasting network in Malawi. The network was established after realising the huge magnitudes and destruction of the floods that occur in the Shire-Ruo river system.

The Limphasa and Luweya rivers experience frequent flooding within their basins, resulting in loss of life and property, damage to bridges and roads, and the water logging of one of the country's most important agricultural schemes, the Limphasa rice fields. The Limphasa River is flooded even when the river flows are as little as 40m³/s. The flat topography of the lower part of the basin through which the river makes its way to the lake, does not lend itself to confining the flow within the river channel.

The SW Lakeshore catchment basin transects plateau, escarpment and the rift valley plains before entering Lake Malawi. High flow

velocities attained as the rivers roar down the escarpment result in devastating floods. Upon entry onto the lakeshore plain the velocities reduce and huge silt and sediment loads are deposited in the river channel restricting its conveyance. Flooding in this area has in the past damaged roads, bridges and other infrastructure almost every rainy season.

The Songwe River which marks the northern boundary between Malawi and Tanzania is another system that causes severe flood damage. Unlike other river systems, the Songwe is renowned for its instability. The river changes its course from one flood season to another. This has devastating effects on both settlements and farming activities along the banks of this river basin. The frequent changes of the river course also affect the position of the international boundary between the two countries. A feasibility study to stabilise the river course by constructing upstream flood storage dams and riverbank protection works was completed in 2005.

The impacts of floods on the natural and human environment are similar from country to country. Flooding causes a lot of national distress, loss of life and property, destroys communication and infrastructure and kills both domesticated and wild animals. Flooding brings about negative impacts to the natural environment, people and infrastructure. The socio-economic and environmental impacts include the following:

- Loss of agricultural land and crops e.g. in the Songwe River system. The flooding sometimes leads to long periods of water-logging extending for durations of about 2-3 months. This situation does not enable people to re-plant their crops (Malawi Government, 2003);
- Damage to infrastructure such as water supply, roads, bridges, and railways lines;
- Loss of wildlife habitat and tourism infrastructure;
- Loss of homes especially in low lying areas, necessitating relocation and provision of relief items.
- Stagnant water left by floods increases the risk of human disease incidences such as malaria, bilharzia, cholera, dysentery and other waterborne diseases;
- Loss of some vegetation that may be affected by high water levels or submergence;
- Severe erosion in upper catchments can result in heavy siltation of river channels which may affect hydropower generation as is the case with Shire River; and
- Forced government expenditure, usually accessed through loans, to offset the unplanned damage.

Table 3
Impact of Selected 2000-2003 Floods on Malawi's Socio-Economy

DATE/PERIOD	EVENT	LOCATION	IMPACT
13 March 2000	Flooding of Lalange, Thangadzi and Shire rivers	44 villages in Mbenje and Mlolo areas in Nsanje	2,259 households had their houses damaged. 1,950 households had their crops damaged. A total of 736.2 ha of maize, millet, sorghum and rice were effected
24 March 2000	Flooding of Songwe, Lufilya and Kyungu rivers	63 villages in Kyungu and Mwakaboko's areas in Karonga District	13,224 households lost their crops. 1,354 ha of cassava, 2,370 ha of maize and 2,348 ha of rice were affected. A lot of livestock were killed and washed away. Lufilya irrigation Scheme, Kaporo Police Unit and 12 primary schools were damaged
December 2000	Flooding of Mwanza and Shire rivers	A number of villages in Maseya, and Kasisi, and Lundu in Chikwawa	16,661 families (83,305 individuals) affected; 3,159 ha of maize, 34 ha of sorghum, 251 ha of rice, and 91.9 ha of sweet potatoes were affected.
4 January 2001	Flooding of Lingadzi River	Gonam'bombo village in Rumphu District	28 households had their houses damaged. Five people belonging to the same family were washed away and their bodies were not found
January 2001	Flooding of the Bwanje River and Saza River	A number of villages in Ganya in Ntcheu	737 households affected, 314 ha of cropland washed away and 38 houses damaged
February 2001	Flooding of Linjizi River and the Shire River	A number of villages in Chigaru and Lundu in Blantyre District	2,000 households (10,000 individuals) were affected, 242 households had their houses damaged. More than 410 ha of gardens washed away
February 2001	Flooding of Lingadzi River, Lipimbi River and Chitala River	23 villages in Khombedza, Chikombe, Kuluunda	9,000 households (45,000 individuals) affected. 6,048.4 ha of maize, 962 ha of rice and 762.6 ha of cotton were affected. 3 people lost their lives in Salima District
December 2001	Flooding of Shire River	A number of villages in Nyachikadza, Ngabu, Malemia and Tengani in Chikwawa District	1,997 families were affected and had their maize gardens washed away
January 2002	Flooding of Rukuru River	A number of villages in Karonga District	45,118 families affected
4 January 2003	Flooding of Lisungwi River and Shire River	Mwanza District	3,935 families had their 1744 ha of crops washed away
February 2003	Flooding of Bua River	A number of villages in Mphonde in Nkhosakota District	97 families had their houses damaged and 1,113 families lost 213 ha of crops
27 March 2003	Flooding of Jalawe and other tributaries of the North Rumphu River	18 villages in Phoka, Chakaka, Junju and Chiweta areas in Kachulu and Mwalwene in Rumphu District	1,872 families lost livestock and 586 ha of crops; 4 people from one family in Khwati village died

Source Government of Malawi (2003)

Table 3 gives an outline of floods that occurred in Malawi during the period 2000-2003. The table also shows the extent of damage caused on the environment. The impacts of these floods in Malawi are similar to those in other countries except that the difference can be in the magnitude. In virtually all the instances of flooding, government along with nongovernmental organisations, the private sector and the donor community assisted with disaster relief items in the form of food, clothing and shelter.

Mozambique

The geographical location of Mozambique renders the country prone to several natural and

human-induced disasters. Three of the most significant disasters that affect Mozambique are droughts, floods and cyclones. Droughts and floods are normally seasonal, cyclical and occur in southern and central parts of Mozambique. Tropical cyclone *Eline* and others such as *Delfina* caused extensive socio-economic damage in Mozambique. Table 4 below gives a chronology of major floods that occurred in Mozambique during the period 2000-2003.

There are six transboundary rivers that are prone to flooding in Mozambique. These are the Zambezi, Shire, and Pungwe in the centre; and the Limpopo, Save and Incomati/Nkomati in the south. Damage caused by droughts

Table 4
Flood Incidences in Mozambique During the Period 2000-2003

DATE/PERIOD	LOCATION	IMPACT
21- 29 February 2000	Flooding along the Limpopo and the Incomati/Nkomati rivers	Damage to crops, vegetation, livestock and housing. 700 people displaced and 700 others killed; roads and bridges washed away. Flood described as worst in Mozambique's history
1-16 February 2001	Flooding in the Zambezi basin following opening of two gates at Cahora Bassa Dam. This released 3,770 m ³ of water per second	Four relief centres opened to accommodate 5,000 displaced people. Fifteen people died in flood-related incidences. There was an improved disaster coordination in 2001 and better advance warning systems compared to the previous years
January - February 2002	Rivers rising to levels of medium to high flooding risk in parts of Mozambique following heavy rains in the central part of the mainland SADC sub-region	Alternative measures were adopted by government to arrange for access to central services including educational institutions
31 December 2002	Flooding in southern parts of Nampula Province and northern Cyclone <i>Delfina</i>	There was localised inundation of crops and vegetation including Mozambique due to tropical loss of habitat and deaths of a number of wildlife species
28 February - March 2003	Flooding following torrential rains as tropical cyclone <i>Japhet</i> approached Inhambane, Vilankulo and Gaza Provinces in southern Mozambique	There was widespread damage to crops, vegetation, livestock and houses as the cyclone was characterised by winds with gusts of up to 140 km per hour. The crops that were damaged included maize, sorghum, rice and millet
6-8 March 2003	Rise of the Runde and Save rivers from the remnants of the cyclone <i>Japhet</i> . Rivers rose to about flood level in the lower catchment of the Save River, near the coast which resulted	There was a positive effect following the occurrence of cyclone <i>Japhet</i> in the Lower Limpopo valley around Chibuko. The situation helped to ease the plight of people in this area that had been undergoing through a period of drought in some minor flooding

Source: Drought Monitoring Centre, Harare

Table 5
Droughts in Mozambique 2000-2003

DATE/PERIOD	LOCATION	IMPACT
December - March 2002	Limpopo River Basin	Reduced water availability in the wells, reservoirs and rivers in the basin.
March 2002	Southern and central regions of the country	Reduction in crop yield, resulting in serious food shortages
April 2002	Southern and central regions of the country	General food insecurity due to continued <i>El Niño</i> conditions
November 2002	Countrywide	Insufficient rainfall to meet crop needs
February 2003	Southern Mozambique	Low moisture for crops
February 2003	Southern Mozambique	Inadequate water supplies for agriculture, domestic and industrial uses
April 2003	Most of Mozambique	Lower than normal crop yields. Hydrological deficits also affected drinking water and irrigation
May 2003	Southern Mozambique	Crop yield was negatively affected due to spotty areas of poor performing rains
June 2003	South & Limpopo Basin	Precipitation deficits of 150 to 400 mm caused water shortages across the sub-region

Source: National Institute for Disaster Management (2002).



Flooding in Maputo after a storm



Helicopters rescuing people from floods

includes degradation of land. This is exacerbated by the local population exerting pressure on the dwindling natural resources during times of drought as communities experience loss of income and livestock. Droughts also result in scarcity of safe drinking water. Table 5 outlines the droughts that occurred in Mozambique during the period 2000-2003. The table also presents the impacts of these droughts on the environment.

Droughts and floods can have varying impacts on the environment. The impact depends upon magnitude of the drought or flood, and also upon how well systems are put in place to mitigate the disaster prior to its occurrence. In order to address the several disasters related to droughts and floods, the government of Mozambique has put in place measures to reduce the negative impact of droughts and floods on the environment. These include preparation of national contingency plans, and awareness raising campaigns targeting mainly the vulnerable communities. At institutional level, appropriate coordination mechanisms among government departments, NGOs, international organisations, and the civil society for preparedness, response and recovery have been established through Mozambique's National Institute for Disaster Management in the Ministry of Foreign Affairs and Cooperation.

The damage caused by the 2000 floods in Mozambique was estimated at US\$600 million (Drought Monitoring Centre, 2000). The years 2000 and 2001 saw massive flooding in Mozambique, particularly along the Limpopo, Save and Zambezi valleys. Reports indicate that in 2000 alone, about 500,000 people became environmental refugees in their own country as their homes had been destroyed. In addition, 700 people lost their lives as a result of massive flooding that occurred in the country (OXFAM 2000).

As a result of the frequency of disasters, especially floods in Mozambique, the government has taken steps to establish a Community Based Disaster Preparedness Programme (CBDPP) whose main objective is to encourage and engage the community to participate actively in finding sustainable solutions to their



People stranded on a broken bridge

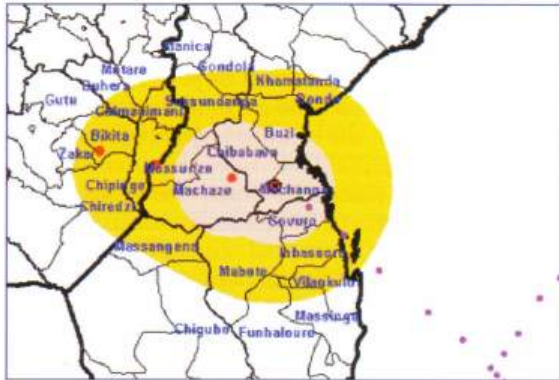


Water purification plant donated by UMCOR

problems. The CBDPP was prepared with particular focus on the following issues (Government of Mozambique 2002):

- to inspire the communities to be self-reliant in the event of a disaster and refrain from depending on external assistance;
- to provide training for communities in evacuation and rescue operations with the assistance of the Mozambique Red Cross Society (MRCS);
- to strengthen partnerships among government, NGOs and civil society;
- to promote disaster prevention;
- to define and allocate clear responsibilities to communities, individuals, government, private sector and NGOs;
- to provide and access adequate expertise and technology required for disaster management;

Map 1
Path of Cyclone *Japhet* in March 2003



- to develop internal capacities of interest groups;
- to provide adequate public education and awareness in disaster management, prevention and mitigation; and
- to undertake a zoning exercise of the most vulnerable districts in the country and establish rapid response groups for disaster management.

Swaziland

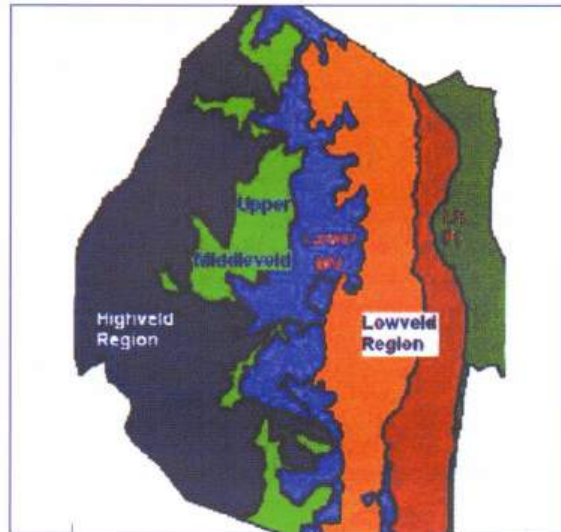
Swaziland is prone to the occurrences of natural disasters, such as droughts and tropical cyclones. The country experienced a major drought during the 2000-2001 rainfall season. Over this period, the onset of rains was late and rainfall totals were below normal. The Lowveld region of Swaziland (see Map 2) was the most affected, resulting in reduced crop yields. Some communities had to rely on food aid. The landscape in the Lowveld region is essentially bare and animals find it difficult to graze or browse. The 2002-2003 rainfall season was not good either, causing some *Acacia* trees to dry up.

The prolonged 2001-2003 drought resulted in low water levels in Swaziland's reservoirs such as dams. This has had an effect on the sugarcane companies which depend on water from the reservoirs. As a result irrigation companies were forced to use only a maximum of 70 per cent of their crop water requirements. The Lupohlo dam which stores water for hydropower generation was also running low due to low inflows from

Table 6
Average Annual Rainfall and Temperature in Swaziland's Physiographic Regions

Physiographic Region	Annual Rainfall (mm)	Annual Temperature (°C)
Highveld	1 500- 900	17.6 – 16.3
Middleveld	810- 580	20.5 – 19.3
Lowveld	<500	22.4 -21.3
Lubombo	710	19.2

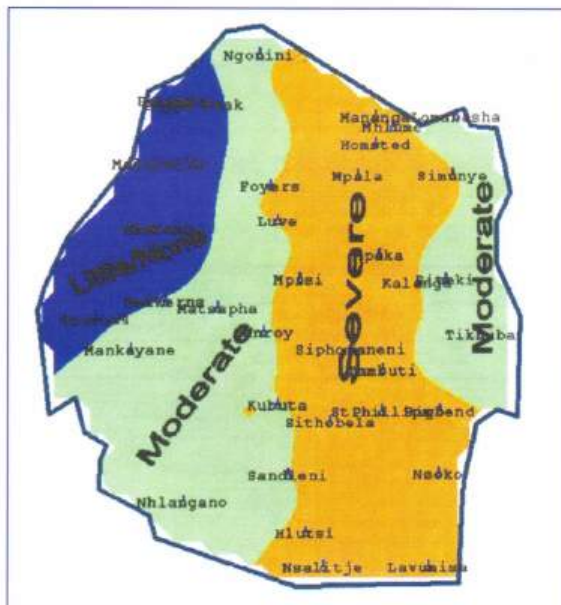
Map 2
Major Physiographic Regions



the Lushushwana River, a tributary to the Usutu River. Map 3 shows the drought risk areas in Swaziland categorised into three regions.

Swaziland is also affected by floods. Floods cause great damage to infrastructure as well as property in the country. The damage was particularly severe after the 2003 heavy rains that caused the Mnjoli Dam to spill. Due to high inflows the right river bank at the spillway of Mnjoli Dam was eroded and created a 30 meter wide channel. The city of Mbabane experienced flood-related problems due to the heavy rainfall of November 28 2003. The Mbabane River which flows through the city flooded the shops in the Mbabane Shopping Mall and most places which are built on the flood plain.

Map 3
Drought-risk Map of Swaziland





Impact of drought on communities (south Lowveld)

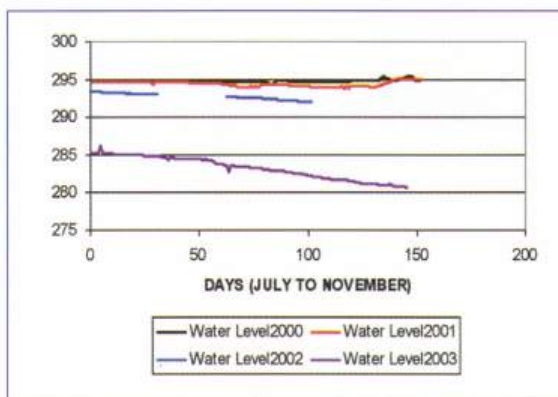


Impact of the drought on the landscape (south east Lowveld)



Impact of the drought on livestock (Siphofaneni, Lowveld)

Graph 1
Water levels for Mnjoli Dam for period 2000-2003



Precipitation during the year 2000 was above average in most parts of the country and resulted in floods. However, there was a rainfall decline from 2000-2002 and people in the severe drought risk region faced acute shortage of food. Drought relief started in July 2002 and by March 2003 over 250,000 people were recipients of food aid in the country (Government of Swaziland May, 2003).

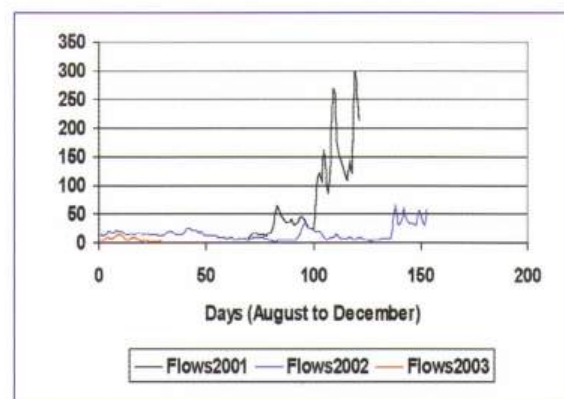
Rivers and reservoirs form the main water sources in Swaziland for domestic, industrial and other uses. The principal rivers are Lomati, Komati, Mbuluzi, Usutu, Ngwavuma, Pongola and Lubombo. Pongola and Lubombo basins are small and under-utilised. Two major dams, the Maguga Dam and the Mnjoli Dam, supply water for agricultural activities, mainly sugarcane, and for domestic and industrial use and for livestock. Since 2001, river flows have been low especially during the winter seasons due to poor ground water recharge in the summer months.

Since the Mnjoli reservoir supplies water for irrigating sugarcane, the low water levels reduced the sugar companies capacity to irrigate their crop.

The Maguga Dam, commissioned in 2002, started impounding water but due to the below-normal rainfall that Swaziland had received between 2002 and 2003, the dam could not reach its full supply level. The reservoir's storage reached the lowest level of less than 10 percent reservoir capacity in November 2003. Like the Mnjoli reservoir, the Maguga reservoir also supplies water to irrigation schemes for sugarcane and because of its low levels in 2003, this had a negative impact on the sugarcane output. Sugarcane irrigation in Swaziland consumes 96 percent of water requirements for agriculture. The crop is mainly grown in the Middleveld and Lowveld regions.

Water allocation among consumers decreased with the advance of the season from 70 percent in March 2003 to 30 percent of their normal supply during the first week of December 2003 (Dlamini, 2003). During the floods of the

Graph 2
Flows for the Usutu River at GS 16





University of Swaziland

Mbuluzi River flow on December 4, 2003

Box 2
Mbabane's historic flood

MBABANE – The events of November 28, 2003 or wet Friday will by no means be forgotten in the near future as unexpected torrents of rainfall swelled up the Mbabane River, which in turn flooded the city. The floods caught people unexpectedly. The places that were flooded, including the Mbabane shopping mall, are built in the floodway of the Mbabane River.

Friday's downpour was not the average terrible storm that Mbabane is used to. In fact, it was reminiscent of the 1984 Cyclone *Domania* that resulted in extensive damage of property including the loss of lives countrywide. The 'angry' Mbabane River, which cuts through the city, was responsible for a trail of destruction as it fiercely swept away everything that lay on its banks. The storm, accompanied by hailstones, began just after mid-day and subsided after 3 p.m. However, what was eyesore was the aftermath of that storm. Businesses were greatly affected in that almost all the trading outlets including the Mall were temporarily forced out of business. Mbabane residents were greatly inconvenienced by the floods and many of them headed back home rather disappointed that they could not make their normal weekend shopping. Crowds of people would occasionally gather just outside the vicinity of the Old Mall and watch workmen cleaning the roads and clearing tree trunks and dirt that came with the flood.

Musa Simelane, Mbabane, Swaziland



University of Swaziland

The Mbabane River at the Mall with receding flows (November 28, 2003)

2000 rainfall season, many people drowned while trying to cross flooded rivers and many communities were cut off from other communities because bridges remained submerged for many days. The Mnjoli dam spillway was breached due to prolonged high flows.

The left bank was eroded and a big opening was created separating the spillway structure from the bank. The spillway had not been repaired by December 2003. During the same period, it was also reported that 56 people died as a result of the floods. Dams in South Africa were reported to have released water to make room for the incoming flood waters and this made the situation worse for Swaziland. As a result, flooded rivers in the country blocked vehicles for more than two weeks. Roads and bridges were washed away while houses were damaged in the process.

Zambia

The drought of 2000-2003 reduced Zambia's Gross Domestic Product (GDP). During this period, it was estimated that about 2.77 million Zambians were deprived of food. In areas most affected by droughts and floods such as in the Western and Southern provinces, over 75 per cent of the population was unable to feed itself.

There are four major flood plains in Zambia, and these are the Barotse on the Zambezi, Kafue flats on the Kafue, Chambeshi and Luapula floods plains.

The Barotse floodplains of Zambia are of great cultural and environmental value. The Barotse Royal Establishment noticed this value around the 18th Century and put in place by-laws and mechanisms to preserve the floodplains. Currently, the Kuomboka Ceremony practised here by the Lozi people bring to Mongu the provincial capital of Western Province, some US\$30,000 in food and hotel accommodation for 3 days in a year.

Drought-induced crop failures in Zambia have been the most common disasters experienced in the recent past. On a local scale recurrent droughts have led to the collapse of the traditional credit delivery system which focused mainly on maize seed and fertilizer inputs, crop



Ministry of Agriculture, Zambia

Siltation "bridges" for elephants on the Chongwe River



Cultural value of floods in Barotse floodplains—the Kuomboka Ceremony

diversification, and contract farming arrangements especially for cotton, tobacco, paprika and castor oil. Droughts are also associated with a reduction in sizes of livestock herds.

Survival practices such as crop production using slash and burn farming systems (locally known as *Chitemene*), charcoal burning, timber logging and wild product collection e.g. grass, timber, fruits and reeds tend to increase during drought periods.

Development has for a long time been guided by economic considerations, where exploitation of resources for maximum benefits has been the norm and little regard paid to the side effects of development initiatives. As a result, development projects impact negatively on the environment causing ecological disturbances, habitat destruction, and loss of animal and plant species, desertification, soil loss and floods became more and more prevalent.

Perhaps an overlooked and indirect consequence of drought is the influence it has had on the deterioration of health standards among people. Drought affected areas of Zambia have experienced high prevalence of water-borne diseases such as cholera and dysentery. Cholera was officially first recorded in 1979, became endemic and resulted in high fatalities. Other non-bloody diarrhoea cases were on the increase during the period 2000-2003 with the highest cases of fatalities reported in the Southern Province, and in the Copperbelt. Disease outbreaks, particularly anthrax drastically reduced livestock numbers in the country in 2001.



Chitemene system of agriculture

Floods in the Northern Province of Zambia caused significant and diverse effects, with both positive to negative impacts. Areas that were flooded include the Chambeshi River, especially in the Ndesa-Mumba area. Positive impacts brought about by floods in these areas included:

- Increased rice yields in the Chambeshi River flats;
- Improved food security for the communities in the area;
- Growth in fish stocks;
- Improved income generation for local people;
- Increased groundwater recharge for the aquifers;
- Provision of an easy mode of transport between Mumba block and Chinsali, due to the increased use of canoes to travel.

In Lusaka Province, the incidents of flooding brought with them better pastures for livestock. People in the Barotse floodplain have relied on nutrient-rich silt brought in by the floods. Every flood season brings with it fertile silt from upland and crop production and output is better than in other areas of the country.

The Southern Province is the driest province in Zambia. Despite its low rainfall, the province was affected by floods, the last one being in the Gwembe Valley on March 17, 2003. The floods had the following negative impacts:

- displacement of fishing villages from the valley;
- destruction of community dams which are used in small-scale irrigation and watering of domestic animals;
- high disease outbreaks, especially diarrhoea;
- blockage and destruction of road infrastructure, which hampered school children from attending school; and
- high cost to government in rehabilitation works.

As a result of the 2002 drought in the country, the overall food security situation deteriorated (Government of Zambia, 2002). About 28 percent of the total population was in need of food aid between December 2002 and March 2003. This was two percent higher than was forecasted during an earlier assessment.

The beginning of the 2002-2003 agricultural season was very disappointing as it was characterised by poor rainfall in terms of amounts received as well as distribution. After the first rains in late October to early November 2002, almost all parts of Zambia experienced a prolonged dry spell (agricultural drought) up to the first week of December 2002. This condition was unfavourable for proper germination and crop growth. The early-planted crop that had already germinated suffered severe water stress to the extent of wilting. In many areas of southern parts of Zambia there was need to replant while in other areas, farmers delayed planting until the rains were fully established. There was

a deliberate effort in the 2002-2003 season to promote planting using conservation farming technology in southern Zambia.

As a result of a dry spell, there was reduced yield during the 2003 harvest season. By the first 10 days of December 2002, many parts of the country recorded below normal rainfall mostly in Eastern, Northern and Southern provinces. The rainfall deficits in these areas were as high as 20 to 74 percent. The rainfall picked up towards the end of the first 10 days of December 2002. Nearly all areas of the country started receiving rainfall amounts favourable for crop germination and growth. Floods during this period were confined to Mbala District in the Northern Province and the southern half of Eastern Zambia.

The availability of cereals at the local markets as a result of low production continued to be a major concern. Not only was the supply of cereals low but also demand for marketed maize increased due to reduction in harvest. This perpetuated food insecurity as rural markets continued having a critical shortage of grain. Consequently, people resorted to winter cultivation as a drought coping strategy. This strategy, first attempted in 2002 with the aim of sustaining food security in the country, will have serious repercussions on the ecosystem.

The price of maize increased as the marketing season progressed in most parts of the affected areas. Large increases were observed in southern and south western parts of the country that were severely affected by 2001/2002 drought. The highest price increases of 50 percent and above was observed in the southern and western parts of the country. This confirmed that grain shortage in most of the rural areas were due to the drought. Consequently the government was compelled to import grain to feed those affected by the drought.

In most of the food insecure areas, the price of livestock went down by August 2002. This was a desperate measure by households in trying to cope with the food crisis situation that resulted from the drought. The reason was that inadequate water caused the number of livestock, particularly cattle, to decline either by slaughter for food or by death from diseases. About 38 percent of households could not cultivate part of their land due to shortage of labour. Only 17 percent of the households used oxen as the main source of draught power for cultivation while 68 percent used hand hoes. The rest used either hired or borrowed draught power as the main source of power for cultivation (Government of Zambia, 2002).

Another drought-related coping strategy was the adjustment on dietary intake. As much as 46 percent of adults were consuming only one meal per day. The effect of cutting down on eating times included malnutrition, miscarriages in pregnant women and marital instabilities.

Due to drought, maize production was too low to sustain the entire country and this naturally caused an increase in the price of maize. The increase in the number of people requiring food assistance in a number of areas could be attributed to sharp increase in maize prices after August making the commodity inaccessible to most households. The critical shortage of maize in most rural areas also made it difficult for those with the means, to purchase the commodity.

Droughts and floods also caused an increase in Zambia's urbanisation rate. Due to food insecurity in the rural areas, migration to urban areas in search of employment was seen as a solution.

Zimbabwe

Zimbabwe faces many environmental challenges, including:

- Growing poverty and its attendant problems of resource over-exploitation;
- Land degradation due to both human activities and natural phenomena, and the impact these have on food security;
- Continued loss of forests due to over-exploitation;
- Loss of biodiversity as a result of human activities;
- Threat of alien species such as the water hyacinth in some of the country's water bodies;
- Water scarcity due to variability of rainfall and ineffective water management measures, including pricing and pollution control;
- Atmospheric pollution due to industrialisation and other factors;
- Natural phenomenon such as drought and climate change.

The main natural disasters that Zimbabwe faces are droughts and floods. These have been mainly linked to climate change and variability particularly in the last twenty years. Zimbabwe is periodically affected by severe and prolonged droughts, which may be interrupted by equally devastating floods in some areas. Drought is an overriding factor in degradation of cultivated lands and rangelands in many parts of the country, impacting on plant cover, livestock numbers, as well as on personal wealth of rural people. Drought increases soil degradation problems, while soil degradation magnifies the effects of the disaster.

Research shows that drought caused a 25 percent reduction in volume of manufacturing output, and a six percent reduction in foreign currency receipts during the 1991-92 season in Zimbabwe. During that period, the Zimbabwe Stock Market was identified by the International Finance Corporation as the worst performer of 54 world stock markets, with a decline of 62 percent (Benson and Clay 1994).

With respect to floods, Zimbabwe has not been a flood-prone country and destruction from floods has been infrequent until very recently. Before the devastating 2000 floods,

damage to crops for example occurred in the Zambezi Valley in the Muzarabani area due to rivers overtopping their banks. Floods are experienced during the wet season, particularly in January and February when most of the rivers experience their peak flows. The highest floods are experienced in the Eastern Highlands due to high rainfall and steep slopes. As expected, the

lowest floods are experienced in the dry western part of Zimbabwe. This is due to low rainfall, and gentle slopes that are not conducive to flooding. Floods in Zimbabwe often occur during and following storms. These floods usually subside quickly, and rarely extend for more than 12 hours even on major rivers such as the Munyati, Gwayi, Mazowe, Runde, and Save.

During the period 2000-2003, Zimbabwe experienced the worst flooding event in recent memory. The rainy-seasons of 2000-2001 and 2002-2003 saw the country experiencing both drought and flooding events. The dry spell experienced at the beginning of the 2000/2001 season was followed by heavy rainfall which came through cyclone *Eline* in February 2000. This led to water logging, flooding and loss of crops, houses and household effects and livestock in some districts. The 2000 floods caused by Cyclone *Eline* affected four provinces: Manicaland, Masvingo, Midlands and Matabeleland South.

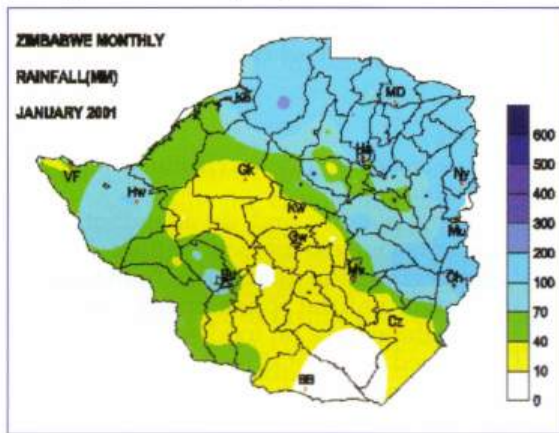
The 2000-2001 season was not good either for some areas. For example, the southern parts of the country had their first effective planting rainfall in January 2002, resulting in yet another poor harvest for the second consecutive season. As the season advanced with more rain coming in, these areas and those in the northern districts of the country in the Zambezi valley were flooded resulting in huge losses of crops, livestock and household effects. Muzarabani and Guruve were the most affected districts in the country during this period.

Generally the 2001-2002 season was characterised by a prolonged drought experienced in January through to March 2002. The drought affected most of the southern Africa region including Zimbabwe. A state of disaster was declared on 3 April 2002 and the Government of Zimbabwe appealed for food aid.

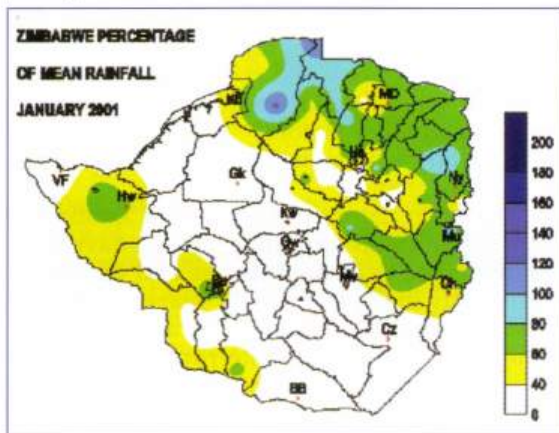
The 2002-2003 rainfall season was characterised by prolonged dry spells and patchy rains particularly in the Midlands, and Matabeleland South and North provinces. However, the latter part of the second half of the season (January to March) saw the development of various rain-bearing weather systems including Cyclone Japhet which, led to flooding in Mashonaland Central, southern sections of Manicaland and Masvingo provinces.

By January 2003 poor harvests were imminent for the 2002-2003 season as poor rains and reduced plantings were likely to reduce gross output (see Figure 7). By mid January, cumulative rainfall was between 32 percent and 80 percent of average rainfall during this period, with large seasonal rainfall deficits in the southern and western areas of the country. When rainfall amounts fall below 75 percent of normal for a particular place in Zimbabwe for an extended period of time, a meteorological drought is said to have occurred (Government of Zimbabwe 2003).

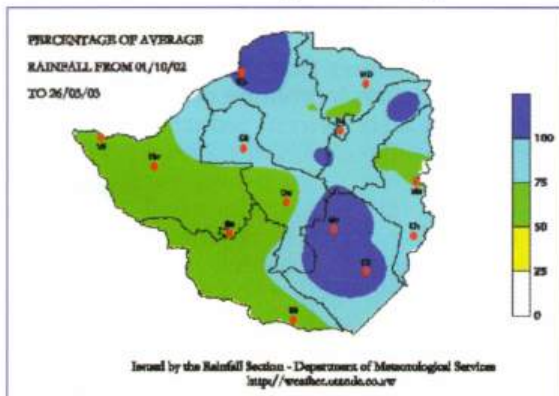
Map 4
January 2001 Rainfall (mm)



Map 5
January Rainfall as Percent of Normal



Map 6
Total Rainfall as a Percentage of the Long-Term Mean



Cyclone *Eline* significantly compounded the effects of the unusually high rainfall in January 2000, causing the worst Zimbabwean natural disaster in living memory. A State of Disaster was declared for four of the country's eight provinces: Masvingo, Midlands, Manicaland and Matabeleland South. The cyclone-induced flooding was identified as one of the major disasters in Manicaland, Matabeleland South and Masvingo Provinces (Government of Zimbabwe, 2000). The cyclone battered the country on the 22nd of February 2000.

According to the Meteorology Services, Cyclone *Eline* originated in Sumatra on 8 February 2000 and dragged westwards passing through Réunion Island. It then weakened whilst over Madagascar but strengthened again before making landfall over Mozambique on 22 February 2000. The cyclone then progressed into a strong inland cyclone and continued to bring stormy conditions across southern Africa.

As shown in Figure 8, the rainfall season of the period 2002-2003 had socio-economic and environmental repercussions on the country. The map compares the cumulative rainfall with the long-term mean across the country. The map suggests a meteorological drought for

Matabeleland North and South, some parts of Midlands as well as areas surrounding Rusape in Manicaland Province to the east of the country. This was however, different from the experiences of 2000 when Cyclone *Eline* totally changed the climatic and weather picture of Zimbabwe. The cyclone influenced heavy continuous rainfall with high wind speeds. The areas which bore the brunt of the storms and the subsequent inundation are Chimanimani, Chipinge, Mutasa districts in Manicaland Province; Chirumhanzi, Mberengwa districts in Midlands Province; all six districts in the Matabeleland Province namely, Beitbridge, Gwanda, Plumtree, Insiza, Matobo and Bulilimamangwe; and Chiredzi and Mwenezi in the Masvingo Province. The main basins of the Limpopo and Save Rivers in the southeast of the country were intensely affected by the impact of cyclone *Eline*, which came with high winds and surges over a period of 36 hours between 21 and 23 February 2000.

The cyclic events of droughts and floods in southern Africa may point to changes in global climate. The observation that there is apparent rise in global temperatures may further reveal why the occurrences of these extreme events are becoming frequent. If the predicted changes occur, there will be inevitable changes in ecosystems and species are likely to become extinct, at least locally. It is likely that many of the currently threatened plant species will become extinct. It is also predicted that sea levels will rise and that drier conditions will induce regional shifts in food production (as maize becomes unsuitable) and the availability of water. Despite lack of a definite trend, the models used to predict the temperature change for southern Africa confirm that the region will not escape the effects of global warming and that the predicted warming will be less than suggested previously by earlier estimates used in the 1990 IPCC assessment. While there is so much weight on the negatives that climate change is associated with, there are however, some positive spin-offs from such a change that

Box 3
New maize variety resists dry conditions

While most people countrywide will reap nothing from their early planted maize crop this year, Flora Rusike of Goromonzi is among the few happy ones who will definitely not starve this year, thanks to her decision to experiment with the "dwarf" maize variety.

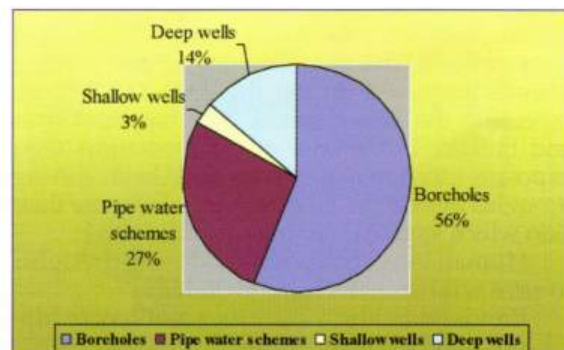
The early planted maize crop, which is about 30 percent of the country's national maize plantings for the 2001/2002, has been declared a write-off following a persistent dry spell from last December.

Rusike says she will be able to feed until next year all eight of her grandchildren whom she does not live with, her two workers, her husband Everisto and herself as she is expecting to harvest about two tonnes from her dwarf maize crop. She grew the dwarf maize crop for the first time this year. The dwarf maize variety, which is resistant to dry weather conditions and excessive rain situations, is a fairly recent arrival in Zimbabwe. Thousands of farmers from her area have had their maize crop wilted beyond recovery this year because of dry conditions for the past nine weeks.

They used the tall maize hybrid seed varieties. "I planted this dwarf maize variety by mistake and I will not go hungry this year," Rusike said. She told *The Daily News* during a visit to her home last Wednesday: "I went to Harare to buy seed and was disappointed to find that the SC709 maize seed that I used over the years was not there. Salespersons from the supermarket suggested I buy the Super Dwarf AC71."

Source *The Daily News*, Monday 4 March, 2002

Figure 1
Access to Different Types of Water Sources in Zimbabwe





Mukuvisi Woodlands in Zimbabwe

southern African countries would benefit from including an increase in sardine and anchovy distribution and quantities, particularly along the west coast of Namibia. Nonetheless a temperature rise of 1.5°C shows indications that this would cause:

- Drying up of large parts of the sub-region;
- Decline of grasslands that will be replaced by thorn savannas, dry forest expansion, and general desertification of most parts of the region;
- Biodiversity in 15-20 percent of national parks affected by changing conditions;
- Variation in runoff;
- Crop yields increasing overall, but with larger variability;
- Changes in the distribution of disease yielding insects.

Drought problems go deeper than just the availability of surface water. The water-table is usually lowered if an area is hit by recurrent droughts. Available data also reveals that approximately 50-60 percent of the shallow or family wells, which are common in Zimbabwe's natural regions I, II and III, dried up.

In the urban areas most water service providers resort to water rationing for domestic and industrial use. However, water intensive industry's such as beer brewing and food processing are severely affected. Reduced runoff, and hence water resources also has an impact on tourism, wildlife and water supply for recreation.

Drought events are known to cause high mortality in wildlife. Drought occurrences in Zimbabwe have led to an overall reduction in species diversity and plant biomass in dryland ecosystems. Grazing animals normally travel long distances in search of food and water due to poor grazing coupled with water scarcity. Because of poor pastures, the mortality rate among grazing animals increased during the 2000-2003 period, especially the larger species like hippopotamus and buffalo. In the case of hippopotamus their exposure to intensive sun and heat during droughts results in blisters and cracks on their skin which lead to dehydration and death.

Human interventions used during droughts to save wild animals have included:

- Provision of sugar cane tops and hay to hippos and buffalos;

- Capture and translocation of elephants, roan, sable and waterbuck; and
- Culling, by selecting the oldest and youngest, and leaving those with the greatest chance for survival.

Droughts also influence animal behaviour especially with respect to what they choose as food. During droughts, baboons will resort to damaging vegetation through defoliation and debarking due to lack of other types of food. Extremely high temperatures contribute to bird and bat mortality due to high metabolism and hyperventilation. However, not all wildlife suffer negative effects from the drought. Many predators such as lions, leopards and hyenas usually survive due to the high mortality rates of the herbivores. Lions in particular, find it easier to kill the weak animals at water points.

Other creatures such as rodents and insects are also witnessed after droughts as they come out in battalions and may waste the very little that people may have harvested during drought periods. The massive build up in population of these creatures is because of the fact that their natural predators – snakes, frogs and small birds perish during the drought. Therefore, droughts result in the breakdown of the ecological system and it can take up to several years for nature's balance to be restored. In the case of Zimbabwe, impacts of drought on wildlife are most felt in the National Parks particularly Gonarezhou National Park due to its location in agro-ecological region V, which is one of the driest in the country.

The timber industry in Zimbabwe contributes about eight percent to the total manufacturing industry and three percent to Gross Domestic Product. However, the contribution of forestry to the informal economy in the form of fruits, food security, firewood (which accounts for 70 percent of rural energy), browse and leaf litter, rural agriculture, building materials, medicine and woodcraft industry is possibly more than that of the formal sector. Fire risks associated with drought conditions are very high. The high temperatures experienced create conditions conducive to devastating veld fires, which apart from destroying fauna and flora, also destroy forests and pollute the environment.

Sawing and drying timber from dying trees during droughts or timber from fire damaged trees presents problems due to reduced moisture content in the timber. Drought affected eucalyptus timber splits more easily after felling and does not debark easily. Delayed felling and thinning worsen the effects of drought due to competition for moisture, and it is recommended that felling and thinning operations be carried out at the normal times.

In terms of agriculture, drought mainly causes land degradation particularly of cultivated land and rangelands. There is a greater impact from wind after a long dry spell. Subsequently, soil from the cultivated land will be blown away. In addition, sheet erosion easily sets in particular-

ly at the early stages of the rainy season. During drought periods, the roots of perennial grasses are unable to survive while annual grasses fail to seed. The effects of droughts are worse in areas where there are poor land management practices. Droughts therefore expose the land to the many agents of erosion and act as major catalysts in land degradation.

Due to depressed growth of vegetation, animals tend to browse species which they normally do not feed on. Therefore, the ecosystem is greatly disturbed during drought period and a virtuous cycle of drought – desertification – more drought may result. Desertification amplifies the impacts of drought by magnifying plant moisture stress because of poor moisture retention capacity of degraded landscapes. The more visible manifestations of desertification include accelerated soil erosion by wind and water, salt accumulation in the surface horizons of dry land soils, a decline in soil structural stability with an attendant increase in surface crusting and surface runoff and a concomitant reduction in soil infiltration capacity and soil moisture storage, and replacement of forest or woodland by secondary savannah grassland or scrub. The worst hit sector by drought is agriculture and the impact is most severe in dry-farming areas. Marginal land is more vulnerable to degradation. Although soil loss due to water erosion slows down during drought periods, when the rain comes, erosion rates go up much higher than during dry years due to lack of plant cover and the crushed soil.

Drought can lead to increased poverty of the rural people, as agricultural yields often decline to zero and livestock numbers reduce. In May 2003, the *Daily News* reported that Zimbabwe's national herd had dropped significantly threatening the viability of the country's beef industry. The decline was partly blamed on reduced output due to the teething problems of the country's land reform programme; massive de-stocking by farmers evicted from their land; drought; as well as stock feed and vaccine shortages.

People in the rural areas are greatly affected by the effects of drought. Their crop production drops, animals die and this forces them to seek alternative sources of livelihoods. The 2000-2003 period has seen people scramble for whatever resources are accessible and remaining. Consequently, there is a lot of deforestation for the sale of fuel wood as a source of income. Illegal gold panning in Zimbabwe is said to be on the increase in Matabeleland South, Midlands and Mashonaland West during the drought periods. The main effects of drought on the lives of communities include:

- declining income sources across all strata. This is mainly because some of the activities depend on water availability (e.g. market gardening, beer-brewing, brick-making etc); and
- reduction in incomes during drought is also accompanied by an intensification of other income-generating activities, leading to increased land degradation. For example,



Forest plantation in Zimbabwe



Agriculture

river banks are damaged by increased *dambo* agriculture and gold panning, and trees are felled for charcoal production and firewood provision.

The encroachment of human settlements in flood prone areas as people decide to locate in wetter areas and avert drought effects, combined with extensive landscape alteration as seen in the Save and upper Limpopo catchment in Zimbabwe predisposes human settlements to disastrous floods. For example the land pressure in urban areas such as Harare often results in unplanned settlements occurring in flood prone urban wetlands, which in the urban plans would have been set aside as non-residential areas. The conversion of catchment areas to roof surfaces and surfaced roads, and reclamation of wetland areas, causing rapid delivery of catchment runoff to the stream channel increases the risk to human life in such unplanned wetland settlements.

Consequently, droughts experienced in the sub-region have led to the exacerbation of poverty among the communities in southern Africa. Typically the poorest families lack the capacity to cope with stress, and suffer acute difficulties, such as sickness and economic impoverishment. Natural disasters and economic crises claim their victims from among these vulnerable sections of society. Besides the direct humanitarian costs of drought, its potential for causing unrest, malnourishment related health disorders and especially its synergy with HIV and AIDS and loss of productivity can have far-reaching economic impacts. Hydropower generation is a critical element of the development and industrialisation activities in the sub-region. For instance, in the 1991-1992 drought the lost production from Kariba was estimated at hundreds of million dol-

lars in direct revenue, but the ripple effects resulted in loss of over 2000 jobs in Zimbabwe. In addition, when urban water supplies are restricted because of drought, there is danger of cholera outbreaks as sanitation breaks down. For example, the most severe cholera outbreak for the City of Mutare in Zimbabwe was associated with drought.

An assessment of water and sanitation services carried out by the Institute of Water and Sanitation and UNICEF in Zimbabwe in May 2002 highlighted a deterioration in community access to these services particularly in the rural areas due to drought, cyclone – induced floods, a reduction in budgetary allocation and the land reform programme. It was found that communities had shifted their attention from rehabilitating damaged structures to spending more time seeking food during the humanitarian crisis that was being experienced during the time.

Damage to infrastructure was mainly experienced during the floods in the 2000-2003 period. In Zimbabwe, most of road systems were designed on historical data concerning probabilities of severe flooding. Bridges were constructed to accommodate anticipated peak discharges while road crest heights and drainage were designed to remain above floodwaters at anticipated precipitation intensity. In urban areas, street storm drains were designed to minimise street flooding during storms. However, the experience with recent floods in Zimbabwe suggests that the design limits of these public works may now be exceeded more frequently.

The disruption of the road network and damage to, and sweeping away of bridges cut off the population's life-line of supplies in areas such as food, fuel and services, in general (Government of Zimbabwe, 2000). In addition, falling trees by the storms severed telecommunications and electricity lines resulting in loss of contact with the rest of the country and power for driving economic activities.

Damage and destruction to clinics, schools, drinking – water sources as well as boreholes and irrigation schemes during Cyclone *Eline* seriously disrupted the lives of the people in the affected areas. *Japhet*, the cyclone that had traversed from the Mozambique Channel through Mozambique into Zimbabwe, only worsened the situation in Mashonaland Central and Manicaland provinces of Zimbabwe. Roof tops were blown off, roads damaged and crops destroyed. The Chimanimani area experienced a few landslides, however there were no fatalities.

The reduction in the inflows to the Kariba reservoir substantially reduced the level of hydropower available to both Zambia and Zimbabwe. As a result of critically low water levels during drought periods, the Zimbabwe Electricity Supply Authority (ZESA) took drastic measures to curtail elec-

tricity usage in the country. ZESA introduced the quota system which entailed some of the following:

- Consumers were allocated a monthly quota of electricity adjusted to available supplies and national priorities;
- ZESA would levy consumers who exceeded their monthly quota an additional charge;
- Load shedding would be used during system breakdown or major loss of generation with or without prior warning; and
- The electricity supply authority introduced a regular information campaign aimed at assisting consumers to understand the power curtailment measures.



Drinking water from urban water supply source



Large industries depend on water for their operations



Drilling for disaster preparedness in Mozambique



Rain harvesting barn and simple conservative irrigation techniques

IMPACT OF DROUGHTS AND FLOODS

Droughts

Extreme hydro-meteorological events in southern Africa are not a new phenomenon. What seems to be for certain however is that droughts and floods are becoming more and more devastating especially on the environment including their ever-rising toll on people's lives and their property. On the other hand, floods can both be beneficial and undesirable. There are those that occur seasonally in the many flood plains of southern Africa and those that are instantaneous and often devastating. They can be culturally useful such as in the case of the *Kuomboka Ceremony* of the Barotse people of Zambia or socially and economically devastating as the various case studies have demonstrated in this booklet. The incidences of floods in the sub-region had multiple effects on the lives of people, their property and also on the economies of the countries in general as well as on the environment.

Droughts in the sub-region have occurred with varying magnitude. Some droughts have been serious and have occurred for an extended period while others have been light and over a short period. During the period 2000-2003 southern Africa received normal to above normal rainfall across the entire sub-region, with the exception of Lesotho, the central part of South Africa and the northern half of Tanzania. Some dry spells were observed at the beginning of the season which were followed by heavy down pours throughout the countries of the sub-region except for Tanzania and the Democratic Republic of Congo (DMC 2002). Therefore this was a relatively wet period even though there were dry spells existing in some parts of the sub-region.

Droughts in southern Africa have resulted in uncompromising conditions on both people and the environment with many communities suffering from prolonged hunger and poor nutrition. Some of the consequences of drought are:

- Many people are prone to disease during drought periods;
- In cases of deficiency in water supply, people especially those in the rural areas turn to any sources that may provide water for their needs. However, these may also be the same sources where wildlife and livestock drink, and because the sources are unprotected, users of the water may contract water-borne diseases;
- Although more research is needed, it can reasonably be deduced that droughts influence the beginning and growth of desertification of land. Under dry conditions soils are hard and may crack and bush fires are common;

- Drought conditions are generally unpleasant, with high temperatures;
- Prices of commodities are usually high as entrepreneurs want to maximise their profits at the expense of people's suffering;
- Corrupt practices may result in the public, private sectors and among ordinary people;
- There is a growing culture among people in southern Africa to rely heavily upon governments for handouts. Even in the event of a good season the dependency syndrome that has been cultivated, has made people to be less creative. The capacity for innovations and creativeness seems to be dwindling away.

In September 2000 the Drought Monitoring Centre together with the Botswana Meteorological Services convened a climate outlook forum to formulate consensus guidance for the October 2000-March 2001 season for the sub-region. The forum reviewed the state of the global-ocean atmospheric system and its implications for the southern African sub-region. Among the principal factors taken into account were the *La Nina* episode which had been observed to be dying down and the sea surface temperatures which were then nearing average and were predicted to remain near normal for the following six months (DMC, 2002). Using ocean-atmosphere models and physical-based statistical models, the experts had predicted that most of the sub-region would receive normal to above normal rainfall during the period October 2000 to March 2001. However, for the period October to December 2000, the northern part of the sub-region including north eastern Angola, the southern half of DRC, northern Mozambique and Tanzania, would have normal to below normal rainfall.

These predictions were correct and what was to occur was more than the predictions had revealed. Heavy rains caused by a tropical depression in January caused flooding and water logging in Mozambique and South Africa. This was followed by a tropical cyclone *Eline* which brought in heavy rainfall within the sub-region especially in Mozambique. Apart from heavy rains the cyclone was also associated with strong winds which caused heavy damage to infrastructure and crops in parts of Botswana, Mozambique, South Africa and Zimbabwe. Another cyclone, *Hudah*, developed at the end of March resulted in late cessation of the rainfall season in the sub-region. However, parts of southern and northern Mozambique and Zambezi Valley between Zambia and Zimbabwe experienced drought conditions.

Droughts in southern Africa are responsible for a number of changes both on the natural and human environment.

Table 7
Chronology of Droughts in Southern Africa

PERIOD	EVENT
1800 - 1830	Southern African rivers, swamps and other water bodies dried up and some well-watered plains turned into semi-arid Karroo
1820 - 1830	This was a decade of severe drought throughout Africa
1844 - 1849	Southern Africa experienced five consecutive drought years
1870 - 1890	This period was humid in some areas and former Lake Name filled up in the northwest of Botswana
1875 - 1910	There was a marked decrease in rainfall in southern Africa, and 1910 experienced a severe drought
1921 - 1930	There was a severe drought in all of southern Africa
1930 - 1950	Southern Africa experienced dry periods alternating with wet seasons and in some years the rains were very good. The 1946-47 season experienced a severe drought
1950s	There was abnormally high rainfall in some parts of the region
1967 - 1973	This period was dry across the southern African region. The equatorial region (including the DRC) experienced above-average rainfall.
1974 - 1980	This six year period was relatively moist over much of southern Africa. In 1974, the average annual rainfall was 100 percent above normal throughout the sub-region
1981 - 1982	Most of southern Africa experienced drought
1982	Most of sub-tropical Africa experienced drought
1983	This year saw a particularly severe drought for the entire African continent
1985	Conditions improved
1986 - 1987	Drought conditions returned
1991 - 1992	Southern Africa experienced the worst drought in living memory
1992 - 1993	Conditions slightly improved but the previous year's drought effects carried on
1993 - 1994	Conditions improved
1994 - 1995	Many of the countries in the SADC region were hit by the worst drought in memory surpassing the effects of the drought of 1991 -92 in some parts of the sub-region
1995 - 1996	Widespread rains in most part of the sub-region prompting forecasts of bumper agricultural season
1999 - 2000	Southern Africa receives very heavy rains as a result of tropical cyclone Eline that caused extensive damage to both primary and secondary road networks, bridges and dams in some countries of the sub-region
2000 - 2001	Southern Africa receives normal to above normal rainfall across the sub-region, except for Lesotho, the central part of South Africa, and the northern half of Tanzania
2001 - 2002	Southern Africa experiences abnormally high rainfall and disastrous floods causing damage to infrastructure and loss of lives and property
2002 - 2003	The sub-region experiences normal to above normal rainfall

Source: Chenje, M. and Johnson, P. (eds.), *Water in Southern Africa*, SADC/IUCN/SARDC, Maseru/Harare, 1996, p35. **Note:** Information for 1999-2003 has been added from the results of this research.

Surface water

Droughts have resulted in declining amounts of both surface and groundwater resources due to inadequate amounts of rainfall to replenish storage in rivers and groundwater sources (Malawi Government, 2001). This situation impacts negatively on water supply schemes which are affected by the variability of seasonal run-off, since most schemes rely on direct abstraction from rivers (Malawi Government, 2001).

The droughts of the 2000-2003 period like those that occurred earlier, are responsible for the deficiencies in water supply experienced by both urban and rural areas in the countries of this study. Due to inadequate rainfall, rivers and streams flow below their normal discharge rates and the remaining runoff is shared between people, and the environment. The high evaporation rates experienced in most parts of the sub-region makes the situation worse.

During the year 2002, the water situation in Zambia was said to be slightly better than during the previous season as the annual mean flow of most of the rivers was slightly above average. Following a government policy to expand access to water sources in drought-prone areas meant that water availability did not deteriorate so much during the drought of 2002 to impact negatively on people, livestock and agriculture (Zambia Vulnerability Assessment Committee, 2003).

Serious shortages of water caused by droughts often lead people to take desperate measures that see them survive the occurrence. These measures may include relocating from a settlement to another, which is close to a river, lake or wetland. Migration to these areas breeds further negative consequences due to the needs of the people. Often new settlements will lead to clearing of land for wetland agriculture and settlement which was otherwise left untouched. While people will carry out these actions for survival, they may or may not be aware that these actions would lead to soil erosion and deposition in rivers and streams. Consequently the pressures exerted on the river banks through wetland agriculture may often lead to drying up of the rivers themselves.

People are often not aware of environmental consequences of their actions and public education and awareness is therefore important. One of the goals of the Malawi National Environmental Policy is "to enhance public awareness of the importance of sound environmental understanding of various environmental issues and participation in addressing them." Such a goal would, with appropriate actions, go a long way in educating people to understand how intrinsically environmental issues are linked.

Women are the most disadvantaged group of society during droughts. Households headed by women and children are the most vulnerable, as they are generally the poorest with limited assets to buy food at inflated prices. In times

of water scarcity, they are forced to walk long distances to fetch water for their families. Under conditions of competition for water, women often have to wake up in the early hours of the morning to rivers and streams to fetch water; a situation which exposes them to attacks by wild animals.

Since the water is usually carried in small containers on the head, it is not sufficient for cooking, washing and bathing. As a result, during drought, sanitation is often made much poorer resulting in people becoming more vulnerable to disease. Even where food is available, intake may be reduced as a result of scarcity or mere absence of water. In Mozambique for instance, it is reported that conditions are severe. "More than 70 percent of the people of the central provinces live below the poverty line – over one million people depended on food aid in early 2003, and that number is rising rapidly."

Recurring floods, drought, and chronic disease keep thousands at the subsistence level of farming with few opportunities for growth (Oxfam, 2003). Even as farmers cope with drought today, aid agencies continue housing and latrine reconstruction in the wake of the terrible events of 2000 and 2001 (Oxfam, 2003).

Wetlands

Wetlands play very important functions in the natural environment including groundwater recharge, flood control, water quality control, food chain support, storm protection, water transport and recreation (Breen C. M. et al, 1997). However, consequences of drought on wetlands can be devastating both for the wetlands themselves and the people who depend on the wetlands.

As wetlands are unable to receive normal inflow of water during droughts, their extent decreases, as well as the volume of water they are able to hold. As a consequence, very little recharge of groundwater takes place. While many people in southern Africa, especially those in the rural areas, depend on groundwater, the drying up of boreholes as a result of poor aquifer recharge means that people are unable to gain access to water for purposes of cooking, bathing, washing and watering animals. This scarcity leads to animal deaths, poor nutrition, poor sanitation as well as added responsibilities for women to fetch water from those areas that are able to offer some.

In Malawi, effluent from industries in urban areas and agricultural estates in the rural areas has created negative environmental consequences. Chemical contamination of stream water in urban and peri-urban areas is becoming a common problem due to improper disposal of waste. The absence of proper biological and physical conservation in farmers' fields leads to pollution of the aquatic environment by agrochemicals such as nitrous compounds through run-off water (Government of Malawi, 1998).

Due to inadequate sanitation facilities, the bacteriological quality of major rivers is poor throughout the year. Three quarters of the rivers in Malawi show faecal coliform counts in excess of 500 per 100 ml in the dry season, which is significantly above World Health Organisation guidelines. About 50 per cent of all illnesses in Malawi are attributed to water borne diseases (Government of Malawi, 1998). Therefore this condition becomes even more disastrous during periods of drought as there is insufficient water in river channels to adequately dilute the wastes.

While periods of normal and above normal flows into and out of the wetlands enable these ecosystems to self-purify, it is difficult for wetlands to carry out this function during droughts. Disposal of waste such as effluents and other chemicals into wetlands during droughts heavily pollutes them and may result in eutrophication, growth of aquatic weeds, death of aquatic plants and animals, collapse of fisheries and loss of the aesthetic value of the ecosystem. Generally, during incidences of drought, there is an increase in the spread of diseases particularly water-borne diseases such as diarrhoea and cholera. Dependence on wetlands for water supply makes people vulnerable to incidences of disease especially where the ecosystems are also depositories of waste. These diseases hinder productivity among people and as a consequence, make them dependent on others for their basic needs.

Agriculture

While agriculture is the single largest employer in southern Africa, droughts result in severe hardships for both the smallholder farmer and the large-scale commercial farmer. Water scarcity due to drought leads to loss of soil moisture essential for plants and vegetation. As a result farmers are forced to delay planting their crops in anticipation of good rains. However, intensification of dry spells and drought may only force them to abandon planting all together since they are heavily dependent on rain-fed agriculture (UNEP, 2002).

The occurrence of seemingly good rains at the beginning of the season has many a time made farmers plant with high expectations of a good year. However, the creeping in of dry spells and drought results in wilting of crops or complete crop failure due to loss of the required moisture. Crop failure is most common in many plateau areas of the southern Africa sub-region where drought occurs unlike in those areas where there is some reasonable water supply such as in valleys of the major river systems.

Communities that solely depend on agriculture, especially subsistence agriculture in southern Africa, are most vulnerable to drought since it is the only source from which they are able to secure food and income. Complete crop failure leads to food insecurity for many households. As a result, families are forced to secure other means of sourcing food. They may be

forced to log trees from conservation and protected areas for charcoal to sell in urban areas so that they can use the income for buying food. Consequently, this leads to deforestation of prime areas. Food insecurity also entrenches poor nutrition in many households and the situation is most grave in female-headed families. Under desperation, families may be forced to lose some of their assets by selling them or exchanging them for food.

Because grazing becomes difficult during drought periods, families are unable to keep large herds of animals and are most often forced to sell some for income. Such losses lead these families into a situation of further insecurity especially among those communities who depend on livestock as part of a life-long insurance and security.

Crime is also rife during difficult times. The absence of food in the home may drive many people to resort to crimes such as theft, prostitution and plundering. These unlawful actions, while aimed at solving the immediate challenges being faced by families breed other undesirable aftermaths such as imprisonment, disease and murder. People are therefore made even more vulnerable to situations which they would not otherwise have gone through.

The failure of crops in agriculture during drought leads people into a cycle of poverty as they may not even have the ability to secure the necessary income required for the agricultural inputs for the following season. As a result, they simply look to the government for assistance – a condition that is becoming common in recent times. This situation does not allow for people, especially smallholder farmers, to be self-reliant and usurps them of the confidence in agriculture leading many male farmers to relocate to urban areas in anticipation of employment.

Poor harvests in agriculture for those countries that depend on the industry mean that they are unable to secure the necessary quota for export to generate the much needed foreign exchange earnings. Droughts also force countries in the sub-region to import food using those resources which would otherwise be needed in other sectors such as health or education.

Land resources

Droughts are responsible for the malfunctioning of ecosystems and can cause severe changes on the environment. Due to scarcity of water in wetlands, rainforests, marshes, swamps and lagoons and other such environments, complete changes may occur with loss of valuable plants and animals.

Deaths of wild animals and plants occur as a result of absence of water. Some of these plants and animals may be endemic to particular locations or countries and are an important national asset necessary for the tourism industry.

Prolonged droughts in southern Africa expose the region to desertification. Dry condi-

tions are a necessary catalyst for loss in soil texture, wilting and drying up of plants and vegetation, and this leads to many areas becoming barren. As the land is not protected from its natural cover of vegetation, crusting and sheet erosion take their toll. In those communities where livestock are plentiful, further grazing on already impoverished land aggravates the situation. During rains, these lands are susceptible to severe erosion because the soil is unable to hold together resulting in excessive deposition of soil in river channels.

The effects of droughts and floods are complementary. With high erosion and severe deposition of the load in rivers, the configuration of channels changes, resulting in the rise of the river bed and making the river channel unable to contain any floods that may occur. Most often, this is part of the reason why many river valleys are flooded wiping the crops, settlements and people in the near neighbourhood.

In societies which entirely depend on land for their survival, land degradation is a harsh punishment to the people as this is permanent to the very resource upon which their livelihoods depend. Under conditions of poor soil fertility, eroded fields, coupled with the inability to secure appropriate and adequate farm inputs due to their high costs, people are unable to produce adequate food for consumption and sale and the land does not offer them any promise for advancement.

Forests

Both natural and exotic forests are an important national asset for southern Africa. The importance of forests in the sub-region is diverse as they offer essential products such as timber, construction material, fuel wood, edible plants and animals, medicinal products, as well as protect land and are a habitat to wildlife.

The pressures on forest resources are aggravated by poverty characterising southern African societies. Loss of arable land due to droughts is cause for many people to relocate from their otherwise once fertile land, degraded by drought and encroach into forest reserves for settlement, cultivation, grazing and sometimes for logging trees to produce timber and charcoal for sale. Even in the presence of standing forest regulations which prevent people from the wanton cutting down of trees in these reserves, people have no choice but to infringe upon the law in order to survive.

The destruction of forests as a result of the pressures people face in the wake of droughts, leads to further land degradation in pristine zones thereby depleting the national potential of producing or providing essential products and services required in national development and growth. The essential services that forests offer in environmental protection are therefore compromised by people's actions because they are unable to lead a secure and productive life

as a result of extreme events such as droughts. Often, conflict has developed between people and government based on whether there is sense in keeping wildlife in national parks and wildlife reserves at the expense of people's life.

The land is often dry as a result of drought, and this exposes forest ecosystems to forest fires. As a result, inferior forest species are destroyed and sometimes fires may cause deaths to wild animals.

In times of drought forests may provide for the basic needs of rural communities including food items. Wild vegetables are known to have saved many lives in drought-stricken areas in Malawi during the 2000-2003 period and their protection becomes even the more important.

Food security

During the period 2000-2003, Malawi, Mozambique, Swaziland, Zambia and Zimbabwe experienced both drought and floods. Sixteen million people were exposed to hunger in the months that followed one of the worst droughts in a decade. Rainfall had been erratic, insufficient at best, and destructive at worst (CARE, 2001). Hundreds of thousands of families throughout the region could not grow adequate food to survive. Farmers had less to sell.

The late start of the planting season as a result of droughts in many parts of Malawi caused panic among many and resulted in massive food shortages that affected as many as 3.2 million people. Households were unable to grow enough maize, the national staple food, to sustain families. As if this was not enough, the occurrence of the tropical cyclone *Delfina* exacerbated the crisis, damaging crops and destroying infrastructure such as telecommunications, roads, bridges and irrigation canals. A late start to the winter planting season also affected the winter crop yields.

In Mozambique, the government had established that the effects of the 2000 drought were still being felt by people where some 1.4 million people were seriously affected. An additional two million people were at risk as a result of the destruction that had been caused by the floods brought on by the tropical storm *Delfina*. The government was therefore faced with the challenge of feeding a total population of some 3.4 million people.

The situation in Zambia was not much different from that in Malawi and Mozambique. About three million people, nearly a third of the total population, were exposed to hunger and starvation. The major problem in Zambia was erratic rainfall which caused the widespread failure of the country's maize crop on which a huge population of Zambians depend as their principal staple food. The Eastern and Southern provinces of Zambia were the most affected. The maize crop in Southern and Western provinces was failing and most farmers predicted harvests of between 1-3 percent of a good

year. Other important food crops, such as cowpeas, groundnuts, sweet potatoes and pumpkins also failed.

In Zimbabwe, the mid-season dry-spell in January 2001 affected crop production in the southern areas while isolated flooding in February and March dampened prospects in the northern districts (SADC, 2001). Food security projections for the 2001-2002 marketing year indicated an overall cereal deficit of 846,000 tonnes. Rainfall in the 2001-2002 season was characterised by below normal rainfall in the October to December period in the northern parts of the country and heavy falls during the first half in the southern parts.

The 2001-2002 crop production was the lowest in the 12-year period from the 1990-1991 season. The poor rainfall season resulted in stunted growth in most crops, high levels of plant pest infestation and temporary and permanent wilting of crops (Zimbabwe Herald, 2002).

However, a report by the Famine Early Warning System Network (FEWS NET) in July 2002 noted that while crops had suffered, the condition of grazing livestock continued to be good throughout the country. The report said that livestock in drought-affected areas, such as parts of Buhera and Beitbridge districts, were being moved to nearby areas with adequate grazing and that water for livestock was generally available.

Floods

Floods in southern Africa have become more frequent and they take different forms. In some cases especially in relatively flat areas, flooding involves total inundation of homes and infrastructure and water may be stagnant for weeks.

Under such conditions, the effects of flooding are not instantaneous but gradual. For instance, houses may continue being destroyed as they become weaker at the foundation and animals may die due to loss of access to food. For plants and vegetation that do not like wet feet, they too die away. Flooding may also occur along river channels where the flood water overflows the river banks. Under such cases, runoff comes in sudden gushes and due to changes in cross-sectional configuration of the river or stream, as a result of mismanagement, proper conveyance is hampered. Such type of flooding may in most cases be associated with cyclonic influences and can usually be blamed for sudden destruction of property and loss of life. Southern Africa has seen some of the worst flood disasters in the world during this century. Although it can be expected that flooding ought to occur in the senile stages of a river basin, floods in the youthful and middle stages of rivers and streams are becoming common of late.

The floods caused extensive damage to both primary and secondary road networks, bridges and dams which are the life line during drought periods. A number of people lost their



Drawing murky water in the Shire River

Nation Newspapers, Malawi



Restoring a bridge on Malawi's M1 road

Nation Newspapers, Malawi



A commuter swept away by floods, Rumphi, Malawi

Nation Newspapers, Malawi

lives, homes were destroyed while crops were damaged extensively. A significant amount of fertile top soil was lost through erosion in many of the flooded areas. With the abundance of stagnant water, the risk of the outbreak of waterborne diseases such as malaria and cholera significantly increased and drinking water was highly contaminated. Many boreholes were damaged which again increased the risk of people contracting water borne diseases. In Mozambique alone, the damage caused by the rains and the floods was estimated at US \$600 million (DMC 2000). Several factors can be attributed to occurrence of floods in southern Africa. The factors include:

- Poor drainage systems;
- Silting of drainage channels especially rivers and streams as a result of erosion from the upper reaches of river basins;
- Gradual encroachment of flood plain area by human settlements and other activities, leading to loss in the drainage capacity of rivers and streams and reduced infiltration rates;
- Highly meandering and unstable rivers (i.e. Songwe and Livulezi);
- Sudden failure or bursting of water retaining structures such as dams and barrages can cause untold damage to life and property;
- Landslides into river valleys have often created temporary dam like obstructions whose subsequent failures cause flooding of downstream areas;
- In deltaic areas, floods are usually caused by the sudden diversion of flow from an existing channel into another channel of poor conveyance; and
- High lake levels arising from heavy storms such as cyclones cause severe flooding as experienced along the Lake Malawi/Niassa lakeshore areas, in 2003.

While floods cause severe problems on the environment, there are also positive elements with which they can be associated. These positive aspects of flooding include:

- Replenishment of nutrients especially in the estuaries and coastal regions which come in the form of silt;
- Cleaning process of ecosystems that have been laden with hazardous waste;
- Resuscitating ecosystems important for the tourism industry; and
- Maintaining essential levels for water systems such as lakes and rivers necessary for navigation.

Surface water

The floods of 2000-2003 had multiple effects on the surface water resources of southern Africa especially in those countries that were affected by them. While it is recognised that floods have positive effects such as replenishment of riverine systems, the devastation that is associated with them far outweighs the positive elements with which they are associated.

Most floods are associated with cyclones. As the rivers are unable to contain the vast amount of water within their banks, large plains and valleys are inundated by flood waters submerging water supply points, farms, settlements and anything in their path.

While most of the essential service points are inundated such as boreholes and dug-out wells, families are unable to have access to safe water for drinking and are forced to use the flood waters. Because of the pollution with which they are associated, people are therefore more vulnerable to disease. Low-lying areas are most susceptible to flooding in southern Africa and these are the same areas where many people are settled in need of fertile land and grazing fields.

Agriculture

Floods cause serious loss of crops in southern Africa. While all the countries in the sub-region rely on maize as their staple food, the loss of this crop during floods leads communities to replant usually with little success since the floods may occur only when the growing season is coming to an end. Flooding has not affected only the smallholder farmer but also large estates where maize, sugar and rice are grown. In irrigated rice schemes, floods have been responsible for the destruction of hydraulic works such as weirs and canals rendering the scheme unmanageable.

The negative effects of floods on agriculture are many and related. These include:

- Destruction to crops and food reserves for communities;
- Loss of initial investment through farm inputs such as fertilisers and labour;
- Lack of food and emergence of poor nutrition;
- Surfacing of nutrition-related diseases such as kwashiorkor especially in young people;
- Loss of food security by communities;
- Indulgence by the government to fend for the people;
- Huge investments are required for rehabilitation of irrigation systems destroyed by floods;
- Injection of financial and other resources such as seed and fertilisers by government for distribution to affected families; and
- Provision of health facilities and other essential services and basic needs for the affected communities.

The cyclic nature of extreme events with which the sub-region is associated requires concerted effort towards understanding how vulnerable different societies are and what measures must be taken to mitigate the disastrous effects of floods in those areas.

Land resources

Much arable land is usually rendered useless during floods as most or all of it is submerged. Although floods can be beneficial in the sense that they bring fertile silt from uplands on to valleys, they are also responsible for the total destruction of once planned areas bringing onto them garbage, logs of trees and other rubbish. They can also cause land degradation through erosion and complete loss of farmland.

Land degradation caused by floods does not only contribute to food insecurity for the flood-affected families but also to the whole population in the country. This is why food imports may become necessary to cover up for losses during droughts and floods. A whole nation, rather than a community or communities may be vulnerable to food shortages. A long-lasting resolve is therefore required to reverse the trend of importing food by putting into place those mechanisms that provide for early warning of impending extreme

events and precautionary measures that guarantee security from disasters. Poor land resources are a permit for loss of agricultural output, less food and income, poverty, disease, vice and conflict.

Forests

Forests have not been spared from the destructive forces of cyclones with which floods are also associated. High winds have pulled down trees in forest plantations. In Zimbabwe, for instance, as a result of strong winds from Cyclone *Eline* vast areas of trees in the Eastern highlands, where 92 percent of the country's timber plantations are situated, were uprooted or destroyed. More than 5,400 hectares or 4 percent of the country's plantation resources were totally or partly destroyed, bringing down nearly 1.01 million cu m of timber (FAO, 2000). Some factories dependent on sawn timber were forced to close or downsize their processing activities following the floods. Plantations on hill slopes were the worst affected by the cyclone, while ridges and valleys suffered less damage.

A number of dangers are associated with high-velocity flood-causing wind systems. Because of the ferocity with which cyclones are associated, people face the danger of being killed by falling trees, falling electricity poles and wires that could electrocute them, destruction of their homes by falling trees, forest fires caused by damaged electricity networks. These dangers are real especially for rural communities who most often have no access to radios or other information networks that would offer early warnings.

Wildlife

While floods may bring positive effects in the wild such as the rejuvenation of plants, they can also cause much destruction on the environment. Different plant and animal species are adapted to different ecosystems and any manipulation or changes in the ecosystem can result in the loss or reduction of these species. Small plants and animals are particularly vulnerable to flooding as they are easily smothered by the floods. Flooding may also result in changes in the food chain causing many predators and herbivores to lose food.

Similarly, some ecosystems are ideal breeding grounds for wildlife including fish. Floods therefore are likely to change the natural state of these ecosystems through erosion or deposition thereby wiping out siblings in the process. Losses in wildlife though not quantified, may be significant as to warrant a comprehensive research on the impact of floods on wild plant and animal species.

Infrastructure

Every flood that has occurred in the sub-region has been associated with destruction of infrastructure. Many houses have been inundated,

submerged or destroyed, including clinics, schools and other buildings offering essential services. Destruction of these buildings may also mean loss of essential drugs and school material.

The destruction of power lines during flooding events also put people at risk of being maimed or killed apart from loss of energy needed in homes and for industry. Many roads and bridges are cut off and destroyed making it impossible for movement between centres. In Malawi for instance, floods have cut access from one region to another with the destruction of the Rivi Rivi River Bridge which connects the southern with the central region and on the Dwambazi River which connects the central with the northern region of the country. Many other access routes have also been rendered impassable due to massive destruction of bridges and the road network.

Due to high inflows into Lake Malawi/Niassa/Nyasa as a result of floods,

high lake levels also cause serious problems for harbours on the lakeshore as ships are not able to dock. As a result they are forced to anchor offshore and goods and people are offloaded using smaller boats.

The massive destruction of infrastructure associated with floods necessitates high rehabilitation and reconstruction costs. Being among some of the poorest countries of the world, the countries of southern Africa are faced with a daunting task of making choices between feeding their people affected by floods and rehabilitating infrastructure. The large amount of revenue needed to bring the situation back to normal is reason why most of the damaged roads and bridges, schools, dip tanks, water and sewage pipelines, and clinics remain unrepaired for some time. Disasters incur high costs due to destruction of income-generating activities including tourism revenues and rehabilitation and replacement of damaged infrastructure and crops (UNEP, 2002).

NATIONAL RESPONSES TO DROUGHTS AND FLOODS

Coping strategies to disasters in southern Africa should recognise the important factors that are cause of disasters such as droughts and floods. These are the driving forces that have been elaborated in this report and it is government responsibility to urgently address those areas of concern. In addition to government policy responses, further national responses should include the establishment of drought levy which must be administered with transparency and provide assistance to rural people in ways that make their land more productive. The following areas need serious consideration:

- Enforcement of the District Environmental Action Planning (DEAP) and the National Environmental Action Planning (NEAP) processes;
- Support for smallholder agricultural development;
- Poverty alleviation programmes;
- Nutritional programmes;
- Research and development; and
- Interventions by NGOs and other specialist agencies among others.

The use of short-term interventions such as food handouts, food-for-work programmes, crop perks, livestock schemes, tillage support and emergency rural and urban water assistance are good but not long-lasting solutions. Governments in the sub-region should aim at bringing on board long-term solutions that focus on both the natural and human environment.

Dealing with Droughts

Sub-Saharan Africa of which southern Africa is part, suffers from some of the most devastating droughts and floods in the world. While natural disasters cannot be prevented, they can be mitigated, and efforts to deal with these extreme events seem to be gaining satisfactory attention (UNCCD, 2000). Significant efforts have been made by many countries to mitigate the effects of drought, particularly in setting up early warning systems at both national and sub-regional levels. However, there are still limitations in dealing with droughts. The acquisition of information from the early warning systems has not always led to early action. As a result, countries have dealt with the situation as it exists and once the drought subsides with the onset of a good season, national efforts to mitigate the effects of drought often fall by the wayside. Improvement of the early warning systems in the countries of the sub-region would assist farmers in planning for their agricultural season as it would save time and resources (SADC, 2004).

To date governments through their lead ministries, such as those responsible for water, disaster relief and rehabilitation, the police,

army and non-governmental organisations still offer the rescue, relief and rehabilitation services when droughts and floods occur. On the contrary, there is lack of active involvement of affected local populations in planning response strategies which results in their treatment as helpless victims needing assistance. The development of the relevant policies and strategies to mitigate the effects of drought and floods has often been done without comprehensive research on the experiences and needs of the local population. They appear to ignore what local people do to help themselves in times of drought, with the unintended effect of undermining local coping strategies and mechanisms and weakening local institutional capacity.

Instead, the situation is perpetuated by policies at national level that favour food aid over proactive contingency planning (UNCCD, 2000) ignoring the need to build effective mitigation and response strategies at sub-national levels. As a result, planning for drought is frequently centralised at the national level, and early warning systems are largely designed to serve as tools for food aid planning as opposed to active contingency planning (UNCCD, 2000).

An analysis of the status of drought preparedness, the constraints and future needs for the countries in southern Africa was made by the Office to Combat Desertification and Drought (UNSO, 2000). Brief summaries of the status for the countries referred to in this report are provided below.

Malawi

The findings on the status of drought preparedness, their constraints and future needs for Malawi reveal that the whole country is vulnerable to drought. There are at present two early warning systems – a national early warning system and a famine warning system. Drought management is the responsibility of several ministries which are coordinated by the Food Security and Nutrition Unit under the National Economic Council (NEC).

A food security and nutrition bulletin is provided regularly with updates of the food situation in the country. In addition, another body, the Natural Disaster Preparedness Committee is mandated with the task of advising on policy issues related to disaster mitigation in the country. The government has also formed structures for the strategic food reserves, introduction of irrigation schemes and improvement of credit opportunities for smallholder farmers.

In direct response to the adverse effects and frequency of disasters in Malawi, a National Disaster Management Plan was developed in 1996 which was directed at the development of a

much wider institutional capacity necessary for dealing with drought and other natural disasters such as floods. However, the traditional practice in dealing with droughts in Malawi has been providing food for those most at risk and as a result of this approach, there has not been a long-term approach to dealing with disasters especially with respect to improved strategies in preparedness and mitigation. There is therefore need for greater funding to put these measures in place.

The observation that the whole country is vulnerable to disasters stems from the fact that there is currently lack of emphasis on long-term issues of mitigation and preparedness. The 1996 plan only highlights measures that need to be taken for drought such as insurance schemes, improved drought monitoring and the development of strategic reserves of seed for pulses and cereals needed by smallholder farmers (UNSO, 2000).

Mozambique

In Mozambique, the responsibility for humanitarian assistance and policy decisions relating to disasters rests with the Department for the Prevention and Combating of Natural Disasters which was established in 1980. This body was mandated to address the impacts of natural disasters with respect to national developmental goals and aspirations. Another organisation, the National Institute of Meteorology provides weather information to farmers. Like in Malawi, there is also a Famine Early Warning System which is responsible for monitoring agricultural and weather conditions and gathering data required by farmers.

As a shortcoming in disaster preparedness and mitigation, there is an apparent shortage or low quality of information available in the country that decision makers can access. There is shortage of training for technicians in the field of disaster preparedness and mitigation (UNSO, 2000).

Other challenges that face the country with respect to dealing with disasters include poor conditions of access roads which hampers the distribution of relief food to areas of deficit; lack of mapping of vulnerable areas and absence of adequate infrastructure such as dams for water storage.

Swaziland

Swaziland's drought preparedness and mitigation dates back to 1994 when the country reviewed its management strategies and examined the linkages that exist between and among institutions. This review also extended to the development of national strategies that would enhance the coping capacities of local communities during events of natural disasters. As a result of this review, the country came up with an all-inclusive plan of action which defined the responsibilities of each participating party in disaster management and the procedures for drought declaration. Eight strategies and ten policy guidelines were proposed.

As a step further in dealing with drought in the country, Swaziland has been divided into agro-ecological zones that identify regions which are most vulnerable to drought. In spite of these efforts, there is currently no legislation or any institutional arrangements that have been developed or established to guide drought management in the country. As a result, there is over-reliance on donor support during disasters because of the absence and lack of financial resources that can be raised from within (UNSO, 2000).

Zambia

In Zambia, disaster preparedness and mitigation efforts gained extra momentum in 1991, a year before the country was to face a severe drought. This is when a drought preparedness and management plan developed a decade before, was replaced by a programme for the prevention of malnutrition later changed to Programme Against Malnutrition.

The main aim of the Programme Against Malnutrition is to reduce poverty through improved food security, health and nutrition. To address this aspect, several strategies have been put in place which, include (UNSO, 2000):

- Networking of government, NGOs and cooperating partners in order to optimise human and financial resources, community empowerment in decision making processes;
- Providing training of stakeholders in programme management, nutritional and environmental management and disaster management and mitigation; and
- Building capacities of NGOs to spearhead community empowerment in disaster management and mitigation and food security through training programmes.

Currently, the strategies that are used in dealing with drought have been recognised to have negative impacts on the environment, and lack of adequate financial resources happens to be a serious bottleneck in dealing with natural disasters in Zambia. As a major step towards dealing with droughts in the country, there is need to encourage farmers to move away from their traditional crop varieties towards those that are more drought-resistant and also to diversify agriculture. The establishment of an early drought warning system including other disasters would be most useful at this stage when the country like its neighbours are constantly battered with extreme events. Some thought could be given to the development of cost-effective irrigation schemes, research, crop diversification and the establishment of a rural investment fund needed for infrastructure projects. The establishment of the Zambia Vulnerability Assessment Committee is a plus for the country since it has been able to provide vital analytical information on disasters in the country.

According to the Zambia Vulnerability Assessment Committee (Zambia Vulnerability Assessment Committee, 2003) several recommendations in dealing with droughts have been

made both for the short-term and the long-term. The short-term measures include:

- Phasing out of free food relief programmes in most areas with the exception of those districts where food should be targeted to the most vulnerable for up to five months when the people are most vulnerable to hunger;
- Establishment of a food-for-work programme which is linked to community development. The government's efforts should concentrate on building upon community financial capital through supplies of credit, savings and markets, improvement and management of road networks and the promotion of good health, education environmental resources, fishing, water and biodiversity;
- Strengthen service delivery systems for HIV and AIDS programmes;
- Strengthen cross border initiative programmes;
- Strengthen programmes that are aimed at reducing stigma and discrimination;
- Support home-based care programmes; and
- Provide timely delivery of quality agricultural inputs at sub-district levels.

Similarly, the government has put in place the medium to long-term measures for dealing with droughts in the country and these include:

- Livestock restocking programmes;
- Strengthening veterinary programmes and this entails the review of the animal disease control programme in order to strengthen the situation in the southern provinces extending to the north-west and west;
- Improvement in extension services including the introduction of early maturing crop varieties;
- Improvement of oil availability by cultivating oil-yielding crops such as groundnuts, sunflower and palm oil;
- Development of cooperative initiatives including partnerships with the private sector;
- Reviving development programmes in irrigation, pineapple cultivation, bee farming and providing micro-credit schemes for small businesses; and
- Improvement in food processing; and rehabilitation and improvement of road infrastructure.

Zimbabwe

Zimbabwe's drought preparedness and mitigation measures rest with the Cabinet Committee on Drought which is presided over by a minister. The committee works closely with the National Consultative Drought Council comprising NGOs, church organisations and the private sector. A review of the structures dealing with drought in Zimbabwe and their effectiveness showed some shortcomings, which included (UNSO, 2000):

- The existence of too many committees and sub-committees dealing with drought management;

- Information flow on drought in the country is largely upward and little, if any, information circulates within the council;
- There are many players entrusted with the responsibility of implementing relief programmes which results in duplication of effort and resources; and
- There is usually slow response in dealing with disasters because the Ministry of Finance is hardly involved.

Like in Malawi, Mozambique, Swaziland and Zambia, Zimbabwe also needs comprehensive institutional development establishment of insurance schemes and short- and long-term drought mitigation measures. In addition, there is need for reviewing national guidelines on nutritional requirements for every household.

The national meteorological network required for drought monitoring needs to be expanded and revamped taking on board up-to-date technology and instrumentation in order to improve early warning capacity at the national level.

As one way of dealing with droughts in the country, the government needs to consider the option of long-term water resources development especially for smallholder farmers considering that the commercial farmers have a reasonable capacity to deal with droughts. Other measures would include establishment and expansion of food storage facilities, research and technology, improvement of the road network to facilitate food distribution during times of drought and establishment of a strategic grain reserve to reduce food imports during such times.

Dealing with Floods

Responses to floods at the national level have not been any different from those to drought. As will have been observed, national responses to drought are more ad hoc even though long-term strategies have been recommended at the national level. The frequency and gravity with which floods are occurring in Malawi, Mozambique, Swaziland, Zambia and Zimbabwe calls for the immediate adoption of long-term strategies which are intended at mitigating the effects of floods on the environment.

The ad hoc measures are more of reactive than proactive solutions in dealing with natural disasters. The existence of early warning systems for flood forecasting and warning in these countries is a viable and most useful tool in mitigating flood impacts such as loss of life. However, there are crucial elements which need to be taken on board such as a complete review of the effectiveness of the systems, community responses to flood warnings, education and awareness on the impacts of floods and how to avert them and the total examination of the structures in place entrusted with the responsibility of dealing with disasters.

Malawi

In the case of Malawi, only one basin, The Shire River Basin has a flood forecasting system

which is used for warning people of any impending floods in the basin. The system established in the late 1970s has been rendered less and less effective due to catchment degradation which has induced changes in the river's cross-sectional configuration through scouring and siltation (Ministry of Water Development, 2003). The ministry responsible for water affairs in Malawi has observed that the calibrated flood warning levels in the Shire River Basin are no longer applicable as they translate into false flood information.

Although a telemetry system has existed since the early 1990s, the system has strongly relied on gauge readers who walk long distances from their place of abode to the river to read the water level and transmit the information to headquarters in Lilongwe. This system of collecting and disseminating information is both unreliable and dangerous especially when the storm occurs during the night where access to the river may not be possible and render the communities vulnerable to sudden floods. Apart from this system, there is no other one in the country that can be used in warning people to move to higher ground in the event of flooding.

However, measures developed by the government in 1996 to deal with floods could provide new ground for alleviating the suffering that arises out of the disasters which have now become more frequent. These measures include (Government of Malawi, 1996):

- Preparing flood zoning maps showing the relationship between river stage and likely areas that can be inundated by floods;
- Improving flood awareness and information generation and dissemination. Information relating to floods could include:
 - Raising awareness and making it mandatory not to settle and cultivate in flood-prone zones;
 - Moving away to higher ground upon being advised of an impending flood disaster;
 - Prohibiting forest logging which influences land degradation and erosion of most catchments; and
 - Prohibiting crossing of rivers when streams and rivers are in flood.
- Undertaking comprehensive research in flood mitigation measures. Such research would focus on the efficient use of flood prone lands and how mitigation measures, flood preparedness, recovery and restoration can be carried out in the event of a flood; warning and emergency responses taking into account disciplinary and inter-sectoral responsibilities and developing better flood data and information;
- Preparation of flood disaster plans that take into account administration and engineering aspects;
- Development of adequate human and technological capacity for accurately predicting flood disasters and their extent;
- Identifying vulnerable areas as a first stage towards relocation of vulnerable societies;

- Preparation for distribution of basic necessities prior to occurrence of floods that would be easily accessed by people after the occurrence of the floods; and
- Devising suitable information dissemination channels for consumption by both the victims and rescue teams.

Mozambique

Weather forecasting in Mozambique becomes an even more important tool for early warning measures considering the extra risk factors such as the international rivers that flow through it to the sea and the Indian Ocean low pressure systems and cyclones that can cause heavy rain (Government of Mozambique, 2001). Occurrence of heavy rains in the upland areas of neighbouring countries such as Malawi, Zambia and Zimbabwe can cause serious flooding in parts of Mozambique and therefore early warning and preparedness are essential tools for flood disaster mitigation. For instance, in 2003 the Caprivi Region in Namibia was flooded with most of the infrastructure submerged and 8 000 people stranded (SARDC 2003). The Zambezi River burst its banks in mid-May 2003 destroying homes, schools, crops and livestock. What is unusual about this incident is that no rains fell in the region. The flooding had originated from upriver in Zambia.

Such incidences of disasters call for collaboration between states in order to minimise losses which would unfold as a result of such occurrences. The floods that occurred in the Caprivi region, demonstrate the vulnerability of southern African countries to natural disasters and point to the need for collaborative efforts in the management of natural resources including large international rivers such as the Zambezi and others (SARDC 2003).

The Southern African Regional Climate Outlook Forum (SARCOF) has been instrumental in providing rainfall outlook which has been used for flood forecasting in Mozambique. In addition, the national meteorological services also play an important part in providing weather data for this function.

Flood incidences prompted the government of Mozambique to institute a contingency plan for dealing with such extreme events. This plan included identification of locations and degree of hazards that are likely to occur at each location and updating of figures of the population at risk and likely to be affected. The immediate reaction to any impending flood disaster was therefore to include:

- The warning phase which would alert communities at risk of the vulnerable locations to floods; and
- Combating disease.

The government was also to participate in search and rescue operations and coordinate humanitarian assistance.

The emergency plan also included the distribution of supplies in the provinces that were vulnerable to flooding prior to the occurrence

of floods to allow communities access to their basic requirements even when the floods have occurred and the road network has possibly been destroyed (Government of Mozambique, 2001). Medicines were also stockpiled in warehouses in the areas at risk of disease outbreaks such as malaria, diarrhoea, measles, meningitis, dysentery and cholera. Other measures involved the sourcing and stockpiling of survival items such as tents, tarpaulin, blankets, clothing, kitchenware, plastic sheeting and farming implements and inputs.

The development of this contingency plan has included participatory processes of dissemination and implementation of rescue and relief operations in the vulnerable provinces and districts coupled with intensified training and public awareness among communities (Government of Mozambique, 2001). It has also been found necessary to decentralise funding for emergency relief operations during disasters.

Swaziland

Disaster management in Swaziland is the responsibility of the National Disaster Management Secretariat. The principal tenets applicable to disaster relief and management are (Government of Swaziland 2004a):

- To ensure effective, efficient and timely assistance to people affected by disasters, and that response and relief efforts support long-term development and vulnerability reduction strategies;
- To ensure the protection of the nation's natural resources and environment;
- To facilitate regional and international co-operation in disaster management; and
- To save lives and livelihoods and reduce damage to property and infrastructure.

The Swaziland Meteorological Services has provided (Government of Swaziland 2004b) useful information for public consumption on the Internet, which provides guidelines on dealing with floods, thunderstorms, lightning and tornadoes. However, this information is only accessible to those that have the required facilities to access it and can therefore not be shared with local communities who are most vulnerable to flood risks.

Zambia

Flood management in Zambia should concentrate on efforts that provide long-term solutions to the challenge especially with respect to people's vulnerability as well as environmental vulnerability (Nyambe, 2003). The vulnerability of the poor to water-related disasters can be mitigated through better planning and re-direction of investment to target their needs. In this regard, innovative approaches, using both structural and non-structural measures that can be supported by physical, social and economic sciences, and the compilation of the necessary data must be developed. The long-term solutions would involve:

- The need to encourage local communities and other stakeholders to participate, on a continuous basis, in the decision-making processes;
- The need to address environmental problems of flooding, particularly in flood-prone areas of river valleys such as the Kafue, Luangwa, Zambezi and others;
- Promote information sharing through appropriate networks and channels including the compilation of necessary data and capacity building for proper maintenance and operation of flood control facilities;
- Encouraging public participation and community based-local co-operation in raising awareness regarding the impacts of floods;
- Enhancing cooperation with neighbouring countries and regional centres;
- Developing and strengthening new and existing frameworks for flood management strategies, policies and legislation regarding preventative measures and emergency management from the viewpoint that floods can never be totally eliminated; and
- Adopting effective collaboration mechanisms with government structures, which include the participation of non-governmental organisations, the private sector, civil society groups and the communities.

These ideas improve upon the present tradition of emphasising on provision of relief measures to people in the event of flood disasters as they would also address environmental challenges.

Zimbabwe

The response strategy to floods in Zimbabwe is not any much different from that of the other countries. Following the floods that have occurred in several districts of the country, effort has been concentrated on providing relief to people in affected areas (UN Relief and Recovery Unit, 2003). Relief efforts have included:

- Provision of water treatment facilities and tools;
- Provision of disease control and treatment facilities and medicines; and
- Conducting field assessment in provinces affected by flooding to determine damage caused by the floods.

Other response measures to floods have been the introduction of winter cropping in affected areas since the floods have at times completely destroyed crops and left families highly vulnerable to hunger and malnutrition. For instance, in response to 2003 flooding and destruction of crops in Muzarabani, Guruve and Kariba the government allowed for districts assessments to identify potential needs for agricultural support, which was carried out by Save the Children (UK) and agriculture and research officials.

Long-term seed availability has also been taken as one measure of reducing the vulnerability of people affected by flood disasters in Zimbabwe. This measure assures that crop pro-

duction and output meets national requirement in order to avoid food imports into the country.

Another response measure to the effects of drought in the country has been the introduction of what has been termed as pilot urban intervention. This initiative is targeted at families who have children under the age of five that demonstrate signs of stunted growth. These families are provided with monthly free food handouts that could include maize, soya and oil. In addition, capacity building for non-governmental organisations has also been identified as one of the initiatives that need to be carried out to allow for concerted effort and interventions during periods of flood disasters.

National, Regional and International Obligations

One of the most important drought and flood preparedness measures for the sub-region has been the establishment of the SADC Regional Early Warning System (REWS) that provides member states and the international community with advance information on food security prospects in southern Africa. REWS comprises a Regional Early Warning Unit and autonomous National Early Warning Units (NEWUs) in each of the SADC member states. These early warning systems offer opportunity for countries to put in place strategies required for minimising losses due to floods which may include training of communities in disaster mitigation measures. The regional and national units provide early warning and food security information on:

- Crop performance, providing alerts in case of crop failures, and other factors affecting food supplies;
- Supply and demand assessments and projections, including imports and exports; and
- Insecure areas and the populations involved.

An important role played by REWU is the dissemination of a Quarterly Food Security Bulletin which is supplemented by monthly updates. The food security situation was therefore well covered during the 2000-2003 period. In addition to the REWU, an operational Drought Monitoring Centre was also established in Harare to provide early warnings and advisories on the occurrence of drought and other adverse weather conditions in the region, and to provide specialised training as well as the famine early warning systems. The objective of the SADC Drought Monitoring Centre (DMC) is to contribute to the reduction of negative impacts of drought and other adverse weather conditions upon agricultural production and to the rational management of the natural resources in the SADC region. Early warning products and advisories are issued regularly to the countries in the region by the DMC as well as training of personnel through workshops, seminars and on-the-job training.

At national level, climate monitoring falls under the responsibility of the Department of

Meteorological Services. Monitoring is done through observation of weather elements such as temperature, rainfall, wind speed and direction at different levels, atmospheric pressure, and solar radiation. Processing of satellite pictures is also done to assess the amount and type of cloud cover, as well as vegetation on the basis of the normalised vegetation index. All these weather elements are observed over a long period of time and then statistically analysed to determine whether the climate is changing or not.

Drought and floods in the sub-region have come and gone and each occurrence of either drought or floods has met different management strategies. Response to national disasters has usually been charged to a specific national committee where at times, important players such as the ministry of finance have not been party to that committee. Secondly, response to drought or flood disaster can either be slow or may involve too many players whose activities are uncoordinated. Nonetheless, different relief organisations, institutions and agencies made up of donors, NGOs, church organisations, and the private sector have played a crucial role in mitigating the impacts of disasters such as droughts and floods in southern Africa.

Disasters such as droughts and floods cannot be prevented but can be mitigated. It is therefore critical that governments in association with other players such as NGOs, civil society groups and communities should put in place mechanisms with which they can afford to mitigate the impacts of extreme events such as loss of life and property. Quite a lot can be done in this area so long as there is political will and commitment towards alleviating the problems that people face in the event of disasters, and adequate resources are allocated for the various activities required under the process.

Countries in the southern African sub-region need to be visionary by not waiting for disasters to strike before they take the necessary measures of preventing many losses. There is an urgent need to take issues of climate change seriously and include climate change programmes in national policy as well as putting into place enforcement and monitoring measures for the policy. Governments in the sub-region are required to review their environment legislation and incorporate climate change issues if this has not yet been carried out. A climate change office at the national level in each of the countries of the sub-region is required to co-ordinate activities on the subject. In addition, the efforts of various NGOs working in the area should be recognised because they could in some way assist the sub-region in partially fulfilling and implementing the UN Framework Convention on Climate Change in areas such as preparing national communications, organising and hosting national climate change workshops and debating climate change issues.

According to NEPAD's Action Plan of the Environment Initiative in Africa (NEPAD, 2003),

the continent is experiencing serious environmental challenges and problems. Unsustainable exploitation and degradation of forests, soils, wildlife, fresh water, and other natural resources threaten to undermine the region's economic development prospects. NEPAD recognises that many sub-regions of Africa are most severely affected by desertification that threatens more than 33 percent of the continent's land area particularly in the Sudano-Sahelian region, southern Africa and the Mediterranean.

Land degradation are mainly a symptom of recurrent droughts in the region and in spite of numerous governmental commitments that have been made in respect of environmental protection since the 1960s, Africa's environment continues to deteriorate. Existing national, sub-regional and regional environmental laws, plans, policies, and institutions have proven inadequate to arrest current trends, including the lack of adequate financial resources. The environmental action plan for NEPAD recognises that sustainable development is about the long-term planning, and as such policies and strategies dealing with disasters such as droughts and floods should take cognisance of this fact. In this regard, the NEPAD approach to dealing with disasters and their impacts on the people and the environment are best illustrated by the objectives of the Action Plan which are aimed at complementing relevant African processes, with a view of improving environmental conditions on the continent. Specifically the objectives call for:

- Promotion of sustainable use of natural resources;
- Strengthening of public and political support to sub-regional and regional environmental initiatives;
- Support in the implementation of country commitments under the global and regional environment conventions and other legal instruments to which they are party to;
- Enhancement of the human and institutional capacities of countries to effectively address the environmental challenges that face them;
- Promotion of the integration of environmental considerations into poverty reduction strategies;
- Fostering regional and sub-regional co-operation to address environmental challenges;
- Building a network of regional centres of excellence in environmental science and management;
- Mobilising and directing African and international scientific and technical communities to solve Africa's pressing environmental problems;
- Enhancing the effective participation of major groups and their contribution to inform intergovernmental decision-making;
- Improving the institutional framework for regional environmental governance; and

Box 4

International Protocols

Convention to Combat Desertification (CCD)

Malawi, Mozambique, Swaziland, Zambia and Zimbabwe have all ratified the United Nations Convention to Combat Desertification. Malawi ratified the convention on 6th June 1996, Mozambique on 13th March 1997, Swaziland on 7th October 1996, Zambia on 19th September 1996 and Zimbabwe on 23rd September 1997 (CCD 2003). The objective of the convention is to foster international co-operation and national and regional initiatives towards combating desertification, and mitigating the impacts of drought particularly in Africa. Commitments for parties to the convention include development of national policies and strategies to combat desertification; and creation of an institutional framework that builds partnerships at the donor, government, community, and NGO level. Action programmes should be based on local participation in their formulation, implementation and evaluation and on an integrated approach that includes environmental, social and economic considerations. The convention's regional annex for Africa emphasises the need for African countries to focus on improving the economic environment with a view to eradicating poverty, developing measures to conserve natural resources, improving institutional organisation, education and awareness, and monitoring and assessing the effects of drought.

United Nations Framework Convention on Climate Change (UNFCCC)

Similarly all the five countries are also party to the United Nations Framework Convention on Climate Change (UNFCCC, 2003). The convention aims to achieve the stabilisation of greenhouse gas concentrations in the atmosphere at the level that would prevent dangerous human interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner. Countries are expected to produce national inventories on greenhouse gas emissions, introduce measures to mitigate climate change by reducing emissions by sources and facilitating assimilation by sinks of all greenhouse gases not covered by the Montreal Protocol. Parties are also expected to promote sustainable management and conservation of sinks and reservoirs of all greenhouse gases. Biomass, forests, oceans, as well as terrestrial and marine ecosystems absorb greenhouse gases. Developed countries are expected to assist developing countries to prepare national inventories and in meeting costs of adaptation. Therefore support in climate change adaptation strategies will go a long way in increasing preparedness to unpredictable changes.

- Mobilising international resources for the implementation of the African environmental initiative.

These objectives apply to specific programme areas of NEPAD which include disasters such as droughts and floods. Droughts are blamed for causing desertification in the various sub-regions of the African continent and in dealing with this serious environmental challenge, it is recommended that there be a bottom up approach that entails the involvement of local populations and communities in decision-making and the implementation of the Convention to Combat Desertification. Also of importance is the role that NGOs and Community Based Organisation (CBOs) can play in the organisation of local communities for effective participation in combating desertification. In Malawi for instance, extreme pover-

ty, high population increase and heavy reliance on natural resources have been identified as the principal causes of land degradation and desertification (Government of Malawi, 2001).

In dealing with these issues, participatory efforts and responsibilities need to be extended to the private and civil society organisations so as to assist the public sector in achieving its goals of eradicating if not at least alleviating poverty, reducing population pressures on natural resources and improving on the environment and societal well-being. The UNCCD also stresses partnership arrangements between the affected people, the government and the donor community in addressing the causes of land degradation. African countries including those of southern Africa have played a leading role in the development and implementation modalities of the Convention to combat desertification. They have committed themselves to:

- Adopt an integrated approach in addressing the physical, biological and socio-economic challenges associated with combating desertification and drought;
- Establish strategies and priorities to combat desertification and mitigate the effects of drought;
- Integrate strategies for poverty eradication into programmes and projects related to desertification control and the mitigation of the effects of drought;
- Strengthen sub-regional, regional and international co-operation, especially in the areas of information collection, analysis and exchange, research and development, and in the transfer, acquisition, adaptation and the development of technology;
- Co-operate within relevant intergovernmental organisations;
- Strengthen reforms towards greater decentralisation as well as reinforcement of participation of local communities in halting and reversing desertification process; and
- Mobilise new and additional national financial resources for the implementation of the Convention.

Natural disasters, such as floods, cause considerable human suffering and economic damage on the continent. As a result, environmental degradation undermines prospects of fighting poverty, economic growth and sustainable development in many countries of the continent. The vicious circle between poverty and degradation of the environment needs to be addressed in a comprehensive manner (NEPAD, 2003).

Dealing with droughts and floods in southern Africa has focused more on the people through provision of their needs only when disasters strike. The centre of attention on the immediate, mid- and long-term impact of the disasters on the environment has been and is shifted to the people. Yet, because of their dependence on natural resources they are bound to overexploit the resources for their survival thereby creating more problems for themselves. To address these chal-

lenges, the SADC Policy and Strategy for Environment and Sustainable Development calls for changes for greater equity and sustainable development with a shift in emphasis in some priorities as follows:

- *Economic development policies* - These are largely focused on the formal sector. Governments should reorient their policies so that they support the larger informal sector which is the main source of jobs, income and affordable goods and services for the poor majority;
- *Agricultural policies* - While agricultural policies promote large-scale production for export of food and horticultural crops there is need to accommodate into these policies food security of the poor rural and urban households and fair returns for small-scale farmers;
- *Land tenure* - Laws and policies have tended to exclude women and a shift must be made towards policies that recognise and expand the rights of women to inherit and own land;
- *Health* - To shift from policies which allocate a disproportionate share of the national budget to specialised medical services and hospitals to policies that focus on primary health care services which are affordable and accessible for the poor majority;
- *Settlements* - There must be a shift from policies that emphasise more planning, research and delivery of unaffordable housing towards policies that give top priority to lethal shelter, water and sanitation problems of the poor majority in the rural and urban settlements; and
- *Wildlife and parks* - Development of policies that give local people and communities a greater voice in wildlife management and a significant share of the benefits of wildlife-based tourism.

These proposals address the pronouncements of the main policy goals of SADC which are:

- To protect and improve the health, environment and livelihoods of the people of southern Africa with priority to the poor majority;
- To preserve the natural heritage, biodiversity and life-supporting ecosystems in southern Africa;
- To support regional economic development on an equitable and sustainable basis for the benefit of present and future generations;
- To strengthen the analytical, decision-making legal, institutional and technological capacities for achieving sustainable development in southern Africa;
- To increase public information, education and participation on environmental and development issues in southern Africa; and
- To expand regional integration and global cooperation on environmental and natural resources management for sustainable development.

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