



REGIONAL TSETSE  
AND TRYPANOSOMOSIS  
CONTROL PROGRAMME

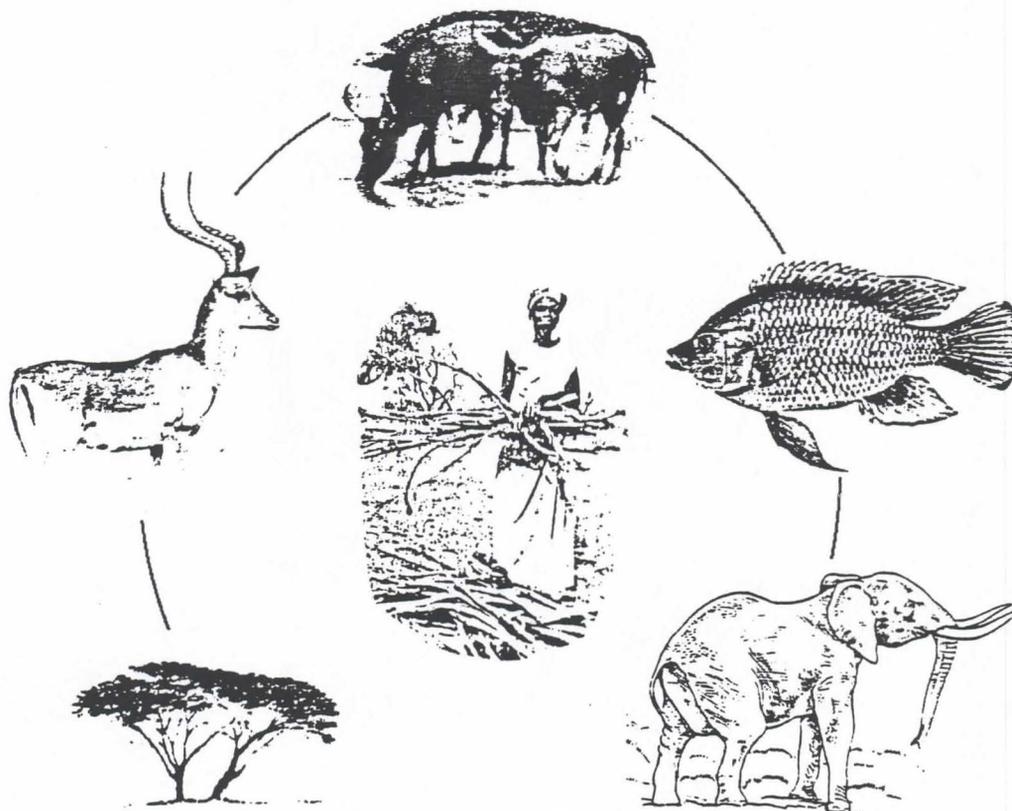
MALAWI, MOZAMBIQUE,  
ZAMBIA AND ZIMBABWE



International  
Co-operation  
Centre of  
Agronomic  
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# NATURAL RESOURCES IN SOUTHERN AFRICA

## AN OVERVIEW OF POTENTIAL AND THREATS



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## SUMMARY

Between now and the year 2020, the population of southern Africa will double, entailing a growing need for land and agricultural products which must be satisfied by exploiting the natural resources in the best way possible. The management of water resources, at present already difficult in extremely variable climatic conditions, will be a key element for development in the region. In fact, the demand for water for domestic purposes and crop irrigation should double over the next twenty years.

Although covered with vast areas of arid or semi-arid lands, the region presents extremely varied ecozones hosting a biological diversity which is extremely important, indeed sometimes unique in the world. The high-altitude tropical and temperate forests, scattered in the eastern part of the region from Tanzania to South Africa, host a variety of flora and fauna comprising numerous endemic species. Over half the area of southern Africa is covered with savannahs which are not easily adapted to crops, especially in the driest regions. These savannahs, with soils which are generally infertile, are suitable for pastureland and are better exploited by wild animals and livestock. Wet regions (dambos, alluvial plains) are not very common in the region: highly sought after for crops, they are also select habitats for wild animals and are important for the maintenance of biodiversity.

The production of timber or fuelwood for domestic requirements and forest clearing to put land under crops are the main causes of destruction and disappearance of habitats. In Zimbabwe and Malawi for example, 700 sq. km are cleared every year for tobacco. In Zambia, wood represents more than 66% of the total energy utilised. Local people remove a considerable quantity of plant and animal by-products from the savannahs and forests. The Tonga people in the Zambezi valley (Zimbabwe and Zambia) use 220 plants, a large number of which are for traditional medicine and fruits. Animal proteins are supplied by a large variety of species including large and small mammals, birds, reptiles and insects.

The heavy pressure on the natural environment by man and livestock is revealed in physical degradation of the soil, loss of fertility and over-exploitation of natural resources. Inappropriate farming practices, such as uncontrolled irrigation, crops on slopes or the absence of fallow periods, contribute to weakening the agricultural potential of the soils. Overgrazing leads to gully erosion and soil loss which limit or prevent the recolonisation of vegetation. This phenomenon is particularly serious in high-altitude forests, or in the Karoo and the Fynbos of South Africa.

A significant portion of the natural resources are at present overexploited. Disappearance or change of habitat is the main cause affecting species. Although many large mammals are still present outside protected areas, some species are now rare or on the verge of extinction (lechwé, black rhinoceros) in zones which are unprotected and subject to poaching.

Livestock populations are increasing slowly but surely: this despite the severe droughts of 1981-83 and especially 1991-92 and infectious diseases. Cattle stand at present at around 45 million heads while smallstock, sheep and goats, number over 71 million heads. Livestock represents 90% of standing crop biomass made up of herbivores, of which 77% are cattle.

Therefore livestock farming competes strongly with wild animals for space and pasture. Furthermore, measures put in place to combat the spread of livestock diseases are often prejudicial to wild animals (fencing, slaughter).

Marine animals are affected by damaging offtakes which harm the fish populations: several marine mammals (whales, dolphins) and sea turtles are threatened by illegal fishing practices. In addition to this there is pollution of estuaries, mangroves and coral reefs which reduces the productivity of these ecosystems.

Other populations among the birds, reptiles (snakes, crocodiles) and amphibians, which include rare species, are affected by capture for commercial purposes, urbanisation or pollution.

Habitat degradation and reduction of natural resources in the region have not gone unnoticed by either the governments of the various countries or the national and international institutions concerned with environmental conservation.

The vast network of protected areas, which covers 17 % of the total area of the region, forms a real sanctuary for flora and wild animals. Current wildlife management policies which seek to link national institutions, the private sector and local communities contribute to increasing the areas of land under surveillance. From a more general point of view, these initiatives strengthen the objectives of conservation of biological diversity while at the same time protecting genetic diversity.

Research in the agricultural and forestry sectors indicates the essential role played by vegetation in the reduction of erosion, protection of river catchments and maintenance of soil fertility.

The development of agrosylvopastoral systems, linking research and traditional knowledge, has made local communities aware of the importance of sustainable management of natural resources and protection of soils. Research carried out on infectious livestock diseases, and especially the fight against the tsetse fly, is becoming increasingly integrated in an over-all conservation policy. The new techniques being implemented (odour-baited, insecticide-impregnated targets) are much less damaging to the environment.

Despite the difficult climatic conditions, cyclical natural catastrophes, like droughts and livestock diseases, and armed conflicts, southern Africa has been able to preserve an environment of great richness. The current political stability should make it possible to deal better with certain development priorities such as population growth, food security and water requirements while at the same time ensuring maintenance of the biodiversity and the quality of the environment.

The region also possesses enormous potential in human resources, in the public and private sectors, in national and international NGOs and local communities. Strengthening the link between these different partners appears essential for the success of natural resource management.

Peasant farmers have a key role to play in the various land use programmes.

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## LIST OF ACRONYMS AND ABBREVIATIONS

<b>ADB</b>	African Development Bank
<b>ADMAD</b>	Administrative Management Design Programme for GMAs (Zambia)
<b>AGRITEX</b>	Agricultural Technical and Extension Services (Zimbabwe)
<b>ALDER</b>	Arable Land Development Programme (Botswana)
<b>APAC</b>	Air Pollution Appeal Committee (South Africa)
<b>BP</b>	British Petroleum
<b>CAMPFIRE</b>	Communal areas Management Programme for Indigenous Resources Association (Zimbabwe)
<b>CASS</b>	Centre for Apply Social Sciences (Zimbabwe)
<b>CENACARTA</b>	National Remote Sensing and Cartography Centre (Mozambique)
<b>CITES</b>	Convention on International Trade in Endangered Species of Wild Fauna and Flora
<b>CORDE</b>	Co-operation for Research, Development and Education (Botswana)
<b>CTA</b>	Technical Centre for Agricultural and Rural Co-operation
<b>DeRuBe</b>	Department of Rural Development (Zimbabwe)
<b>DNPW</b>	Department of National Parks and Wildlife (Malawi)
<b>EDA</b>	Environment and Development Agency (South Africa)
<b>EC</b>	European Community (former designation of EU)
<b>EEC</b>	European Economic Community/Communities
<b>EIA</b>	Environmental Impact Assessment
<b>ERSI</b>	Environment and Remote Sensing Institute, Scientific and Industrial Research and Development Centre (Zimbabwe)
<b>FAB</b>	Forestry Association Botswana
<b>FAO</b>	Food and Agriculture Organisation of the United Nations
<b>FEWS</b>	Famine Early Warning System
<b>GMA</b>	Game Management Area
<b>ICRAF</b>	International Council of Research in Agroforestry
<b>IIED</b>	International Institute for Environment and Development
<b>ILRAD</b>	International Laboratory for Research on Animal Disease
<b>IUCN</b>	World Conservation Union (Zimbabwe)
<b>IUCN-ROSA</b>	IUCN Regional Office for Southern Africa
<b>LIRD</b>	Luangwa Valley Integrated Resource Development Programme (ZAMBIA)
<b>MAB</b>	Man and Biosphere
<b>NCC</b>	National Conservation Committee (Zambia)
<b>NCDP</b>	National Commission for Development Planning (Zambia)
<b>NCE</b>	National Committee for Environment (Malawi)
<b>NCI</b>	National Institute of Research and Documentation (Botswana)
<b>NGO</b>	Non Governmental Organisation
<b>NCS</b>	National Conservation Strategy
<b>NRI</b>	Natural Resources Institute
<b>NRI</b>	National Institute of Research and Documentation (Botswana)
<b>NHM</b>	Natural History Museum (London)
<b>ODA</b>	Overseas Development Assistance
<b>PAC</b>	Programme Animal Control

<b>PELUM Ass.</b>	Participatory Ecological Land Use Management (Zimbabwe)
<b>PTES</b>	People Trust for Endangered Species
<b>RTTCP</b>	Regional Tsetse Trypanosomosis Control Programme
<b>SADC</b>	Southern African Development Community
<b>SADC FANR</b>	SADC Food Agriculture and Natural Resources Sector (Zimbabwe)
<b>SADC SACCAR</b>	SADC Southern African Centre for Co-operation in Agricultural Research
<b>SARCUSS</b>	Southern African Regional Commission for the Conservation and Utilisation of Soils
<b>SARDC</b>	Southern African Research and Documentation Centre
<b>SASIN</b>	Southern African Subregional INFOTERRA Network
<b>SEMG</b>	Scientific Environmental Monitoring Group
<b>SIDA</b>	Swedish International Development Authority
<b>SLEMSA</b>	Soil Loss Estimation Model Southern Africa
<b>TSBF</b>	Tropical Soil Biology and Fertility Programme, International Union for Biological Sciences
<b>UNDP</b>	United Nations Development Programme
<b>UNEP</b>	United Nations Environment Programme
<b>UNESCO</b>	United Nations Organisation for Education, Science and Culture
<b>WCMC</b>	World Conservation Monitoring Centre
<b>WHO</b>	World Health Organisation of the United Nations
<b>WRI</b>	World Research Institute
<b>WWF</b>	World Wide Fund for Nature
<b>ZERO</b>	Zimbabwe Energy and Environmental Research Organisation

## PART I

### NATURAL RESOURCES IN SOUTHERN AFRICA

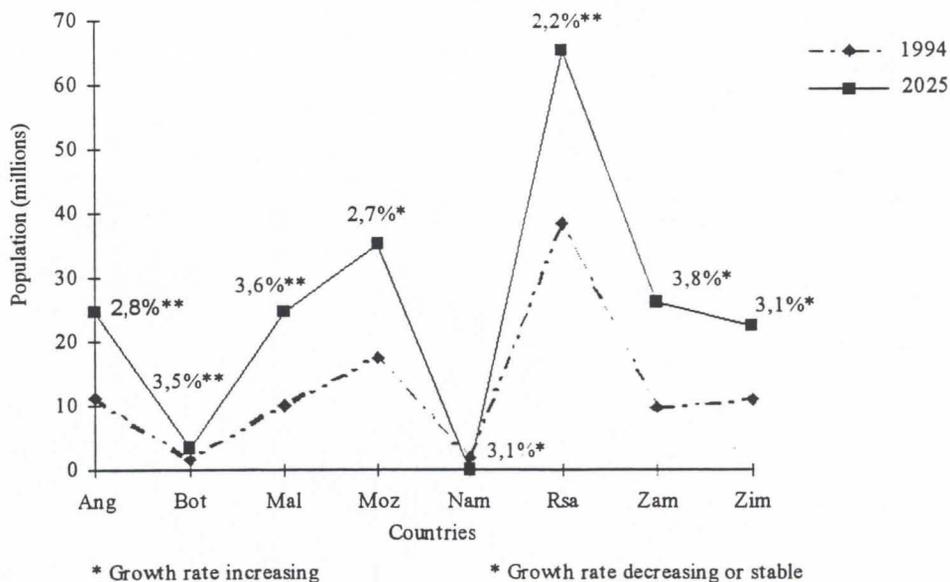
#### - POTENTIAL AND THREATS -

#### 1. INTRODUCTION

Most of the countries in southern Africa are arid or semi-arid and rainfall is extremely variable from one region to another and from one year to another. Rainfall is a major factor for the survival of people and wildlife: the arid regions suffer not only from a deficiency of moisture but also from unpredictable growing seasons.

The climate, which is humid with a relatively high temperature in the tropical and eastern coastal forests (rainfall between 800-2000 mm/yr.), becomes more difficult in Afromontane and temperate forests (average rainfall: 700 mm/yr.). In savannah areas, it becomes very severe in the Karoo or the Namib desert with a rainfall of 10-300 mm/yr. Moreover, low nutrient levels of soils due to leaching can reduce the beneficial effects of high rainfall, as often happens in the moist savannahs. Last, the region is affected by drought cycles, particularly the dry ecozones, leading to insufficient production from subsistence farming and loss of natural resources such as wildlife, livestock, trees and valuable crops.

Natural resource management and the future of the environment in southern Africa are linked to the social, economic and political context. Use of land and natural resources are affected by the increasing population in the region, which has a 2,2-3,8 % average growth rate (fig. 1), and the increasing demand for agricultural land.

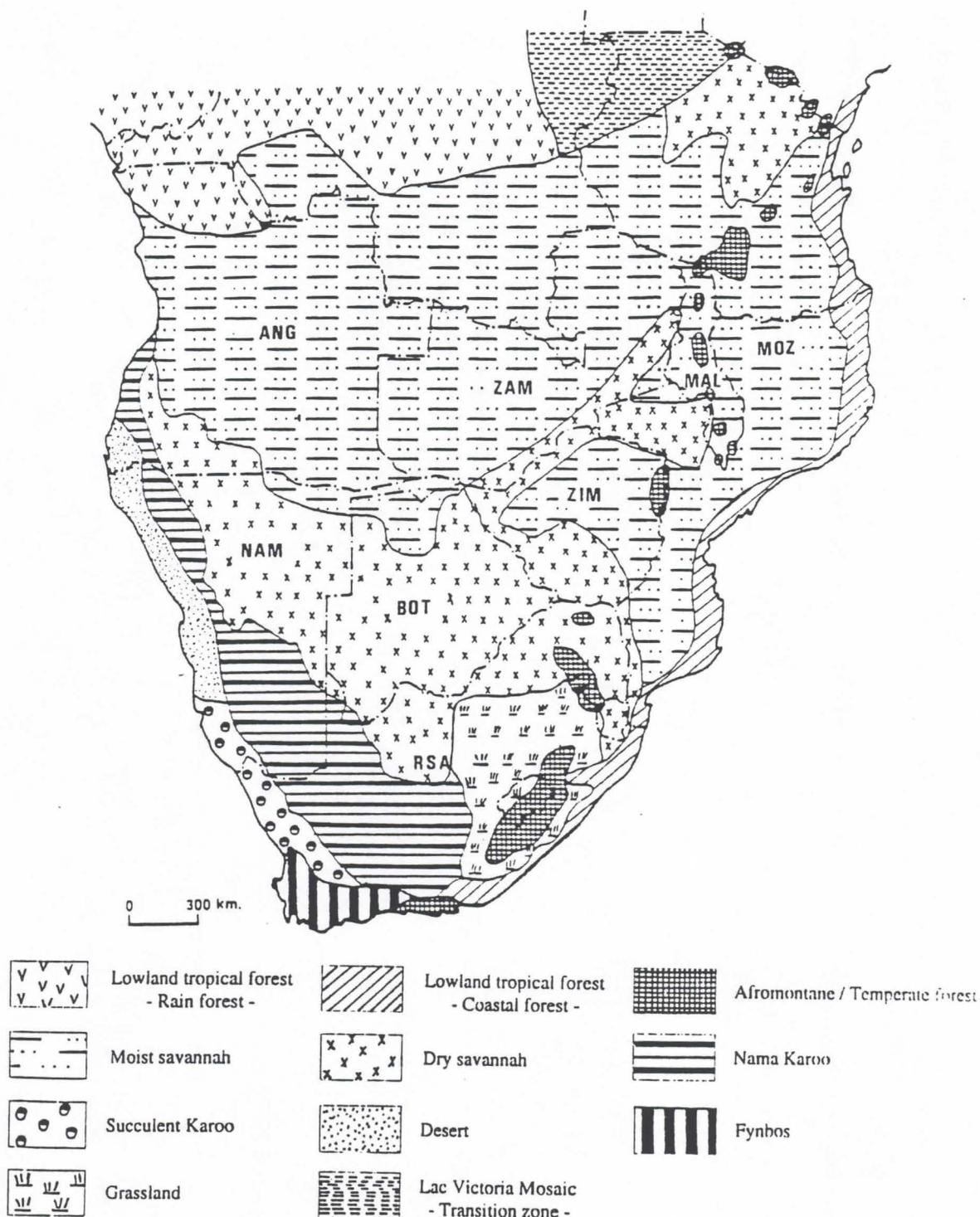


**Fig. 1: Population size and population growth in Southern Africa - Angola, Botswana, Malawi, Mozambique, Namibia, South Africa, Zambia and Zimbabwe -**

(Sources: State of the Environment in southern Africa: SARDC/IUCN/SADEC, 1994 - Centres of Plants Diversity, Vol. 1: WWF/IUCN/EU/ODA, 1994).

## 2. ECOZONES

The main part of southern Africa, in terms of large biomes, is covered by tropical dry forests and woodlands. A large area of warm deserts and semi-deserts occurs in the East of the region (fig. 2).



**Fig. 2: Ecozones of Southern Africa**

(Sources: State of the Environment in Southern Africa: SARDC/TUCN/SADEC, 1994 - Determination of Structure and Function of southern Africa Biomes: Frost, P.G.H. for SARDC, 1993).

The ecological zones or “ecozones” that form large natural units are often difficult to separate and the transition from one to the next is practically unnoticeable. Moreover, they may be sub-divided or overlapping so that mapping them accurately is not realistic. Also, mapping ecosystems may take into account human activities (landscapes, for example) to attempt to produce a contemporary map of land-cover types.

The environment, which is very rich, is composed of a complex and shifting landscape subject to variation of physical factors (climate, relief, soil, fire) and biological factors (vegetation, wildlife, people).

Vegetation appears to be a good factor for classifying ecozones because it is closely dependant on all these conditions. The main types of ecozone of the region include:

- Lowland tropical forest;
- Afromontane and temperate forest;
- Woodland (savannah);
- Grassland;
- Desert in Angola and Namibia;
- Nama-Karoo in South Africa, Namibia and Angola;
- Succulent Karoo in Namibia;
- Fynbos in South Africa;
- Transition between forest and savannah.

Wetlands (rivers, lakes, herbaceous swamps) and marine ecosystems (including mangrove swamps, estuaries and coral reefs) are not formal ecozones. They are included in this report because they harbour a wide variety of natural resources and provide large quantities of food.

### 3. NATURAL RESOURCES

#### 3.1 Vegetation and flora

##### 3.1.1 Vegetation

Table 1 illustrates the main vegetation types in the different countries of southern Africa. In the SADC Region there is a total of 23 distinctive indigenous forest ecozones: forest, woodland, savannah and grassland cover about 67 % of the region.

Vegetation type Country	Coastal	Major wetlands	Desert and semi-desert	Grass and shrub	Interrupted woods	Major forests	Crop Settlements
Angola	0	0	1	30	18	46	4
Botswana	0	4	68	5	22	3	?
Malawi	0	2	0	2	2	46	29
Mozambique	6	6	0	18	17	38	16
Namibia	0	1	44	33	21	1	?
South Africa	4	0	15	29	37	2	13
Zambia	0	1	0	2	17	73	7
Zimbabwe	0	0	0	14	38	31	18

**Table 1: Estimates of main vegetation type and percent cover**  
(Source: Global Biodiversity: NHM/TUCN/UNEP/WWF/WRI, 1992).



## > Forests

Because of the climate, rain forests are rare in the region (table 2): much of the land (about 75%) has tree cover but this is often savannah woodland and grassland (including trees). Most of the forests are found in Angola, Mozambique, Malawi, Zimbabwe and South Africa. The fragmented relict forests harbour impressive levels of species diversity. The Afromontane forest zone, which is like an isolated mountain range extending from Tanzania along the sub-continent's eastern escarpment to South Africa, is particularly rich.

Country	Land area (sq. km)	Rain forest land (sq. km)	%
Angola	1,247,000	29,000	2,3
Malawi	94,000	320	0,35
Mozambique	784,000	9,350	1,2
Zimbabwe	391,000	80	0,02

**Table 2: Rain forest land as percentage of total land  
in Angola, Malawi, Mozambique and Zimbabwe**

(Source: State of the Environment in southern Africa: SARDC/IUCN/SADC, 1994 -  
The Conservation Atlas of Tropical Forests: BP/IUCN/WCMC, 1992).

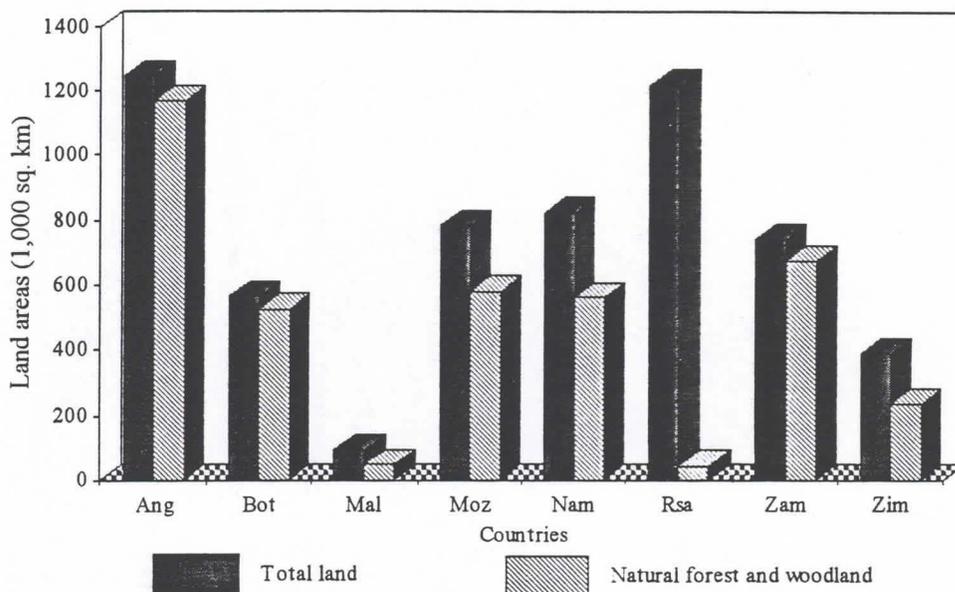
In Angola specialists estimate that closed broad-leaved forests cover about 29 000 sq. km (FAO, 1980) but there is no recent information on the extent or the management of these areas. Malawi has about 320 sq. km of evergreen rain forest distributed over 40 major sites in which Afromontane forest (218,1 sq. km) and mid-altitude forest (71,6 sq. km) are dominant. In Mozambique closed broad-leaf forests (rain and montane forests, dry or deciduous forests) cover about 9 350 sq. km. They include a large area of mangroves and gallery forests but no recent information is available on their management.

The vegetation of Zimbabwe is predominantly dry woodland and only about 80 sq. km of rain forest (high, medium and low altitude rain forest) exist in the East of the country (Nyanga Mountains, Vumba Mountain., Chimanimani Mountains, Chirinda forest). Patches of Afromontane forest (temperate) and lowland subtropical forest (coastal) remain in South Africa (Natal): they cover about 1,000 sq. km and are very diverse with a high level of biological diversity. Northern Angola, southern Malawi, eastern Zimbabwe and part of the Indian Ocean coast represent the main centres of lowland tropical forest in the region.

## > Woodlands (moist and dry savannahs)

Woodlands cover about half of southern Africa. The moist savannahs are composed of two main types. The miombo woodland is the most extensive, covering 2,7 million ha, dominated by *Brachystegia*, *Julbernardia*, *Isoberlinia* trees and the mopane woodland characterised by *Colophospermum mopane*. Dry savannahs include the *Acacia-Commiphora* wooded grasslands (Namibia) and the *Acacia* woodlands of the lower-altitude regions (South Africa, Zambia, Zimbabwe). Another woodland, distinguished by the absence of elements of miombo and mopane, are undifferentiated woodlands. They present a diversified flora in which *Burkea africana*, *Azelia quanzensis*, *Pericopsis angolensis*, *Pterocarpus angolensis* are numerous. Woodlands provide many products: the most important are pasture, fodder, fruits, wood (fire and construction), game, insects and medicine.

Figure 3 gives an estimation of woodland and forest resources in southern Africa. Forest resources include large woodlot plantations owned by governments, tree-planting and village woodlots, and individual planting or agroforestry.



**Fig. 3: Natural forest and woodland resources in southern Africa - Angola, Botswana, Malawi, Mozambique, Namibia, South Africa, Zambia and Zimbabwe -**

(Sources: State of the Environment in southern Africa: SARDC/TUCN/SADEC, 1994).

#### > Grasslands

Grasslands are covered with grasses and other herbs, sometimes mixed with woody plants the cover of which does not exceed 10 %. Grasslands occur mainly in east central South Africa with some small areas in Malawi, Zambia and Zimbabwe. They are edaphic, sometimes associated with seasonally waterlogged soils and can be also secondary, after human intervention in forest or woodland areas. Grasslands are quite important for large wild herbivores, agricultural activities (maize) and livestock (beef, dairy cattle, sheep) and - from a global point of view - for biodiversity.

#### > Nama Karoo

Covered by dry, dwarf shrub vegetation the Nama Karoo extends from west-central South Africa along the Namibian coast to southern Angola. Among the commonest of the numerous species of Karoo shrubs are *Chrysocoma tenuifolia*, *Euryops multifidus*, *Rhogosum trichotomum*, various species of *Pentzia* and, on saline soils, *Salsola* and *Atriplex*.

#### > Succulent Karoo

The Succulent Karoo borders the south-western coast, from south of Luderitz (Namibia) to the Cape shrublands (Fynbos). The plants, rarely more than 40 cm high, include the genus *Mesembryanthemum* (with numerous species), ericoid shrublets and taller succulents (*Aloes spp.* and *Euphorbia spp.*). *Acacia karoo* and *Rhus viminalis* are common along water courses while grasses are common on the eastern part but rare elsewhere.

## > Desert

The Namib desert which forms a coastal strip from southern Namibia to Angola (Mossamedes desert) is a true desert with very little plant cover. The cold Benguela ocean current provides fog for 150 days or more in a year adding to a rainfall not exceeding 50-85 mm/yr. On the sand dunes, some species form a sparse vegetation including *Barleria solitaria*, *Indigofera cuneneensis*, *Petalidium angustilobium* and some grasses as *Stipagrostis ramulosa*. The stony desert, in the central Namib desert, harbours halophytic succulent plants such as *Mesembryanthemum spp.* or *Aizoon dinteri*. The vegetation is well-developed along seasonal rivers flowing from the highlands in the East: *Rhus lancea*, *Salvadora persica*, *Commiphora saxicola* are common shrubs on the river banks.

## > Fynbos (Cape shrublands)

The Fynbos, in the extreme southern tip of South Africa, is a "Mediterranean sclerophyllous type of vegetation" with a high diversity of plant species. It includes evergreen shrubs, generally small and heath-like, which grow on very infertile soils and contain oil or resin: grassland occurs only sporadically. Among the small trees or shrubs are *Cassine parvifolia*, *Cliffortia spp.*, *Diospyros glabra*, *Leucadendron procerum* and *Philippia chamissonis*.

## > Transition between forest and savannah

This ecozone is a complex mixture of lowland tropical forest and savannah characteristics. Vegetation is largely scrub forest, bushland and thickets induced by markedly seasonal rainfall: the dry season is less severe than in the savannah area. The flora are a mixture of poor Guinean-Congolese and Zambian flora. Because of their fertile volcanic soil, the upland areas support crop production including coffee, tea, maize and cassava.

## > Wetlands

Wetlands cover about 13 % of the region but they are not a formal ecozone. They include rivers, lakes, floodplains, freshwater swamps, peatlands, estuaries and mangroves. Their high productivity supports fisheries, pasture lands and agriculture and is very important for the conservation of wildlife (water birds and game) and biodiversity. The main uses are grazing, fishing, hunting, irrigation, water supply, hydropower, extraction of traditional products (grasses and sedges for roofing material or making baskets) and conservation (table 3). Rivers and lakes provide fishing and related activities, irrigation, hydroelectric power generation and recreation and tourism (e.g. Lake Kariba in Zimbabwe). Floodplains such as Kafue Flats in Zambia, Morrumeu in Mozambique, Okavango river and floodplains in Botswana and Namibia are fairly flat silt areas of river valleys. These areas can be highly productive for vegetation growth and for the associated wetland fauna. In Kafue Flats in Zambia the production of fish reaches 11 000 tonnes/yr and about 50 000 people are involved in seasonal fishing activities on floodplains in Angola.

Dambos are seasonally waterlogged grass-covered depressions covering 10 % of the central part of southern Africa. Like the freshwater swamps (Okavango Delta in Botswana, *osbanas* in northern Namibia/southern Angola) they provide livestock grazing (and dry season grazing), natural irrigation for crops, garden cultivation and domestic water supply. They also form sanctuaries for wildlife during the dry season. Areas bordering on dambos are favoured for cultivation (maize and vegetables) in the dry season because they stay moist enough.

Wetland types	Mangroves - estuaries	Floodplains	Freshwater marshes	Lakes
<i>Functions</i>				
Groundwater recharge		□	□	□
Groundwater discharge	•	•	□	•
Flood control	•	□	□	□
Erosion control	□	•	□	□
Toxicant retention	□	□	□	□
Nutrient retention	□	□	□	□
Recreation - Tourism	□		□	□
<i>Products</i>				
Forest resources	□	□		
Wildlife resources	□	□	□	•
Fisheries	□	□	□	□
Forage resources	•	□	□	
Agricultural resources	•	□	•	•
Water supply	•	•	•	□

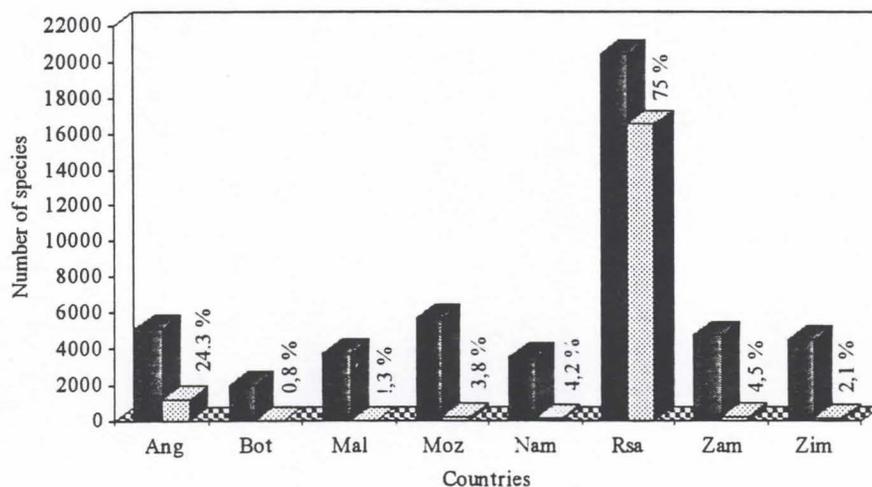
□ Important value    • Less important value

**Table 3: Main wetlands functions and values in southern Africa**  
(Source: Global Biodiversity: NHM/TUCN/UNEP/WWF/WRI, 1992).

### 3.1.2 Flora

The flora of southern Africa, which is extremely diverse with very high levels of endemism, numbers more than 23 000 species of vascular plants. It contains 14 of the 27 endemic families of Africa and 75-80 % of species in the region are endemic. Biodiversity is not evenly distributed over the continent. The Ténéré, a vast part of the Sahara Desert in northern Africa harbours only 20 vascular plants: Namibia, with an area of 825 000 sq. km (32 % of the southern Africa region) has 15 % of southern Africa species whereas the Cape Region which covers 90 000 sq. km has 41 % of the species, i.e. more than 8 500 species.

Figure 4 shows the number of vascular plant species and levels of endemism in some countries of southern Africa: Angola and South Africa have the highest level of endemism.



**Fig. 4: Species richness and endemism (%) in higher plants in southern Africa**  
- Angola, Botswana, Malawi, Mozambique, Namibia, South Africa, Zambia and Zimbabwe -  
(Sources: Global Biodiversity: NHM/TUCN/UNEP/WWF/WRI, 1992 -  
Botanical Diversity in southern Africa: Strelitzia 1, B.J. Huntley, Ed., 1994)

Some areas called “Hot-spots” are clearly more species-rich than others. Eight sites have been identified in southern Africa as Centres of Plant Diversity, containing more than 1 000 vascular plant species, of which more than 100 are endemic to that site or phytogeographic region (table 4). Other characteristics of these sites include high value genepool plants valuable to humans, a diverse range of habitats, a proportion of species adapted to special edaphic conditions and danger levels. In southern Africa, these sites form a continuous arc including a large portion of the sub-continent’s eastern escarpment.

Country/Site	Size (sq. km)	Altitude	Flora* and %endemism	Vegetation
<b>Angola/Namibia</b> Kaokoveld (1)	70 000	0-2000 m	952 (12 %)	Deciduous shrubland - mopane savannah - Desert escarpment vegetation
<b>Malawi</b> Mount Mulanje (2)	500	750-3002 m	> 800	Woodland - rain forest - montane grassland - high altitude scrub - rupicolous communities
<b>Mozambique, South Africa</b> Albany (1)	22 500	0-1800 m	2000 (10%)	Subtropical thicket
Maputaland (3)	26 734	0-1800 m	1100 (15%)	Savannah - rain forest - grassland - wetland
Pondoland (3)	1 880	0-1800 m	1500 (8%)	Subtropical grassland - rain forest
<b>South Africa</b> Cape floristic region (4)	90 000	0-2325 m	8600 (68%)	Sclerophyll bushland - Fynbos - Afromontane forest
Drakensberg/Eastern Mountain (2)**	40 000	1800-3482 m	1750 (30%)	Subalpine and alpine grassland - rain forest - shrubland - savannah - wetland
Succulent Karoo (1)	111 212	0-1907 m	5000 (35%)	Succulent shrubland (veld) with associated annuals
<b>Zambia</b> Zambezi Source Area (5)	1700	1200-1490 m	>1000	Miombo woodland - dry evergreen forest - swamps

\* Vascular plants only

\*\* Including also Mt. Mulanje in Malawi

(1) Karoo-Namib Regional Centre of Endemism - (2) Drakensberg Alpine Region - Afromontane Centre of Endemism

(3) Indian Ocean Coastal belt: Southern Section - (4) Cape Regional Centre of Endemism - (5) Zambian Regional Centre of Endemism.

**Table 4: Characters of southern African Hot-spots**

(Sources: Centres of Plants Diversity, Vol. 1: WWF/TUCN/EU/ODA, 1994 - Botanical Diversity in southern Africa: Strelitzia 1, B.J. Huntley, Ed., 1994).

In these southern African hot-spots, specialists have identified 8 830 endemic plant species comprising 52,2 % of the region’s endemic flora. Table 5 shows the importance of endemic plant species in southern Africa compared to other recognised hot-spots in some important biogeographic countries in the world.

Hot-spot areas	Areas (sq. km)	% earth's area	Number of endemic species	Endemics as % of total plants species
Tropical rain forests	2 428 000	1,6	37 235	14,9
Mediterranean climate	765 400	0,5	14 165	5,6
Southern Africa	305 306	0,2	8 830	3,5
Total	3 498 706	2,2	60 230	24

**Table 5: Number of endemic plants species in southern Africa and other Hot-spots**

(Source: Botanical Diversity in southern Africa: Strelitzia 1, B.J. Huntley, Ed., 1994).

Southern Africa is less rich in endemic species than the tropical rainforests or countries with a Mediterranean climate. In spite of this, the richness of the Cape floral Region in relation to its size and that of the Succulent Karoo in relation to the ecosystem is exceptional. Other areas of the region, less rich in plant species, are also important for conservation (table 6).

Areas	Types of vegetation
<b>ZAMBIAN REGIONAL CENTER OF ENDEMISM</b>	
<i>Angola</i> Benguela and Bié Districts	High-altitude wooded grassland - miombo - gallery forest - scrub and thicket at lower altitude.
<i>Zambia</i> Luangwa valley	<i>Acacia-Combretum</i> woodland- <i>Acacia tortilis</i> woodland - mopane - miombo - thicket - riparian forest.
<i>Zimbabwe</i> Great Dyke	Short grassland
<b>INDIAN OCEAN COASTAL BELT: Northern Section</b>	
<i>Mozambique</i> Middle Ruvuma River area	140 vascular plants are endemic in this region but other information is lacking
<b>AFROMONTANE REGIONAL CENTRE OF ENDEMISM</b>	
<i>Malawi (and Zambia)</i> Nyika Plateau	Open grassland - patches of submontane evergreen forest
<i>Zimbabwe</i> Chimanimani Mountains	Montane and submontane grassland - patches of woodland and forest - low-altitude rain forest.
Nyanga	Submontane grassland - patches of <i>Brachystegia</i> woodland forest - submontane forest.

**Table 6: Important areas for conservation but not included in southern African Hot-spots**  
(Source: Botanical Diversity in southern Africa: Strelitzia 1, B.J. Huntley, Ed., 1994).

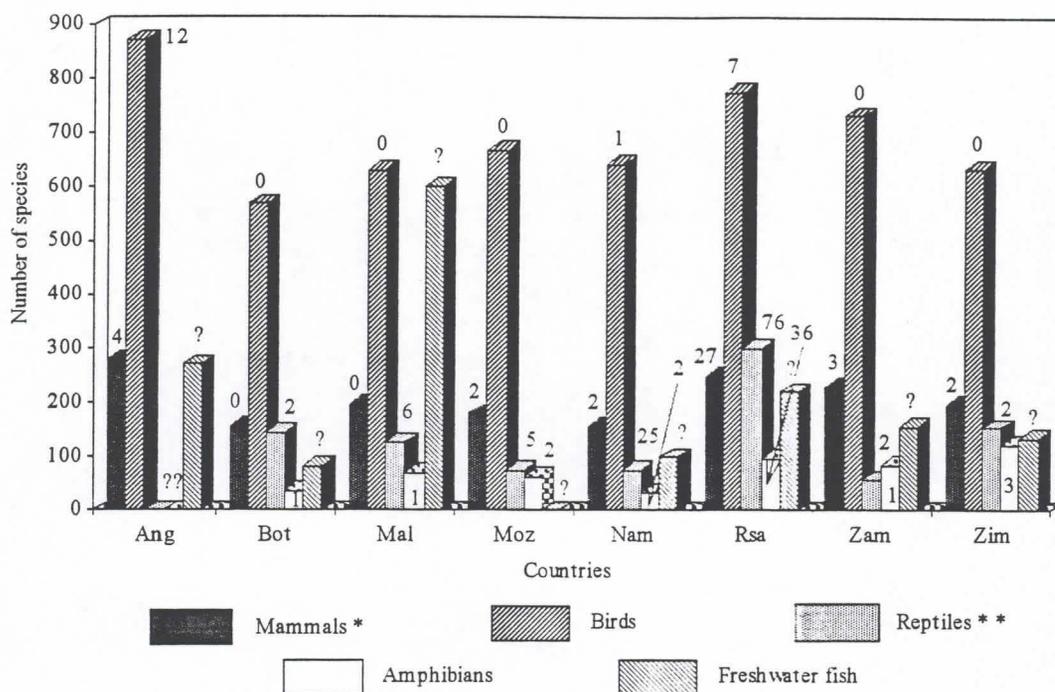
## 3.2 Fauna

The southern Africa Region harbours a wide range of terrestrial and marine mammals, birds, reptiles, amphibians and fishes within the different ecozones. Figure 5 shows the species richness and endemism for vertebrates in the region.

### 3.2.1 Mammals

Southern Africa harbours about 203 species of mammals: Angola, South Africa and Zambia are the richest countries while South Africa has the greatest number of endemic species (11 %). Some other countries in Africa have more species, for example in Central Africa - Zaire (415), Uganda (315), Nigeria (274), Cameroon (297) and Central African Republic (209); in East Africa - Kenya (309), Tanzania (306) and Ethiopia (255); in West Africa - Ivory Coast (230) and Ghana (222). Highest mammal endemism occurs in Madagascar (63,8 %), Sao Tome and Principe (25 % for only 8 mammal species), South Africa (11 %), Ethiopia (10,2 %), Zaire (6 %), Cameroon (3.4 %), Kenya (3,2 %) and Tanzania (3 %).

This richness of large mammals (but also of plants and birds), over 40 species in southern Africa, led to the establishment well before colonisation of a large network of protected areas in the region (SARDEC/IUCN/SADC, 1994). National parks, reserves, game parks, hunting safari areas currently provide important income, sometimes together with community use of wildlife resources.



\* Marine mammals excluded  
 \*\* Snakes only in Mozambique, Namibia and Zambia - Sea turtles and sea snakes excluded  
 - 1 Number of endemic species - ? no data

**Fig. 5: Species richness and endemism in vertebrates in southern Africa - Angola, Botswana, Malawi, Mozambique, Namibia, South Africa, Zambia and Zimbabwe -**  
 (Sources: Global Biodiversity: NHM/TUCN UNEP/WWF/WRI, 1992 -  
 A Complete Guide to Snakes of southern Africa: J. Marais, Southern Book Publishers, 1992).

### 3.2.2 Birds

Angola, South Africa and Zambia appear to be the richer countries in bird species in the region: few species are endemic, mainly in Angola (1,4 %) and South Africa (0,9 %). Southern Africa harbours an average of about 690 species (8 countries) while West Africa has about 577 species (13 countries), Central Africa about 711 species (11 countries) and East Africa about 889 species (4 countries). In Africa, the high levels of endemism in birds occur in Madagascar (39 %), Sao Tome and Principe (19,43 %), Mauritius (9,8 %), Comoros (9,1 %) and Ethiopia (3,1 %).

### 3.2.3 Reptiles

For seven countries of southern Africa (data from Angola are not available), richness of reptiles amounts to about 131 species. South Africa, with 299 species, is the richest country with a high level of endemism (25 %). Endemic species include the yellow-bellied house snake *Lamprophis fuscus*, Swazi rock snake *L. swazicus* in South Africa, the Visser's shovel-snout *Ptosymna viseeri* in Namibia, the Mozambique centipede-eater *Aparallactus nigriceps* in Mozambique. In other parts of Africa high levels of endemism occur in Madagascar (91,6 % for 252 species), Cape Verde (83,3 % for 12 species), Sao Tome and Principe (37,5 % for 16 species), Namibia (33,8 %), Somalia (34,2 % for 193 species), Kenya (17,5 % for 187 species) and in Tanzania (19,6 % for 245 species). In many other countries data are not available or very imprecise: the estimates will become increasingly accurate as more and better data become available.

In spite of a lack of data, reptiles are relatively well described in southern Africa and the region is of a great interest because of its richness and its endemism.

### 3.2.4 Amphibians

As for reptiles, data are lacking in much of Africa but are available in southern Africa, with the exception of Angola. Zimbabwe with 120 species is the richest country: South Africa harbours 95 species with a high level of endemism (37,9 % including plain and desert rain frogs (*Breviceps fuscus*, *B. gibbosus*, *B. macrops*), Cape platana (*Xenops gilli*), long-toed frog (*Leptopelis xenodactylus*). Such a level of endemism occurs in other countries in Africa such as Tanzania (33 % for 121 species): it becomes very high on some islands such as Madagascar (98,6 % for 144 species) or Seychelles (91,7 % for 12 species). Mulanje Mountain in Malawi harbours several endemic species because it represents a temperate pocket isolated on the tropical plateau.

### 3.2.5 Freshwater fishes (lakes and rivers)

Fishes are the least known of the vertebrates and the quality and extent of fauna studies vary widely from country to country. Africa harbours about 1800 freshwater fish species and come second to South America in species richness by continents. Richness in freshwater fishes is also relatively well known in southern Africa, though data are not available for Mozambique. Malawi, Angola, South Africa, Zambia and Zimbabwe are the richer countries in the region because of their large lakes and rivers. The subregion harbours six aquatic eco-regions, i.e.:

- Tropical east coast region, including extensions along the Zambezi and Limpopo valleys (flooded plains, coastal lakes, swamps, rain-filled pans);
- Tropical interior region: large and well-watered catchments with a distinct annual flood regime;
- Highveld region including the interior plateau regions of Zimbabwe and the Transvaal-Orange Free State region;
- Montane escarpment region with steep-gradient streams harbouring some characteristic species such as mountain catlets and chiselmouths;
- Cape Fold Mountain region characterised by cool-temperate acid water streams in which fish fauna is highly endemic;
- Kalahari-Karoo-Namib region with intermittent rivers and temporary pans harbouring hardy or relict species.

The fish fauna of the Zambezi River System is complex. Species appear to be distributed and/or restricted to six zoogeographical sub-systems of the Zambezi River, i.e. headwaters, middle Zambezi, lower Zambezi or Lake Kariba.

In the Lake Kariba the distribution of fish varies with the nature of the lake basins, and species diversity appears to be greater in the western part of the lake which is richer in Cyprinids. Information about endemism is not easy to acquire and further studies must be done. For example, Malawi is by far the richest country with about 600 species. Some scientists estimate that there are at least 1000 species inhabiting Lake Malawi with 95 % of the total fish fauna endemic to the lake. Such a level of endemism occurs also in Lake Tanganyika and Lake Victoria. Endemic fish species include spook-klipstamper *Paramormyrops jacksoni* in Angola, Burchell's redbfin *Pseudobarbus burchelli* and redbfin *Pseudobarbus spp.* in South Africa, Otjikoto tilapia *Tilapia guinasana* in Namibia, Beira killifish *Nothobranchius kuhntae* in Mozambique.

### 3.2.6 Invertebrates

Invertebrates are not well researched in southern Africa and the lack of data does not permit adequate assessment. Scientists have described 1,4 million invertebrates in the world compared with 0,25 million plants and only 21 000 vertebrates. Of these invertebrates, 0,75-1 million insects in the tropical forest regions are still little known. However, they have an important biological, ecological, economical, scientific and often aesthetic interest.

However, nematodes for example, which number about 500 000 species (with 15 000 described) are often studied in their destructive capacity (pests in crop farming, parasites in humans and livestock). They play an important role in decomposition and nutrient recycling and in biological control of a wide range of insect pests.

Soil fauna can reach a biomass of 12,5 g/m<sup>2</sup> in undisturbed woodland, dominated by termites, millipedes and beetle larvae. Soil fauna communities have an enormous positive impact on soil fertility and forest productivity. Soil macrofauna (Isoptera, Blattaria, Collembolla, Scorpions,...) include decomposers which are important in the breakdown and recycling of nutrients throughout mature ecosystems, in the rehabilitation of damaged ecosystems and in releasing minerals for uptake by vascular plants. Many birds and mammals regularly feed on soil fauna such as *Soricidae* (shrews), *Erinaceidae* (hedgehogs), *Charadriiformes* (wading birds), reptiles and amphibians.

Deep-sea invertebrates could be also included in this study; but studies on benthic fauna species are very complex and still in their infancy.

### 3.3 Freshwater resources

Freshwater resources (table 7) depend primarily on rainfall: water is then stored naturally in the ground (aquifers), rivers and lakes or in dams established by humans. Wetlands (marshes, floodplains, etc.) also provide a large quantity of water which is used by farmers for part of the year. Large dams (Lake Kariba, Kafue Gorge) represent enormous hydroelectric resources and hydropower potential. Southern Africa harbours thousands of medium-size or small dams (about 50 000 in South Africa and 8 000 in Zimbabwe) used for water-supply in the dry season and during periods of drought. Water demand for urban and rural water supply, watering livestock and a large quantity for crop irrigation is closely linked to water resources and supplementary water when irrigation is possible. In South Africa for example irrigated lands produce about 30 % of the value of agricultural production but much of this land supports crops of low value such as grain or pasture. Dambos are often used as natural irrigated lands, although their exploitation is not permitted in some countries such as Zimbabwe. Water demand for domestic use and irrigation is predicted double between 1993 and 2020 in southern Africa (table 8).

Country	Annual Internal Renewable Water Resources	Annual Withdrawal
Angola	158 000	0,48
Botswana	100	0,09
Malawi	900	0,16
Mozambique	5800	0,76
Namibia	?	0,14
South Africa	500	9,2
Zambia	9600	0,36
Zimbabwe	2300	1,22

**Table 7: Freshwater Resources and withdrawals (cubic km) in southern Africa**

(Source: World Resources Institute: World Resources 1994-95).

Country	Demand 1993	Irrigation 1993	Demand 2020	Irrigation 2020	Total available
Angola	1 135	0,350	2 757	0 750	78 000
Botswana	0 129	0 020	0 336	0 047	0 230
Malawi	1 135	0 795	0 268	0 160	2 490
Mozambique	1 967	1 308	3 210	3 000	132 000
Namibia	0 265	0 108	0 538	0 248	0 740
South Africa	19 295	9 615	30 168	12 674	28 470
Zambia	0 994	0 690	2 192	1 580	60 000
Zimbabwe	2 524	2 175	5 737	4 980	7 860

**Table 8: Current and projected water demand (cu km/yr) in southern Africa  
- Angola, Botswana, Malawi, Mozambique, Namibia, South Africa,  
Zambia and Zimbabwe -**

(State of the Environment in southern Africa: SARDEC/TUCN/SADEC, 1994 -  
World Resources Institute: World Resources 1994-95).

### 3.4 Marine ecosystems

From the southern part of Tanzania to South Africa and Angola, along a 9 600 km coast, marine ecosystems can be divided into four main zones:

- The warm east coast (Mozambique);
- The temperate Agulhas bank (eastern South Africa);
- The cooler Benguela system (western South Africa, Namibia and Angola);
- The warm Angolan coast (Angola).

Because of a nutrient-rich system, the cold part of the southern African's coast (Benguela system) produces high plant growth and harbours a wide variety of fishes (South African sardine, Cape anchovy, kingklip), birds (African penguins, Cape gannets, Hartlaub's gull) and mammals (fur seals, Heaviside's Dolphin).

Warm coasts are also rich in species but because of a low nutrient composition they provide a low rate of plant and fish production. Tuna, sardinella, predatory mackerel are the main fish species of this warm ocean: prawns are another important resource.

Mangroves on the eastern shores of Africa are characteristic from the Mozambique coast (850 sq. km in the Provinces of Sofala, Zambezia and Nampula with 8 protected sites) to the south coast of South Africa (6,7 sq. km with 11 protected sites): patches of mangroves also appear in Angola (1100 sq. km with 2 protected sites). Mangroves, a highly productive marine ecosystem, occur in brackish swamps by river estuaries and are composed of *Rhizophora*, *Sonneratia*, *Avicennia* and *Burqueira* trees: they have a strong tropical Asian affinity.

They provide wood for fuel and raw material for boat-builders, salt, lime, fish, prawns and honey: in Africa, goats and cattle feed on foliage (see table 3).

Coral reefs, also limited to warm seas, extend from Mozambique (Mocambo bay) to northern Natal (Maputaland coast in the north-east). Coral reefs, composed of shelf and oceanic reefs, are one of the most productive and diverse of all natural ecosystems. They play a crucial role by providing important local resources and they are sometimes considered the marine equivalents of the rain forests. Reefs protect the coastline against waves, prevent erosion, contribute to the formation of sandy beaches, and harbour numerous fish, mollusc and crustacean species used for food. They also provide an important source of income from the tourist industry. The Agulhas bank system stretches between the cold Benguela system and the warm Agulhas current<sup>1</sup>. It harbours fishes also found in the Benguela system, and the largest breeding colonies of African penguins and Cape gannets (in Algoa Bay).

<sup>1</sup> The Agulhas current promotes a western extension of fish species by transporting eggs and larvae to the Benguela system where they feed and grow.

### 3.5 Mining

Currently mining occupies a crucial position in the economy of southern Africa, mainly in countries such as South Africa or Zimbabwe where mineral reserves are important (especially coal) (table 9). Several hundred minerals have been identified in Namibia, of which a number are exclusive to the country but only sixty have been exploited to date. Mining, an important pillar of the economy, contributes major foreign currency earnings and generates wealth and employment of great significance. In Zimbabwe, mining generates 7 % of Gross Domestic Production (GDP). There are mining operations for coal (South Africa, Botswana, Malawi, Zambia, Zimbabwe), petroleum (Angola), asbestos (Zimbabwe, South Africa), iron, nickel, cobalt, copper, silver (Zimbabwe), uranium (Namibia), gold (Zimbabwe), chromium ore (Zimbabwe: Great Dyke), diamonds (Angola, Namibia). Heavy minerals (titanium, rutile) are mined in South Africa and used in the production of lead-free paint, chips for computer parts and nuclear technology.

Product	Domestic exports 1990-1994 (tonnes)	Domestic exports 1995 (tonnes)
Coal	49 450	62 960
Coke	109 900	361 300
Graphite	10 800	9 460
Asbestos	138 670	174 500
Lithium ores	15 600	17 800
Copper ores	4950	116

**Table 9: Domestic exports of the main mineral products in Zimbabwe**

(Source: SITC, Harare, Zimbabwe, 1995).

Large and value lodes stand under the coastal dunes (St. Lucia's eastern shores) classified in 1986 as Wetlands of International Importance: a serious controversy currently exists between mining companies and nature conservation organisations.

## Summary of Chapter 3: NATURAL RESOURCES

In spite of the difficult climatic conditions prevailing in southern Africa, due mainly to poor and erratic rainfall, the different ecozones contain an important biodiversity.

Tropical plain forests are present especially in Angola and Mozambique. Tropical and temperate mountain forests are restricted to isolated patches along the escarpment that stretches in the East from Tanzania to South Africa. Savannah woodlands cover roughly half the region and are made up of two dominant types, miombo and mopane. Prairies or savannah grasslands cover only small areas, except in South Africa, but they are important for agricultural production and for wildlife.

Wetlands, that cover around 13 % of the region, are ecosystems with high productivity supporting high agricultural production. They are also vital for fish, wildlife and maintenance of the biodiversity. The local people's water requirements, constantly increasing as a result of population increase (2,2-3,8 % per annum) are met by the reservoirs made up of the rivers (Zambezi), lakes (Kariba, Malawi) and the thousands' dams that have been built in the region.

The diversity of ecozones leads to that of the vegetation and flora, and southern Africa hosts more than 23 000 plants species.

The particular climatic conditions linked to certain ecozones have resulted in differentiation of the vegetation and flora.

The high-altitude forests, Succulent Karoo and Cape bush contain flora unique in the world, comprised of more than 75 % of endemic species. This biological richness and diversity also apply to the wild animals. Southern Africa has some 203 species of mammals with a high level of endemism in South Africa and 690 species of birds. The presence of important large mammal populations, represented by some 40 species, has led to the creation of a vast network of protected areas throughout of the region. The reptiles, amphibians and fish, whose populations are less known, also contain a large number of species, many of which are endemic. The Malawi Lake harbours about 1 000 species of fish with a 95 % level of endemism.

This great biological diversity, to which should be added the under-ground resources (minerals), which are presently of great economical interest to the region, constitutes enormous potential for southern Africa in terms of its natural resources and their management.

## 4. LAND USE

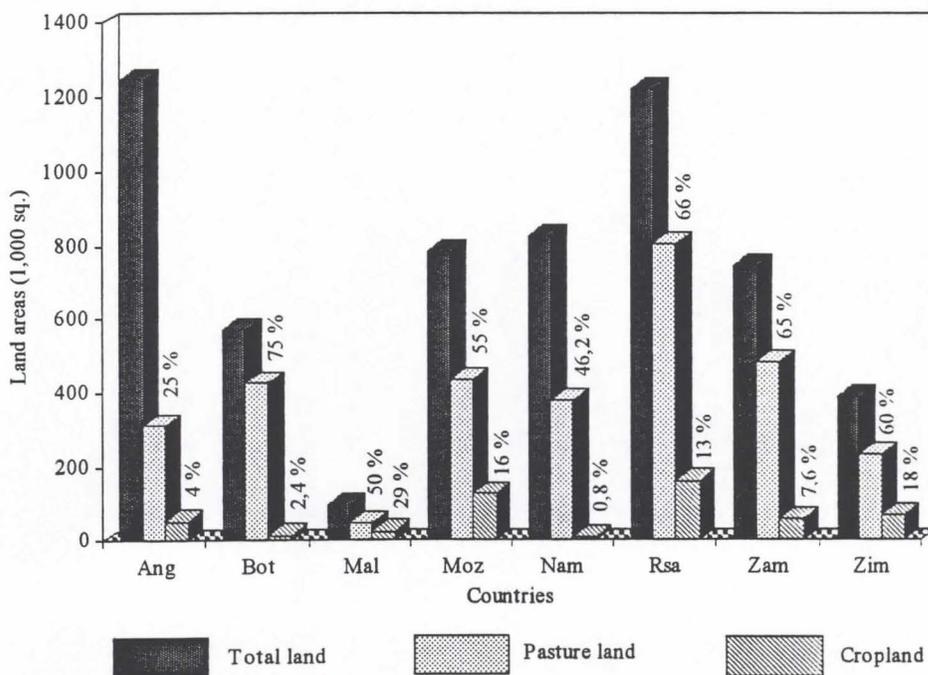
Land use in Southern Africa is linked with the agricultural potential of the region which, in turn, is linked with the high diversity of soil types and climatic conditions. Land tenure overall consists of protected and wildlife areas (national parks, game reserve, safari areas<sup>2</sup>, forest reserves) commercial farms, customary and traditional land, water bodies and urban areas.

Traditional land is the most widespread system, although commercial farms are extensive in Zimbabwe. Communal farming lands form 65 % of the land area of southern Africa while commercial farm lands in private ownership extend to about 23 %. Protected areas and forest reserves occupy an important place (about 10,5 % of all state land) while water bodies are restricted to the lakes.

A large part of the region has an arid or semi-arid climate. Erratic rainfall presents a risk for cash crops, although drought resistant fodder crops can be used, and so livestock production is often the best means to use the land.

### 4.1 Cultivation/Cropland

Malawi, Zimbabwe, South Africa and Zambia have the highest proportion of arable land with 29, 18, 13 and 7,6 %, respectively, while Angola, Botswana and Namibia have the lowest proportion (fig. 6). Most of the best cultivated lands are in the grassland zone, often under irrigation as in South Africa (1,8 million ha). The area of land suitable for rainfed crop farming and irrigation is limited in southern Africa to about 7-10 %: less than 4 % of the land is currently under cultivation.



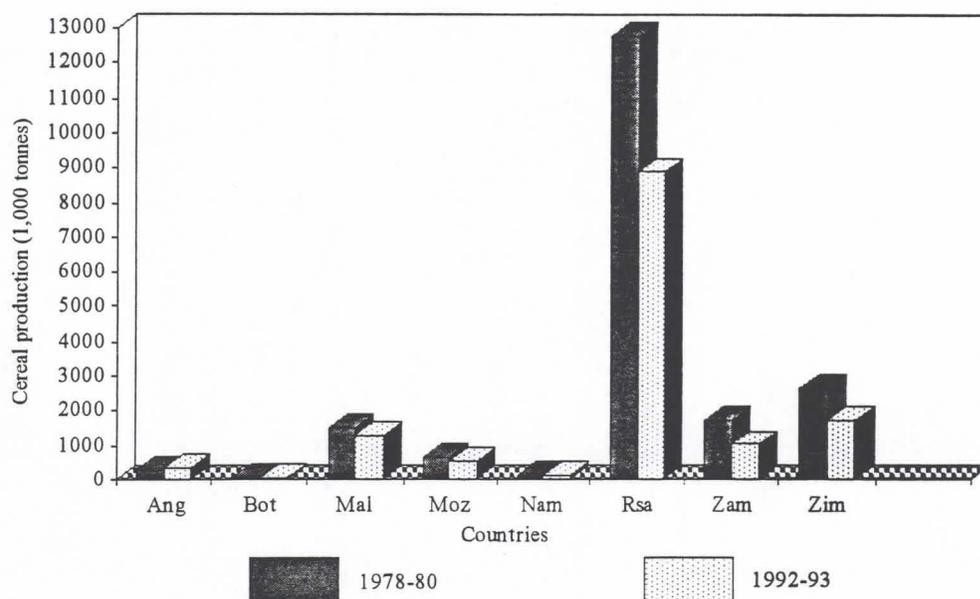
**Fig. 6: Pasture and cropland as percentage of total land in southern Africa - Angola, Botswana, Malawi, Mozambique, Namibia, South Africa, Zambia and Zimbabwe -**

(Sources: Global Biodiversity: NHM/TUCN/UNEP/WWF/WRI, 1992 - State of the Environment in southern Africa: SARDEC/TUCN/SADEC, 1994 - World Resources Institute: World Resources 1994-95).

<sup>2</sup> In Zambia Game Management areas are classified as "customary lands".

Cereal production (fig. 7), like wood production, in the communal lands is linked to the farmers' access to woodland and to the livestock production system.

Use of agricultural inputs varies from country to country. It is relatively high in South Africa, Zimbabwe and Malawi with 35 to 70 kg of fertilizers per hectare cultivated, but insignificant in Botswana and Mozambique with only 1 kg/ha. Although people prefer maize, drought resistant cereals (new varieties of sorghum and millet) are currently used as a less risky food source: other grain crops include wheat, barley, mhunga and rapoko. The main industrial crops consist of cotton, tobacco, groundnuts, sunflowers and soyabeans. Other crops include vegetables such as potatoes, tomatoes, beans and onions.



**Fig. 7: Cereal production (average) in southern Africa**  
 - Angola, Botswana, Malawi, Mozambique, Namibia, South Africa, Zambia and Zimbabwe -  
 (Sources: Botanical Diversity in southern Africa: Strelitzia 1, B.J. Huntley, Ed, 1994 -  
 World Resources Institute: World Resources 1992-93 and 1994-95).

Fruits grown commercially are represented mainly by oranges, lemons, naartjies, bananas, mangoes and occasionally by pawpaws and guavas.

In Zimbabwe, land use on commercial farms in 1993 was as follows:

- Crops 49 %;
- Industrial crops 37 %;
- Fodder crops 10 %;
- Fruit 2 %;
- Other 2 %.

with a notable increase of the total area under grain crops and with a downward trend in industrial crops since 1990.

#### 4.2 Grazing and livestock

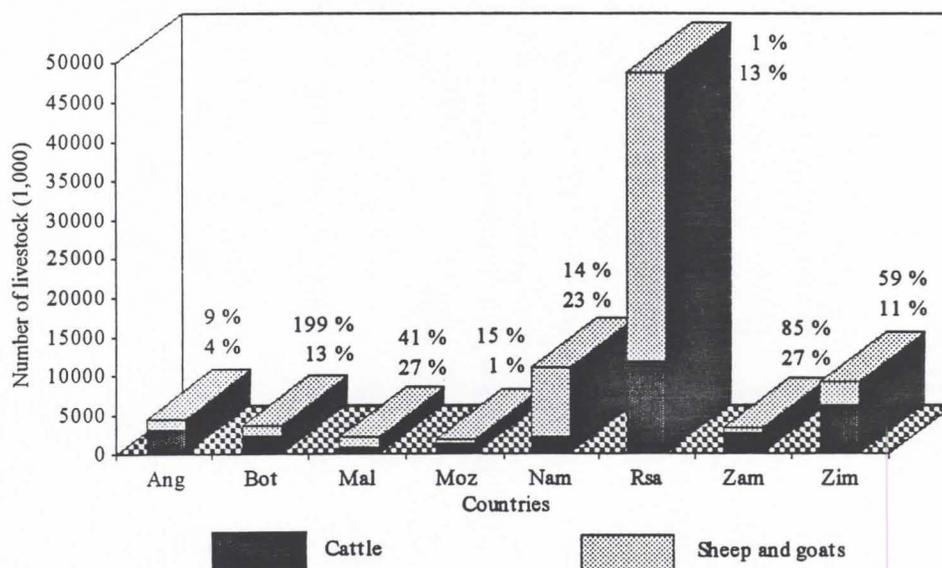
A large portion of moist and dry savannah is not suitable for crop production, and grazing is the most extensive form of land use in southern Africa. Grazing areas also include grassland, Fynbos (sheep-grazing), Nama and Succulent Karoo (sheep-grazing), lowland tropical forest and temperate Afromontane (sheep-grazing).

About two-thirds of the region is considered suitable for grazing and pasture land covers more than 50 % in each country, except in Angola.

Livestock plays an important role in southern Africa, in both traditional culture and in the economy. It represents the basis of life in some countries. Domestic livestock accounts for 90 % of the large herbivore standing crop biomass (with 77 % for cattle) in southern Africa: wildlife represents only 10 %. Livestock systems can be divided into four main categories:

- The extensive pastoral system in which herders are entirely dependent on livestock for their livelihood: pastoralists make use of marginal lands;
- the transhumance system in which livestock is moved seasonally but the household is more or less static: this system and the one above are not well developed in southern Africa;
- The Agropastoral system in which livestock supplements crop farming systems in a static community: this system is widespread in communal lands;
- The commercial ranching system where livestock is kept to produce marketable goods.

A preponderance of small stock is found in the more arid south and west of the subregion; the wettest parts in the north support cattle ranching and agropastoralism systems. The number of livestock has been increasing in southern Africa (at a slow rate < 1 %) since 1978-80 (fig. 8 and table 10), in particular goats and sheep in Botswana, Malawi, Zambia and Zimbabwe. Drought reduced this progression, mainly in 1992-93, where more than one million cattle died in Zimbabwe and many more in other countries. Livestock populations are estimated at 45 million cattle and 71 million goats and sheep in southern Africa. Overgrazing and overexploitation of woodland lead to rangeland degradation which becomes less suitable or unsuitable for cattle: goats and sheep which are less selective feeders are in such a case brought in preference. Donkeys and goats are increasing in the more arid areas. In livestock-based agroforestry systems (in some parts of Zimbabwe for example) livestock is not completely dependant on grasses and can feed on browse-able woody perennials (*Colophospermum mopane*, *Piliostigma thonningii*, *Terminalia sericea*) providing essential crude protein during the dry season.



**Fig. 8: Number of livestock in southern Africa and percentage increase since 1978-80**  
 - Angola, Botswana, Malawi, Mozambique, Namibia, South Africa, Zambia and Zimbabwe -  
 (Sources: Botanical Diversity in southern Africa: Strelitzia 1, B.J. Huntley, Ed, 1994 -  
 State of the Environment in southern Africa: SARDEC/TUCN/SADEC, 1994).

Country	Cattle	Sheep	Goats
Angola	157,4	92,9	102,1
Botswana	49,7	160,4	196
Malawi	193,3	168,3	89
Mozambique	44,2	30,4	- 15,6
Namibia	- 3,2	123	76,9
South Africa	- 5,4	- 21,2	14,2
Zambia	115,9	123,7	262,9
Zimbabwe	81,6	83,7	493,8

**Table 10: Percentage increase of livestock number in southern Africa between 1961 and 1989**

(Source: Multispecies Animal Production System Project, Project Paper No. 22: D.H.M. Cumming & I. Bond, 1991).

In 1990-92 the population of pigs was about 1 487 000 in South Africa, 805 000 in Angola, 294 000 in Zambia, 389 000 in Zimbabwe and 235 000 in Malawi. Equines were found mainly in Botswana, Namibia and Zimbabwe with, respectively, 190 000, 129 000 and 127 000 animals. The population of chickens is important in South Africa (n = 40 million), Mozambique (n = 22 million), Zambia (n = 17 million) and Zimbabwe (n = 13 million).

### 4.3 Afforestation

Southern Africa has large areas of tree plantations, mainly in Swaziland and South Africa. Afforestation principally provides poles and fuelwood and is useful in the peri-urban areas. Estimated areas under plantations in the region are listed in table 11. Exotic species used in tree plantations contain several *Eucalyptus* species (from Australia) such as *E. grandis* for good sites, *E. tereticornis* for mediocre sites and *E. camaldulensis* for poor sites. Other large Australian genera include *Casuarina*, *Melaleuca* and *Grevillea*: more recently *Acacia holosericea* and *A. auriculiformis* have done well in some countries. In Zimbabwe *Eucalyptus* plantations are estimated at 300 sq. km, mainly in farm woodlots. In the eastern districts about 130 sq. km of black wattle are grown for tannin production by private farmers. Afforestation currently provides employment for about 14,000 people in Zimbabwe. Large scale afforestation with soft woods has been undertaken in the Eastern Districts: more than 630 sq. km have been planted.

At medium altitude, tree growing includes *Pinus elliottii*, *P. taeda* and *P. kesiya*. By 1993-97 exotic species (with 22 *Eucalyptus* and 6 *Pinus*) had been tested in introduction plots and provenance trials. In the region *Pinus patula*, *P. elliottii* and *P. taeda* are species chosen for pulp production.

Country	Land area (sq. km)	Tree plantations (sq. km)
Angola	1 246 700	1 800
Botswana	566 730	10
Malawi	94 080	1 440
Mozambique	784 090	400
Namibia	823 290	2
South Africa	1 221 037	16 400
Zambia	743 390	630
Zimbabwe	390 580	1 500

**Table 11: Tree plantation areas in southern Africa**

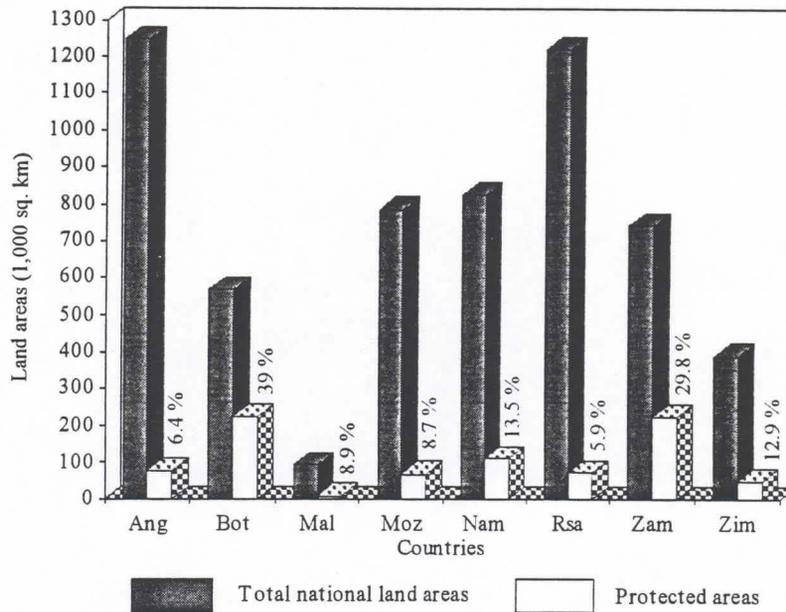
(Source: State of the Environment in southern Africa: SARDEC/TUCN S.ADEC, 1994 - World Resources Institute: World Resources 1996-97).

Exotic species are also used in agroforestry systems for fuelwood and/or fodder production: *Leucaena leucocephala*, *Prosopis chilensis*, *Sesbania sesban*, *Calliandra sp.* and *Gliricidia sp.* are the most common. Plantations with indigenous species have been successful with *Baikiaea plurijuga*, *Peltophorum africanum*, *Acacia erioloba*, *Ricinodendron rautanenii*.

Other species including *Azelia quanzensis*, *Kirkia acuminata*, *Entandrophragma caudatum* and *Pterocarpus angolensis* have shown partial success.

#### 4.4 Protected areas

The network of protected areas of southern Africa is extensive, representing some 17 % of the total land area of the eight countries studied, from 6,4 % in Angola to 39 % in Botswana (fig. 9).



**Fig. 9: Protected areas in southern Africa as proportion of national land areas - Angola, Botswana, Malawi, Mozambique, Namibia, South Africa, Zambia and Zimbabwe -**  
 (Sources: The Conservation Atlas of Tropical Forests: BP/IUCN/WCMC, 1992 - State of the Environment in southern Africa: SARDEC/IUCN/SADEC, 1994).

The highest proportion of protected areas and land under wildlife use is found in Botswana and Zambia. Protected areas include: National Parks, Integral Nature Reserves, Partial Reserves, Special Reserves, Regional Nature Parks, Controlled Hunting Areas, Game Reserves, Conservation Areas, Wildlife Research Areas, Botanical Reserves, Sanctuaries, Natural Monuments, Nature Reserves, Wilderness Areas and Parks. The existing national protected areas system evolved largely for the big game animals. It concerned first hunting and then tourism, making a significant contribution to the economy of countries in southern Africa by providing foreign currency and jobs. One result of this has been that large areas of savannah have been conserved while some other biologically rich habitats (mainly in tropical forest regions) currently have no legal protection. Most African mammals and birds live in protected areas but many areas of high plant diversity and endemism remain unprotected.

In southern Africa, moist and dry savannahs are the most extensively protected compared with only 2 % of grasslands. These ecozones contain the highest concentration of wild animals including elephant, ungulates (buffalo, eland, impala, kudu, oryx, wildebeest, hartebeest, zebra, giraffe, warthog) and primates (baboon, vervet monkey) and carnivores (lion, leopard, cheetah, hyena, jackal). They represent a large protected area as National Parks (Kafue National Park in Zambia, Kasungu and Chobe National Parks in Botswana, Matobo and Hwange National Parks in Zimbabwe, Kruger National Park in South Africa). However, some animal species, among large mammals, have a restricted area in the region as:

- Tree dassie *Dendrohyrax arboreus* in the coastal plains of the eastern Cape, Natal and south-central Mozambique;

- Hook-lipped rhinoceros *Diceros bicornis* that occurs now naturally only in Zululand Reserves, Zambezi valley and possibly in parts of southern Mozambique. The square-lipped rhinoceros *Ceratotherium simum* is currently naturally restricted to Humfolozi Game Reserve and Hluhluwe Game Reserve. These two species have been widely introduced or reintroduced to other reserves;

- Sitatunga *Tragelaphus spekei* that occurs only in Botswana's Okavango Delta and adjacent areas;

- Lechwe *Kobus leche* restricted to Okavango and Chobe areas and the puku *Kobus vardonii* which exists only on Pookoo Flats and vicinity on Chobe River (Botswana);

- Cape Grysbok *Raphicerus melanotis* restricted to a narrow area along south-western and southern Cape coastal belt.

Forest ecozones are quite well protected in Zimbabwe within two National Parks (Nyanga and Chimanimani) and five Botanical Reserves, in addition to state forest areas, some of which contain rain forest. Chimanimani mountains, with montane and submontane grassland, patches of woodland and forest and low-altitude rain forest contain 859 vascular plant species with 42 totally endemic. Nyanga area with Mt Inyangani (the highest mountain in Zimbabwe) associates submontane grassland, patches of *Brachystegia* woodland and submontane forest. It is one of the richest areas in Zimbabwe but the total number of species is currently unknown.

Afromontane and temperate forests are also quite well protected in Zambia and Malawi (2/3 of Malawi's Afromontane forest are in reserves) including:

- Nyika National Park 90 % covered by short open grasslands but with patches of submontane evergreen forest (*Juniperus procera* forest) and Mulanje Reserve<sup>3</sup>;

- Royal Natal National Park in South Africa harbouring undifferentiated Afromontane forest, bushland, thicket and grassland with a high level of endemism in plant species.

In Angola lowland tropical forests are underprotected and the forest habitats in the mountains need protection. Most of the 1 260 known endemic plant species are concentrated in the high escarpment areas in western Angola. Small areas of mangrove forest are protected within Kisama National Park. Eastern coastal forests have been disturbed but some patches remain in Mozambique (Maputo National Park) and South Africa (St. Lucia Wetland Park). They are composed of evergreen rain and semi-deciduous forests associated with valley bushveld and grasslands, littoral evergreen thickets, swamp forests and mangroves. These areas harbour about 20 % of endemic plant species including giant heaths (*Erica* spp.) and arborescent *Encephalartos*, *Aloe* and *Euphorbia*.

In South Africa Nama Karoo and Succulent Karoo (including 162 445 ha Richtersveld National Park) harbour a large portion of endemic species (35-50 %). They are inadequately represented in the network of protected areas with only 1 and 1,2 %, respectively, of their areas being protected. These ecozones contain 95 endemic genera and 1 500 endemic species of the *Aizoaceae* family and many other groups with large numbers of endemic species including *Asclepiadaceae*, *Asteraceae*, *Crassulaceae* and *Iridaceae* families.

Namibia (Skeleton Coast Park: 1 639 000 ha) and Angola (Iona National Park: 1 515 000 ha) contain a large section of the desert ecozone where desert plants and animal species are still found. In the Cape Regional Centre of Endemism only 14 percent of the Fynbos, the richest plant area of the planet, is currently under protection.

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<sup>3</sup> With the support of WWF/WSM environmental education project

Differentiated into mountain and lowland forms, the Fynbos contain about 70 % of endemic species in some families such as *Ericaceae* (600 species of *Erica*), *Proteaceae*, *Restionaceae*, *Rutaceae* and *Thymelaeaceae*.

Few mammals such as blue duiker, red forest duiker, bushbuck and blue monkey are found exclusively in the montane forest, the majority being "ecological transgressors" which also live in the lowland forest. In Zimbabwe, for example, 37 species have been recorded in rain forest, ten of which are confined to it. Some of the forest species are endemic or rare (mainly rodents) and depend on the forest for survival:

- Black-and-red squirrel *Paraxerus lucifer* in Malawi;
- Sun squirrel *Heliosciurus mutabilis* and red squirrel *Paraxerus palliatus* in eastern Zimbabwe and Mozambique;
- Arends's golden mole *Chlorotalpa arendsi* in Zimbabwe;
- Greater grey-brown musk shrew *Crocidura luna* is restricted to the eastern Highlands of Zimbabwe;
- Swamp rats as *Otomys typus* and *Otomys denti* in Malawi;
- Vlei rat *Otomys irroratus* rare in Zimbabwe but more common in South Africa;
- Groove-toothed rat *Pelomys fallax* in eastern Zimbabwe and Mozambique;
- Gorongosa gerbil *Tatera inclusa* in eastern Zimbabwe and Mozambique;
- Chequered elephant shrew *Rhynchocyon cirnei hendersoni*;
- Greater hamster rat *Beamys major*;
- Selinda rat *Aethomis silindensis* in Zimbabwe;
- Black-nosed monkey *Cercopithecus ascanius atrisanus* and a rare subspecies of the black mangabey *Cercocebus aterrimus opdenboschi* in Angola;
- Syke's monkey *Cercopithecus albogularis*;
- Samango monkey *Cercopithecus mitis* the populations of which are isolated in forest and patches of forest from eastern Cape Province to Mozambique and eastern Zimbabwe;
- Tree civet *Nandinia binotata* only in eastern Zimbabwe and adjacent areas of Mozambique;
- Bocage's fruit bat *Rousettus angolensis* is only known from eastern Zimbabwe and the adjacent areas of Mozambique.

Forest habitats harbour many rare or endemic bird species:

- Gabela helmet-shrike *Prionops gabela*, Gabela akalat *Sheppardia gabela*, Monteiro's bush-shrike *Malacomotus monteiri*, Swierstra's francolin *Francolinus swierstrai*, Fernando Po swift *Apus sladeniae*, black-chinned weaver *Ploceus nigrimentum* in Angola;
- Malawi has no endemic bird species but several species are rare: Thyolo alethe *Alethe choloensis* (also in Mozambique), spotted ground-trush *Turdus fisheri*, white-winged apalis *Apalis chariessa*, green-headed oriole *Oriolus cholocephalus* for example;
- In Mozambique, where information is less precise, some species appear to be rare such as: dappled mountain robin *Modulatrix orostruthus*, Thyolo green barbet *Atactolaema olivacea blecheri*, Namuli apalis *Apalis lynesii*, East coast akalat *Sheppardia gunningi*, southern banded snake eagle *Circaetus fasciolatus* for example;
- Two species of the 46 recorded in Zimbabwe's forests are endemic, Robert's prinia *Prinia robertsi* and Chirinda apalis *Apalis chirindensis* and several others are rare such as Swynnerton's forest robin *Swynnertonia swynnertoni*;

Information concerning other animal groups could be mentioned in connection with the importance of forest habitats. In Malawi, Mt Mulanje harbours most of the country's forest butterflies. Three are endemic: *Baliocbila woodi*, *Charaxes margaratae* and *Cymothoe melanjae*. In Zimbabwe, 182 butterfly species have been recorded in the Chirinda forest.

Among reptiles and amphibians there is one endemic chameleon *Rhampholeon marshalii* and one endemic frog *Probreviceps rhodesianus* in the forests of Zimbabwe.

Protected marine areas occur in South Africa with De Hoop Marine Reserve which covers about 23 000 ha. Eight species of baleen whales (Brydes's whale *Balaenoptera edeni*, humpback whale *Megaptera novaeangliae*, right whale *Balaena glacialis*) and thirty species of toothed whales and dolphins (Arnoux's beaked whale *Berardius armuxii*, Gray's beaked whale *Mesoplodon grayi*, pygmy sperm whale *Kogia breviceps*, common dolphin *Delphinus delphis*) have been recorded off the coasts of southern Africa. Other marine mammals such as seals can be observed along the coasts of southern African. The most common species is the Cape fur seal *Arctocephalus pusillus* which occurs off the western and southern coastline: the sub-antarctic fur seal *Arctocephalus tropicalis*, southern elephant seal *Mirounga leonina*, crabeater seal *Lobodon carcinophagus* and leopard seal *Hydrurga leptonyx* are vagrant in this part of Africa. Another aquatic mammal, the dugong *Dugong dugon* is found in Mozambique in the sheltered areas along the southern coast: it is seldom found in Northern Natal.

#### 4.4.1 Sites of international importance

##### > World Heritage Sites

The Convention concerning the "Protection of the World Cultural and Natural Heritage" (1972) provided for the designation of areas of outstanding universal value with the principal aim of fostering and strengthening international co-operation in safeguarding these exceptional areas. Few areas have been selected as World Heritage Sites in southern Africa:

- Lake Malawi National Park in Malawi;
- Victoria Falls/Mosi-oa-Tunya in Zambia (Zambia section);
- Victoria Falls/Mosi-oa-Tunya in Zambia (Zimbabwe section) and Mana Pools National Park, Sapi and Chewore Safari Areas in Zimbabwe.

##### > Biosphere Reserves

Biosphere Reserves are not covered by a specific convention but are included in an International Scientific Programme - Man and Biosphere (MAB) - initiated by UNESCO. These areas are designated not only to protect unique sites but also for research, recreation, monitoring and training. In southern Africa no Biosphere Reserves have been selected.

##### > Wetlands of international importance

These sites are under the Ramsar Convention, signed in 1971 in Iran, by which signatory states have the special obligation to safeguard wetlands throughout their territories. In southern Africa, Ramsar sites occur only in South Africa and Zambia:

- South Africa: Baberspan - Blesbokspruit - De Hoop Vlei - De Mond - Kosi Bay - Lake Sibaya - Lagebaan - Orange River Mouth - St. Lucia System - Turtle Beaches/Coral Reefs of Tongaland - Verlorenvlei - Wilderness Lakes;
- Zambia: Bangweulu Swamps: Chikuni - Kafue Flats (Lochinvar & Blue Lagoon).

## Summary of Chapter 4: LAND USE

Land utilisation is directly linked to the agricultural potential of the soils and climatic conditions in each region. Traditional land management, which is the most common system, is practiced in 65 % of the land of the region; commercial farm lands private ownership extend to about 23 %. Land potentially suitable for crops, because of the poor soils, are only 7 to 10 % of the total land area of the region. Maize and drought resistant cereals are the most common crops in traditional system. Commercial farms produce mainly cotton, tobacco and fodder crops.

A large part of the region covered with savannah is therefore used for livestock farming, while also providing for the needs of the local people in wood (timber and fuelwood) and secondary products of plant and animal origin.

Livestock farming mainly takes the form of agropastoralism (communal lands) or commercial ranches. The cattle population, estimated at about 45 million heads has progressed slowly over the last few decades. The droughts of 1981-83, 1986-87 and 1992-93 considerably reduced numbers in most of the countries of the region.

Erratic rainfall, shortages of mineral elements (phosphorus) in the soils, water supplies and diseases are so many factors limiting the development of livestock farming in the region. Small livestock, goats and sheep, have on the other hand very definitely increased in most arid regions: the population in South Africa alone is around 36 million head.

Large scale afforestation with softwoods has been undertaken in some countries such as in Zimbabwe and South Africa. The main exotic species used in tree plantations include *Eucalyptus*, *Pine* and *Acacia* (black wattle).

Southern Africa has another vocation in wildlife management and use. The network of protected areas, that is very extensive, covers some 17 % of the total land area and is representative of the different ecozones in the region. This network has an important place in the regional economy through tourism (national parks) and hunting (game reserves) and in biodiversity conservation (botanical reserves, conservation areas).

## 5. NATURAL RESOURCE USE

Of the estimated 250 000 flowering plants, only 3 000 are considered as food sources and 200 have been domesticated. Currently, no more than 20 species are crops of major economic importance. Relatively few botanical families account for the world's main domesticated plants: *Gramineae* (*Oryza*, *Zea*, *Triticum*), *Fabaceae* (*Cajanus*, *Arachis*, *Vigna*), *Crucifereae* (*Brassica*), *Solanaceae* (*Capsicum*, *Solanum*) and *Umbellifereae* (*Daucus*) are among the most important. Wild plants provide a wide range of useful products (food, timber, gum, medicines, fibre, etc.) relied on by people in all the countries of the world. Use of plants is a traditional feature of the most African economies, irrespective of the primary means of subsistence.

In Africa and Madagascar, 614 tribes out of 740 depend to some extent on wild resources. The Tonga people, on the Zambia-Zimbabwe border, use about 220 plant species.

Plant use is very important in the economy, for example :

- Food use: crop plants and wild plants;
- Wood use;
- Medicinal use;
- International trade: ornamental plants (orchids, cacti and other succulents), essential oils, gum arabic, bulbs;
- Industry: pesticides, herbicides, drugs, perfumes;
- Agriculture and Horticulture: pasture, forage, new fruit crops (marula *Sclerocarya birrea*), medicinal plant crops;
- Ecotourism: non-consumptive use with a high economic value in southern Africa.

Many of the species from which crop plants have been selected continue to survive in the wild. These plants and the closely related species are of immense value in crop breeding programmes and provide a large reservoir of genetic diversity. Another important source of genetic crop diversity is the range of variation of the "land races". "Land races" are breeds or populations of crops which have become adapted under natural and artificial selection processes to the local conditions under which they are cultivated. They are resistant to major pests and diseases and could be used for crop improvement programmes.

### 5.1 Uses of plants

#### 5.1.1 Food use

Food crops, mainly cereals (see fig. 7), are important subsistence and commercial crops. Table 12 gives figures of the main crop areas and production in Zimbabwe.

Crop	Area (ha)	Production (tonnes)
Maize	1 535 000	2 609 000
Soybeans	57 720	110 310
Cotton	264 120	242 020
Groundnuts	147 200	80 250
Sunflowers	108 200	50 600
Sorghum	193 800	107 250
Mungha	194 800	74 110
Rapoko	77 300	36 185
Flue-cured Tobacco	80 964	200 516
Burley Tobacco	5 540	8 152

**Table 12: Estimates of area planted and expected production of the main crops in Zimbabwe (1995-96)**

(Source: Central Statistical Office: Harare, Zimbabwe, 1996).

Most of the countries need international food aid in addition to their cereal production. Between 1971 and 1989, Mozambique received an average of about 469 000 tonnes, Malawi about 168 000 tonnes, Angola about 100 000 tonnes, Zambia about 72 000 tonnes, Botswana about 30 000 tonnes and Zimbabwe about 12 000 tonnes.

Wild and traditionally domesticated plants supply a wide range of the needs of indigenous people in developing countries. Fruits of wild tree species provide a very important resource in sustaining livelihoods in the small-scale farming sector in the region. In southern Africa, the miombo woodland in the richest ecosystem in fruits. Fruits from *Ziziphus mucronata*, *Z. mauritiana*, *Uapaca kirkiana*, *Ximenia caffra*, *Tamarindus indica*, *Sclerocarya birrea* trees are among the most consumed: people harvest them for home consumption or for the market. Other fruits from forest trees are also edible, such as those of *Chrysophyllum viridifolium*, *Ficus sur*, *Myrianthus holstii*. In Zimbabwe, some 50 tree species provide edible fruits: fruit consumption is important in resettlement areas, mainly in those where food aid is lacking. The Tonga people extract salt from 5 plant species and harvest a large quantity of *Grewia flavescens* fruits during the dry season. Rural people appear to be selective (according to their taste) when they harvest fruits, and the harvest does not necessarily coincide with the peak fruiting activity of trees. Often, fruit tree species of high value are retained in the crop farming areas, for example *Azanza garkeana*, *Diospyros mespiliformis* *Strychnos madagascariensis* and *S. cocculoides*. Farmers attempt to replace them when these trees have died.

Fruit trees also play a major role in the food of wild fauna. Small (rodents) and large mammals (duikers, bushbuck, monkeys, warthog), birds (hornbills, barbets, toracos) feed on fruit trees which are often the same species as those used by people. In Botswana and Namibia, wild manketti tree nuts (*Ricinodendron rautanenii*, also present in Zimbabwe) and tsin beans (*Bauhinia esculenta*) are a primary diet of the San people because of their richness in protein and fat content. The leaves, fruit and nuts of the baobab (*Adansonia digitata*), eaten throughout Africa, are remarkably high in minerals including calcium, potassium and phosphorus. In Namibia, *Acanthosicyos horridus*, a cucurbit plant endemic to the Namib desert, is an important source of food and water for local communities.

Wild vegetables and mushrooms are collected during the rainy season: people often cook and dry them in the sun for use in the late dry season when food stores are low. Edible mushrooms include the parasol mushroom *Macrolepiota zeyheri*, splitgill *Schizophyllum commune*, *Termitomyces chypeatus*, field mushroom *Agaricus campestris*. Roots and tubers (*Dioscorea spp.*) provide a fleshy food during the dry season.

Some plants are used as substitute for coffee, tea or milk and sometimes to make "brandy" (*Hyphaene petersiana*, *Berchemia discolor*). Several edible fruits of indigenous trees *Parinari cutatellifolia*, *Sclerocarya birrea* are used for production of wine.

### 5.1.2 Wood use

Wood provides the primary source of fuel in developing countries and is widely used in home building: there is also a trend towards value-added processing in the timber industry (table 13). In the subregion, wood is used mainly for producing fuelwood, charcoal, roundwood and secondary sawnwood, sleepers, panels, pulp and paper. Forests and woodlands are exploited by selective logging for timber and hardwoods, urban fuelwood and charcoal use, fuelwood for rural industries (brickmaking, fish smoking, tobacco curing, beer brewing), and for subsistence use. Indigenous tree species used for fuelwood reflect sophisticated choices regarding burning quality, cultural restrictions, labour time and species availability. Exotic species such as *Eucalyptus* are more frequently used in areas with sparse land cover.

Afforestation with exotic species (*Pinus spp.*, *Eucalyptus spp.*, *Casuarina equisetifolia*, *Cupressus lusitanica*) help to produce timber, panels, pulp and paper.

Country	Fuelwood	Roundwood	Sawn	Panels	Paper *
Angola	5 539	6 448	7	11	15
Botswana	1 303	82	0	0	0
Malawi	7 814	346	48	14	0
Mozambique	15 022	1 005	44	5	2
Namibia	1 790	0	21	0	0
South Africa	7 078	12 283	2 225	398	1 636
Zambia	11 565	1 220	76	8	4
Zimbabwe	6 229	7 893	213	26	82

**Table 13: Wood production in southern Africa (1 000 cubic meters)**  
\* (1 000 tonnes)

(Sources: State of the Environment in southern Africa: SARDEC/TUCN/SADEC, 1994 - World Resources Institute: World Resources 1994-95).

The household fuel consumption for cooking is estimated at 80 million cubic meters/yr in southern Africa. In Zambia, some 430 sq. km are cleared every year for producing 100 000 tonnes of charcoal: fuelwood accounts for about 66 % of the total energy need. In South Africa, charcoal is mainly produced from plantations (Australian *Acacia sp.*). In Zimbabwe, Malawi and Mozambique, each hectare of tobacco requires about 50-60 cubic metres of wood to be cured. In Zimbabwe and Malawi, about 7 00 sq. km of woodland are cleared each year to grow tobacco. Still in Zimbabwe, brewing uses about 1 tonne of wood per household annually. A large quantity of fuelwood is also sold at urban markets after new farmers clear their land for cultivation.

Commercial timber exploited from indigenous woodlands comes principally from Zambezi teak *Baikiaea plurijuga*, Mukwa *Pterocarpus angolensis* and to a lesser extent *Guibourtia coleosperma*. In Zimbabwe, for example, about 3,42 million cubic metres of teak and mukwa have been extracted by sawmillers from 2 million ha of forests between 1908 and 1986. More than 70 000 tonnes of teak, mahogany and mukwa logs have been taken annually over the past five years from the natural woodlands of the Kalahari sands in the West and North-West. Wood use includes also construction of poles, agricultural tools (yokes, hoes, tool-handles, granaries), craft carvings (sculptures with *Pterocarpus angolensis*, masks, musical instruments), canoe building (with *Baikieia plurijuga*) and furniture.

Mangroves also provide fuelwood and poles for construction. It should be noted that some other plant products can be used for fuel: crop residues, bark and tree roots are often collected in areas of low woodland cover.

### 5.1.3 Medicinal use

Large numbers of indigenous medicinal plants are collected for traditional uses for people and livestock. Medicinal plant use is often closely linked with ritual purposes and religious practices. Plants are now often sold to urban herbalists by wholesalers. In Zimbabwe, 10 % of the flora (500 plant species) is known to be used medicinally: for sustainable use of the flora the traditional healers follow certain rituals when collecting their plants. The number of n'angas (traditional medical practitioners) is estimated at 3 289 in the communal lands, or about 1: 1 000 people in the rural community. A n'anga is not only a minister of religion but also a physician and a healer and could be regarded as the most influential upholder of custom and tradition. This example shows the social importance of traditional medicine in Zimbabwe, and can be applied to the all subregion. Among the Tonga people of the Zambezi-Zimbabwe border more plant species are used for medicinal purposes than for any other single category (table 14).

A number of plants prescribed by healers are toxic or may be toxic at one stage of their growth (*Senecio spp.* or *Aloe spp.*). These plants may have real medical value when n'angas administer them in subtoxic doses.

They can also be used for arrow poison (*Urginea spp.*) or as fish poisons, for example *Euphorbia ingens*, *Sphenostylis marginata*, *Synaptolepis alternifolia*, *Swartzia madagascariensis*, *Trichilia dregeana* or *T. emetica*.

Use	Number of plants species
Axes, adze, hoes handle	9
Construction of canoes	-
Ropes, knots and nets	15
House construction:	
- Poles	30
- Withes	12
- Thatching grasses	2
Food:	
- Fruits and nuts	33
- Vegetable relishes	30
- Cooking aids and edible plants	26
- Oil-bearing plants	-
Medicinal and ritual purposes	49
<i>Total</i>	<i>220</i>

**Table 14: Plant species use for various purposes by the Tonga people of the Gwembe valley**

(Source: *The Importance and Value of Wild Plants and Animals in Africa*: UNEP/IUCN/WWF, 1981).

Some exotic tree species as *Eucalyptus*, mango, guava, lemon, peach, avocado are also used in traditional medicine.

#### 5.1.4 Ornamental plant use

Cut flowers, orchids, carnivorous plants, cacti and other succulents and bulbs are an important commodity in international trade with an expanding international market. Cut flower exports are worth about US\$ 6,17 million/yr in South Africa. In 1989, exports of living plants (mainly cacti) accounted for 22 197 plants in South Africa. Plants collected for sale in southern Africa include:

- Elephant's trunks *Pachypodium namaquanum* (South Africa, Namibia: young plant);
- Elephant's foot *Dioscorea elephantipes* (South Africa);
- Bastard cobas *Cyphostemma juttae* (Namibia);
- *Ceropegia stapeliiformis* (South Africa, Eastern Cape);
- Prickly-stemmed pelargonium *Pelargonium echinatum* (South Africa: young plant);
- Kaffir lily *Clivia miniata* (South Africa: bulb);
- Paint brush *Haemanthus albiflos* (South Africa: bulb);
- Encephalartos *altensteinii* (South Africa: young plant);
- *Aloe albida*, *A. vossii*, partridge-breast aloe *A. variegata* (South Africa: young rosettes and young plants).

#### 5.1.5 Fodder use

Fodder is provided by herbaceous plants (mainly grasses) and lignaeous plants (trees and shrubs). Pasture quality and quantity depend on species composition, soil fertility, rainfall total and annual distribution, fires, competition from trees and intensity of grazing. These factors determine the potential livestock carrying capacity linked with the grass production.

For example, in the Common Fly Belt, with an average rainfall of about 800 mm, grazing area per LU (Livestock Unit) is estimated at 8-12 ha, but it is less on rocky soils. Cattle are able to include a large portion of browse in their diet which provides essential crude protein.

Mopane woodland is generally more frequented in the rainy season while miombo woodland where the flushing of *Brachystegia spp.* and *Julbernardia sp.* occurs before the end of the dry season is chosen in the dry season.

#### 5.1.6 Other plant uses

Other plant products include:

- fibres from tree bark (*Brachystegia spiciformis*, *B. glaucescens*, *B. boehmii*, *Acacia rehmanniana*, *A. tortilis*). In drier areas rope is made from baobab tree bark for weaving hats, baskets, mats;
- Gum to make glue, cosmetics;
- Resin: seeds of the mopane tree provide a hard resin in extraction called gum copal, Angola copal or balsam and can be used for mending broken pots, fixing spear heads;
- Dyes from roots;
- Fertiliser, for example the ash of the mopane tree which contains between 15 and 55 % lime;
- Thatching grass: some species provide good thatching material, such as *Cymbopogon sp.*

Forests and woodlands play other very important roles ("services") such as the reduction of erosion, the protection of watersheds and retention of soil fertility by recycling nutrients, the maintenance of level of organic matter in the soil. During drought periods when crops fail, trees are more likely to yield something because of their deeper roots.

## 5.2 Uses of animals

As for plants, wild animals and fish are mainly used for local community subsistence as a source of protein, fats and oil. Animal products are also used in medicine often mixed with wild plant species and provide some secondary products such as horns, hides, furs, etc.

### 5.2.1 Food use

#### > Livestock production

Livestock production systems in the subregion are closely linked with the tenurial status of arable land, grazing resources and water. Socio-economic constraints can affect the productivity of livestock in small-scale systems. These are principally the land tenure system, conditions of markets in the SADC region, macro-economic policy, availability of capital, labour availability and interaction of socio-economic and biological constraints. Livestock production varies with the nature of farming systems. Commercial farming produces beef, mutton, poultry, milk, eggs, wool and fibres. The agropastoral system is characterised by subsistence and small-scale farmers who keep livestock for draft power, milk, manure and transport, and sometimes as a store of wealth.

Table 15 shows the beef exports of southern Africa as a percentage of total agricultural exports. Only four countries exported beef in 1988 and only in Botswana do beef exports form a significant proportion of total agricultural exports. At the same time only two countries, South Africa and Zimbabwe, exported dairy products.

Other constraints in livestock production in the region are linked to rainfall (total amount and distribution), soil nutrients (deficiencies in phosphorous are widespread in the region) and drinking water (boreholes are often necessary to ensure water supplies).

Finally animal diseases are another major constraint mainly in countries like Angola, Mozambique where disease control measures are inadequate.

Animal diseases play an important role in limiting livestock production: the tsetse fly is a serious constraint on livestock production over about one third of southern Africa. Tick-borne diseases and their economic impact in the region require further study to determine their relative significance.

Country	Beef exports	% of total agriculture exports
Angola	0	0
Botswana	2 551	63.05
Malawi	0	0
Mozambique	0	0
Namibia	3 300	19.19
South Africa	867	0.60
Zambia	0	0
Zimbabwe	3 859	6.98

**Table 15: Beef exports (1 000 US\$) as a percentage of total agriculture exports in southern Africa in 1988**

(Source: Multispecies Animal Production System Project, Project Paper No. 22: D.H.M. Cumming & I. Bond, 1991).

> Wild fauna production: game

The difference between the size of populations of domestic livestock and those of wildlife in the subregion is enormous. Wildlife numbers and biomass of wild large herbivores within the region are estimated to be a tenth or less of the biomass of domestic livestock. Game often has a higher nutritional value than domestic meat. The chemical score of the meat of wild species is often higher or can compare favourably with domestic products (table 16). Meat from ungulates, monkeys, rodents and fruit bats figures prominently in game consumption and trade in Africa. Birds provide eggs and meat for human consumption while amongst reptiles monitor lizards (*Varanus spp.*), sea turtles (meat and eggs) and crocodiles are also an important source of protein. Invertebrates are an important supplementary source of calories in many countries of Africa. Termites, ants, caterpillars, beetles, grasshoppers, crickets, stick and leaf insects and mantids are commonly collected in the subregion.

Food	Chemical score
Beef and veal ( <i>Bos taurus</i> )	94
Chicken ( <i>Gallus gallus</i> )	91
Rat ( <i>Rattus sp.</i> )	83
Caterpillar ( <i>Bombycomorpha sp.</i> )	89
Elephant ( <i>Loxodonta africana</i> )	112
Zebra ( <i>Equus sp.</i> )	78
Wildebeest ( <i>Connochaetes sp.</i> )	88

**Table 16: The chemical score of meat from various wild and domestic animal species**

(Source: The Importance and Value of Wild Plants and Animals in Africa: UNEP IUCN/WWF, 1981).

Butterflies and moths are undoubtedly the largest number of species eaten: fleshy larvae of saturniid are dried and sold or exchanged and are important in the local economy. The mopane worm, the edible larvae of the Sturnid moth *Gonimbrasia belina*, widely collected in Zimbabwe, is considered a delicacy in Botswana and the Transvaal.

In Africa, the demand for bushmeat is constantly increasing whereas few tribal economies traditionally showed a major dependence on wildlife. In southern Africa, wildlife utilisation has taken distinctive forms:

- Safari hunting (part of wildlife-based tourism) which is a productive activity on state, private and communal land;
- Protein production by intensive farming, ranching combined with cropping and culling schemes on commercial farms;
- Game viewing, wildlife-based tourism as a non-consumptive use of wildlife.

Wildlife resources can support a wide variety of uses, and combinations of these different options are possible so that the resource provides the best possible economic return. Game cropping schemes (with impala and springbok) and control of the big mammal populations (elephant, buffalo, hippo) in National Parks has been successful in many countries in the region. In Zimbabwe, there is also control of antelope species involving impala, blue wildebeest and waterbuck in National Parks such as Hangwe, Mana Pools and Gonarezhou. In the communal lands results have been mixed because of the cost of the cropping operations in Zimbabwe (Nyaminyami Wildlife Management Trust) and Botswana (Kedia Project) and the social problem of equitable distribution of meat.

Game ranching on small-scale commercial farmland provides many products (meat, hides, ostrich feathers). In Zimbabwe, about 10 % of commercial farmers keep wild animals: 8 % of the land in In Namibia, there are more than 300 hundred hunting farms under the control of the Ministry of Wildlife, Conservation and Tourism. Botswana is under private ownership where land is used for hunting and wildlife-based tourism.

Every year 130 000 ostrich hides from South Africa are marketed internationally. In Zimbabwe the average production of ostrich was about 20 500 animals in 1995 for an exportable meat production of 286 tonnes. In 1994, people hoped to export some 9 tonnes of crocodile meat from South Africa. Currently people are working on the possibility of integrating crocodile with ostrich and/or fish production. On a larger scale, game ranching provides meat and income from a wide range of species, among which impala, Cape eland, great kudu, sable, blue wildebeest, Cape buffalo, Burchell's zebra, common waterbuck, bushbuck, warthog and bushpig.

In the communal lands, community-based natural resource management is a potential solution to the inter-linked problems of poverty and conservation. Safari hunting in Zimbabwe, for example, associating Campfire and the commercial safari operators, provides meat and income distributed to the local households, which decide how to use the money. The Campfire programme is operating in 13 districts, involving 20 communities. In Nyaminyami District, income amounted to about US\$ 467 390 over the three years 1989-91, with about 38 % elephant contribution. Earnings have come from a number of management and utilisation activities, including hunting, cropping for meat production, problem animal control (PAC), game viewing and photographic tourism. In 1989, each of 12 wards of Kariba District received Z\$ 16 000 from two safari concessions. Total income of Hurungwe District in 1992 including trophy and concession fees was US\$ 119 342.

In Botswana, where 20 % of the land is designated as Wildlife Management Areas, the potential gross return in 1989 was US\$ 2,7 million from a total area of 60 842 sq. km in five districts. In Zambia, Game Management Areas (GMAs) cover 160,488 sq. km (21,3 % of Zambia) where different projects rely largely on the consumption use of wildlife resources (safari hunting, game cropping). The ADMADE Programme (National Parks and Wildlife Service Administrative Design) presently manages 24 GMAs. In 1989-90, US\$ 1 287 820 accrued to the programme, mainly from safari hunting: 35 % of the gross revenue has been distributed to local communities. In Namibia, night-cropping of game, mainly springbok, has become a very important facet of the game industry: carcasses are both marketed locally and exported.

### > Mixed livestock/wildlife systems

South Africa, Namibia and Zimbabwe are countries with 40-70 % of their land privately owned. On some of these commercial farms people own cattle and at the same time crop wildlife: farmers can get gain direct benefits from hunting, game viewing and photographic safaris.

In Zimbabwe, about 190 farmers are involved in wildlife production (safari hunting): in South Africa about 19 % of farmland carries croppable populations of wildlife through more than 8 200 game ranches.

### > Fish production

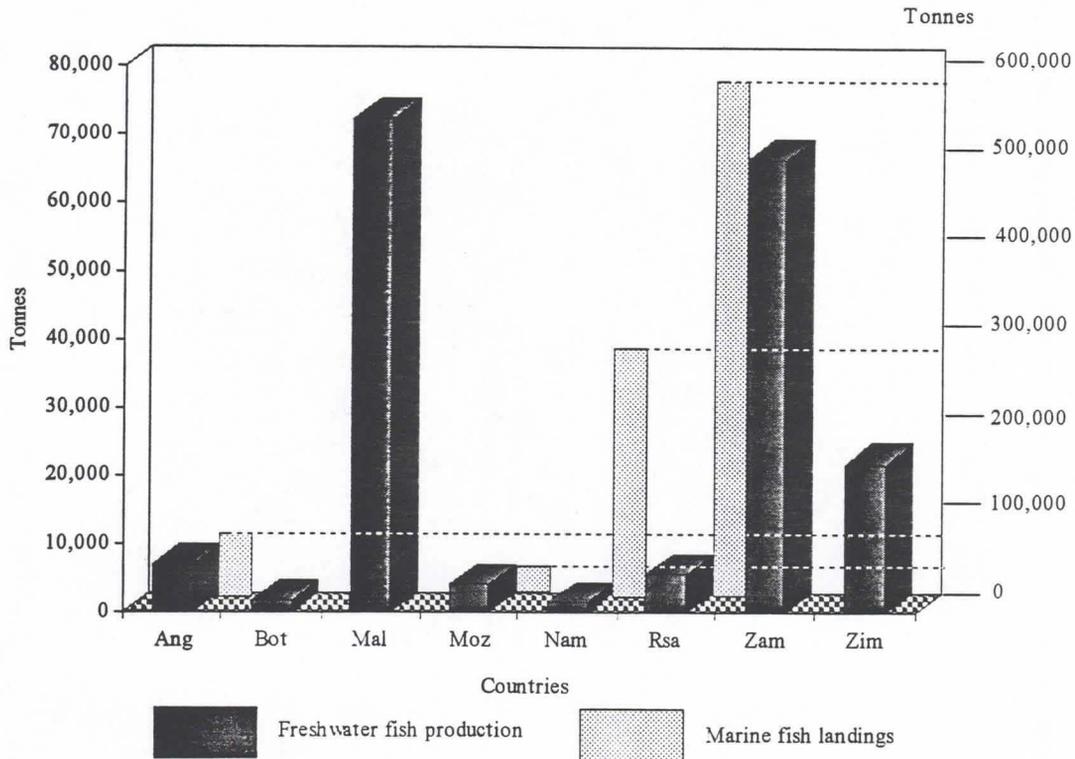
Total world fish production exceeds that of cattle, poultry and eggs and is the largest source of animal protein for the developing countries. Annual world landings of aquatic resources have increased from 21,9 millions tonnes to 99,5 million tonnes in the last 40 years. This comprises about 85,8 million tonnes of marine landings and 13,7 million tonnes of freshwater products.

#### \* Freshwater fish production

The large lakes provide almost all of the inland commercial and subsistence catches in the region, about 500 000 tonnes/yr. Fish is often a large part of the diet of people living near lakes and rivers (fig. 10). In Lake Kariba 40 000 tonnes of fish are caught every year by the commercial fisheries that provides 90 % of Zimbabwe's fish-yield: 85 000 tonnes are harvested in Lake Malawi/Nyasa (Malawi, Mozambique and Tanzania). River fisheries are extremely valuable to the local communities: in the Okavango River in Namibia yields of 840 tonnes per year have been reported. In the 1980s, more than 480 commercial fishermen were operating along the Zambezi-Chobe floodplains in the Caprivi area. Some fish species have been introduced in lakes and dams. Among them is the Lake Tanganyika sardine or "kapenta" *Limnothrissa miodon* which currently provides more than 25 000 tonnes per annum.

Fish farming (aquaculture) is a rapidly growing sector of agriculture. In South Africa, 30 major producers of trout (in Eastern Transvaal and Cape) produce more than 7 50 tonnes per annum with a value of R11 millions. Rainbow trout and sharptooth catfish *Clarias gariepinus* are the two main species used in fish farming: other species include tilapia *Oreochromis spp.*, tilapia *rendalli*, common carp *Cyprinus carpio* and largemouth bass *Micropterus salmoides*. Current catfish production amounts to 120 tonnes/yr in southern Africa. Average annual aquaculture production in Malawi is estimated at 200 tonnes.

As a tourist activity angling is certainly the largest sport in southern Africa: 117 000 licences were issued in the Transvaal in 1977-78. About 20 % of the indigenous freshwater fishes are suitable angling species. They include for example the tiger fish *Hydrocymus vittatus*, cornish jack *mormyrops anguilloides*, *Barbus spp.* and largemouth breams *Serranochromis spp.* Fishing safaris for sportsmen are well organized in several fishing camps in the Okavango Delta in Botswana, the Caprivi and at Lake Kariba in Zimbabwe. Fly fishing in both rivers and dams is also very popular: private facilities for bass (American basses *Micropterus spp.*) and trout (rainbow trout *Oncorhynchus mykiss* and brown trout *Salmo trutta*) fishing are well established in South Africa and Zimbabwe.



**Fig. 10: Freshwater and marine fish production in southern Africa - Angola, Botswana, Malawi, Mozambique, Namibia, South Africa, Zambia and Zimbabwe -**

(Sources: State of the Environment in southern Africa: SARDEC/TUCN/SADEC, 1994 - World Resources Institute: World Resources 1996-97).

Another activity which must be considered in fish use is aquarium trade, which is currently a huge international industry. Ornamental fishes include for example goldfish *Carassius auratus*, koi *Cyprinus carpio*, guppy *Poecilia reticulata*, swordtail *Xiphophorus helleri*, mosquitofish (introduced) *Gambusia affinis* and blakback barb *Barbus barnardi*. Local producers of ornamental fishes for local and export markets are now well established in South Africa. In this country the largest ornamental fish farm produces more than 1,5 million of fishes each year and the total production is estimated to be 3-4 millions.

**\* Marine fish production**

South Africa and Namibia are the main producers of marine fish in southern Africa with an average of 584 000 and 275 000 tonnes/yr respectively (fig. 10) although the production is decreasing (because of overuse). In these two countries since 1988, it reached 900 000 tonnes in South Africa and 1 200 000 tonnes in Namibia. Mangroves and estuaries have a high social and economic value. A well-managed mangrove ecosystem can provide an annual yield of about 400 kg of fish from a single hectare.

Annual average aquaculture of fish and shellfish in South Africa amounted to 3 700 tonnes in 1993.

**> Other food use**

Honey is one of the most widely accepted insect products. Production is significant in some countries of the region. In Angola, for example, more than 10 000 tonnes honey were produced in 1989, representing a value of about US\$ 3 000.

## 5.2.2 Non-food use of animals and animal products

> Sport hunting, game viewing, aesthetic value

In the SADC region tourism is largely wildlife-based combined with scenic wildlands (Victoria Falls in Zimbabwe, coastal areas in Mozambique and South Africa, for example). Other activities are included in tourism such as boat trips, rafting, local culture, hiking/trekking, mountaineering, botany, fishing, camping.

Wildlife tourism is primarily centred on national parks and protected areas: In Zambia 55 % of international tourists visit the national parks. In Namibia, some private farms specialise in camera safaris.

In affluent societies, private individuals can pay large sums of money for the privilege of hunting wild animals: hunting licences, permits, trophy preparations can provide significant income for central and local treasuries. Trophy hunting in Namibia (concerning mainly kudu, gemsbok and springbok) is currently the most lucrative option for wildlife utilisation on private farms. In this same country game capture, to distribute surplus game animals from conservation areas to local private farms at subsidised prices, is successful and leads to the establishment of species on farms where they previously occurred

Although tourism has an important value in most countries, its contribution in terms of Gross National Product may not be significant (table 17).

Country	Tourism 1986	G.N.P. 1987	Exports 1987
Botswana	28	1 600	1 100
Malawi	7	1 200	300
South Africa	388	60 000	-
Zambia	7	1 900	800
Zimbabwe	45	5 700	1 400

**Table 17: Receipts from tourism (US\$ millions) compared with Gross National Product (G.N.P.) and Exports of some countries in southern Africa**

(Source: Multispecies Animal Production System Project, Project Paper No. 22: D.H.M. Cumming & I. Bond, 1991).

> Utilitarian and ornamental use

Fur, hides (mammals), scales (turtles) bones and feathers (ostrich) can be used to make a wide range of clothes or domestic utensils such as needles and hooks in bones and ivory, musical instruments in horn or wood together with skins. Animal fat can be used as oil. Application of manure (cow-pats or collected from livestock pens) is commonly used on communal and commercial lands to improve crop yields. Guano is sometimes used as fertiliser in the coastal regions. Demand for animal products such as furs (cat skins), ivory, tortoiseshells, reptile (snakes, monitors, crocodiles), bird (ostrich) and mammal (buffalo, kudu, elephant) skins is increasing for the manufacture of shoes and fancy goods.

The most important issue of the trade sector in the region is the question of elephant products. Before 1990, ivory consumption at its peak in the region reached about 30 tonnes per annum, generating sales of US\$ 11 millions. The ban on the international trade in elephant products, since 1990, has had a serious impact on the countries in which elephant populations reduction programmes are required (Cumming & Bond, 1991).

### > Medicinal use of animal products

Animal products are used widely in medicines by traditional societies. The durable parts (hides, teeth, shells, scales, nails, tails, claws) of a wide range of species are used as adornments, initiation objects, status and prestige symbols. Traditional healers often use animals for their particular prowess: the lion and the elephant are strong and some parts of these animals are mixed with other ingredients (often plants) to give strength.

In Niger (West Africa), for instance, the Hausa use 181 animals as “animal-based remedies” for social competition, sickness, inheritance, warding off witchcraft and spells, acquisition of goods and aggression. In Zimbabwe, more than 30 animal species are used to give strength, as remedies for venereal disease (powder of blister beetles), for vertigo (dove’s nest), for aphrodisiac (urine of a baboon) or for magical purposes (skin of a hedgehog, heart of a vulture).

### > Working animals

In communal lands draft power provided by cattle play a key role in farming systems. In Zimbabwe for example, in Masvingo District, value of cattle can be deduced as following:

Draft power 42 % - Manure 8 % - Milk/meat 33 % and Cash sale 18 % -.

Wild animals can be used as in South Africa where elephants are trained to assist in tourist activities, bringing people into the bush.

### > Companion animals

Wild animals have been kept in captivity for centuries and for many reasons. There is currently an important export trade of wild animals for pets from many tropical countries, providing significant sums of money: pets include birds, mammals (cheetah, monkeys, mongooses), reptiles. Among birds the trade of live parrots is particularly important: it concerned about 160 000 birds in Africa in 1989. Table 18 shows the trade in live parrots (exports) in some countries of southern Africa.

Country	1980	1985	1989
South Africa	4	10550	0
Zambia	0	4	605
Zimbabwe	1	332	390

**Table 18: Exports of live parrots from some countries of southern Africa between 1980 and 1989**

(Source: Global Biodiversity: NHM/IUCN/UNEP/WWF/WRI, 1992).

### > Pollination

Pollination is a vital role of insects or mammals (bats and sometimes rodents) ensuring regeneration of plant species. Bees play a key role in the pollination of man’s crops.

### > Social and cultural significance

The economic, nutritional and medicinal use of wild fauna and plants is in reality part of culture that is the most important part of human-wildlife interactions. Wildlife influences philosophy, language, art, religion and social structure itself. Within certain tribes game meat, for instance, is of vital importance in feasts and exchanges linked with initiation rituals. Wildlife plays an important role in linguistics and in the development of languages (vernacular names).

In African art animals are often used as patterns for basic ideas and motifs. Economic dependence on wild resources has important consequences in the social organisation of many tribes. The seasonal rhythm of the bush or forest is often reflected in the cyclical nature of activities such as hunting, fishing and harvesting. Traditional fishing activities using traps, fences and funnels sometimes involve hundreds of people and are an important social activity on the east coast (Mozambique, Maputaland) and on the floodplains of the upper Zambezi and Okavango rivers in Angola, Zambia, Namibia and Botswana.

## Summary of Chapter 5: NATURAL RESOURCE USE

Food is an important utilisation of natural resources. The main agricultural productions, such as maize and sorghum, are often not sufficient to meet requirements, and most countries receive external food aid. The local people use a great variety of natural products, both plant and animal, to meet their requirements or to complement them at certain periods of the year.

More than 50 species of indigenous trees are regularly exploited in the region for their fruits. Certain species of plants are also used as vegetables or in the preparation of traditional medicines.

Wood is an other important resource used traditionally mainly as a source of energy, and in building and furniture making. It is estimated that on average one family consumes 1 tonne of wood per annum in domestic requirements. In Zambia more than 400 sq. km of woodland are exploited every year for the production of 100 000 tonnes of charcoal. Precious wood (mukwa, teak) have long been exploited for industrial purposes in miombo regions, mainly in Zimbabwe. Locally, certain species are prized for making farm implements and artefacts (masks, sculptures). For example, the Tonga people in the Zambezi valley use some 220 plants in their daily life: a high proportion are for medicinal purposes.

The exploitation of plant resources also encompasses the production of ornamental plants (mainly in South Africa and Namibia) and fodder. The bark of the baobab and thatching grasses are used in basketry and gum from *Acacia* is used for glue and cosmetic preparation.

Food products of animal origin are represented especially by meat from cattle and game animals, occasionally in mixed livestock farming, and fish. Beef is produced mainly in Zimbabwe, Botswana, Zambia and South Africa. Game meat, with a high nutritional value, is being utilised more and more in Africa. It comes from traditional hunting, safaris, ranches and game farms, often linking government institutions, private sector, NGOs and local communities.

In the region, the most commonly exploited species in game cropping are the impala (Zimbabwe) and the springbok (South Africa). The elephant, buffalo and hippopotamus are mainly exploited outside safari hunting, for population control (culling). Ostrich and crocodile farms make it possible to produce meat and secondary products with a high commercial value such as feathers and skins. Animal proteins are also supplied by birds, eggs and a wide variety of invertebrates such as termites, crickets, caterpillars and ants. Most of the fish production comes from the lakes (Kariba in Zimbabwe and Zambia, Malawi/Nyasa in Malawi and Mozambique) and is approaching 500 000 tonnes per annum in the region. This production is complemented by traditional fishing; in Namibia, it provides around 840 tonnes of fish per year. Aquaculture is expanding in the region and tilapia or catfish farms in South Africa and Malawi are reaching annual production of between 100 and 200 tonnes per annum. A large quantity of fish comes from industrial sea fishing, that is important mainly in South Africa (580 000 t/p.a.) and Namibia (270 000 t/p.a.).

Wild animals are also utilised for non-food purposes. Game viewing, hunting and fishing are highly developed activities in southern Africa and are important from the economical point of view.

Fur, hides, ivory, scales can be used for ornamental or utilitarian uses (shoes, clothes, fancy goods).

Animals are not used as much as plants in traditional medicine, however, some thirty species have been counted in Zimbabwe as being often used in treatment linked to witchdoctors. Finally animals can help with work (draught animals) or as pets, or even play an important role in culture or the social system of different ethnic groups (collective fishing in the Okavango).

Insects (bees) and some mammals (bats, rodents) play a key role in pollination, ensuring plant regeneration.

## 6. THREATS TO NATURAL RESOURCES OF SOUTHERN AFRICA

### 6.1 Ecozone threats

Table 19 shows the characteristics of the main southern Africa ecozones. Most of them, because of low or medium rainfall and relatively poor soils can be affected by many factors including climate, soil nutrients, fire, human activities, grazing or browsing by wild or domestic animals. Climate, principally rainfall, appears to be the most important factor influencing southern African ecozones. Drought cycles have serious consequences on water supplies and affect mostly dryland farming areas and livestock production. In 1991-92, drought killed more than 1,5 million cattle in Zimbabwe, and more in some other countries in the subregion. In 1984, due to lack of rainfall in Botswana, where most cultivation is rainfed, crop production was under 7 000 tonnes instead of 60 000 tonnes. Drought affected also industrial crops such as sugarcane in the large estates at Triangle, Hippo Valley or Chiredzi in Zimbabwe.

Climate is often linked with soil conditions. Less than half the region's soils are suitable for cultivation. High population densities, poor farming methods and overgrazing have led to decreasing productivity of cropland and grazing land. Soil degradation by loss of natural nutrients (nitrogen, phosphorus) has a serious effect on natural resources and economies of the region. Physical (erosion, compaction of topsoil) and chemical (input-intensive agriculture and irrigation) degradation often relate to human activities. New settlements and farms that develop after tsetse eradication and tsetse control operations often lead to environmental changes through clearance of natural vegetation, soil degradation and settlement on poor land. Furthermore, all tsetse control methods have ecological side effects and insecticide uses (mainly by residual (non long in use) and non-residual applications) lead to possible long-term risk in wild animal populations.

Ecozones	Lowland Trop. Forest	Afromontane forest	Grassland	Moist savannah	Dry savannah	Karoo	Desert	Fynbos
Rainfall	high	high to medium	medium	medium	low	very low	very low	very low
Soil fertility	low	varies	low to medium	low	medium to low	low	very low	very low
Graze and browse	low	low	medium to high	medium	medium to high	low	very low	low
Occurrence of fire	none	rare	frequent	medium to frequent	rare to frequent	very rare	very rare	medium
Plant production	high	high	low to medium	medium to high	low to medium	low	very low	medium
Threat of bush encroachment	very low	very low	high	low	medium to high	medium	low	low
Threat of erosion	low	low to medium	low to high	low to medium	medium to high	medium to high	low	medium to high
Agricultural development potential	low	medium to high	medium to high	medium to high	medium to high	low	very low	medium

**Table 19: Characteristics of southern African ecozones**  
(Source: Environment in southern Africa: SARDC IUCN/SADC, 1994).

### 6.1.1 Threats to forests

On the East Coast low altitude tropical forest is mainly vulnerable to erosion in areas with high density population. In Mozambique, destruction of tropical forest is a serious problem near urban areas. The annual deforestation rate in Mozambique amounts to 100 sq. km by logging and agricultural encroachment, principally near urban areas (Rusitu valley, north of Beira). In the South of the country, sand dunes are encroaching onto agricultural land following removal of the dune forest.

In Malawi, large areas of lowland forest (Thyolo and Mulanje districts for example) gave way to tea or rubber plantations or were cleared to establish farms. Elsewhere forests have been lost to subsistence or damaged by felling (Shire Highlands) with a 3% annual deforestation.

In South Africa coastal tropical forests have disappeared and currently remain only in patches in the North of Algoa Bay. Afromontane and temperate forest are easily degraded when the vegetation is removed. Wood collection, clearance for agriculture, overgrazing (mainly by sheep) and fire are the main threats and cause loss of top soil and gullying. In many highland areas large tracts of forest and ericaceous bushland have been replaced by fire-induced grassland or by plantations of exotic commercial species. In the Drakensberg Afromontane Regional System forest species are also threatened by bark-stripping of medicinal trees.

Because of the lack of information from Angola, real threats to the forests are currently unknown. However, patches of Afromontane forest survive in deep wet ravines but are almost certain to disappear completely unless drastic conservation efforts are implemented (Huambo and Kwanza Sud provinces, Serra de Chela of Huila Province). Northeast of Luanda forest patches are under threat from timber and fuelwood extraction: in Benguela and Bié Districts, understory of forests is cleared for coffee cultivation.

Although Afromontane forest is under protection in Malawi, Mt. Mulanje forest in the south of the country, containing 30 unique plant species, is currently threatened by expanding cultivation, tree-plantation and fire. The remaining medium altitude forest in Zimbabwe is threatened by shifting cultivation, plantations of tea and coffee and by fire. The rain forests are too small for commercial exploitation and are in danger due to traditional use of wood for construction. Above 1 500 m, forests are now well protected, under the Department of National Parks and Wildlife Management. However, in Nyanga National Park, exotic *Acacia* (wattle) is now spreading within the Park from plantations outside.

### 6.1.2 Threats to woodlands

If some parts of the moist savannah are unaffected by human activities, large areas of woodland are currently under agricultural pressure (shifting cultivation), overgrazing and cutting trees (for fuelwood). This is particularly striking in Malawi where moist savannahs have the second highest rate of deforestation in Africa (most of the woodland has been removed and replaced by bush thickets). This is also the case in the Zambezi valley catchment where mopane woodland is used by commercial woodcutters. In Mozambique deforestation has serious consequences in Maputo (where the deforested "fuelwood ring" reaches a diameter of 55 km wide), Zambezia and Nampula Provinces. The north-central and southern areas have been identified as critical zones with a positive balance of 0.25 to 1.10 cubic metres per person and a negative one of - 0,2 to - 0,9 cubic metres per person, respectively. Fire-resistant scrub is changing the savannah land into shrub thickets.

In the North-West of Zimbabwe, eradication of the tsetse fly has led to settlements and croplands in communal lands which were sparsely populated. In the dry season, cattle feeding with cut branches is common in southern Zimbabwe: 30 species of trees are used for feeding animals in Chivi South.

The loss of woodland has been estimated at 70 000 hectares/yr and about 30 % of the rural population is currently suffering from fuelwood shortage. In Zambia, although 80 % of the energy used in urban areas is provided by fuelwood (0,5 % of woodland is lost /yr) the primary cause of deforestation is extension of agriculture. Riverine forests are threatened in Namibia by people moving into floodplain areas where they remove trees to establish crops. In these same sites the number of livestock is increasing and overgrazing (principally sheep and goats) prevents natural regeneration: natural regeneration is also going to be endangered due to frequent fires and collection of fuelwood. Some tree species, like *Spirostachys africana*, are overharvested for mining activities. In the northern communal areas where most of the forests and woodlands are located increasing wood (for fencing, kraals and furniture) and fuelwood requirements are leading to destruction of the natural habitats. In Botswana, 71 % of the rural land area is communal land where overstocking, overgrazing, deforestation and mining activities lead to wide-scale depletion of vegetation, principally around water points. In South Africa fuelwood consumption is 200-800 kg/yr per capita and clearing for agri-business has led to wide-scale deforestation. Deforestation of the land is the most serious environmental problem in the Homelands. Pine and *Eucalyptus* plantations which cover about 1,2 million hectares skew the ecological balance and are no substitute for the mixed wood forests.

Fallow periods have become shorter, because of population growth. In some cases fallow periods have been eliminated, leading to serious declines in soil fertility and crop yields and stopping the recovery of woodland. This is evident in Angola and southern Mozambique where populations, because of armed conflicts, are concentrated in urban or coastal areas.

Dry savannahs, in general unsuitable for crop production, provide good pastures. However, low rainfall combined with overgrazing, browsing, droughts and fires is resulting in their becoming more vulnerable to erosion by water and wind and to encroaching bush (Botswana, Namibia). Deforestation (collection of fuelwood and poles) and overgrazing are more serious in high population density areas such as south-central Zimbabwe, or in Angola where the war concentrated people on the border with Namibia.

Frequent fires adversely affect woodland favouring grasses, killing tree saplings, reducing the value of timber species, depleting soil nitrogen and organic matter and increasing erosion. Most of fires are deliberately set, by poachers for hunting and resettled farmers to establish crops or to improve grazing, and half or more of the region is burnt every year. Natural regeneration of some tree species such as *Baikiaea plurijuga*, *Commiphora spp.*, *Guibourtia coleosperma* or *Ochna pulchra*, is affected due to more frequent fires.

### 6.1.3 Threats to grasslands

Grassland is a very suitable ecozone for human settlement and crop production: only a small percentage is currently protected. Overstocking, overgrazing and irrigation are the main threats: irrigation in a large part of South Africa has damaged soils by salination and waterlogging and has caused serious erosion.

### 6.1.4 Threats to Karoo

Nama-Karoo is mainly used for extensive grazing (5 ha for each sheep and 10-40 ha to sustain a cow) and shallow, poor soils are easily eroded by overgrazing linked with irregularly rainfall. Bush encroachment is currently a major problem in this ecozone where 14 million hectares are now useless for grazing in South Africa.

Overgrazing is also the main threat in the Succulent Karoo which has the highest diversity of succulent plants in the world. In the south-eastern Cape succulent thicket has been eliminated by overgrazing combined with wind and gully erosion and bush encroachment. Industrialisation, mining (alluvial gold mining on the west coast of South Africa and Namibia) has also led to habitat loss and there is currently another threat with the picking of wild flowers and poaching lizards for sale.

#### 6.1.5 Threats to desert

Because of the low rainfall, the desert is hostile to man and livestock. Threats are mainly due to human activities such as mining, armed conflicts, poaching and fencing. Armed conflicts had serious consequences on wildlife populations in the desert in Angola where game has been depleted during the past two decades of war.

#### 6.1.6 Threats to Fynbos

Although Fynbos soils are infertile this ecozone is one of the most highly cultivated in the region because of its winter rainfall. The natural vegetation that harbours 65 % of southern Africa's endangered and rare plants is degraded by agriculture, urbanisation, overgrazing (sheep) and fire. The Fynbos is also exposed to coastal winds, and wind erosion combined with salination and compaction due to overcultivation are other major threats. Invasive alien species (exotic *Acacia* - black wattle- and pine trees for example) have spread into mountain Fynbos and are threatening indigenous plant species.

#### 6.1.7 Threats to wetlands

In southern Africa, wetlands are threatened by natural climatic conditions (drought) and by human activities, principally through cultivation, drainage and overgrazing, and they can dry up or break down with overuse. The Okavango Delta in Botswana contains more than 95 % of the country's surface water with important plant and animal communities. Major potential threats include the expansion of cattle into the delta, following the eradication of the tsetse fly, and large-scale water removal for development schemes. However, recent removal of cattle populations in Ngama land, due to contagious bovine pleuropneumonia (CBPP), could have serious impact on the environment. Wetlands are also particularly vulnerable to acidification by acid deposits from pollution, which changes or spoils aquatic life.

Dams often have a dramatic impact on floodplain ecology by changing river sections into lakes, controlling river flow, decreasing or eliminating downstream flooding, damaging shoreline vegetation and blocking fish migration. Since the construction of Kariba dam the flooding of the Zambezi valley has been reduced by 25 %, affecting large areas of floodplain such as Mana Pools in Zimbabwe. Irrigation systems are the main cause of chemical degradation of soils through salination and nutrient depletion. Nutrient depletion occurs also when dams trap silt and nutrient and prevent the annual flooding which ensures the replenishment of soil fertility.

Silting of dams is a major problem in southern Africa and results from erosion due to poor land-use practices. In Zimbabwe, a survey of 120 dams showed that 2/3 were half full of silt.

## 6.2 Threats to species

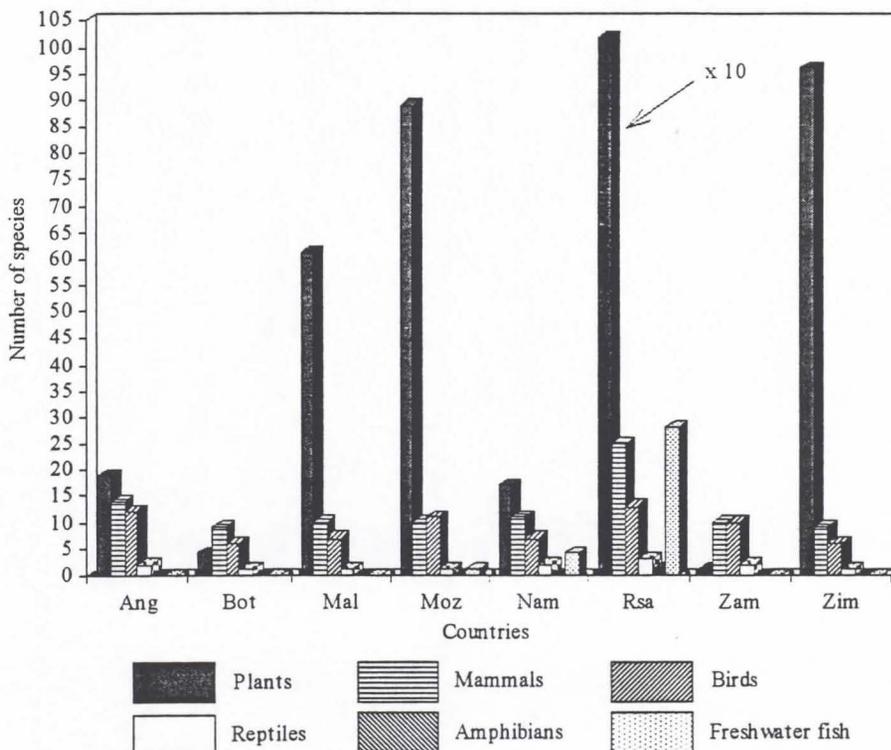
Threats to ecozone have repercussions on species inhabiting the different ecosystems. Most of the causal factors threatening species are causal by humans, induced or influenced by man. These factors include:

- Habitat loss or change including habitat fragmentation, cultivation, settlement, forestry operations, plantations, fire, pollution;
- Over-exploitation for commercial or subsistence uses;
- Accidental or deliberate introduction of exotic species;
- Deliberate eradication of species considered to be pests;
- Insecticide uses for tsetse eradication and tsetse control operations;
- Diseases, both exotic and endemic, exacerbated by increasing livestock or introduced plant species.

IUCN in its Red Data Book defines six threat categories that are:

- Extinct (Ex) species wiped out of existence;
- Endangered (E) species facing extinction;
- Vulnerable (V) taxa that will move into the “endangered species” category if current threats are not checked;
- Rare (R) taxa with a small world population and at risk of declining;
- Indeterminate (I) taxa known to be Endangered, Vulnerable or Rare but with lack of information;
- Insufficiently known (K) species about which too little is known.

Figure 11 shows an estimate of threatened plant and animal species in southern Africa. South Africa, Zimbabwe, Mozambique and Malawi harbour a large number of threatened species, mainly plants, then birds in Malawi and South Africa, mammals and freshwater fish in South Africa.



**Fig. 11: Country total of threatened plants and vertebrates in southern Africa - Angola, Botswana, Malawi, Mozambique, Namibia, South Africa, Zambia and Zimbabwe -**

(Sources: Global Biodiversity: NHM London/TUCN UNEP/WWF/WRI, 1992 - World Resources Institute: World Resources 1996-97).

### 6.2.1 Threats to plants species

Plant species are mainly threatened by loss of habitat (*Protea spp.*, *Raphia farinifera*), overgrazing (*Caralluma spp.*), deforestation (*Juniperus procera*), over-exploitation for commerce (timber, flower-picking) and subsistence use (*Warburgia salutaris*, *Borassus aethiopicum*), invasive alien species (exotic *Acacia* and *Pinus*) and fire (*Erica spp.*).

In South Africa, about 1326 plants are threatened in the Fynbos, among them 108 are endangered, 558 in the Succulent Karoo with 15 that are endangered, and 67 in the Nama Karoo. In the Maputaland-Pondoland and Karoo-Namib regions annual clearance of mesic thicket for agriculture, overgrazing and invasive plants (*Opuntia sp.*, *Acacia cyclops*, *A. saligna*, *Leptospermum laevigatum*) are the main threats. Some fodder plants as the bacon tree *Portulacaria afra*, vital to the livestock industry are severely overgrazed. In Zimbabwe for example pachypodus plants (*Pterodiscus spp.*), lilies (*Kniphofia spp.*, *Dierama spp.*, *Cyrthanthus spp.*), orchids, tree ferns and cycads are threatened by collection as garden subjects. A lot of plants with attractive flowers are over-exploited in South Africa and Namibia. Some species are currently scarce due to traditional use. The major source of weaving material in the region is fibre from palm leaves, and that of brown dye is the bark of the *Berchemia* tree. These species are threatened in Botswana, South Africa and Zimbabwe due to over-exploitation.

In the Cape metropolitan area, the process of urbanisation has fragmented previously intact natural environments, leading to a loss of natural habitats threatening a large number of endemic plant species.

### 6.2.2 Threats to animals species

#### > Threats to mammals

##### \* Wild mammals

##### • Terrestrial mammals

Loss of habitat, poaching and over-hunting are the main threats to mammals. Habitat destruction or fragmentation is detrimental to the Cape mountain zebra *Equus zebra zebra*, the lechwe *Kobus leche* (northern Botswana) and the riverine rabbit *Bunolagus monticularis* (Karoo). In Zambia the lechwe lost part of its habitat when the Kafue dam changed the flood regime in grazing areas downstream.

Some species are particularly threatened by poaching, such as the black rhino *Diceros bicornis* and the white rhino *Ceratotherium simum* which need special protection, and the elephant *Loxodonta africana*. Poaching continues to be a problem in spite of the CITES Ban. In Malawi the elephants of Majete Wildlife Reserve appear to be extinct due to heavy poaching, and in Zimbabwe illegal killing of elephants has increased since the ban came into effect. Other species, currently rare or threatened, have been overhunted because they are considered to be pests, such as the wild dog *Lycaon pictus*, the cheetah *Acinonyx jubatus* and the brown hyena *Hyena brunnea*.

In Zambia (Luangwa valley) pressure for human settlement has restricted game migration and has concentrated populations of some animals within the valley, leading to degradation of habitats. In Zimbabwe some localised and rare species among the small carnivores are currently under special protection to ensure their survival:

- Spotted-necked otter *Lutra maculicollis*;
- Striped weasel *Poecilogale albinucha*;
- Tree civet *Nandinia binotata*;
- Selous's mongoose *Paracynictis selousi*;
- Bushy-tailed mongoose *Bdeogale crassicauda*;
- Yellow mongoose *Cynictis penicillata*;
- Meller's mongoose *Rhynchogale melleri*;
- Water mongoose *Atilax paludinosus*.

Table 20 shows the current status of antelope species in southern African. Because of war, the increase of poaching, the competition between livestock and wildlife (for grazing and water) and considerable areas used for subsistence farming, half the antelope species of Angola are currently endangered, vulnerable or rare. In Botswana, antelope fauna is still widespread with some common or abundant species mainly in and around protected areas: some other species have a restricted area (klipspringer, mountain reedbeek). The current status of most antelope species in Botswana is satisfactory. Botswana's natural ecosystems form part of the resources on which the country must base its development: wildlife is an important resource threatened by the development of the Okavango region. However, wildebeest *Connochaetes taurinus* genetic population diversity is currently threatened due to a severe decrease in the population.

Most of Malawi's wild fauna is confined to protected areas. This country still harbours the characteristic species of the *Brachystegia* woodland, and some species that occur on higher nutrient soils such as nyala *Tragelaphus angasii* and greater kudu *Tragelaphus strepciseros*. Threats occur mainly on the border of many reserves because of dense human settlements. The blue wildebeest has been extinct in Malawi for about 50-80 years.

In Mozambique, the antelope fauna has been affected by such factors as the civil war, wide-scale destruction for tsetse fly control, and uncontrolled hunting. Destruction of natural habitats is also another threat factor (Sofala and Manica Provinces). Half of the antelope species of Mozambique are now threatened to some degree. In the mid-1970s only tsessebe, roan and mountain reebuck was regarded as endangered, vulnerable or rare. In Namibia the country's large mammal populations are still in a healthy state. Antelope species are well represented and only some species are endangered because of their restricted habitat (wet habitats) in the extreme north-east of the country.

The variety of habitats in South Africa is reflected by the diversity of antelope species: of 29 species 5 are endemic (grey rhebok, bluebuck, black wildebeest, bontebok/blesbok and Cape grysbok). Antelope and other large mammals are satisfactory represented in a large network of efficiently protected and managed areas with some high populations such as those of the black wildebeest, red hartebeest, blesbok and springbok. Threats come from rapid human population growth, habitat degradation and soil erosion, and underline the necessity of developing land-use systems integrating the requirements of local communities.

In Zambia, all the main species characteristic of the miombo woodland formerly occurred: lechwe, tsessebe and puku are well represented on floodplains and riverine grasslands. In spite of this, half the 22 antelope species are currently vulnerable or rare outside the national parks: the Natal red duiker occurs only in Nyika National Park in patches of montane forest.

Poaching, agricultural encroachment, illegal grazing and uncontrolled fires remain serious problems and antelope populations are threatened outside conservation areas. The increase of the livestock population, the expansion of settlements and the rapid growth of human population are the main threats to wildlife conservation in Zimbabwe. In spite of this, most antelope species still occur within and outside protected areas.

However, some species (eland, roan and sable) currently remain low in numbers due to habitat disturbance or the consequences of tsetse eradication in the communal farming areas of the Zambezi valley.

Species	Country	Ang	Bot	Mal	Moz	Nam	South Africa	Zam	Zimb
Bushbuck		S	S	S	S	En	S	S	S
Nyala		-	-	S	S	-	S	-	R
Common Eland		I	S	S	V	S	S	S	S
Greater Kudu		S	S	S	S	S	S	S	S
Sitatunga		R	S	-	R	En	-	S	R
Blue Duiker		S	-	S	K	-	S	S	I
Bay Duiker		R	-	-	-	-	-	-	-
Black-fronted Duiker		R	-	-	-	-	-	-	-
Natal Red Duiker		-	-	R	S	-	S	R	K
Yellow-back Duiker		R	-	-	-	-	-	S	-
Grey Duiker		S	S	S	S	S	S	S	S
Waterbuck		En V	R	R	V	En	S	S	S
Red Lechwe		R	S	-	-	V	-	S	-
Puku		V	R	En	-	En	-	S	R
Mountain Reedbuck		-	R	-	En	-	S	-	-
Southern Reedbuck		S	S	S	S	V	S	S	S
Bluebuck		-	-	-	-	-	Ex	-	-
Roan		I	R	S	En	R	R	S	V
Sable		V	S	S	V	R	S	S	S
Gemsbock		I	S	-	-	S	S	-	R
Black Wildebeest		-	-	-	-	-	S	-	-
Blue Wildebeest		S	S	Ex	-	S	S	S	S
Red Hartebeest		En V	S	-	-	S	S	-	R
Lichtenstein's hartebeest		En V	-	R	V	-	R	S	En
Bontebok		-	-	-	-	-	R	-	-
Blesbok		-	-	-	-	-	S	-	-
Tsessebe		I	S	-	Ex	V	R	V	S
Klipspringer		S	R	S	S	S	S	S	S
Damaraland Dikdik		-	-	-	-	S	-	-	-
Kirk's Dikdik		S	-	-	-	-	-	-	-
Oribi		S	R	R	S	-	V	S	V
Steenbuck		S	S	-	S	S	S	S	S
Cape Grysbok		-	-	-	-	-	S	-	-
Impala		En V	S	S	S	R	S	S	S
Sharpe's Grysbok		-	R	S	S	-	S	S	S
Springbuck		S	S	-	-	S	S	-	-
Suni		-	-	S	S	-	V	-	R
Grey Rhebok		-	Ex	-	-	-	S	-	-

Ex: Extinct - En: Endangered - V: Vulnerable - R: Rare - S: Satisfactory - I: Indeterminate - K: Insufficiently known

**Table 20: Current status of Antelopes in southern Africa**  
**- Angola, Botswana, Malawi, Mozambique, Namibia, South Africa, Zambia and Zimbabwe -**  
 (Source: Antelopes Global Survey and Regional Action Plans, Part. 2: R. East - PTES/IUCN/WWF, 1989).

If the status of antelope species are generally satisfactory in most of the countries, some species are currently seriously threatened or at risk:

- Endemic antelope under immediate threat (sable);
- Endemic antelope potentially at risk (red lechwe, Kafue lechwe, black lechwe, bontebok, Cookson's wildebeest (subsp. of blue wildebeest in Zambia), black wildebeest, black-faced impala);
- Widespread antelope under immediate threat within the region (Nyassa wildebeest (subsp. of blue wildebeest in Mozambique);
- Widespread antelope potentially at risk within the region (blue duiker, yellow back duiker);
- Antelope which occur marginally within the region (bay duiker and black-fronted duiker).

Finally veterinary cordon fences that restrict migrating wildlife may constitute another important threat. Game migrations are dictated by pasture and water availability in response to changing range conditions linked with climatic conditions.

In Botswana, fences sometimes have the effect of funnelling all migrating animals into restricted areas, thus causing an important concentration of large mammals that sometimes leads to high mortality. In the long-term, game fences on private farms can affect the genetic diversity in commercially utilised game populations. Game populations are isolated from populations of the same species, hindering cross-breeding between different populations.

- Marine mammals

Marine mammals provide meat and oil, and whales have been decimated due to hunting: use of gill and drift nets to harvest pelagic fishes also kill many marine mammals. Use of large nets results in capture or killing of marine mammals such as dolphins and whales (Indopacific humpback dolphin *Sousa chinensis*, southern bottlenose whale (Natal) and dugong. Among the large whales the blue whale and the humpback whale are now endangered while the fin whale and the southern right whale are ranked as vulnerable. Pollution, culls and competition for food are other major threats to marine mammals. Seals are threatened by hunting on some islands in Mozambique, Namibia and South Africa.

- \* Livestock

Drought, cattle diseases and habitat changes are the main natural threats to livestock populations.

- Drought

Drought appears to be the principal factor limiting livestock production in southern Africa. Vegetation production fluctuates from year to year depending on rainfall, and carrying capacity is not a sufficient parameter to prevent range degradation. Livestock management should be opportunistic, with livestock population increasing or decreasing in response to availability of palatable vegetation mainly in the dry savannah ecosystem. In 1964-67, in Botswana drought reduced livestock numbers from 1,35 million to 900 000: drought of 1981-82, 1986-87 and mainly 1991/92 had also catastrophic consequences in livestock populations. This cattle mortality is often linked with overgrazing and degradation of pasture lands, particularly around the waterholes.

- Cattle diseases

Southern African livestock are threatened by infectious diseases occurring endemically in the region. The most important are due to:

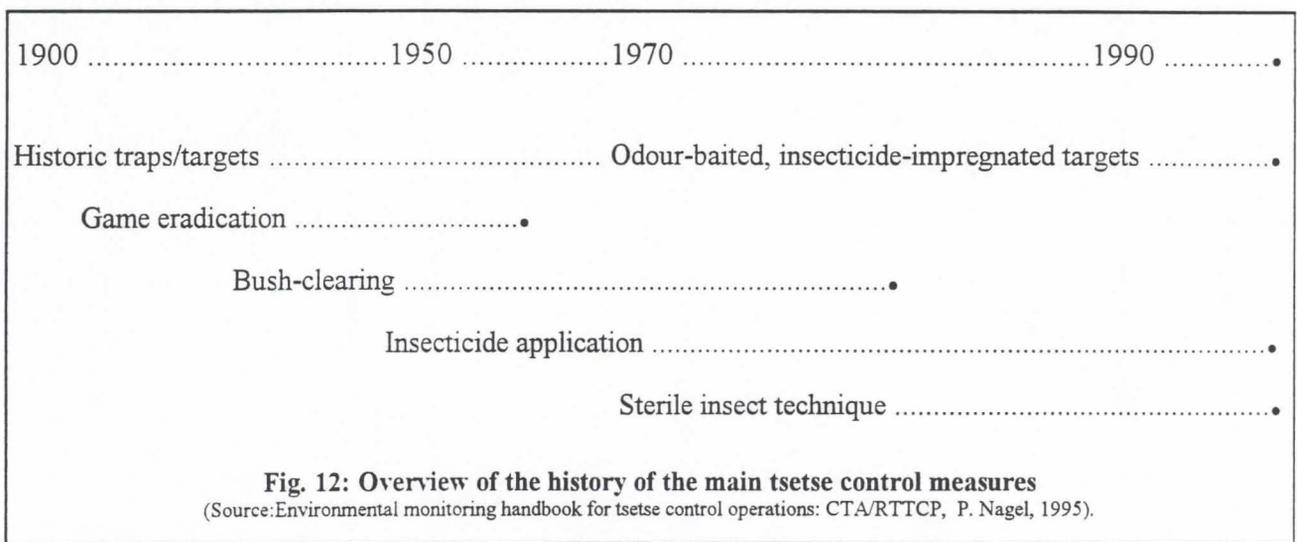
- Ticks, such as heartwater, babesiosis, anaplasmosis and theilerioses;
- Tsetse flies (*Glossina spp.*): trypanosomiasis plays a major role in southern Africa;
- *Muscidae spp.* and *Tabanidae spp.* (flies) which cause irritation to livestock, and because of their potential as mechanical vectors of various disease organisms;
- *Culicoides spp.* (flies) as a vector for filarial nematodes and different viruses;
- Mosquitoes that transmit viruses such as rift valley fever virus or wesselsbron virus which are periodically responsible for serious diseases in cattle and sheep;
- Viruses such as foot-and-mouth disease and pleuropneumonia.

Some of these vectors are also harmful to man, such as the tsetse fly which transmits human trypanosomiasis and *Culicoides* which transmit filarial worms. Rural development in Africa is a complex interaction between pastoral communities, livestock and the fragile ecosystem of dry land.



The tsetse fly appears to be one element of this system, where it acts as an obstacle. Tsetse control was attempted by game eradication, which was the only practicable method of control, up to the 1960s. Some species, providing a large part of the blood diet of tsetse flies were shot (warthog, bushpig, bushbuck and kudu). Then the bush-clearing method was used to destroy the natural habitats (humid, cool resting sites) that favour the tsetse survival. Insecticide use (synthetic organic insecticides) dates back as far as post-Second World War and methods have continued to improve with application from the ground, the air and using traps and odour-baited, insecticide-impregnated targets.

Other approaches include chromosomal abnormalities (sterile-male-technique), biological control and application of growth regulators that prevent hatching of the imago (fig. 12). Eradication (elimination of the vector in a given area) and control (sufficient reduction of the tsetse population) of tsetse fly have been successful in Zimbabwe and further trials are proceeding in diverse habitats of Zimbabwe, Zambia and Malawi.



Other strategies currently exist for dealing with trypanosomosis in different areas such as promotion of trypanotolerant cattle and containment of the tsetse fly in areas without cattle. In Africa, 7-10 million sq. km of land are infested by the tsetse fly and currently no more than 2 % have been cleared on a permanent basis.

- Habitat changes

Clearance of woodland, degradation of pasture by fires, overstocking and overgrazing lead to habitat loss or habitat change. Disappearance of trees habitually used as fodder, perennial grasses replaced by annual grasses or less palatable species result in a loss of cattle production. Another threat is due to the competition between livestock and game when wildlife move into restricted areas because of human settlements.

> Threats to birds

As for mammals, habitat change and loss of habitat are major threats for birds in the region. Commercial overfishing, egg-collection and oil pollution threaten marine birds such as the jackass penguin *Spheniscus demersus*. This species is also threatened by over-exploitation of guano (to make fertilisers) on which it used to nest, and it is currently extinct in 11 out of 38 former colonies. Pollution by toxic chemical pesticides causes birds to lay eggs with shells too thin for hatching properly.

Settlements in agricultural areas lead some species populations to decline in number, such as the bateleur *Terathopius ecaudatus* or Swynnerton's robin *Swynnertonia swynnertoni* (in the highlands of Zimbabwe and adjacent Mozambique). The wattled crane *Bugeranus carunculatus* is currently an endangered species through loss of sponge habitats. In Zambia and Botswana, the shoebill *Balaeniceps rex* is threatened by human interference. Along the west coast of southern African, the damara tern *Sterna balaenarum*, highly localised, is now vulnerable because of disturbance due to gravel-mining and pressure of tourism in its breeding habitat.

Illegal trapping for cagebird trade is reducing numbers of species as the black-cheeked lovebird *Agapornis nigrigenis* and the lilian's lovebird *A. lilianae*. The crowned crane *Balearica regulorum* is now a restricted species in Zimbabwe because of its high value in commercial trade. Some birds are killed by farmers or pigeon fanciers as pests, such as Cape vulture *Gyps coprotheres* (now endangered in the region), Ayre's hawk eagle *Hieraaetus dubius*, martial eagle *Polemaetus bellicosus* or tawny eagle *Aquila rapax*.

Other birds of prey are protected because of their potential for falconry, such as the black eagle *Aquila verreauxi*, the black sparrowhawk *Accipiter melanoleucus*, the crowned eagle *Stephanoaetus coronatus*, the lanner falcon *Falco biarmicus* or the peregrine *Falco peregrinus*. Healers use parts of birds in traditional medicine, such as the brain and the heart of the Cape vulture.

Marine birds are threatened due to a lack of food (over-fishing) and pollution near the main coastal cities (discharge of agricultural fertilisers, sewage into the sea, waste from factories). Oil pollution affects the Jackass penguin *Spheniscus demersus* on the west coast which is now vulnerable. In South Africa, sand-dune mining harms some coastal habitats threatening the African skimmer *Rhynchops flavirostris* that loses a part of its nesting habitat. Over-exploitation of fish and egg-collecting have considerably reduced the seabird populations (from 14 to 7) in the Benguela system and Agulhas Bank.

Some diseases such as Avian Cholera and Newcastle Disease Virus have reduced Cape cormorant *Phalacrocorax capensis* and Jackass penguin (at Boulders Beach) populations. On Dassen island in South Africa introduced cats (feral cats) feed largely on sea birds.

#### > Threats to reptiles

In southern Africa several species of turtles are threatened by over-exploitation (Mozambique, Angola, South Africa) for meat, eggs and shells. Among them are the green turtle *Chelonia midas*, the hawksbill turtle *Eretmochelys imbricata*, the olive ridley turtle *Lepidochelys olivacea* and the leathery back turtle *Dermochelys coriacea*. Some other species such as the pancake tortoise *Malacochersus tornieri*, endemic in South Africa, and the geometric tortoise *Psammobates geometricus* are affected by habitat destruction (by urbanisation and cultivation), fire, meat consumption and the pet trade.

The Nile crocodile *Crocodylus niloticus* (now vulnerable in some countries especially outside protected areas), the African slender-snouted crocodile *Crocodylus cataphractus* and the African dwarf crocodile *Osteolaemus tetraspis* are threatened by hide hunting, egg-collecting, food use and habitat loss or change. Some snakes are threatened by loss of habitat, fire and human activities. The beaked blind snake *Typhlops schinzi* endemic to southern Africa and the southern African rock python *Python sebae natalensis* are often killed by vehicles while crossing roads at the night. The gaboon adder *Bitis gabonica gabonica* from Zimbabwe and Mozambique and the forest cobra *Naja melanoleuca* are listed as vulnerable in the South African Red Data Book due to illegal collecting by snake fanciers and deforestation.

Peringuey's adder *Bitis peringueyi* from Namibia is also threatened by over-collecting for the pet trade. In Namibia, the Anchieta's dwarf python *Python anchietae* is one of the rarest snakes of southern Africa, fully protected, and only 50 individuals are known to exist.

#### > Threats to amphibians

Data on threatened amphibian species in Africa are lacking. In spite of this, amphibians are threatened by change and loss of habitat due to human activities. Overgrazing, change in floodplains regime, road and reservoir construction, fires, acid deposits from pollution in wetlands are major threats to this group of animals. In South Africa, in the extreme north-west of Namaqualand, the desert rain frog *Breviceps macrops* is threatened by strip-mining for diamonds. The Cape platana *Xenops gilli*, localised in the Cape of Good Hope Nature Reserve, is endangered by urbanisation, alteration of wetlands and agriculture: hybridisation with the common platanna *Xenopus laevis* is currently an other threat to this species.

The Amatola toad *Bufo amatolicus*, confined to the Amatola and Katberg mountains, is threatened by invasive alien plant species and forestry activities. Two other species, the Rose's toadlet *Capensibufo rosei* and the Hewitt's ghost frog *Heleophyne hewitti* are threatened by road construction and fires. Between June 1985 and August 1986, 7 000 animals were removed from the 3-7 m wide "Eastern National Water Carrier" canal in Namibia: a large proportion of them, composed of amphibians and reptiles, were dead.

Many species, mainly in South Africa, occur in very restricted areas with a high level of endemism. Some species such as Johnston's rana *Rana johnstoni inyangae* in Zimbabwe are threatened by the introduction of fish (trout) in the rivers.

#### > Threats to fish

Within southern Africa the widespread destruction of habitats is a major problem. Agriculture practices often lead to the draining of wetlands (which often form the head of the streams) or pumping water from the rivers for irrigation. Dam building changes the flow of rivers, restricts the migration of fish and fragments fish populations. Another threat is due to expansion of cultivation, overgrazing and riverbank changes (by invasive trees) which often lead to soil degradation and erosion. Transportation of sediments by the rivers and turbid water are harmful for food organisms and breeding sites.

Pollution of the freshwater environments by consequences of mining or industry activities, fertilisers and pesticides destroy living aquatic organisms. Pollution and change of water composition are often propitious to invasion of plants which cover bodies of water and smother habitats. In southern Africa, 24 freshwater species occur in the Red list of IUCN. Many threatened endemic populations are small and have a very restricted area, such as the cave catfish *Clarias cavernicola* in Namibia or the berg river redbfin *Pseudobarbus burgi* in the south-western Cape in South Africa. Other species have declined in recent years, even species such as the well-known tiger fish *Hydrocymus vittatus*. Many indigenous species, mainly in South Africa, have been reduced or eliminated by the introduction of exotic predator species such as trout *Salmo trutta* or bass *Micropterus spp.* and parasites and diseases such as the Asian tapeworm *Botriocephalus acheilognathi*.

Marine fish are mainly threatened by over-exploitation, inappropriate practices (dynamite fishing, small mesh nets), diseases and pollution. Mangroves, estuaries and coral reef changes due to siltation and oil pollution threaten the survival of marine organisms: 75 % of the estuaries in Cape Province have been altered by pollution.

In Namibia diamond mining in the Benguela system affect not only fish populations but also sea bed vegetation. Uncontrolled fishing due to war in Angola and Mozambique has led to over-exploitation of fish and prawns by foreign poachers.

> Threats to invertebrates

Although this group of animals is still little-known, many species are threatened in southern Africa. Swallowtail butterflies are greatly affected by habitat loss and over-collecting. Species have become endangered or vulnerable in Angola (*Papilio antimachus*, *P. cynata*) and Mozambique (*Graphium junodi*, *G. columna*) where 16 species are threatened. In Malawi and Zambia there are, respectively, 22 and 23 vulnerable or currently rare species.

Earthworms of which there are many species are often of great ecological interest and can play a key role as habitat change indicators. In South Africa several endemic species belonging to *Diplostrema*, *Chilota* and *Udeina* genera are threatened by destruction of indigenous forests.

Some terrestrial molluscs like the carnivorous Plant's gullela snail *Gullela planti* is now vulnerable in Natal because of clearance of the coastal bush. Among the numerous marine molluscs the Triton's trumpet *Charonia tritonis* is currently vulnerable because of over-collection of shells.

## Summary of Chapter 6: THREATS TO NATURAL RESOURCES

The constant increase in population growth, the need for new land for agriculture production, the extension of urban areas are so many factors threatening the environment. In southern Africa, droughts are also a major threat for all the ecozones. Abusive exploitation of plain and high altitude forests for wood production or crops, and overgrazing have resulted in a major reduction of the forest area in some countries such as Mozambique, Malawi and Zimbabwe.

The same applies in savannah regions that are subject to heavy exploitation for wood and increasingly heavy agriculture pressure. In Zambia, 0.5 % of the savannah area is disappearing every year. Most of the savannah woodlands in Malawi have been turned into bush under the pressure of farmers, foresters or overgrazing. In Botswana, the vegetation in 70 % of the communal lands is presently suffering from over-exploitation by deforestation, overgrazing and mining. These threats are more felt in areas of high population density, such as the peripheries of urban areas (Maputo in Mozambique) or coastal regions where armed conflicts (Mozambique, Angola) have led to heavy population concentration.

Certain fragile ecozones with great biological diversity, such as the Karoo or the Fynbos in South Africa are threatened mainly by overgrazing. Soil degradation is followed by colonisation by exotic plants (*Acacia*) which are presently threatening the natural flora of these regions.

Increasing water requirements, construction of dams, crops under irrigation often have a negative impact on wetlands.

Uncontrolled utilisation of irrigation has led to salination of large tracks of land in South Africa. Dam silting is a major problem in the entire region and is the result of erosion of surrounding land due to bad farming practices.

Degradation of the ecozones brings with it that of the inhabitants and threatens the species living there. The destruction of habitats and over-exploitation of species is the main cause of rarification, if not extinction, of certain plants especially in Namibia, Botswana, Zimbabwe and South Africa. In South Africa, more than 1 300 plants are threatened in the Fynbos of which 108 are in danger of disappearance.

Wild animals are also subject to the consequences of habitat reduction. Putting land under crops and poaching force the large mammals to migrate and concentrate in the valley where they degrade the vegetation (Zambezi valley, for example). Other species, considered harmful, have been practically exterminated in certain regions: this is the case for the wild dog, brown hyena and cheetah. The increase of livestock populations constitutes another threat factor for the wildlife, entailing competition in terms of space and grazing.

Some species, many of which are endemic, are threatened directly by over-exploitation of their populations: cage-birds, aquarium fish, sea fish, raptors for falconry, sea tortoises, crocodiles. Pollution (oil products, oils, fats) is the main threat for sea birds and aquatic animals in the rivers.

## 7. CONCLUSIONS

Natural resource management in southern Africa is closely linked with the severe climatic conditions, the high rate of population growth and the poverty. Poor soils, lack of water, drought and limited energy resources lead to overuse of potential of the southern African environment. The degradation of soils is currently a serious problem in the whole region. Water, wind, chemical and physical erosion results in a large quantity of soil losses affecting particularly countries such as South Africa or Angola (fig. 13). Soil losses for South Africa are estimated at 300-400 million tonnes annually: in Zambia about 3 million tonnes of topsoil from cultivated land are lost each year.

Degradation of the environment and loss of natural resources and biodiversity are mainly due to:

- Inequitable land allocation linked with high population densities;
- Lack of land use planning together with illegal human settlements (fig. 14 et 15) after tsetse eradication and control;
- Over-exploitation of forests and woodlands for timber, fuelwood and charcoal, cultivation;
- Expansion of cultivation and cultivation with inappropriate practices: ploughing on marginal lands and slopes, use of fertilisers and pesticides, methods of harvesting without returning organic matter to the soil, monoculture;
- Uncontrolled irrigation practices resulting in soil salination (fig. 14);
- Overstocking and overgrazing and trampling, resulting in loss of overall plant cover and decline of palatable types of grasses which are replaced by unpalatable grasses and invasive species (bush encroachment);
- Pollution due to mining, industrial activities, fertiliser uses, pesticides uses;
- Poaching for the pot and for cash;
- Overcollecting of terrestrial or marine plant and animal species (rare or threatened species) for trade;
- Ineffective policies due to inadequate skills, lack of political support, lack of environmental impact assessments to predict and mitigate negative environmental impact and to promote positive impact;
- Lack of information about environmental issues (information, education);
- Armed conflicts leading to large settlements of refugees in restricted areas where natural resources are over-exploited.

Increase of poverty, loss of habitats, soil degradation, decrease in crop yields and species extinction make people aware of the interest in safeguarding the environment and managing natural resources in a sustainable way. In spite of a lot of remaining problems such as lack of an overall environmental strategy, insufficient number of technical personnel, lack of co-ordination between the different institutions, lack of funds and government support, most of the countries have many government departments now dealing with environmental issues. Efforts have been made to introduce ecological management and land use practices in development programmes: for example, Malawi, Zambia and Zimbabwe have adopted National Conservation Strategies (NCS).

International co-operation is well established by some countries and many institutions are currently involved in environmental issues: SADC, Soil Loss Estimation Model Southern Africa (SLEMSA), International Council for Research in Agroforestry (ICRAF), international (IUCN, WWF) and national NGOs, universities, etc.

In order to implement natural resource management, ensure food production (maintaining harvest of species at sustainable levels) and water supply and maintain ecological processes, general policy directions must try to achieve consolidation of human resources and maintain a healthy environment. Recommendations should include:

- Collecting of information for comprehensive environmental management should be strengthened: there is still a lack of data in a wide range of disciplines at local, national and regional level;

- Furthering research in animal diseases must be initiated within the framework of a regional programme;

- Include cattle disease control in sustainable rural development programmes;

- Furthering research in use of chemical fertilisers and pesticides must be encouraged to prevent soil degradation and biodiversity loss;

- Training of environmental specialists and land use planners should be strengthened;

- Implementing environmentally sound projects for the use of natural resources to benefit the local people should be encouraged;

- Publishing environmental impact assessment studies;

- Implementing recommendations of workshops about natural resource management and land use planning;

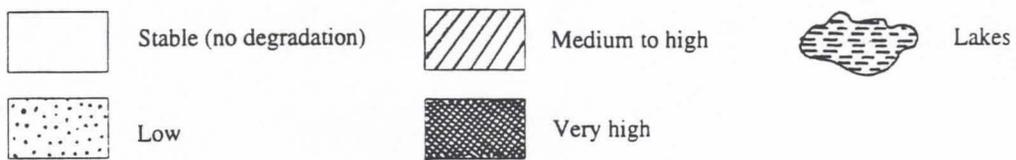
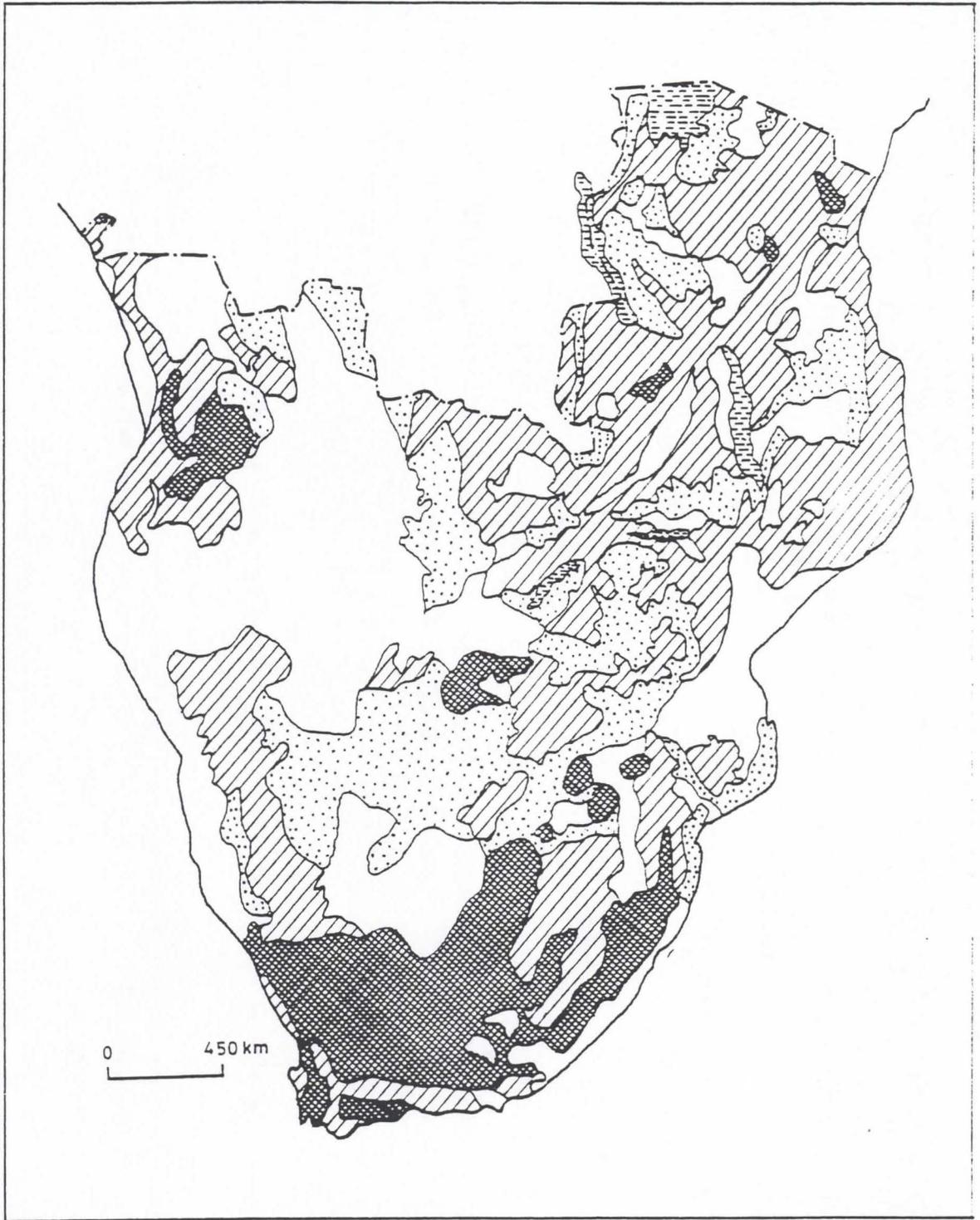
- Stengthening NGOs;

- Implementing different types of agroforestry agrosylviculture (crops and trees), silvopastoral (pasture/animals and trees), silvientoculture (trees and insects, e.g. beekeeping for honey production), agrosilvoaquaculture (crops and trees and fish, e.g. rice-growing with *Sesbania grandiflora* and fish farming, etc.;

- Taking traditional knowledge into account in natural resource management;

- Assessing the environmental effects of resettlement should be a priority in land use programmes;

- Considering customary in improving environmental legislation.



**Fig. 13: Severity of soil degradation in southern Africa**  
 (Source: World Atlas of desertification: UNEP/ISTRIC, CRU/UEA, 1992).

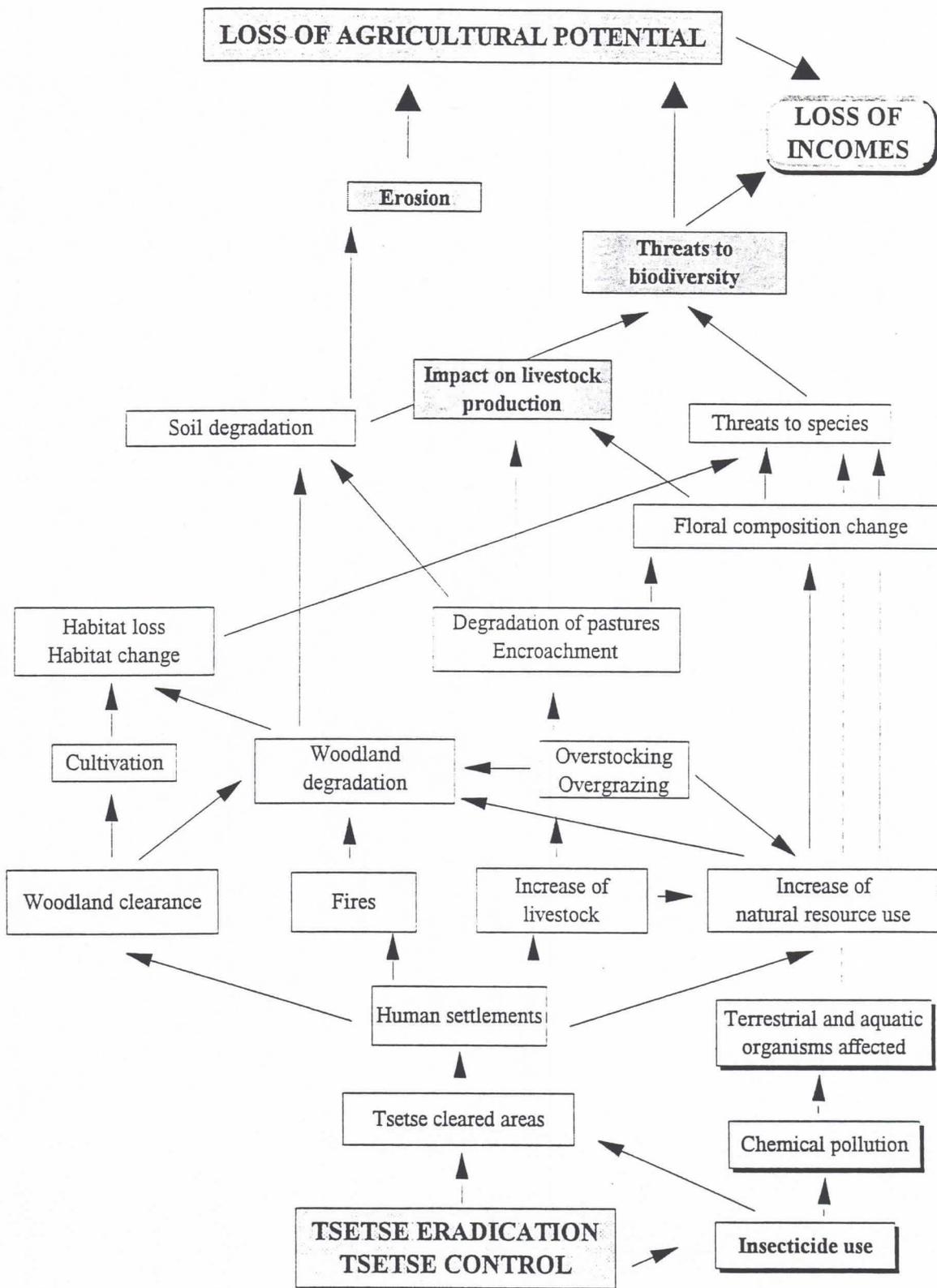


Fig. 14: Simple diagram showing possible consequences of human settlements in land use and natural resource use.

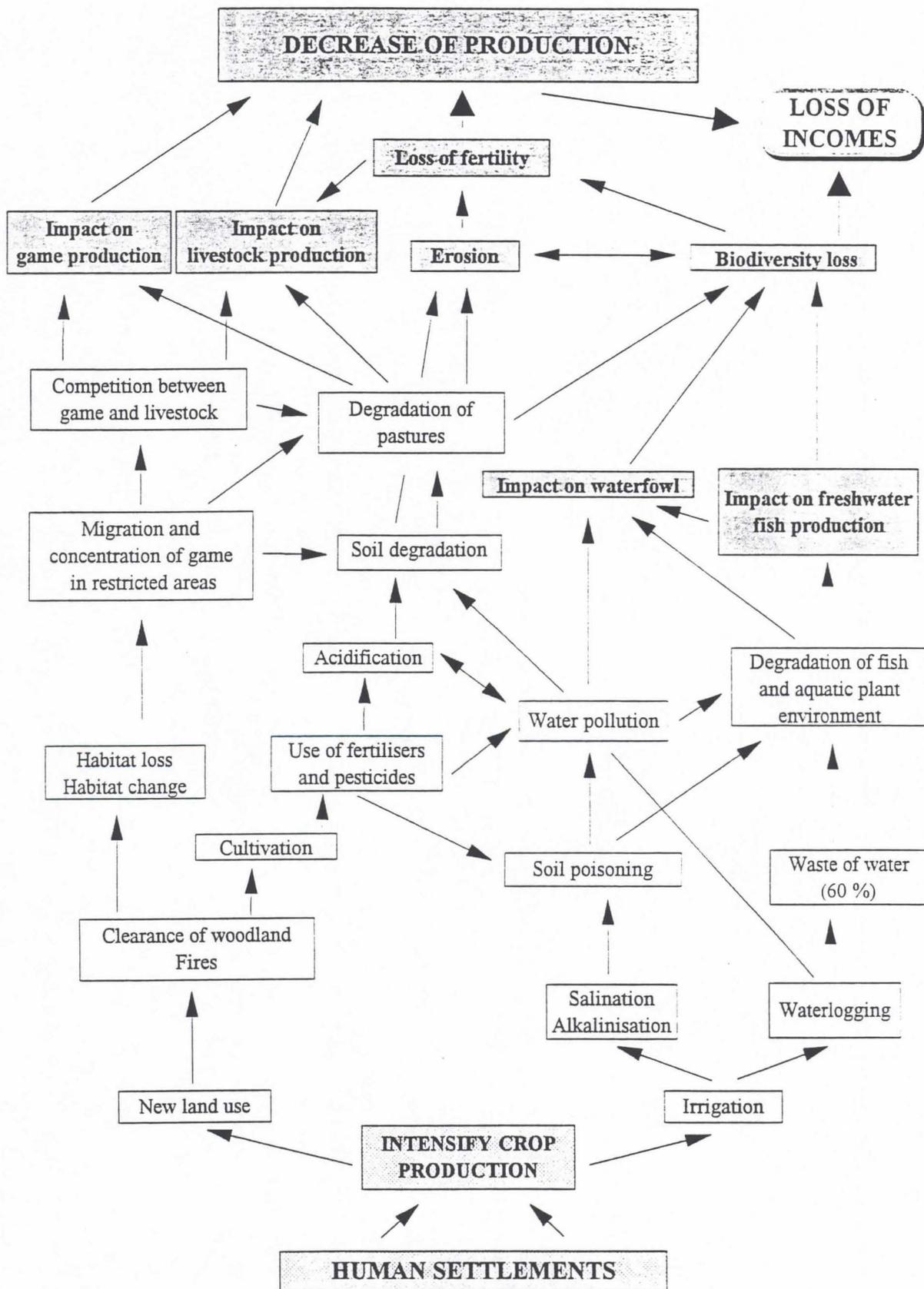


Fig. 15: Simple diagram showing possible consequences in land use and natural resource use after tsetse eradication and tsetse control programme.

## PART II

### HUMAN RESOURCES AND CAPACITY BUILDING IN NATURAL RESOURCE MANAGEMENT IN SOUTHERN AFRICA

#### 1. HUMAN RESOURCES IN NATURAL RESOURCE MANAGEMENT (see Annex 1)

Southern Africa possesses important expertise in natural resource management. National agencies, international institutions, international and national NGOs, universities, foundations and associations provide human resources and funds in a wide range of environmental disciplines. Human resources among the different Ministries appear through departments such as Zimbabwe's Department of Rural Development (DeRuDe), committees such as Zambia's National Conservation Committee (NCC) or Malawi's National Committee for the Environment (NCE), and commissions such as Zambia's National Commission for Development Planning (NCDP) or Malawi's Department of National Parks and Wildlife (DNPW).

The main international institutions involved in environmental and development projects include UNPD, FAO, ADB, EEC, SIDA, WHO, IIED. International NGOs are represented principally by WWF and IUCN. Some organisations such as ERSI, NPWLM, ILRI, NRI, FEWS, TSBFP are currently involved in development projects or express interest in eco-system studies and processes. In 1994, it was proposed that SEMG within RTTCP strengthen its role in the region so that appropriate monitoring systems and data bases can be developed for the Zambezi valley. At the same time NRI and others could assist with research training.

Local communities have the key role to play as human resources in natural resource management. Natural resource management has a conservation component but it is primarily focused on sustainability of use requiring community management. It appears crucial that guidance to local communities in resource management and use come from local leaders.

Rural populations should be more readily involved in local resource management if socio-economic conditions are improved. To this end several conditions should be met:

- Increase in awareness of problems and their possible solutions;
- Involvement and participation in decision-making;
- People should reap significant benefits from changes in resource uses;
- People should possess knowledge and means to manage sustainable use of natural resources and should be self-reliant and self-confident;
- Development of local institutions.

To defend their interests, local communities should be integrated in a wider organisation that can ensure protection against intervention by outside actors.

## Annex 1

### MAIN INSTITUTIONS AND ORGANISATIONS CONCERNED WITH THE ENVIRONMENT IN EACH COUNTRY

<b>ANGOLA</b>	
SADC Energy Sector (Regional contact)	Ensures that energy can be made available in the SADC Region.
<b>BOTSWANA</b>	
Botswana Society (NGO)	Concerns itself with the Kalahari, drought and the state of the environment.
Kalahari Conservation Society	Concerns itself with issues related to wildlife and is successful in creating awareness on the vital conservation issues.
Forestry Association Botswana (FAB)	Focuses on reforestation and contributing to raising of awareness on environmental problems.
Co-operation for Research, Development and Education (CORDE)	Concerns itself with community mobilisation and the promotion of small enterprises and sustainable agriculture.
Ministry of Agriculture, Local Government and Lands Ministry of Commerce and Industry Natural Resources Board	Implement Conservation Strategy, land management, wildlife management and multi-sectoral environment issues
Botswana Technology Centre	Initiates projects in the fields of education, public information and research
National Institute of Research and Documentation (NCI)	Does research on various environmental problems
SADC Livestock Production and Animal Disease Control Sector ( <i>Regional contact</i> )	Faces problems as poor breeding, inadequate services and overgrazing. This sector has priority objectives of disease control, livestock production and production of veterinary products and stock feeds.
SADC African Center for Cooperation in Agricultural Research - SACCAR - ( <i>Regional contact</i> )	Provides the technical support for National Research Systems.
Tribal Grazing Land Policy and the Arable Land Development Programme (ALDER)	Includes ecologically sound management and land-uses practices in work programmes as a result. In Botswana many departments are now undertaking Environmental Impact Assessments.
Southern African Subregional INFOTERRA Network (UNEP-Infoterra) - SASIN - ( <i>Regional contact</i> )	Aims to help provide solutions to common environmental problems facing countries in the region. It is part of one of the largest environmental network in the world.

<b>MALAWI</b>	
Ministry of Research and Environmental Affairs	Carries out resource inventories, monitors impact of industrial crops on the environment and is setting up a data bank.
Ministry of Agriculture and Livestock Development (Department of Land Use and Natural Resources, Land and Conservation Branch)	Promotes the long-term sustainable use of natural resources
Parks and Wildlife Department	Manages all protected areas, undertakes research, promotes public awareness of the value of natural resources.
SADEC Inlands Fisheries, Forestry and Wildlife Sector (Regional contact)	Promotes sustainable utilisation and development of the natural resources in the region

<b>MOZAMBIQUE</b>	
Centre for Research on Basic Techniques for the Rational Utilisation of Nature and Centre for Communication	Carries out research programmes.
National Remote Sensing and Cartography Centre (CENACARTA)	Ensures dissemination of remote sensing techniques to all potential users, and is currently a national archive of all the imagery used in the country by all State Institutions and the Private Companies.
Department of Biological Sciences	Carries out research on ecology of coastal zones and gives lectures on biology.
Ministry for Co-ordination of Environmental Affairs	Is responsible for the national environmental policy and undertakes projects related to natural resource management.
National Directorate of Forests and Wildlife	Is responsible for the conservation of forests and wildlife resources in the country.

<b>NAMIBIA<sup>4</sup></b>	
Desert Ecological Research Unit	Is working on ecological issues in arid regions of the country.
Endangered Wildlife Trust	Manages Rural Community Development Projects to integrate the needs of the rural community with nature.
Ministry of Wildlife, Conservation and Tourism	Is concerned with environmental issues.
Ministry of Land, Resettlement and Rehabilitation	Is involved in environmental issues.
Ministry of Agriculture, Fisheries and Rural Development	Carries out land-use surveys and analysis, measurement of crop areas. Implemet marine resources management
Ministry of Mines and Energy.	
SADC Marine Fisheries and Resources Sector (Regional contact)	Aims at the sustainable exploitation of the marine fisheries.

<sup>4</sup> In Namibia there is a lack of specialised NGO efforts in environmental problems.

SOUTH AFRICA	
University of Cape Town, University of Witwatersrand	Carries out research on environmental issues.
Environment and Development Agency (EDA)	Organises rural development around local development projects.
Air Pollution Appeal Committee (APAC)	Develops public awareness through information and work to introduce environmental awareness curricula into schools.
Wildlife Society of Southern Africa	Is concerned with conservation of air, soil, water and all forms of life.
Endangered Wildlife Trust	Is concerned with nature reserves and the need to improve relations with communities on their borders.
African National Congress' Department of Economics and Planning	Has a policy emphasising the importance of sustaining the environment.
Department of Environment Affairs Department of Water Affairs and Forestry Department of Agriculture	Promote Environmental Impact Assessment (EIA) Develop and co-ordinate environmental policy Implement freshwater and forest resources management

ZAMBIA	
Lusume Services	Develops rural activities.
Pan African Institute for Development (East and Southern Africa)	Does research on environmental problems.
Zambia National Resource Data Centre	Provides information on environment and natural resources.
Wildlife Conservation Society of Zambia	Promotes environmental awareness at all community levels and supports government in research and control of nature resources.
Ministry of Environment and Natural Resources	Includes The Department of National Parks and Wildlife Services.
Ministry of Agriculture, Food and Fisheries	Produces regional and land resources maps participates in preparation of regional conservation and catchment conservation plans, plans settlement, land improvement and production schemes.
Environment Council of Zambia	Undertakes environmental awareness programmes and publications. It is a monitoring co-ordinating body for all institutions involved in environmentally related activities. Government bodies are involved in the National Conservation Strategy (NCS) which initiated important projects (LIRDP, ZEEP, ADMADE) to link the socio-economic development to the rational management and use of human and natural resources.

<sup>5</sup> The number of environmental NGOs is limited in Zambia.

ZIMBABWE	
Africa Resources Trust (Regional contact)	Focuses on alleviation of poverty through the ecologically and economically sound of wild species.
Agricultural Technical and Extension Services (AGRITEX - Ministry of Land, Agriculture and Water Development)	Provides technical and developmental services to stimulate the adoption of proven agricultural practices and to promote sustainable agricultural development.
Biodiversity Foundation for Africa (NGO)	Aims to improve scientific knowledge of African biodiversity to support its sustainable management at grassroots level.
Communal Areas Management Programme for Indigenous Resources Association (CAMPFIRE)	Seeks to promote natural resource utilisation as an economic land-use option in Zimbabwe's communal areas.
Department of National Parks and Wildlife Management (Ministry of Environment and Tourism)	Protects and manages all protected areas, undertakes research, promotes public awareness of the value of natural resources.
Drought Monitoring Center (Regional contact)	Analyses and monitors drought conditions and devises strategies for mitigating the impacts of drought.
Environment and Remote Sensing Institute (ERSI)	Specialises in application-oriented training and consultancy and technology-oriented research in remote sensing and geographic-information systems for resource detection and environmental monitoring.
Environment 2000	Provides environmental awareness aimed at uplifting socio-economic sustainability.
Food Security Network of SADEC NGOs (Regional contact) that	Focuses on all areas of the food cycle including natural resources management and utilisation, food policy recommendations, house-based research, etc.
Forestry Commission	Is a multi-faceted organisation with heavy involvement in environmental management.
Institute of Environmental Studies (University of Zimbabwe)	Contributes to the development and sustained well-being of people by undertaking research, providing information collation, education and consultancy.
Natural History Museum (Bulawayo)	Preserves and enriches natural collections to support research, exhibition and educational activities.
Participatory Ecological Land-Use Management - PELUM ASSOCIATION - (Regional contact).	
SADC Food Agriculture and Natural Resources Sector - SADC FANR - (Regional contact)	Aims to increase agricultural production and food security of households.

ZIMBABWE (cont.)	
Southern African Research and Documentation Sector - SARDEC - (Regional contact)	Collects, analyses and disseminates information about the southern African region.
Wildlife Society of Zimbabwe	Encourages all people to take an active interest in Zimbabwe's wildlife heritage through conservation-oriented educational and research projects.
World Wide Fund for Nature (WWF)	Carries on a programme focused on community-based conservation and wildlife management.
World Conservation Union - Regional Office for southern Africa - IUCN-ROSA - (Regional contact)	Aims to facilitate and strengthen an integrated approach for the sustainable uses of natural resources and the conservation of biological diversity.
Zambesi River Authority	Monitors water management and environmental pollution of Lake Kariba to both Zambia and Zimbabwe.
Zimbabwe Energy and Environmental Research Organisation - ZERO - (Regional contact):	Analyses environmental policies, makes documentation of environmental development and diffuses skills to grassroots communities through participatory research methods.
Zimbabwe Trust (Regional contact)	Focuses on the enhancement of the productive capacity of villages, wards and districts based on a sustainable use of land and natural resources ( linked with Campfire programme).

## 2. TRAINING NEEDS FOR A REGIONAL PROGRAMME ON NATURAL RESOURCE MANAGEMENT (see Annex 2)

Training facilities in environmental issues are not evenly distributed throughout the region. However, most countries have at least one university and some countries such as Malawi, Zambia, Zimbabwe and South Africa have more than one. For example, South Africa has 47 institutions participating in the indigenous plant use survey while Zimbabwe has only 9 and Namibia and Mozambique only one each. Training facilities in southern Africa reflect the social and political situation of each country. While South Africa trains more than 3 000 undergraduate and about 250 postgraduate botany students, Botswana, Mozambique and Namibia have no postgraduate students in this discipline. This example could be extended to many other environmental sciences.

Natural resource management in a regional programme requires basic elements to be efficient. These are for example:

- Detailed information about the natural resource base;
- Identifying and monitoring biodiversity for conservation and sustainable management;
- Regional co-ordination of biodiversity inventory and monitoring (database, standard criteria and procedures);
- Land-use planning in accordance with capacity of the resource base to sustain utilisation;
- Monitoring of changes in the resource base;
- Assessment of biodiversity value;
- Sharing of information;
- Documentation available: maps, atlases, libraries, bibliographic database and archive, gazettes.

Collecting data and monitoring land-use changes require human resources and skills at all levels. Environmental management is an interdisciplinary subject: the expertise of all national specialists is equally important and they must all have an input into natural resource uses. Recommendations should include:

- Training in biological and human sciences, environmental monitoring and land-use planning;
- Establishing a regional network of specialists in natural resource management;
- Setting up or rationalising and co-ordinating the national standardised Geographic Information System (GIS) database. That is crucial to improve:
  - Using of climatic, topographic, soil and vegetation data;
  - Producing of land-use maps of areas of natural resource management;
  - Mapping of land-use changes;
  - Integrating of socio-economic data;
  - Mapping of distribution of cattle diseases and the risks of disease extension;
- Setting up a regional GIS database for natural resource management; that will be helpful to co-ordinate the acquisition and analysis of data and to establish mechanisms for the free flow of information for research purposes;
- Improving socio-economic studies at local, national and regional levels for a better knowledge of agricultural systems and traditional practices;
- Strengthening research in cattle diseases and rationalising training courses within the veterinary discipline in the region;
- Improving mechanisms to co-ordinate functions and cross-reference between planning at different levels. A wide range of organisations are involved in environmental studies but the level is not indicated, leading to inadequate co-ordination between conservation and development efforts
- Assisting in land-use planning;
- Assisting in training.

## Annex 2

### MAIN INSTITUTIONS AND ORGANISATIONS CONCERNED WITH TRAINING AND EDUCATION IN EACH COUNTRY

<b>BOTSWANA</b>	
Botswana College of Agriculture	Provides refresher courses for field staff.
Botswana Wildlife Training Institute	Offers training on conservation and protected areas, wildlife resources, biological sciences and ecology, environmental assessments.
Department of Environmental Sciences	Offers courses on biological sciences and ecology, wildlife resources, environmental planning.
Environmental Conservation Society	Promotes local community and public awareness by means of education, social and agroforestry programmes.
National Institute of Research and Documentation (NRI)	Is active in human resources and development, environmental assessment, rural development, education, and training.
SADC African Center for Cooperation in Agricultural Research - SACCAR - (Regional contact)	Provides professional training in the Food, Agricultural and Natural Sector (FANR).
<b>MALAWI</b>	
Bunda College, University of Malawi	Leads to diploma in ecology and biology.
Department of Surveys, Zomba	Concerns maps reading and aerial photography interpretation.
<b>MOZAMBIQUE</b>	
Centre for Research on Basic Techniques for the Rational Utilisation of Nature and Centre for Communication	Organises training courses on environmental issues for people in communal areas.
National Remote Sensing and Cartography Centre (CENACARTA)	Organises training sessions on topographic or thematic map production, inventory and management of natural resources, environmental change monitoring, land-use and land cover mapping.
University of Mozambique	Trains in biology, ecology, Trypanosomosis and Tsetse work.
<b>ZAMBIA</b>	
NEUDAM College of Africa	Leads to diploma in Agriculture.
Namibian Institute of Personnel Management.	
Wereldsend Environmental Centre	Carries out training courses in environmental education for teachers, students and farmers.

<b>SOUTH AFRICA</b>	
University of Cape Town, University of Witwatersrand	Provides training in biology and environmental issues.
Environment and Development Agency (EDA)	Provides training and education.

<b>ZAMBIA</b>	
Conservation Society of Zambia	Trains in environmental education and organises conservation clubs in schools.
Department of Agriculture	Teaches local communities new or improved methods of agriculture.
Department of Fisheries	Conducts training programmes for fishermen and provides extension services in fish culture and fishery management services.
Department of National Parks and Wildlife Service	Has an environmental education programme.
University of Zambia.	
Zambia Institute of Animal Health	Leads to certificate, animal health courses, diagnostics.
National Development College	Leads to a general diploma in Agriculture and Livestock Studies.

<b>ZIMBABWE</b>	
Centre for Applied Social Sciences (CASS)	is responsible for an interdisciplinary applied social science research and teaching programme (Tropical Resource Ecology) at the University of Zimbabwe.
Environment 2000	Promotes environmental education.
Institute of Environmental Studies (University of Zimbabwe).	
Veterinary Training Institute.	

The considerable environment capability and capacity within the region are often reduced by bottlenecks such as:

- Recurrent expenditure restrictions;
- No co-ordination with other work programmes;
- Needs for additional specific training;
- Availability of transport.

## GLOSSARY

- Afforestation:** planting trees in an area where there have not necessarily been trees before.
- Afromontane forest:** distinguished from tropical forests by much cooler temperature, greater temperature extremes and usually a longer dry season.
- Agroforestry:** agriculture using trees that serve multiple purposes such as shelter from wind and sun, improving soil fertility, providing wood, fodder and fruit.
- Alien plants:** plants invading and becoming established in areas in which they do not naturally occur.
- Alkaline:** high in certain elements such as magnesium and calcium, or salts such as sodium chloride.
- Arid:** area with less than about 250 mm rainfall per year.
- Arthropod:** a member of the animal phylum Arthropoda, which includes the insects, crustaceans, spiders, scorpions, mites, millipedes and centipedes.
- Biodiversity:** term used to describe the number, variety and variability of living organisms. It includes genetic and species diversity.
- Biological control:** the use of a pest's natural enemies in order to control that pest.
- Biomass:** the weight of living material, commonly used as a measure per unit area of land.
- Biome:** One of the major categories of the world's distinctive plant assemblages (tropical forest biome, tropical savannah biome).
- Biosphere:** where life exists on, in and around the earth.
- Browser:** animal (herbivore) that eats the leaves, pods, twigs, shoots and fruits of shrubs and trees.
- Bush encroachment:** the increase of thorny and unpalatable shrubs at the expense of grass, due to overgrazing and frequent fires which destroy the grass.
- Carrying capacity:** the maximum population size of livestock or wildlife (or other living organisms) that can be supported indefinitely by a given environment without damaging it.
- Catchment:** the entire area drained by a particular stream or river, equivalent to drainage basin.
- Chemical degradation:** changes in soil chemistry resulting from human activities, especially intensive agriculture and irrigation, including salinisation (salinisation), nutrient and organic matter loss, acidification and pollution.
- Competition:** an interaction between two or more organisms (or species) in which, for each, the birth and/or growth rates are depressed and/or the death rate increased by the other organisms (or species).
- Conservation:** wise use of nature's resources to prevent loss of ecosystem function and integrity.
- Cordon fence:** long fence designed to separate livestock from wildlife to reduce the transmission of diseases.
- Crop residues:** portions of plant remaining in fields after the crop is harvested (straw, maize stalks).
- Crop yields:** the amount of food produced by a given crop, usually expressed as a certain weight per hectare.
- Customary law:** law based on customs and traditions.
- Dambo:** a shallow, seasonally or permanently waterlogged, grass-covered depression.
- Deciduous:** trees or other plants which shed their leaves during the dry season.
- Deforestation:** removal of trees from a landscape.
- Destocking:** removing most or all of the livestock from an area, as a soil conservation measure, thus reducing grazing pressure and allowing the plants to grow back.
- Disease:** the disturbed or altered condition of an organism caused by the presence of an antagonist (toxin or pathogen) or the absence of some essential (vitamin, micronutrient).
- Dry savannah:** semi-arid area with widely spaced trees, often *Acacia* species, sometimes with touching crowns but a light canopy that allows grass to grow beneath.
- Ecosystem:** all living and non-living components of the environment that interact and influence one another.

**Ecotourism:** tourism in which the natural environment is a main interest of the tourist - tourism that is not harmful for the environment.

**Ecozone:** ecological zone, a large natural unit controlled by a set of common processes, mostly climatic, and dominated by life forms with similar physical adaptations to those processes.

**Endemic:** - a particular taxon is called endemic if it lives only in the area being considered.  
- permanent occurrence of a disease in a particular geographic region.

**Environmental impact assessment (EIP):** management tool to predict and mitigate negative environmental impacts and promote positive ones.

**Exotic:** species not native to a particular area.

**Extensive agriculture:** agricultural techniques which require large areas of land, such as pastoralism and shifting cultivation.

**Fallow:** allowing cultivated land to “rest” for a period to restore fertility, often with a cover crop.

**Floodplain:** area beside a river which is seasonally flooded when water levels rise due to high rainfall.

**Fynbos:** Afrikaans word for fine-leaved bush, an ecozone in South Africa’s southern Cape area comprised of shrubs and shrubby woodland of three metres high, with patches of hardwood forest.

**Gallery forest:** dense riverine vegetation of running waters in savannah areas.

**Grasslands:** grass with some trees, but differing from savannah woodland by being generally cooler and drier.

**Grazers:** animals that eat mainly grass.

**Gross Domestic Product (GDP):** the value of all goods and services produced by all factors of production in an economy by both residents and non-residents over the period of a year, regardless of the allocation to domestic and foreign claims.

**Gross National Product (GNP):** GDP plus the value of goods and services produced by a country’s citizens and their investments in other countries, minus the value produced by foreign residents and their investments in the country where GNP is being measured.

**Groundwater:** water found underground.

**Gullies:** the end result of sheet erosion, usually growing in years of above average rainfall, especially after a period of drought when the plant cover has died.

**Habitat:** living space, natural environment, of a particular plant or animal species.

**Hectare:** a unit of measure land, equal to 10 000 square metres.

**Herbivores:** plant-eating animals.

**Hot-spots:** centres of plant diversity with a high species’ richness and high levels of endemism.

**Indigenous:** native to an area or occurring naturally.

**Intensive agriculture:** agricultural techniques which intensify production from a small area of land, as with irrigation and agroforestry.

**Invasive plants:** usually unpalatable indigenous or alien species that tend to become established and out-compete native species, eventually dominating.

**Karoo:** shrubby, semi-desert landscape.

**Land tenure:** the type of land ownership system.

**Manure:** organic fertiliser, usually taken to mean animal dung but also including compost made from plant wastes.

**Marginal lands:** lands not suitable for cultivation.

**Microfauna:** the smallest arbitrary size categorisation of animals in a category.

**Miombo:** a common type of moist savannah woodland co-dominated by the tree species *Brachystegia* and *Julbernardia*, in South-Central and southern Africa.

**Moist savannah:** a semi-arid area with a partly closed canopy of trees 5-20 m high, often miombo species, a few shrubs beneath and a often sparse but continuous layer of grass and other ground cover.

**Mopane woodland:** a type of dry savannah dominated by mopane trees (*Colophospermum mopane*) because of their ability to tolerate poorly drained or alkaline soils.

**Nomadic pastoralism:** people who rely primarily on livestock to meet their needs, moving to different grazing areas with the seasons.

**Nutrient cycling:** the transformation of chemical elements from inorganic form in the environment to organic form in organisms and, via decomposition, back to inorganic form.

**Nutrient depletion:** type of chemical degradation of soil in which soil nutrients are lost through too frequent fires, topsoil loss or loss of natural flooding regimes due to dam construction.

**Organic fertiliser:** fertiliser made from natural, plant-based materials (such as crop residues) or animal dung.

**Organic matter:** living organisms or their products, the “glue” that stick soil particles together in clumps.

**Overexploitation:** exploitation of a natural population at a rate greater than the population is able to match with its own recruitment.

**Overgrazing:** grazing by livestock or wildlife to the point where grass cover is depleted, leaving bare unprotected patches of soils with a corresponding increase in erosion by water and wind, especially on clay soil.

**Palatable:** plants preferred by feeding animals.

**Pan:** very shallow, often seasonal, body of water, usually salty.

**Pastoralism:** the moving of livestock to different grazing areas depending on plant cover and rainfall.

**Perennial plants:** plants that live for more than one year, often many years, and established by seeds, roots or shoots.

**Permaculture:** permanent agriculture, an ecologically designed sustainable agricultural system of annual and perennial plants that has the diversity, and resilience, of a natural ecosystem.

**Physical degradation:** a type of degradation characterised by physical changes in the soil structure and usually related to rainfall, including sealing and crusting of top soil, loss of water-holding capacity, compaction of top soil, waterlogging and aridification.

**Policy:** a set of government or corporate objectives and guidelines deliberately chosen to influence future decisions.

**Pollution:** the poisoning of land, air or water with anything that reduces its ability to support life.

**Population density:** the total number of inhabitants divided by the surface area.

**Population growth rate:** the annual growth rate of the population calculated from mid-year.

**Rainfall variability:** the pattern of rainfall in arid environments where the amount of rain and where it falls differs widely from year to year.

**Reforestation:** planting trees in an area which previously had trees.

**Resilience:** capacity for a natural area to recover from disturbance.

**Salinisation (salination):** the surface or near-surface accumulation of salts, resulting in poor growth or death of crops, often the outcome of poorly managed irrigation in dry areas.

**Savannah:** arid to semi-arid area with a mix of grass, trees and shrubs, the proportions of each varying with rainfall, soil type and other physical factors.

**Sedimentation:** deposition of river-borne sediments in a lake or dam, siltation.

**Semi-arid:** areas where mean annual rainfall is between about 250 and 600 mm, rainfall is seasonal and variable, and potential evaporation is high.

**Sheet erosion:** rainfall washing evenly over the land and removing the most productive top layer, the most common and widespread of erosion.

**Shifting cultivation = ash fertilisation:** a form of agriculture where a wooded area is cleared and woody material burnt in heaps to kill weed seeds and pests in the soil, fertilise the soil with ash, and heat the soil to release nutrients for plant growth.

**Soil conservation:** an intervention to stop degradation and even reverse it, through physical structures such as contours and terraces, or biological means such as intercropping and grass strips.

**Soil degradation:** somewhat reduced agricultural productivity with part of topsoil removed; major improvements are required to restore it.

**Soil nutrients:** organic and inorganic compounds, including nitrogen, potassium and phosphorus, found in the soil which are essential to plant growth and maintenance.

**Soil rehabilitation:** a high level of technical input or radical restructuring of the land use.

**Southern Africa:** the region encompassing Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe.

**Species diversity:** an index to community diversity that takes into account both species richness and the relative abundance of species.

**Species richness:** the number of species present in a community.

**Stocking rate:** the number of hectares required to support one livestock unit (cow) based on the theoretical carrying capacity of the range.

**Succulents:** plants with thick, fleshy leaves which retain water and have a low evapotranspiration rate.

**Sustainable agriculture:** agriculture which does not degrade the soil or other resources on which it depends.

**Sustainable development:** development which meets the needs of the present without compromising the ability of future generations to meet their own needs.

**Sustainable resource use:** to use something in such a way that the supply is not diminished.

**Tonnes:** metric measure of 1 000 kilogrammes.

**Topography:** natural features on the surface of the earth.

**Topsoil:** the top few centimetres of soil, which contains most of the soil organic matter and nutrients.

**Tropical forest:** the type of vegetation in areas with high regular rainfall and no more than two months of low rain, having a completely closed canopy of trees which prevents sunlight penetration to the ground and discourages groundcover growth.

**Trypanosomosis:** infectious disease of humans (sleeping sickness, Chaga disease) and warm-blooded vertebrates caused by flagellate protozoa's of the genus *Trypanosome*.

**Tsetse:** fly that carries the disease "nagana" in livestock and sleeping sickness in humans, inhabiting moist savannah areas.

**Unpalatable:** plant avoided by feeding animals.

**Waterlogging:** natural flooding and over-irrigation which brings underground water levels to the surface, displacing the air in the soil, with corresponding changes in soil processes and an accumulation of toxic substances which impede plant growth.

**Weed species:** plants that threaten human welfare by competition with other plants that have food, timber or amenity value.

**Wetlands:** include rivers, lakes and swamps, and change the immediate area due to the presence of abundant water.

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